



APPENDIX 13B

Aboriginal Archaeological
Values Assessment



THE ENVIRONS IN THE NORTH OF THE PROPOSED DISTURBANCE AREA.

ABORIGINAL ARCHAEOLOGICAL VALUES ASSESSMENT

**Mount Owen Continued Operations
Near Ravensworth, Upper Hunter Valley, NSW
Singleton LGA**

Author: Ben Churcher

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**Report prepared by
OzArk Environmental & Heritage Management Pty Ltd
for Mount Owen Pty Ltd**



**Environmental and
Heritage Management P/L**

OzArk EHM

145 Wingewarra St
(PO Box 2069)
Dubbo NSW 2830

Phone: (02) 6882 0118

Fax: (02) 6882 0630

jodie@ozarkehm.com.au

phil@ozarkehm.com.au

www.ozarkehm.com.au

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	Ben Churcher		
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Prepared For	Prepared By		
Mount Owen Pty Ltd	Ben Churcher Senior Archaeologist OzArk Environmental & Heritage Management Pty. Limited P 02 6882 0118 F 02 6882 6030 M 0416 009 910 email: ben@ozarkehm.com.au		

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EXECUTIVE SUMMARY

This report records the methodology and results of an assessment of Aboriginal archaeological values across the Proposed Disturbance Area for the Mount Owen Continued Operations Project (the Project) located to the northeast of the former village of Ravensworth in the Hunter Valley, NSW.

The Aboriginal archaeological values assessment of the Proposed Disturbance Area included both survey and test excavation components and was carried out by OzArk Environmental and Heritage Management (OzArk) for the Proponent (Mount Owen Pty Limited [Mount Owen]) between November 2012 and March 2013. During both the survey and test excavation components of the assessment, OzArk was accompanied in the field by representatives from the Registered Aboriginal Parties (RAPs).

Throughout late 2013, Glencore refined the mine plan for the proposed North Pit in order to further optimise the benefits of the Project. The optimisation of the North Pit continuation plan has yielded approximately 4 million additional minable coal tonnes for the Project and resulted in an additional area of approximately 21ha that was not included in the Proposed Disturbance Area previously surveyed (refer to Section 2 of the EIS for further detail). Accordingly, a further survey focussing on this additional area of proposed disturbance was undertaken on 29 April 2014.

Social, historic and aesthetic values of the Project Area are assessed in the accompanying Aboriginal Cultural Heritage Assessment (ACHA) which this document supports. The ACHA is being prepared by Australian Cultural Heritage Management Pty Limited (ACHM).

The Proposed Disturbance Area covers approximately 485ha and large portions of this area (223ha) have been the subject to previous Aboriginal Heritage Impact Permits (AHIPs) with extensive areas having already undergone archaeological assessment and salvage. Within the Proposed Disturbance Area, 18 sites have already been salvaged by manual excavation and more expansive additional areas have been subject to grader scapes to salvage subsurface artefacts. Over the years, both from within the Proposed Disturbance Area and from adjacent landforms, over 11,000 artefacts have already been recovered as a result of these programs.

As a period of time had lapsed from the time of the salvage programs, the Proposed Disturbance Area was re-assessed in its entirety and was subject to pedestrian survey over an 11 day survey period undertaken in 2012 and 2014. As a result, the Proposed Disturbance Area is known to contain 42 Aboriginal sites consisting of:

- 11 artefact scatters (MOCO OS-1 to MOCO OS-11) recorded as a result of the 2012/2014 surveys;

- 25 isolated finds (MOCO IF-1 to MOCO IF-25) recorded as a result of the 2012/2014 surveys;
- Three extensions to previously recorded sites (Extension to site #37-3-0649, Extension to site #37-3-0611 and Extension to site #37-3-0600) recorded as a result of the 2012/2014 surveys; and
- Three further previously recorded sites, #37-3-0611, #37-3-0985 (low density artefact scatters) and #37-3-0527 (isolated artefact).

The majority of the sites recorded in 2012/2014 display a low artefact density.

At two locations within the Proposed Disturbance Area, test excavations were carried out under the NSW Office of the Environment and Heritage (OEH) *Code of Practice for the Archaeological Investigation of Aboriginal Objects in NSW (Code of Practice)*. At one location (MOCO OS-3), no artefacts were recorded during the test excavations, while at the second location (MOCO OS-4), 114 artefacts were recorded, with over 80% coming from one discrete concentration. As a result, it was determined that MOCO OS-3 is a displaced site with no associated archaeological deposits, while MOCO OS-4 is a low density artefact scatter along the banks of the eastern drainage line with one known concentration of artefacts.

Using the information gained during the survey and test excavation components of the assessment, 36 of the newly recorded sites were assessed as having low scientific significance. This assessment was due to the fact that all sites in this category are low density artefact scatters or isolated finds without associated subsurface archaeological deposits. Sites such as these are essentially surface manifestations with a high likelihood that individual artefacts have been displaced. These sites can only be relevant to the most basic of research questions and therefore their scientific significance is low.

Three newly recorded sites (MOCO OS-4, MOCO IF-16 and Extension to site #37-3-0611) were assessed as having low-moderate scientific significance. Both MOCO OS-4 and Extension to site #37-3-0611 are low density artefact scatters where there is a possibility of subsurface archaeological deposits. However, from the test excavation at MOCO OS-4 and from field assessment at Extension to site #37-3-0611, it is assessed that these deposits could lack integrity and that they would only contain a further low density of artefacts. This limits the ability for these sites to further inform about the region's past and therefore they are assessed as having low-moderate scientific significance. MOCO IF-16 is a knapped glass artefact that was recorded without associated artefacts or deposits. However, due to the rarity of the artefact type, this site was assessed as having low-moderate scientific value.

No site was assessed as having moderate or high scientific value.

An assessment of the likely impact of the Project to Aboriginal sites within the Proposed Disturbance Area determined that of the 42 sites included within this assessment, 34 would be

directly impacted by the Project and eight (MOCO IF-3, MOCO IF-4, MOCO IF-6, MOCO IF-16, MOCO IF-17, MOCO IF-23, MOCO IF-24 and MOCO IF-25) will be avoided as they are located beyond the Proposed Disturbance Area boundary.

This report examines several management options ranging from a 'do nothing' scenario (Option A) through to a 'full Project approval' scenario (Option C).

Option B, namely to modify Project design to avoid impact to archaeological values, was not recommended due to the low scientific values of the assessed sites within the Proposed Disturbance Area. Option C, namely, 'full Project approval' was considered as a possibility and a management framework is presented in this report in order to mitigate against the loss of scientific values in the Proposed Disturbance Area should the Project obtain approval in its present form.

Under an Option C scenario, the common management process is the surface collection of artefacts from all sites. Management recommendations, beyond the surface collection of artefacts from all sites, apply to:

- MOCO OS-4: It is assessed that there is a probability that this site contains a low density of subsurface artefacts. Mapping, description and collection of surface artefacts should take place in the first instance. Up to a total of 2m² in total of manual excavation should be undertaken adjacent to the recorded artefact concentration to ensure that it is an isolated feature. Any expansion beyond this limit would require the agreement of the Proponent, archaeologist and RAPs as to whether further excavation is justified (see **Section 10.5.2**);
- MOCO Extension to site #37-3-0611: It is assessed that there is a probability that this site contains a low density of subsurface artefacts. Mapping, description and collection of surface artefacts should take place in the first instance. Up to a total of 2m² in total of manual excavation should be undertaken adjacent to the erosion gully that bisects the site to confirm that any subsurface artefacts are at a low density. Any expansion beyond this limit would require the agreement of the Proponent, archaeologist and RAPs as to whether further excavation is justified (see **Section 10.5.2**);
- The locations of proposed bridge piers within 20m of the current bank edge on the eastern bank of Bowmans Creek and on both banks of Bettys Creek should be salvaged by manual excavation to culturally sterile soil levels such as basal clays.

While these recommendations are made concerning MOCO OS-4 and MOCO Extension to site #37-3-0611, this report considers that MOCO OS-4 has already been adequately sampled during the test excavation program and that a more intensive subsurface archaeological investigation than what is recommended here is unwarranted.

Similarly, at MOCO Extension to site #37-3-0611, this report assesses that subsurface artefacts are likely to be at a low density and that a more intensive subsurface archaeological investigation than what is recommended here is unwarranted.

These recommendations are also framed in the knowledge that there have already been many archaeological subsurface investigations within the Proposed Disturbance Area, including extensive manual excavation along Bettys Creek and large areas of grader scrapes. This work informs us that archaeological stratigraphy is lacking within the Proposed Disturbance Area and that many of the most sensitive archaeological areas within the Proposed Disturbance Area (i.e. along Bettys Creek) have already been thoroughly investigated and that further subsurface archaeological investigation is unwarranted.

In order to address the issue of cumulative loss of sites in the district, the Project should investigate funding a storage facility to be built in or adjacent to the Yorks Creek Voluntary Conservation Area where all artefacts from the Mount Owen Complex can be secured and made available for future research.

In addition, the Project should investigate undertaking a management program to ensure that the integrity of remaining AHIMS registered archaeological sites (n=57) within the Mount Owen Complex are maintained¹. This recommendation would enhance and extend the existing management protocols in the current Mount Owen Aboriginal Cultural Heritage Management Plan (ACHMP) by initiating a pro-active management regime rather than the current passive management regime.

Under the Project's planning pathway, should the Project be approved, an AHIP will not be required so long as the impact accords with the terms and conditions of the approval. Instead, impacts to Aboriginal heritage would be managed through an ACHMP that is prepared by the Proponent, in consultation with RAPs and OEH. The archaeological management recommendations within this report would normally be incorporated into the ACHMP that is usually formulated following Project approval.

¹ Sites that are located outside of the Proposed Disturbance Area include eight sites recorded as part of this assessment along with 49 previously recorded sites. See footnote 13.

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1 INTRODUCTION

1.1 ACKNOWLEDGEMENTS

OzArk would like to acknowledge the Traditional Custodians of the Project Area “the Wonnarua Peoples” and pay respect to their cultural heritage, beliefs and continuing relationship with the land.

We would also like to acknowledge the post-contact experiences of Aboriginal peoples who have attachment to the Project Area and surrounds.

We pay our respect to the Elders “past, present and future” for they hold the memories, traditions, culture and hopes of Aboriginal Peoples in the area.

OzArk would also like to thank Gary Bernasconi (Mount Owen) who made the organisation and logistics of both the survey and test excavation program run so smoothly.

OzArk would also like to thank all Registered Aboriginal Parties (RAPs) or RAP representatives who participated in the survey and test excavation program. As this involved many people it is impossible to thank everyone individually although OzArk acknowledges that your hard work, and the dedication you showed towards the understanding and protection of your cultural heritage, contributed to the success of this assessment program.

As a result of feedback from RAP meetings attended by the author, a brief explanation of the archaeological term ‘occupation’ may be helpful.

It is acknowledged that Aboriginal people occupied all corners of Australia, in most areas, for a very long period of time. Archaeologists working today attempt to bring some clarity as to where, when and how this occupation took place.

Archaeologists use terms such as ‘occupation’ very specifically to describe whether there is material evidence at a location to indicate that it has been ‘occupied’: i.e. whether a precise location been used for tool making, and by implication, is associated with a particular event such as camping or butchering (as stone tools are our primary type of material evidence in this regard). A lack of ‘occupation’ evidence in archaeology in no way means that the area was not used in many different ways, it only indicates that specific evidence for the type of use is lacking in the archaeological record.

The author accepts that all areas of the current Proposed Disturbance Area were occupied by Aboriginal people in the past and that the present task, as it has been for the archaeologists who have come before, is to use what remaining evidence there is to accurately describe the way of life of the many generations of Aboriginal people who have lived in the region, including the most recent generations: should that evidence be present within the Proposed Disturbance Area.

1.2 ABBREVIATIONS

The following abbreviations are used in this report (**Table 1**).

Table 1: Abbreviations used in this report.

ACHA	Aboriginal Cultural Heritage Assessment
ACHM	Australian Cultural Heritage Management Pty Limited
ACHMP	Aboriginal Cultural Heritage Management Plan
AHIMS	Aboriginal Heritage Information Management System. Administered by OEH.
AHIP	Aboriginal Heritage Impact Permit. Application for an AHIP is made to OEH and must demonstrate RAP consultation.
<i>Code of Practice</i>	<i>Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales</i> . Under Part 6 of the NPW Act.
IMT	Indurated Mudstone/Tuff. A common stone used for stone tool manufacture in the district.
NPW Act	<i>National Parks and Wildlife Act 1974</i>
OEH	The NSW Office of the Environment and Heritage. Formerly DECCW (Department of the Environment, Climate Change and Water), DECC (Department of the Environment and Climate Change) and DEC (Department of the Environment and Conservation)
OzArk	OzArk Cultural & Heritage Management Pty Limited
Project Area	The area within which the Project will have application.
Proposed Disturbance Area	The area within the Project Area where there are predicted to be direct impacts to the ground surface arising from the Project.
RAP	Registered Aboriginal Party
The Project	Mount Owen Continued Operations Project
The Proponent	Mount Owen Pty Limited is the applicant of the Project.
Mount Owen	Mount Owen Pty Limited

1.3 BRIEF DESCRIPTION OF THE PROJECT

The Mount Owen Complex is located within the Hunter Coalfields in the upper Hunter Valley of New South Wales (NSW), approximately 20km north-west of Singleton and 24km south-east of Muswellbrook (**Figure 1**).

Mount Owen Pty Limited (Mount Owen), a subsidiary of Glencore Coal Pty Limited (formerly Xstrata Coal Pty Limited (Xstrata)) currently owns the three open cut operations in the Mount Owen Complex, Mount Owen (North Pit), Ravensworth East (West Pit) and Glendell (Barrett Pit). Mount Owen anticipate that mining will commence in the northern portion of the Ravensworth East in an area known as the Bayswater North Pit in 2015. The mining operations at the Mount Owen Complex include the integrated use of the Mount Owen coal handling and preparation plant (CHPP), coal stockpiles and the rail load-out facility.

Mount Owen is seeking development consent for the Mount Owen Continued Operations Project (the Project) to extract additional mineable coal tonnes through continued open cut mining methods. The Project proposes to continue the existing mining operations within the North Pit to the south beyond the current approved North Pit mining limit (the North Pit Continuation) and to undertake mining operations within the Bayswater North Pit, sequentially followed by Ravensworth East Resource Recovery (RERR).

The Project is State Significant Development as defined by the provisions of the *State Environmental Planning Policy* (State and Regional Development) 2011 and requires development consent under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The Minister for Planning is the consent authority for the Project.

An Environmental Impact Statement (EIS) has been prepared for the Project to accompany a Project Application following Department of Planning and Environment (DP&E) issuing Director-General's Requirements (DGRs) for the Project in March 2013. The following Aboriginal Archaeological Values Assessment was prepared to meet the Director-General's Environmental Impact Statement (EIS) requirements in relation to Aboriginal Archaeology issues for the Project.

OzArk Environmental and Heritage Management (OzArk) have been engaged to undertake the identification and assessment of archaeological values within the Proposed Disturbance Area.

Australian Cultural Heritage Management Pty Limited (ACHM) has been engaged by Mount Owen to undertake Aboriginal community consultation for the Project and to author the Aboriginal Cultural Heritage Assessment (ACHA) to which this report contributes.

1.3.1 Assessment history

In 2012, Mount Owen identified a conceptual design for the project which included continuation of mining in the North Pit as identified above. The conceptual design and associated Disturbance Area were subject to archaeological survey and test excavation in late 2012 and early 2013. The archaeological assessment was completed in accordance with relevant guidelines and in consultation with the Registered Aboriginal Parties (RAPs) and the *Aboriginal Archaeological Values Assessment* was provided to the RAPs on 27 September 2013 for review and/or comment.

Throughout late 2013, Glencore refined the mine plan for the proposed North Pit in order to further optimise the benefits of the Project. The optimisation of the North Pit continuation plan has yielded approximately 4 million additional minable coal tonnes for the Project and resulted in an additional area of approximately 21ha that was not included in the Proposed Disturbance Area previously surveyed (refer to Section 1 of the EIS for further detail). Accordingly, a further survey focussing on this additional area of proposed disturbance was undertaken on 29 April 2014 with the results of this survey, combined with the previous assessment completed in 2013, detailed in this report. The outcomes of the additional assessment were provided to RAPs for 28 days of review in July 2014.

Figure 1: Location map.



1.4 PROPOSED WORKS

The Project's proposed works include:

- 381ha southern extension to the existing Mount Owen North Pit to continue mining beyond current approved pit limit;
- Provision for a northern rail line turn-out and new rail line;
- Hebden Road overpass over Main Northern Rail Line;
- New Hebden Road bridge crossing over Bowmans Creek;
- Product stockpile extension; and
- MIA extensions and improvements.

The Project seeks to maintain the current approved North Pit extraction rate of 10 million tonnes per annum of Run of Mine (ROM) coal, extracting approximately 74 million tonnes of ROM coal from the North Pit Continuation. The extraction of these additional mineable coal tonnes would continue the North Pit life to approximately 2030 (an additional 12 years). Additionally, the Project seeks to maintain the current approved Ravensworth East extraction rate of 4 million tonnes per annum of ROM coal, and to extract approximately 12 million tonnes of ROM coal from the BNP. Mining within the BNP area would be undertaken from 2015 to 2022, with the mining in the RERR mining area to follow sequentially from 2022 to 2027 and extracting approximately 6 million tonnes of ROM coal.

The Project is also seeking approval to expand the existing product stockpile to manage additional product types. The Project also seeks approval to upgrade and extend the Mount Owen mine infrastructure area. These upgrades are all proposed within existing operational areas.

To allow for increased efficiencies within the Hunter Valley Coal Chain, the Project is seeking approval for the provision of an additional rail line and northern turn-out, to the west of the existing Mount Owen rail spur. The existing rail spur will be used as a park-up area for Glencore trains that are not in service.

The Project is seeking approval to construct a rail overpass and remove the existing level crossing on Hebden Road to improve traffic flow and reduce traffic hazards. The project is also seeking approval to construct a new bridge on Hebden Road to allow for two-way traffic movements over Bowmans Creek.

Mount Owen currently has approval to use the existing Ravensworth East and M-series conveyor to transport ROM coal to the Bayswater and Liddell power stations. The Project is seeking approval to extend the use of this existing infrastructure to cover the transport of ROM coal and crushed gravel to Liddell Coal Operations and the Ravensworth Coal Terminal. In

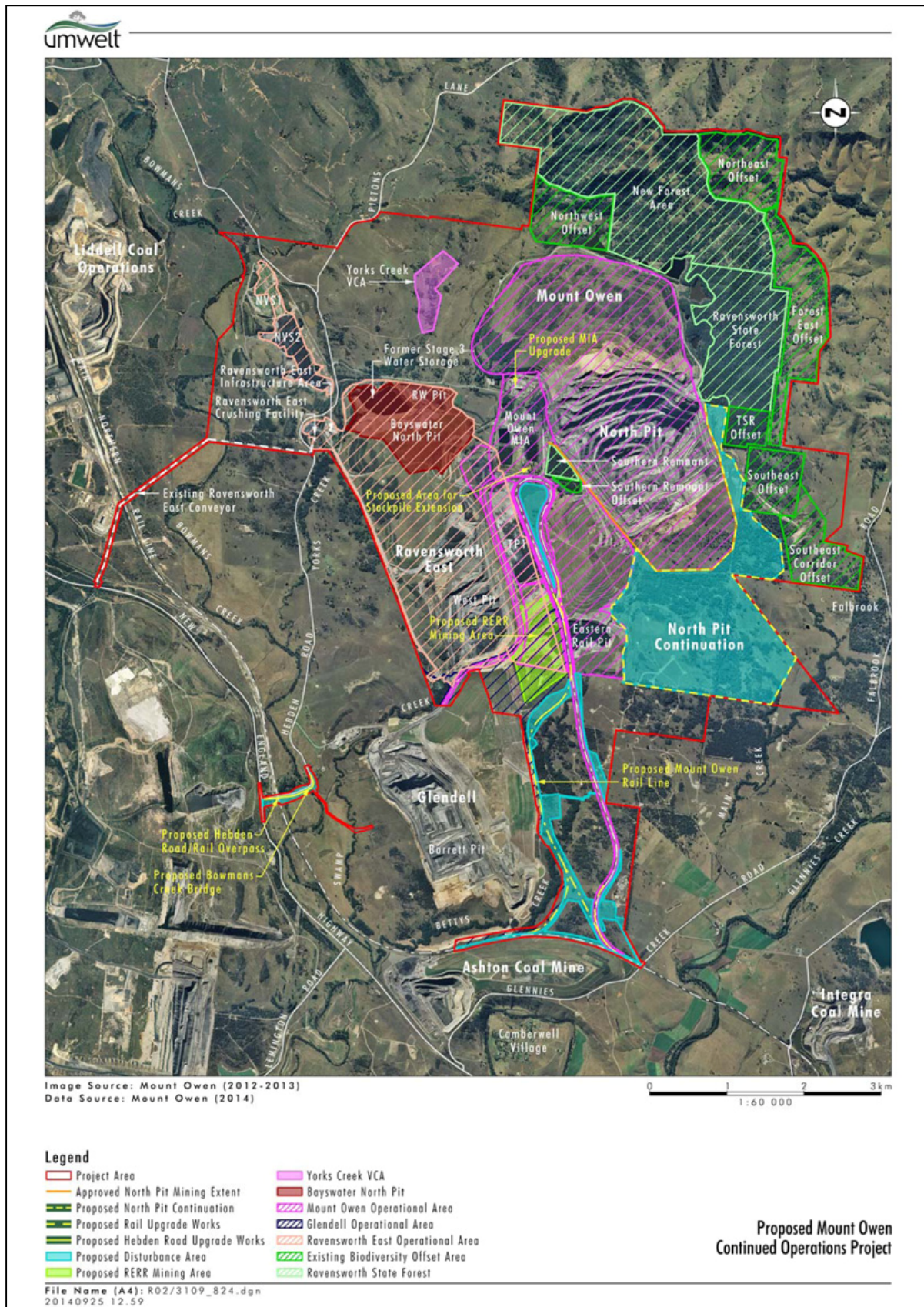
addition, the Project seeking approval to allow for tailings from other mines to be emplaced within the Mount Owen tailings emplacement areas.

The Project will enable the consolidation of the Mount Owen and Ravensworth East Operations to provide for further operational efficiency by providing a single development consent for continued operations. The Project does not include any aspect of the ongoing operations at Glendell Mine and it will continue to operate in accordance with its current development consent.

The Proposed Disturbance Area is the area of land that would be directly impacted by the Project. The total Proposed Disturbance Area is approximately 485ha (North Pit Continuation approximately 381ha and the proposed Hebden Road Infrastructure and Mount Owen Rail works approximately 104ha). The Proposed Disturbance Area represents the area that is additional to the currently approved disturbance areas within the Mount Owen Complex.

Further detail on the proposed works is outlined in the Environmental Impact Statement (EIS). This report forms part of the EIS.

Figure 2 identifies the Proposed Disturbance Area and shows the location of key Project components.

Figure 2: Location of Proposed Disturbance Area and proposed works.

1.5 THE PROPOSED DISTURBANCE AREA

The Proposed Disturbance Area covers approximately 485ha and is the area of land that would be directly impacted by the Project. The Proposed Disturbance Area represents the area that is additional to the currently approved disturbance areas within the Mount Owen Complex.

In accordance with the relevant NSW Office of the Environment and Heritage (OEH) guidelines, the Proposed Disturbance Area will also be referred to as the impact area for the Aboriginal archaeology and cultural heritage assessments.

It is noted in this report that the Proposed Disturbance Area is the area in which all direct Project impacts will occur.

The Proposed Disturbance Area includes:

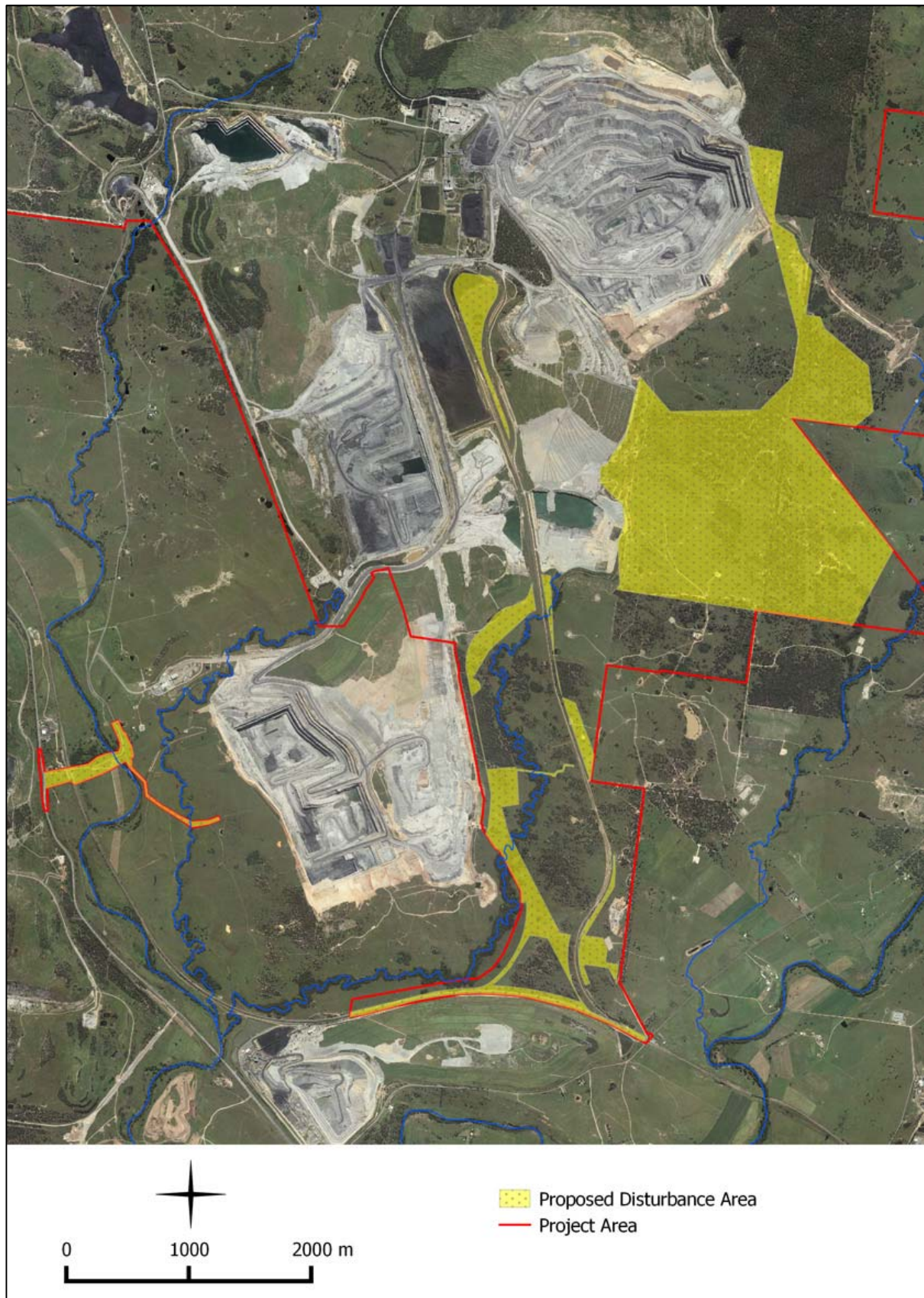
North Pit Continuation. Mining operations will continue within the North Pit and Ravensworth East by extending the North Pit south by approximately 381ha. The continuation of operations would be located wholly on land owned by Mount Owen.

Road Diversions and Upgrade. The Project includes the construction of a rail overpass for road traffic adjacent to the existing level crossing where Hebden Road crosses the Main Northern Rail Line. Due to the anticipated increase in future train movements on the Main Northern Rail Line as a result of anticipated western coal expansions, the purpose of the proposed rail overpass construction is to improve traffic flow and reduce traffic hazards by eliminating the potential for traffic to queue back onto the New England Highway. Further to the east of the Main Northern Rail Line, Hebden Road crosses over Bowmans Creek via the single lane Bowmans Creek Bridge. As part of the Project, Mount Owen proposes to construct a new bridge to allow for two-way traffic movements. The purpose of the new bridge is to provide further road traffic safety improvements.

Rail Transportation. Mount Owen will continue to utilise the existing Mount Owen rail spur that currently services the Mount Owen Complex. In addition, Mount Owen is seeking approval for the provision of an additional rail line and northern turn-out west of the existing Mount Owen rail spur. The existing rail spur would be used as a park-up area for Glencore trains that are not in service.

Figure 3 shows the Proposed Disturbance Area with the large contiguous area in the northeast being the North Pit Continuation, the central, more linear, disturbances being for the Mount Owen rail spur and the small area in the west being for the Hebden Road realignment. Hebden Road realignment disturbance area also includes a small portion of Swamp Creek that is impacted by the upgrade of a non-public road that will be used during construction.

Figure 3: Location of the Proposed Disturbance Area.



1.6 RELEVANT LEGISLATION

Commonwealth and State government legislation is relevant to the current Project. **Sections 1.6.1** and **1.6.2** outline the various Commonwealth and State legislation governing Aboriginal cultural heritage while **Section 1.6.3** summaries the applicability of these Acts to the Project Area.

1.6.1 Commonwealth Legislation

Aboriginal and Torres Strait Islander Heritage Protection Act 1984

The purpose of the Aboriginal and Torres Strait Islander Heritage Protection Act 1984 is the preservation and protection from injury or desecration of areas and objects in Australia and in Australian waters that are of particular significance to Aboriginal people in accordance with Aboriginal tradition.

Environment Protection and Biodiversity and Conservation Act 1999 (EPBC Act)

Amendments to this Act in 2003 established the National Heritage List and the Commonwealth Heritage List, both administered by the Department of the Environment. Ministerial approval is required for proposals involving significant impacts to National/Commonwealth heritage places.

This Act applies if the activity is deemed to be a controlled action under the Act or if it is likely to impact places listed on the National Heritage Register or the Commonwealth Heritage Register.

1.6.2 NSW Legislation

The National Parks and Wildlife Act 1974

The National Parks and Wildlife Act 1974 (NPW Act), administered by OEH, is the primary legislation for the protection of some aspects of Aboriginal cultural heritage in NSW. Section 86 of the Act deals with harming and desecrating Aboriginal Objects.

'Aboriginal object' means 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.'

Under section 86 of the NPW Act, it is an offence to 'harm' an Aboriginal object. 'Harm' means any act or omission that:

- destroys, defaces, damages or desecrates the object
- moves the object from the land on which it had been situated, or
- causes or permits the object to be harmed.

There are two types of offences for harming an Aboriginal object:

- An offence of harming an object which a person knows is an Aboriginal object (a 'knowing offence')
- An offence of harming an object whether or not a person knows it is an Aboriginal object (a 'strict liability offence').

The NPW Act provides several defences to prosecution for both types of offence. Where a person either knows or does not know they are harming an Aboriginal object, a person has a defence where:

1. the harm was authorised by an Aboriginal Heritage Impact Permit (AHIP), and all the permit's conditions are complied with; or
2. the harm occurred during the exercise of a power or function under the State Emergency and Rescue Management Act 1989 (for emergencies as defined under that Act); or
3. the harm was specifically required or permitted under the terms of a conservation agreement entered into under the NPW Act (only where the agreement was entered into or modified after the commencement of the *National Parks and Wildlife Amendment Act 2008*).

Where a person does not know they are harming an Aboriginal object, they have an additional defence to prosecution if:

'...[They] exercised due diligence to determine whether the act...would harm an Aboriginal object and determined that no Aboriginal object would be harmed' (a 'due diligence defence').

Clause 3A of the National Parks and Wildlife Regulation 2009 specifies that an act carried out in accordance with the *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW 2010; *Code of Practice*) is excluded from the definition of harm.

The NPW Act also provides exemptions to harming Aboriginal objects in the following circumstances:

1. Aboriginal people and their dependants are exempt from being prosecuted for harming an Aboriginal object if, in carrying out any traditional cultural activities, they would otherwise harm an Aboriginal object within the meaning of the Act.
2. Emergency fire fighting activities authorised under the *Rural Fires Act 1997*.

There is an additional strict liability offence related to harming an Aboriginal Place. An Aboriginal Place, declared under section 84 of the NPW Act, is 'a place that, in the opinion of the Minister, is or was of special significance with respect to Aboriginal culture'.

The Environmental Planning and Assessment Act 1979

The Environmental Planning and Assessment Act 1979 (EP&A Act) provides a framework for environmental planning and assessment in NSW and requires that consideration be given to environmental impacts as part of the land use planning process.

On 1 October 2011, Part 3A of the EP&A Act was repealed and replaced by new provisions in the EP&A Act, which create an environmental assessment framework for two new categories of development: State Significant Development (SSD) and State Significant Infrastructure (SSI).

The classes of development that are SSD or SSI are set out in the State Environmental Planning Policy (State and Regional Development) 2011 which also commenced on 1 October 2011.

The procedures for SSD are set out in Division 4.1 of Part 4 of the EP&A Act.

The Minister for Planning is the consent authority for SSD; however, this role has been delegated to the NSW Planning Assessment Commission or senior officers of the Department of Planning & Infrastructure in certain circumstances. A Development Application (DA) for SSD is to be accompanied by an EIS. Applicants for a SSD must seek the Director General's Requirements (DGRs) for the EIS prior to lodging a DA.

Section 79C of the EP&A Act applies to SSD, therefore, all relevant planning controls contained in any environmental planning instruments will need to be considered, including local environmental plans. However, development control plans do not apply to SSD.

Some concurrences or subsequent approvals are not required in respect of SSD, including in relation to heritage, bushfire and threatened species. Input from relevant agencies will occur at DGR stage.

DAs for SSD must be exhibited for at least 30 days.

1.6.3 Applicability to the Project Area

No item listed on Commonwealth, State and local heritage registries is known to exist within the Project Area.

EPBC Act

Mount Owen is of the view that the Project is unlikely to have a significant impact on matters of national environmental significance. However, Mount Owen is referring those parts of the Project requiring additional disturbance outside that already approved under the existing consents to the Minister for the Minister's decision as to whether or not the Project is a controlled action.

NPW Act

The framing of the archaeological survey methodology, the survey itself and this report have been conducted in accordance with the *Code of Practice*. The test excavation component of this assessment was also conducted in accordance with the *Code of Practice*. The *Code of Practice* refers to Part 6 of the NPW Act. **Section 2.1** tabulates the sections that refer to the guidelines set out in the *Code of Practice*.

The NPW Act protects Aboriginal archaeological sites that have been previously recorded within the Project Area, as well as the artefact scatters and isolated finds recorded during the current assessment.

EP&A Act

The Project is SSD as defined by the provisions of the *State Environmental Planning Policy (State and Regional Development) 2011* and requires development consent under Part 4 of the EP&A Act.

As a SSD, the Project is bound by Director General Requirements (DGRs) that were issued for the project on 13 February 2013 from the NSW Department of Planning and Infrastructure (State Significant Development - Director-General Requirements Mount Owen Continued Operations Project [SSD-5850]). The DGRs in relation to Aboriginal cultural heritage are set out in **Section 2.2**.

Under the EP&A Act (Sect 89J), following approval, an AHIP under section 90 of the NPW Act would not be required to impact an Aboriginal site or object.

Instead, if the Project is approved, the approval conditions of the DA are likely to stipulate that an Aboriginal Cultural Heritage Management Plan (ACHMP) be developed which will become the management policy document for any impact to the cultural heritage of the Project Area.

2 CODE OF PRACTICE AND DIRECTOR GENERAL REQUIREMENTS

2.1 THE CODE OF PRACTICE

The purpose of the *Code of Practice* is to:

- establish the requirements that must be followed when carrying out archaeological investigation in NSW where an application for an AHIP is likely to be made; and
- establish the requirements for undertaking test excavation as a part of archaeological investigation without an AHIP.

The *Code of Practice* lists 26 Requirements governing any archaeological investigation that has either of these listed aims. The *Code of Practice* was followed during this assessment as the investigation recorded Aboriginal archaeological sites which may be harmed by the Project (Requirements 1 to 13). The assessment also included a test excavation program (Requirements 14 to 20). Requirements 21 to 26 are not applicable to this assessment. **Table 2** provides a check-list of where information pertaining to particular Requirements under the *Code of Practice* can be located.

Table 2. Code of Practice Requirements.

<i>Code of Practice Requirement</i>	<i>Report Section</i>
Preparing an Aboriginal cultural heritage assessment report	
Requirement 1 – Previous archaeological work. The review of previous archaeological work must:	
be appropriate to the scale of the proposed activity, its anticipated impacts and the size of the subject area	The regional and local archaeological context for the Project is provided in Section 5 .
include an Aboriginal Heritage Information Management System (AHIMS) search	See Section 5.3 .
synthesise the known archaeology and ethnohistory of the region using relevant published and unpublished sources, published material, local knowledge and other sources	See Section 5 . Further information is also available in the ACHA.
evaluate the results of any previous reports for the subject area in light of current knowledge	See Sections 5.2 and 5.3 .
describe the range and nature of Aboriginal sites and features present within and near the subject area, including presentation of the results in tabulated form	See Section 5.3, Appendix 5 .
describe existing predictive models that are relevant to the project and subject area, such as models of past Aboriginal land-use strategies and cultural systems together with models of relevant taphonomic processes that highlight the main issues and regional character of the archaeology; depending on the scale of the project and information available this may be simple or complex	See Section 5.4 .
present a map in the Archaeological Report, preferably prepared using a geographic information system (GIS), showing the location of previously recorded sites and, where available, areas of previous surveys. Where there are restrictions placed on data by Aboriginal people, these must be respected and appropriately documented in the Archaeological Report.	See Figure 22 and Figure 23 .
Requirement 2 – Review the landscape context	Section 4 describes the environmental and land use background to the Project Area.
Requirement 3 – Summarise and discuss the local and regional character of Aboriginal land use and its material traces	Section 4.7 and Section 5.3 summarise the environmental and archaeological context of the Project Area.

Code of Practice Requirement	Report Section
Requirement 4 – Predict the nature and distribution of evidence	Section 5.4 presents a predictive model for Aboriginal site distribution within the Project Area.
Requirement 5 – Archaeological survey	Section 5.5 and Section 5.6 outline the archaeological survey of the Project Area. The Proposed Disturbance Area covers 485ha and so the archaeological investigation has been appropriately thorough with 11 days of survey and a five day test excavation program.
Requirement 6 – Site definition	Section 6.2 presents all data on the Aboriginal sites recorded during this assessment.
Requirement 7 – Site recording	Section 6.2 presents all data on the Aboriginal sites recorded during this assessment.
Requirement 8 – Location information and geographic reporting	Section 6.2 presents all data on the Aboriginal sites recorded during this assessment.
Requirement 9 – Record survey coverage data	Section 6.1 outlines survey coverage and Section 3.6 and Section 4.6 outline the survey constraints/limitations.
Requirement 10 – Analyse survey coverage	Survey effectiveness is presented in Section 6.1 .
Requirement 11 – Archaeological Report content and format	This report adheres to this requirement.
Requirement 12 – Records	OzArk undertakes to maintain any paper or digital files, including photographs, for the mandated period.
Requirement 13 – Notifying DECCW and reporting	Not applicable to this Project.
Archaeological test excavation	
Requirement 14 – Test excavation which is not excluded from the definition of harm	The test excavation program did not investigate any areas that are excluded from the definition of harm in Requirement 14.
Requirement 15 – Pre-conditions to carrying out test excavation	The draft test excavation methodology was sent to all RAPs on 6 February 2013. The methodology for the test excavation program was sent to OEH on 15 February 2013. The sampling strategy for the program is set out in Section 7.2 .
Requirement 16 – Test excavation that can be carried out in accordance with the Code of Practice	The excavations complied with the guidelines, see Section 7.4 .
Requirement 17 – When to stop test excavations	No human remains were encountered and excavation ceased when sufficient information had been obtained to characterise the archaeological nature of the investigated areas.
Requirement 18 – Artefact recording	The guidelines contained in Requirement 18 were followed during the field survey.
Requirement 19 – Attribute recording	Section 7.3 outlines the artefact recording system used during the test excavations.
Requirement 20 – Photography and drawing	The guidelines contained in Requirement 20 were followed during the test excavation.

2.2 DIRECTOR GENERAL REQUIREMENTS

DGRs were received by the Project on 13 February 2013 (SDD-5850). **Table 3** sets out the DGRs and shows where this report complies with the requirements.

Table 3. Director General Requirements.

	Director General Requirement	Report Section
State Significant Development - Director-General's Requirements Mount Owen Continued Operations Project (SSD-5850) 2013	Heritage – including an Aboriginal cultural heritage assessment (including both cultural and archaeological significance) which must: - demonstrate effective consultation with Aboriginal communities in determining and assessing impacts, and developing and selecting mitigation options and measures; and - outline any proposed impact mitigation and management measures (including an evaluation of the effectiveness and reliability of the measures)	The consultation process is outlined in the accompanying ACHA. Discussion of management options and management and mitigation measures are set out in Section 10 and following of this report.

3 BACKGROUND TO THE ARCHAEOLOGICAL INVESTIGATION

3.1 PURPOSE AND OBJECTIVES OF THE ARCHAEOLOGICAL INVESTIGATION

The purpose of the current study is to provide an assessment of scientific values that will inform the ACHA and to provide recommendations for the future management of any sites within the Proposed Disturbance Area.

The objectives of the current study are to:

Objective One: In conjunction with RAP representatives, survey and assess the Proposed Disturbance Area in order to identify Aboriginal sites or landforms with potential to contain Aboriginal sites.

Objective Two: In conjunction with RAP representatives, to carry out test excavations at any locations where the nature and extent of archaeological deposits require further clarity.

Objective Three: To use the results of the survey and the test excavation program to formulate appropriate management and/or mitigation strategies.

In particular the assessment aimed:

- To locate surface evidence of Aboriginal sites within the area to be affected by mining and associated activities;
- To undertake preliminary recording of the nature, condition and context of Aboriginal sites. All site recording was restricted to surface exposures of artefacts. The test excavation program examined subsurface deposits at two locations;
- To provide basic analysis of the artefact assemblages present within the survey area, in order to characterise the raw materials utilised, artefact types and technologies, occupation densities, presence of knapping floors, etc.;
- To describe and analyse the landscape context of the archaeological assemblage, particularly with respect to the nature and age of geomorphic surfaces providing the substrate for occupation, and the impact of active surface erosion on site visibility and site preservation. At this locality, the ephemeral nature of streams and water quality may also have been a constraint in prehistoric occupation patterns;
- To assess the scientific significance of the assemblage of Aboriginal sites and of individual sites, on the basis of information obtained from the field survey;
- To evaluate the necessity for further investigation of individual sites, or of archaeological context in order to clarify the significance of the archaeological record preserved in the study area; and
- To provide recommendations for the management of the Aboriginal archaeological resource.

3.2 DATE OF HERITAGE ASSESSMENT

The survey of the Proposed Disturbance Area took place over two weeks from 26 November 2012 to 7 December 2012.

The archaeological test excavation program took place over one week from 11 March 2013 to 15 March 2013.

In 2014, the Proposed Disturbance Area was expanded slightly necessitating a further one day of survey (Survey Units 5 and 6, see **Figure 5**). This took place on 29 April 2014 and concentrated on Survey Units 5 and 6.

3.3 ABORIGINAL COMMUNITY INVOLVEMENT

The Project Area is within the traditional lands of the Wonnarua (Tindale 1974). It is also within the boundaries of the Wanaruah Local Aboriginal Land Council.

Aboriginal community consultation on the Project has been facilitated by Mount Owen and ACHM and is detailed in the separate ACHA which accompanies this report.

Arrangement of the fieldwork roster whereby RAP representatives participated in the field work was arranged by Mount Owen.

The Aboriginal community consultation for the Project has been extensive and all RAPs, including the three registered Native Title Claimant groups (as existed at the time, see ACHA), were invited to participate in a series of meetings and work in the field. This report will limit itself to recording and responding only to those points raised that had a direct impact on either the methodology or execution of the archaeological values assessment.

The survey methodology for the Project was sent to RAPs for comment on 23 October 2012 (**Appendix 1**). Following a 28 day review period, no direct comment on the proposed survey methodology was received.

From 26 November 2012 the survey component of the assessment was undertaken with the assistance of representatives from the three Native Title Claimant groups and a rotating roster among other RAPs. At the end of the survey on Friday 7 December 2012 a discussion was held with the RAP representatives present about the effectiveness and results of the survey. Those present felt that there had been adequate survey of the Proposed Disturbance Area, although some locations were seen as requiring test excavation. The OzArk archaeologist suggested the area around MOCO OS-4, and following discussions with RAPs, all agreed that another location would be adjacent to MOCO OS-3.

At the conclusion of the surveys in 2012 and 2014, a written summary was provided to all RAPs for their information (**Appendix 2**).

The proposed test excavation methodology was sent to all RAPs on 6 February 2013, and following the 28 day review period, three comments supporting the proposed test excavation methodology were received (**Appendix 3**).

Archaeological results from the survey were presented to a meeting consisting of representatives of the three Native Title Claimant groups on Monday 4 March 2013. At this meeting the forthcoming test excavation was discussed and no direct comment on the methodology was raised.

The test excavation took place from 11 March 2013; again with the participation and assistance of RAPs.

At the conclusion of the test excavation, a written summary was provided to all RAPs for their information (**Appendix 4**).

In addition to this, Ben Churcher (OzArk) has been in the field with representatives of the three Native Title Claimant groups who were undertaking cultural values assessments. Ben was present to show where the sites are located and to be generally on hand to answer questions. The first site visit took place from 4 to 6 March 2013 and included the opportunity for all three groups to participate. The second took place on 15 May 2013 with representatives from the Plains Clans of the Wonnarua People (PCWP).

The first site visit included viewing both locations where the test excavation was to take place and a general tour of all portions of the Proposed Disturbance Area. During this visit interest was shown in the archaeological results, although no further cultural information that directly pertained to any one site was provided to the archaeologist.

The second site visit was to accompany PCWP representatives to view, as part of their cultural values assessment, a recorded stone arrangement that is located 200m east of the northern portions of the Proposed Disturbance Area. The AHIMS, administered by OEH, records two stone arrangements in this area although this visit confirmed there is only one and that both Dyall's 1980 recording [#37-3-0018] and the later 1998 Umwelt (Australia) Pty Limited (Umwelt) recording (#37-3-0637) are the same site. The AHIMS location for #37-3-0637 is the correct location for the stone arrangement. The site is correctly identified in the field by signage.

Representatives from the PCWP did not specifically know what the stone arrangement could have been used for, but considered it culturally significant and warranting of further comparative research. The OzArk archaeologist present was unable to locate direct evidence of Aboriginal construction and/or use and while it is also not obviously a historic construction, this cannot, at this stage, be ruled out. The previous assessments of this item also offer no conclusive evidence for an Aboriginal origin. However, the site cards state that the arrangement has been extant since at least 1939 and that property owners in the early twentieth century reported that

current Aboriginal people did not use the site but reported that their ancestors did and knew it as a 'ring of fire'. The arrangement is located at least 200m from impacts from the Project.

Further consultation involving OzArk occurred between Tuesday 10 September 2013 and Thursday 12 September 2013 when a series of meetings were held for two of the Native Title Claimant groups (Wonnarua People, Wonnarua Traditional Custodians) and for those RAPs not being consulted through one of the Native Title Claimant groups. At these meetings OzArk presented the archaeological findings and management recommendations. There was robust discussion and general RAP disapproval regarding the option that development consent will be granted to the Project and that salvage of archaeological sites will take place (Option C in this report).

The Wonnarua Traditional Custodians, in particular, made clear their belief that the Proposed Disturbance Area consists of a significant cultural landscape and that previous archaeological interpretations for Aboriginal land use in area (such as those presented in **Section 5.3.3**) were not seeking Aboriginal perspectives on the archaeological data.

The meetings demonstrated that there are a breath of views and attitudes within the RAP group for the Project, and while there was no direct comment on the contents or interpretations arising from the current assessment, it is clear that the RAP community are disappointed, and even angry, concerning the loss of cultural heritage sites in the immediate region.

An earlier version of this report was issued to all RAPs on 27 September 2013 for the requisite 28 day review period and to allow comment from the RAPs on any aspect of the report. As of the closing date for the review period (31 October 2013), no comments were received from RAPs concerning this report.

In 2014, the Proposed Disturbance Area was expanded slightly and a further one day of survey was necessary (Survey Units 5 and 6, see **Figure 5**). This took place on 29 April 2014 with the assistance of representatives from the three Native Title Claimant groups and a rotating roster among other RAPs. As noted above, all RAPs were supplied with a summary of the results of this assessment following the field work (**Appendix 2**).

A summary document of all changes to this report arising from the 2014 survey was issued to RAPs on 23 July 2014 for a 28 day review period and to allow comment from the RAPs on any aspect of the new findings. As of the closing date for the review period (20 August 2014), no comments were received from RAPs concerning this report.

3.4 OZARK INVOLVEMENT

3.4.1 Field assessment

The archaeological survey was undertaken for OzArk by Ben Churcher (BA [Hons]: University of Queensland, Dip. Ed.: University of Sydney; OzArk Principal Archaeologist).

Ben was assisted in the field for the 2012 assessment by Joshua Noyer (BA Anthropology/Archaeology: University of California, Santa Cruz, OzArk Project Archaeologist). For the 2014 assessment, Ben was assisted by Jennifer Bertolani (BS Anthropology, Central Washington University; OzArk Project Archaeologist).

3.4.2 Test Excavation

The test excavation program was directed by Ben Churcher. Ben was assisted by OzArk archaeologists Nicolas Harrop (OzArk Senior Archaeologist) and Joshua Noyer. Rowan Murphy was OzArk's Operations Manager for the excavation period.

3.4.3 Reporting

The reporting component of the current project was undertaken by:

- Report author: Ben Churcher.
- Reviewer: Dr Jodie Benton (PhD University of Sydney, Director OzArk).

3.5 DESKTOP DATABASE SEARCHES CONDUCTED

A desktop search was conducted on the following databases to identify any potential issues. The results of this search are summarised in **Table 4**.

Table 4: Database search results.

Name of database searched	Date of search	Type of search	Comment
Australian Heritage Database http://www.environment.gov.au/heritage/ahdb/	August 2014	Singleton Local Government Area (LGA).	No Aboriginal places are on the National or Commonwealth Heritage Lists within the Singleton LGA.
NSW Heritage Office State Heritage Register and State Heritage Inventory http://www.heritage.nsw.gov.au/	August 2014	Singleton LGA	12 places are listed on the State Heritage Register (State heritage values; none specifically Aboriginal) and none are located in the vicinity of the Proposed Disturbance Area. 159 places are listed on the State Heritage Inventory (Local heritage values listed with the Singleton Local Environment Plan [LEP]; none specifically Aboriginal) and none are located in the vicinity of the Proposed Disturbance Area.
National Native Title Claims Search http://www.nntt.gov.au/Applications-And-Determinations/Search-Applications/Pages/Search.aspx	August 2014	NSW	The Project Area is within the claim area for Scott Franks and Anor on behalf of the Plains Clans of the Wonnarua People (NC2013/006). The claim is listed as 'active' although it is noted that the claim was 'Not Accepted' on 27/02/2014. The claimant is challenging this decision.

Name of database searched	Date of search	Type of search	Comment
OEH AHIMS	27/8/14	11km (east-west) x 12km (north-south) centred on the Project Area.	448 sites are within the search area (see Section 5.3.1).

3.6 HERITAGE ASSESSMENT CONSTRAINTS

There were no access issues in any region of the Proposed Disturbance Area that prevented the archaeological assessment from being carried out. When the team was in the field the weather was mostly dry with warm to hot temperatures that did not inhibit the progress of the survey team.

There were no other constraints that hindered the successful completion of the archaeological assessment apart from the usual archaeological constraint: variable ground surface visibility.

As discussed in **Section 6.1**, the variable ground surface visibility was not a great hindrance to the overall assessment. In areas of low ground surface visibility, such as on the flat landforms adjacent to drainage lines, there were sufficient exposures along tracks and fences as well as around features such as dams and ant mounds (**Figure 4. 1** and **.2**). In sloping landforms there were sufficient natural bare patches affording views of the ground surface (**Figure 4. 3** and **.4**). In drainage landforms, in the areas of highest archaeological potential, sizeable exposures often existed which afforded views of the ground surface.

In summary, due to the sizeable exposures along the drainage systems, the most archaeologically important areas were assessed with very little hindrance. While areas of no ground surface visibility existed along creeks such as Bettys Creek, the exposures were frequent enough as to allow extrapolation between exposures.

In other landforms, the archaeological potential was much lower and the assessment was sufficiently able to sample these landforms both through extensive pedestrian surveys across them and also by utilising any available exposure to characterise the archaeological values of the landform.

Figure 4: Ground surface visibility in the Proposed Disturbance Area.

	
1. IN CLEARED AND GRASSED AREAS, THE GENERAL GROUND SURFACE VISIBILITY WAS VERY LOW.	2. IN REGENERATING WOODLANDS (MOSTLY CASUARINA) LOCATED ON FLAT LANDFORMS, NATURAL BARE AREAS WERE MORE FREQUENT AFFORDING GROUND SURFACE VISIBILITY.
	
3. IN SLOPING LANDFORMS, NATURAL BARE AREAS WERE FREQUENT ENOUGH TO ENABLE THE GROUND SURFACE TO BE EXAMINED.	4. A FURTHER EXAMPLE OF VARIABLE GROUND SURFACE VISIBILITY IN SLOPING LANDFORMS.

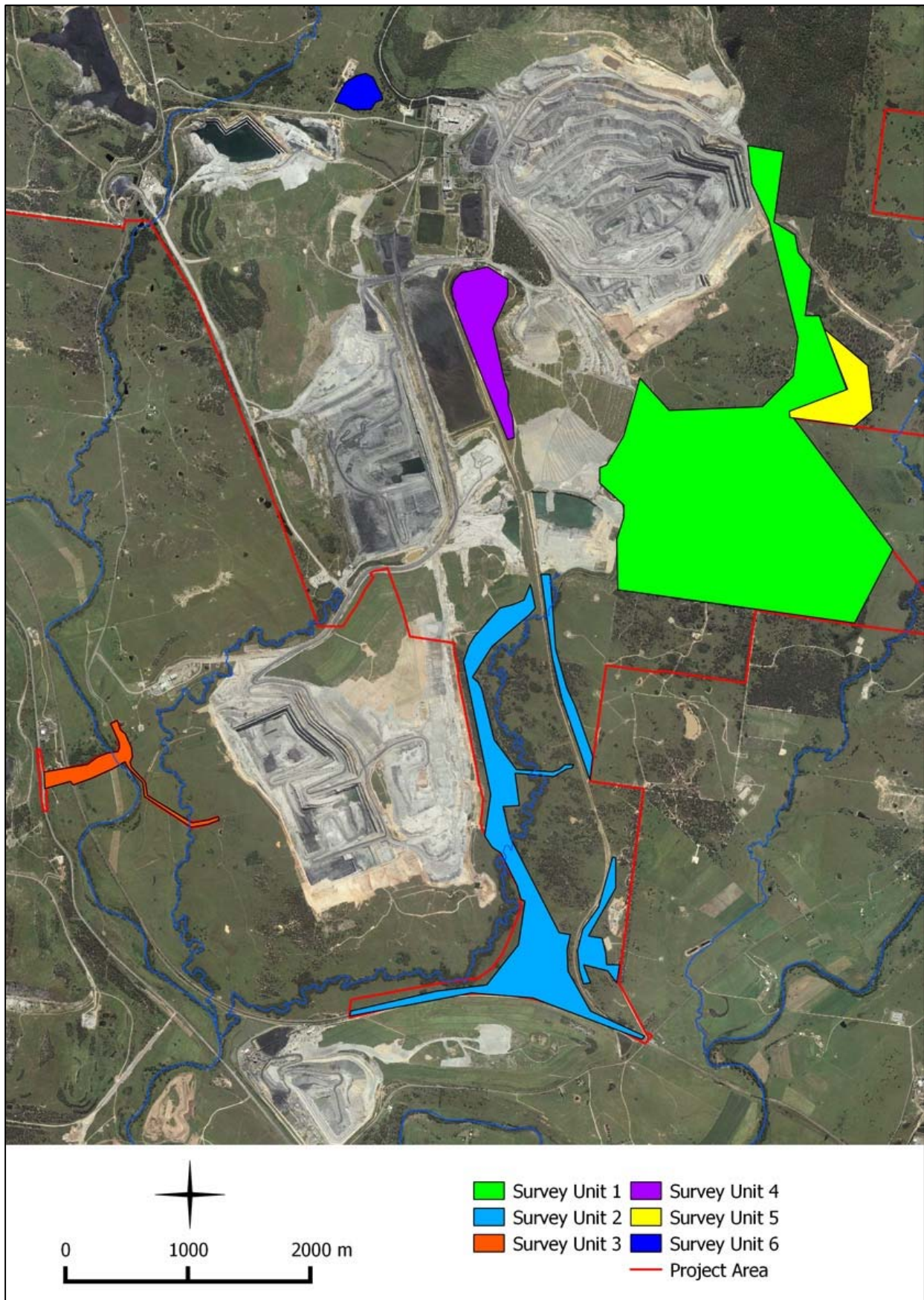
4 LANDSCAPE CONTEXT

The Project Area is located wholly within the Singleton LGA, the Sydney Basin Bioregion (SBB) and the Hunter Subregion. The Hunter is situated at the far north of the SBB and contains the townships of Scone, Muswellbrook, Singleton, Cessnock, Maitland and the city of Newcastle.

Prior to mining, the Project Area exhibited similar landscape features to the broader Hunter subregion: rolling hills with low ridgelines and gentle to moderate slopes.

The Proposed Disturbance Area was divided into six survey units for the purposes of the survey component of the assessment (**Figure 5**):

- Survey Unit 1 is located to the north east of the Proposed Disturbance Area where the main impact is the proposed North Pit Continuation.
- Survey Unit 2 is located in the central south of the proposed Disturbance Area where the main impact is the proposed rail spur construction.
- Survey Unit 3 is located in the west of the Proposed Disturbance Area where the main impact is the proposed Hebden Road realignment.
- Survey Unit 4 is located centre north in the Proposed Disturbance Area where the main impact is the proposed rail spur construction.
- Survey Unit 5 is located on the eastern edge of the North Pit Continuation Proposed Disturbance Area. Survey Unit 5 is contiguous with Survey Unit 1, however, it is given a separate identifier as Survey Unit 1 was assessed in 2012 and Survey Unit 5 was assessed in 2014.
- Survey Unit 6 is located to the northwest and is centred on a formerly proposed location for a Detention Basin. This area was surveyed in order to define the Aboriginal cultural heritage constraints (i.e. the presence or absence of sites) in this area, however, subsequent to the survey further surface water modelling has identified that the Detention Basin is not required and this area will not be impacted by the Project.

Figure 5: Survey units.

4.1 TOPOGRAPHY

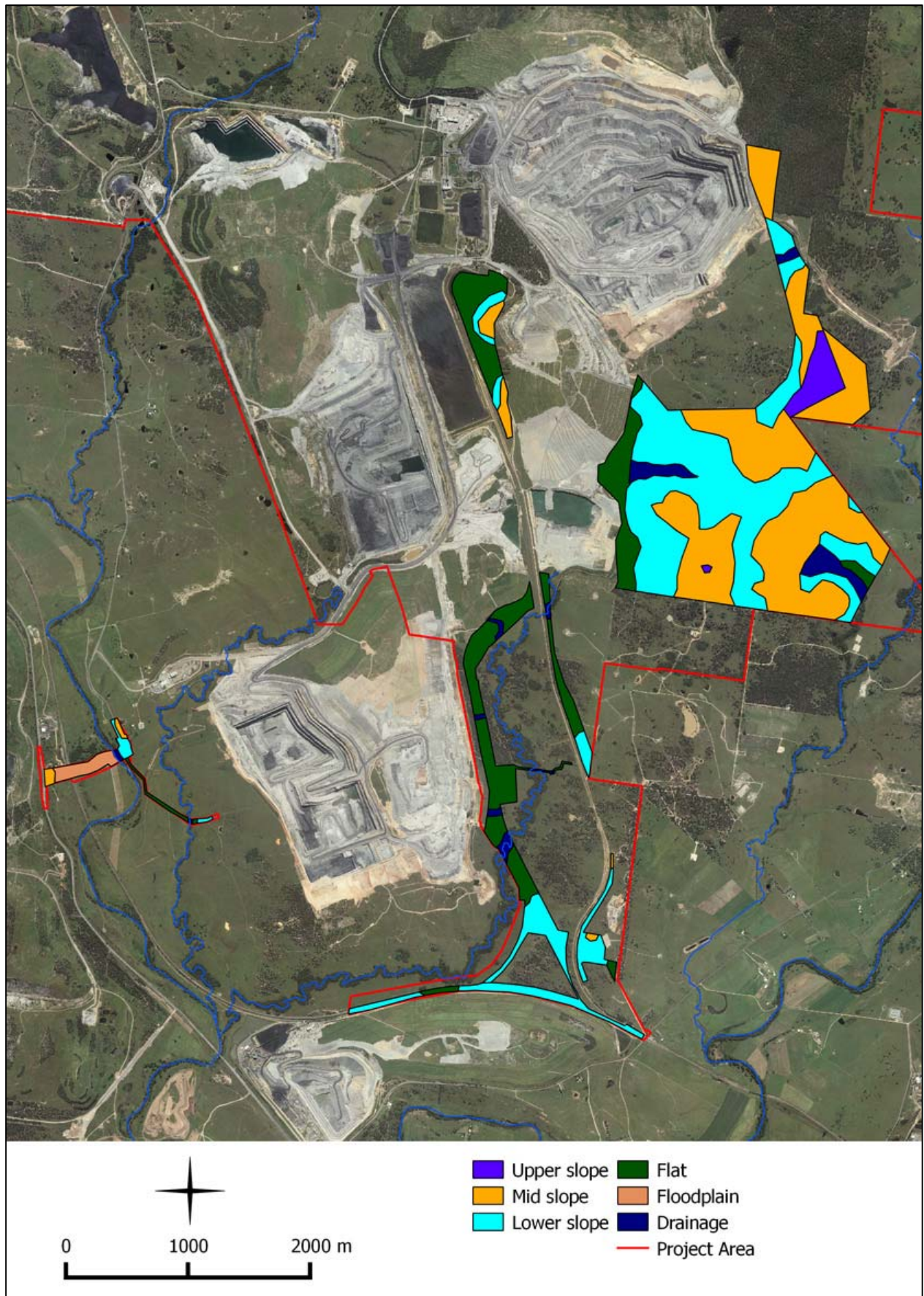
The Proposed Disturbance Area covers approximately 485ha and is, in the main, comprised of sloping landforms (although minor ridges and benches are included within these landform units). Of the 485ha within the Proposed Disturbance Area (i.e. excluding Survey Unit 6 that will not be impacted by the Project), over forty percent of the total area are either upper or mid slope landforms that would be generally unsuitable as locations for long-term camping and tool making (**Table 5**). Thirty-seven percent of the area is lower slope landforms that are generally more gradual in their gradient, and when located adjacent to a reliable water supply, form suitable locations for camping. Seventeen percent of the Proposed Disturbance Area is characterised as flat or floodplains. In general, flat landforms are associated with drainage systems and would make good camping areas. The 1 percent of landforms characterised as floodplain are associated with Bowmans Creek and these would have been ideal camping areas although, archaeologically, these landforms fail to retain evidence of occupation due to the relatively frequent incidence of flooding and stream channel changes. Four percent of landforms within the Proposed Disturbance Area are characterised as drainage. These landforms include small sections of Bowmans, Swamp and Bettys Creeks, as well as a number of ephemeral tributary systems.

Table 5: Landform types within the Proposed Disturbance Area.

Landform type	Total area within Proposed Disturbance Area (ha)	Percentage of total Proposed Disturbance Area (%)
Drainage	19.4	4
Floodplain	4.5	1
Flat	83.9	17
Lower slope	179.2	37
Mid slope	178.2	37
Upper slope	19.8	4
Total	485	100

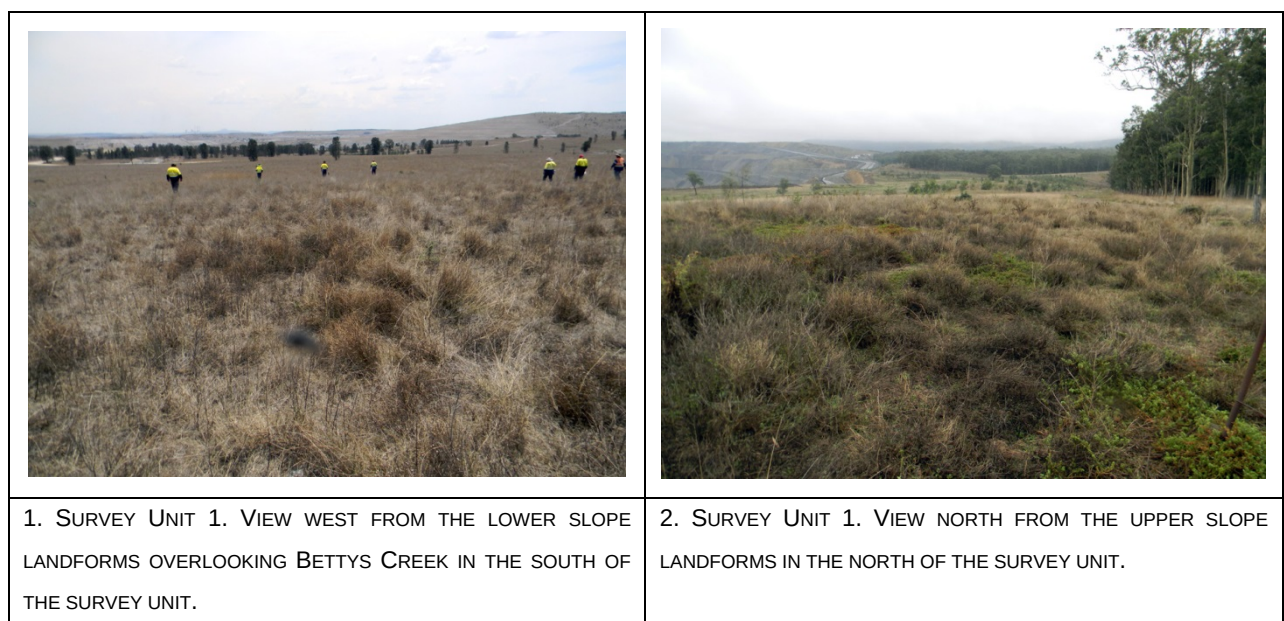
Figure 6 maps the various landform units within the Proposed Disturbance Area. A description of the topography within the Survey Units is presented below (for the location of the Survey Units see **Figure 5**).

Figure 6: Landform units within the Proposed Disturbance Area.



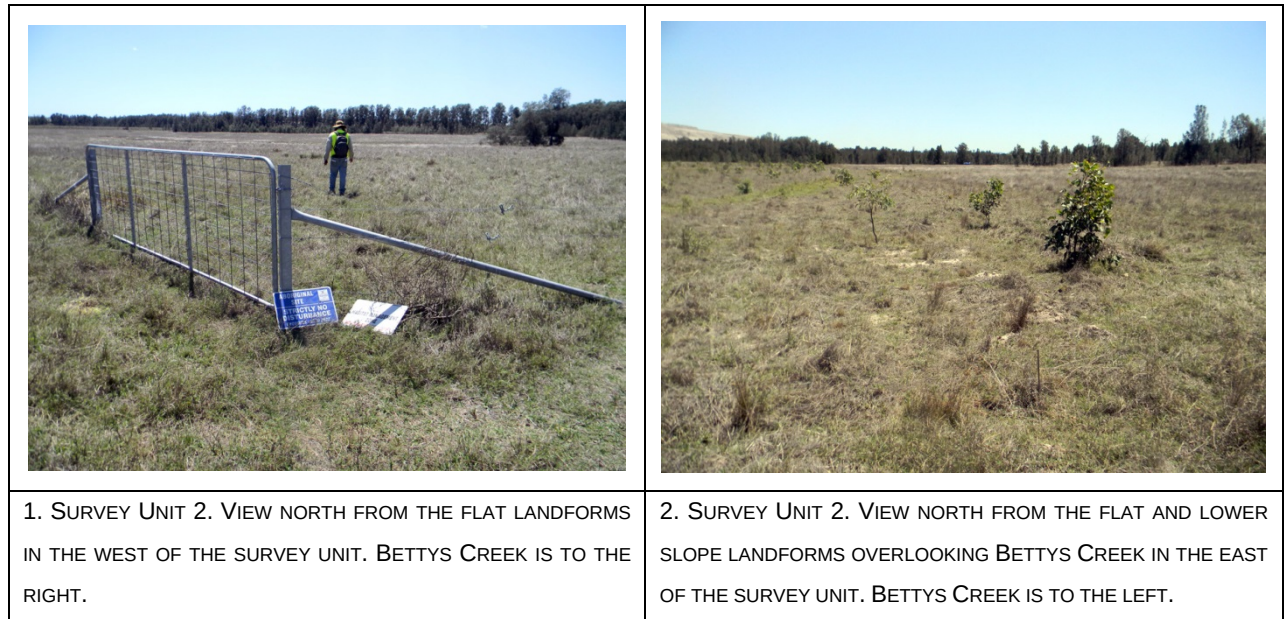
Survey Unit 1 (Proposed North Pit Continuation): The topography rises from west to east and forms the eastern boundary of the Bettys Creek catchment. In the west the landforms are flat and would have once been associated with Bettys Creek (although this association has been lost due to existing approved mining activities; **Figure 7. 1**). To the east, the hills rise, and in places, are reasonably steep (up to 15 degree slopes). Within this slope system are minor crests, ridges and benches. The survey unit also includes minor drainage lines, the largest being a tributary to Main Creek in the east. The very north of Survey Area 1 is hilly and would have been the headwaters for Bettys Creek (before landform modification from approved mining activity; **Figure 7. 2**). In the east, the Proposed Disturbance Area crosses a dividing ridge and includes areas within the adjoining Main Creek catchment. Topography in this area drops from west to east.

Figure 7: Landforms within Survey Unit 1.



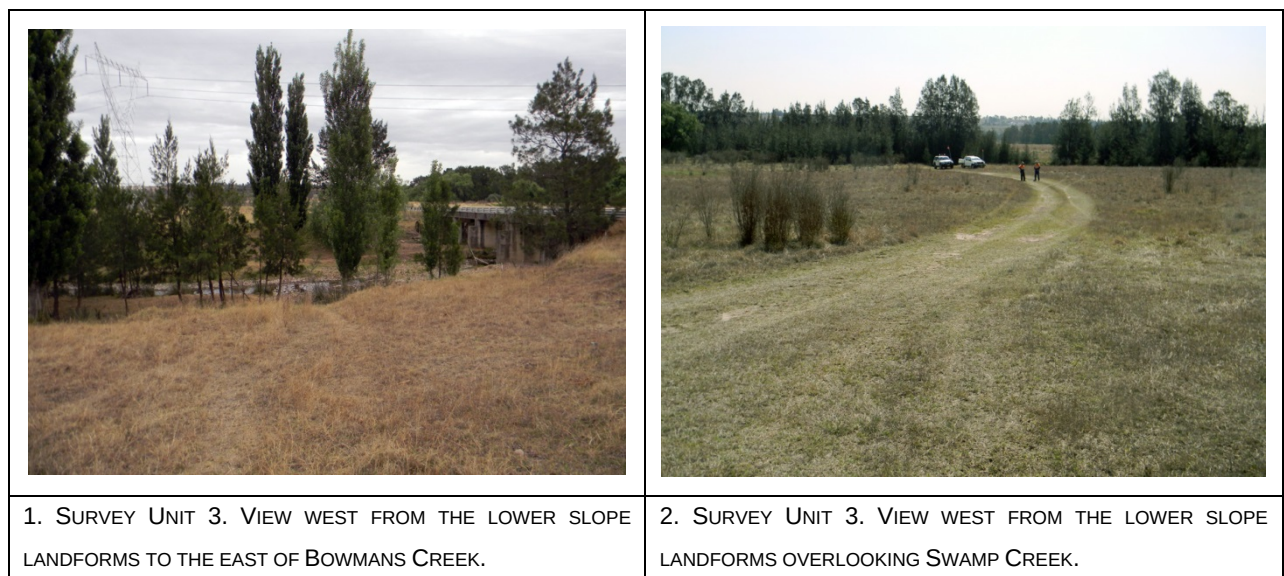
Survey Unit 2 (Proposed Rail Spur and Line Duplication). This survey unit is primarily flat or lower slope landforms surrounding Bettys Creek (**Figure 6**). In the west of the survey area the landforms are very flat and while there are flat landforms to the east of Bettys Creek, the lower slope landforms are closer to the creek as the topography rises to the east (**Figure 8**). At the eastern extent of the survey unit, low hills divide the Bettys Creek catchment from the Glennies Creek catchment. The survey unit includes a portion of these hills and a small amount of flat landform that is part of the landform surrounding Glennies Creek.

This survey unit includes portions of the banks of Bettys Creek although the areas of bank within the Proposed Disturbance Area are limited to a 130m wide easement that crosses the creek for the Proposed Rail Spur and Line Duplication.

Figure 8: Landforms within Survey Unit 2.

Survey Unit 3 (Proposed Hebden Road realignment). This survey unit crosses Bowmans Creek and the associated floodplain on the southern bank (**Figure 6**; **Figure 9. 1**). The survey unit also includes the lower and mid slopes on the northern bank of Bowmans Creek and the southern extent of the floodplain.

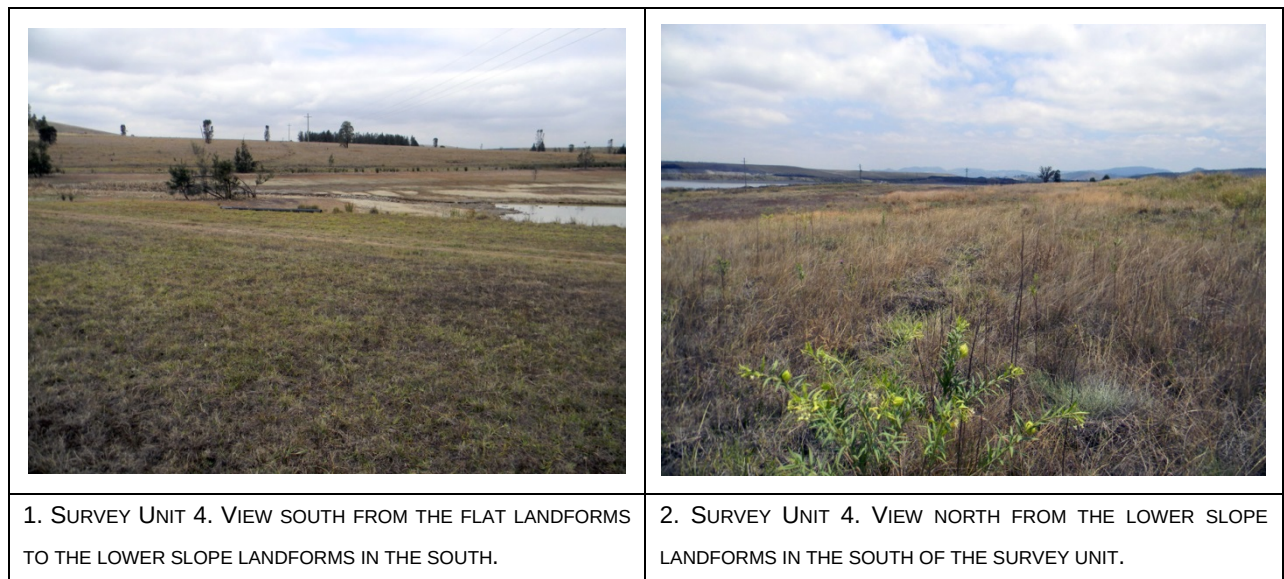
To the southeast, a portion of this survey unit extends to Swamp Creek (**Figure 9. 2**). The terrain to Swamp Creek is flat and low slope landforms rise to the east on the far side of Swamp Creek.

Figure 9: Landforms within Survey Unit 3.

Survey Unit 4 (Proposed Rail Spur and Line Duplication; **Figure 6**). The topography drops from the south to the north with low hills in the south and relatively flat land to the north (**Figure 10**).

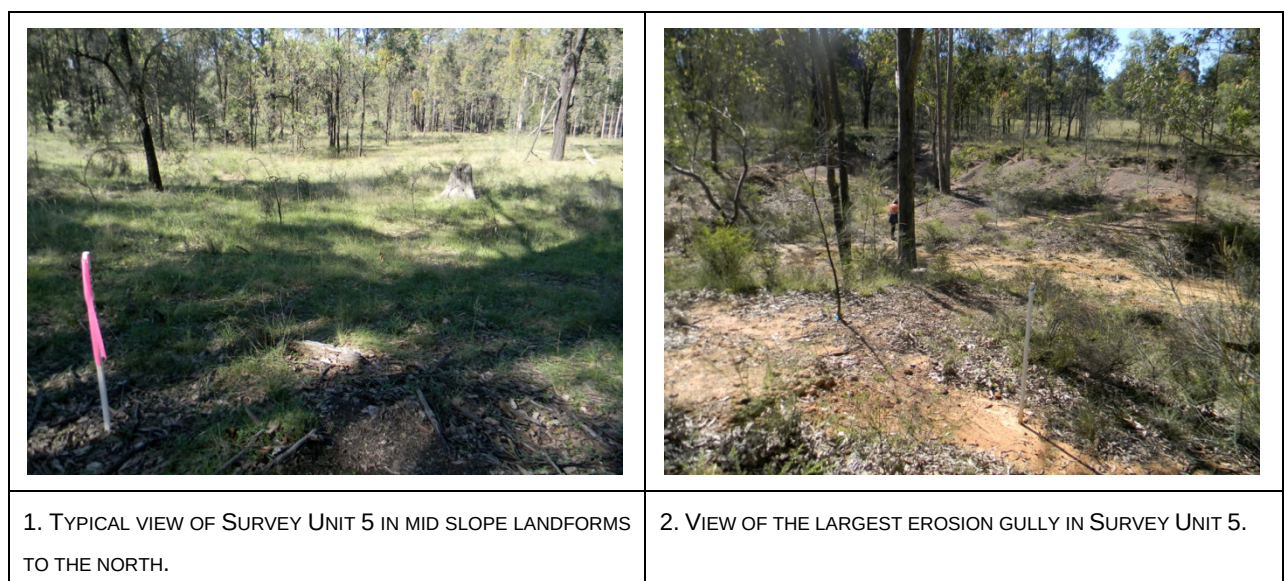
The northern portion was once a drainage depression although the surrounding landscape is highly modified from approved mining activity and there is no drainage line there today.

Figure 10: Landforms within Survey Unit 4.



Survey Unit 5 (Proposed North Pit Continuation; **Figure 6**). Survey Unit 5 is contiguous with Survey Unit 1 although they are distinguished as separate survey units, as Survey Unit 1 was assessed in 2012, while Survey Unit 5 was assessed in 2014. While Survey Unit 1 is mostly located within the catchment for Betty Creek, Survey Unit 5 includes mid slope landforms that are part of the Main Creek catchment (**Figure 11**). These slopes have a moderate gradient in places and fall away to the east. Survey Unit 5 does not include any landforms adjacent to Main Creek itself. No permanent drainage systems are located within the survey unit although there is evidence of run-off gullies (**Figure 11. 2**) that would contain water only following rainfall events.

Figure 11: Landforms within Survey Unit 5.



Survey Unit 6 (Figure 5). The topography in this survey unit displays gentle gradients that include both lower slope and flat landforms (**Figure 12**). While evidence of water movement is conspicuous in the survey unit (see **Figure 12. 2**), it is due to water being channelled through this area from nearby modified landforms rather than representing the remnants of a natural drainage system. As this area will not be impacted by the Project, it is not part of the Proposed Disturbance Area.

Figure 12: Landforms within Survey Unit 6.



4.2 GEOLOGY AND SOILS

The Proposed Disturbance Area is confined to the Central Lowlands geological subregion. The subregion is located in the centre of the valley and is an area of undulating to hilly terrain (in any given area local relief rarely exceeds 60m) dissected by the Hunter River and numerous creeks which have developed on largely unresistant Permian sediments. Sandstones, shales, tuffs and conglomerates are the principal constituents. Coal resources come from this source. Alluvial flats extend up to 2.5km from the Hunter River and its major tributaries where they flow through the Central Lowland belt. Soils on either side of the flood plain are Podzolics or Solodics with a sandy to silty A Horizon which changes abruptly to clayey material with a blocky structure (B Horizon). The A Horizon is believed to be the result of sedimentary deposits forming within the last 5,000 years (Davies 1991: 5). Due to a combination of cultural and non-cultural processes, ground and vegetation disturbance has occurred. Cattle grazing, cultivation, open cut coal mines as well as other industrial and commercial industries have altered the vegetation and disturbed the ground surface (and in some places greatly modified the landscape) throughout the region of the Proposed Disturbance Areas. Natural processes such as erosion have been accelerated due to European impact in the area.

As has been commonly reported in other surveys in this region (Brayshaw 1986a; Godwin 1987), there are two major soil depositional units in the Proposed Disturbance Area. An upper

unit (commonly called the A Horizon) composed primarily of sand and silt but sometimes with gravel present overlies, and is very distinct from, the underlying clay and gravel B Horizon which ranges from brown to yellow in colour. The upper unit is usually less than 50cm thick and varies from grey to buff in colour, and is thought to be no older than mid-Holocene while the lower unit, which shows evidence of deep weathering and pedogenesis, is considered to be Pleistocene in origin. As many researchers (such as Brayshaw 1986a) have noted, open sites in the Hunter Valley tend to occur within the A Horizon and are often exposed only when this is disturbed. Where it has been totally removed artefacts can be found resting on the B Horizon surface (Godwin 1987: 5).

Geomorphic studies by Dr Peter Mitchell (2002: 32-33) within and closely adjacent to the Proposed Disturbance Area concluded:

- The lower reaches of Bowmans Creek, Swamp Creek and Bettys Creek have up to three fluvial terraces each. The highest (third) terrace is the only one of Pleistocene age or older, and the only one where evidence of buried land surfaces has been located. (This higher, possibly Pleistocene, terrace is outside of the Proposed Disturbance Area.)
- At Bettys Creek the third terrace (once located to the west of Bettys Creek) was composed of Bettys Creek sediments and hill slope colluvium did not appear to be a major component of the materials in the terrace.
- European land uses have had major impacts on stream morphology.
- The smaller streams are changing from a 'chain of ponds' morphology to discontinuous gullies and deeply incised meanders.
- All areas of floodplain and first and second terraces, particularly along Bowmans Creek, have been extensively disturbed by cultivation.
- Hill slope areas have been subject to extensive sheet erosion and some gully erosion.
- Extensive river engineering has occurred to parts of Bowmans Creek, particularly in the vicinity of the Proposed Disturbance Area (see **Section 4.3.1**).

4.3 HYDROLOGY

The Proposed Disturbance Area contains a limited amount of hydrological resources and although it crosses two larger drainage systems, it does not include extensive bank areas. As noted in **Section 4.1**, only four percent of the Proposed Disturbance Area is covered by drainage systems. This figure includes systems that would only hold non-permanent water, as well as more reliable sources such as Bowmans Creek (**Figure 13**).

Further south from the current Project Area, the water in Bayswater Creek during dry periods tends to be saline, an attribute first remarked upon over 150 years ago. In his *Index and Directory* (1828: 18) the surveyor Henry Dangar referred to the waters of the Parish of Liddell, as the area was then known, as being impregnated with saline matter, suggesting that it was

therefore not a good place to settle at, though perfectly suitable for winter and spring grazing of sheep and cattle. On the map accompanying this volume "salt ponds" are indicated along what we know as Bayswater Creek. Peter Cunningham (1827: 154) referred to the "brackish nature" of the water of Bayswater Creek, "of which the sheep have a great predilection". Sir Thomas Mitchell also noted that this and other "lesser tributaries of the north bank of the river Hunter become brackish when the current ceases" (Mitchell 1838: 14).

In an examination of the region's salinity and its implications for Aboriginal settlement patterns, Brayshaw and Hagland (1984: 50) noted that the richest sites in their study area (at Ravensworth south of the current Project Area) appear to cluster along Bayswater Creek (to the south of the Project Area), which has, they noted, salinity close to that of seawater. The authors found it hard to imagine that Aboriginal groups would prefer to camp and work along a creek with salt water when there are creeks with sweeter water in the region and posed several hypotheses:

- Could the creek have provided some other, particularly attractive resource?
- Had the creek channel not yet cut down to, or deeply into, the rock strata which cause the salinity so that the water was still sweet for all or parts of the year?
- Were there swamp formations with freshwater nearby, e.g. where there are now intermittent tributaries in shallow erosion gullies?

The reason for the salinity in the ground water is because of the underlying geology (Resource Planning 1991: 11). Most of the Mount Owen mining lease area is underlain by the Vane Subgroup, comprising coal seams, siltstone, lithic sandstone, clay and conglomerate. This area includes the catchments of Swamp Creek and Bettys Creek. The eastern part of the catchment of Yorks Creek is underlain by the Saltwater Creek Formation, comprising sandstone and siltstone with minor coaly bands. The channel of Yorks Creek follows the boundary between the Saltwater Creek Formation and the Mulbring Siltstone (Siltstone, claystone, minor grained sandstone).

This geological setting has important implications for Aboriginal settlement patterns in the district as the strata of the Saltwater Creek Formation are highly saline, so that groundwater discharges to drainage lines are also saline. Under modern land use conditions, any water present in these drainage lines would be unsuitable for consumption.

With regards to the Proposed Disturbance Area, only a small portion in Survey Area 3 is associated with the Saltwater Creek Formation that is restricted to the proposed works around Bowmans Creek. As Swamp and Bettys Creeks, at the centre of the current Proposed Disturbance Area, are associated with the Vane subgroup, salinity would be less of a problem than it is further west in the Yorks, Bowmans and Bayswater Creek systems.

Further, the vagaries of water supply in the Hunter Valley are clear in early reports. As early as 1826, a severe drought, of several years duration was reported, during which the Hunter River ceased to flow (Resource Planning 1991: 16). During dry periods, tributaries to the Hunter River in the Ravensworth area (e.g. Bayswater Creek) became brackish, and were therefore of dubious value for settlement in the summer months. Unreliable or seasonal fresh water supplies have clear implications for prehistoric settlement patterns in tributary valleys of the Hunter, with an emphasis on winter occupation. It is not clear however, how such patterns would be evidenced in the archaeological content of open sites.

Other researchers such as Umwelt (2013b: 3–4) have postulated that water would have been available year round from the three spring-fed swamps within the Mount Owen area and from pools in Bowmans Creek. Larger pools that were semi-permanent in nature were also likely at the tributary confluences with the main creek channels. Less reliable water would have been available after heavy rain in chains of ponds in the main channel of Bettys Creek, Swamp Creek, Main Creek and some of their tributaries.

At the time of the current assessment between 2012 and 2014, rainfall conditions were good and the preceding few years had enjoyed average or above-average rainfall. The annual average rainfall for the Hunter River Catchment is about 600mm with 50% of this average occurring between December and April. According to long-term climate statistics, relatively dry conditions are experienced between July and October. Therefore, as the 2012 survey took place in November/December, water resources throughout the Proposed Disturbance Area were in a wet phase. However, apart from Bowmans Creek (**Figure 14. 1**), all other creek systems within the Proposed Disturbance Area were dry: particularly Bettys Creek (**Figure 14. 2**) but also Swamp Creek (**Figure 14. 4**) and all their tributaries (**Figure 14. 3**). It is noted that, at times of rain, Bettys Creek has a chain of ponds morphology but that a complete absence of water is also possible. It is also accepted that changes to the hydrology of the area from mining and creek diversions is likely to have greatly altered the pre-1788 form of Bettys Creek.

The 2014 survey took place in April, again within the high rainfall period for the district. While the 2014 Study Area did not contain any sizable drainage features, no pooling or running water was noted in any of the ephemeral drainage systems within Survey Units 5 and 6. This again indicates that, in general, the Proposed Disturbance Area has low frequency of reliable water resources.

Figure 13: Aerial showing the major creek systems within and adjacent to the Proposed Disturbance Area.

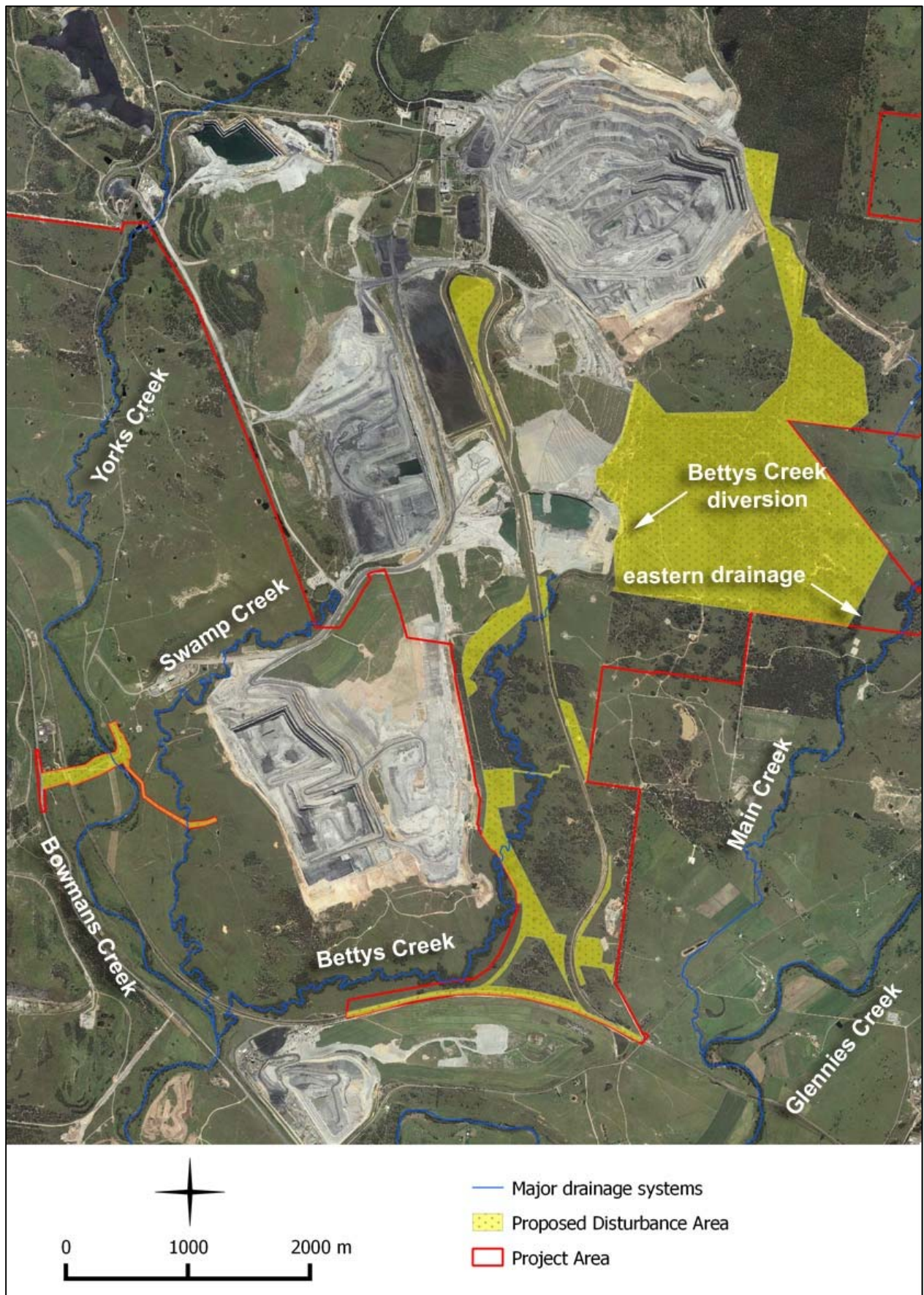


Figure 14: Hydrological resources.

	
1. VIEW OF BOWMANS CREEK IN THE VICINITY OF THE PROPOSED DISTURBANCE AREA. THE BRIDGE FOR HEBDEN ROAD SEEN HERE WILL BE REPLACED BY A SECOND BRIDGE ON THE FAR SIDE IN THIS VIEW (DECEMBER 2012).	2. VIEW OF BETTYS CREEK SHOWING A DRY BED (DECEMBER 2012).
	
3. VIEW OF THE EASTERN DRAINAGE WITHOUT STANDING WATER (DECEMBER 2012).	4. VIEW OF SWAMP CREEK WITHIN THE PROPOSED DISTURBANCE AREA WHERE A FARM TRACK CROSSES THE CREEK BED. THERE IS PUDDLING OF WATER ON THE ROAD BUT LITTLE STANDING WATER IN THE CREEK ELSEWHERE (DECEMBER 2012).

Bettys Creek and Swamp Creek are similar to one another having catchments of about 5km² with their headwater tributaries rising immediately north of the Project Area (Mitchell 2002: 6). Both the creek systems include numerous meander cut-offs, swampy hollows and intermittent pools that may be the remnants of the 19th century 'chain of ponds' morphology. At Swamp Creek, Dean-Jones and Mitchel (1993) noted evidence of recent changes to channel form with greater incision and restriction to a single channel bed.

In their 1993 assessment, Pacific Resources thought that Bettys Creek would contain water most times of the year (Pacific Resources 1993: 17). The local property owner at the time,

Mr Ellis Richards, showed the archaeologist a water hole within the creek that he had never seen dry, even in the harshest drought. This spring, concluded the report, may have provided the ancient Aboriginal people with a constant water supply, even in drought times, which would have enabled them to camp in the area at all times of the year.

Further inspection of a spring (probably the one mentioned by Mr Ellis) on the east bank of Bettys Creek by Dr Peter Mitchell (Mitchell 2002) concluded that this spring only dates to the historic period following the extensive changes to the region's hydrology brought about by vegetation clearing and other such activities.

It is interesting to also note that in 1993 Bettys Creek was considered to hold permanent water whereas the current survey, taken at a time of above average rainfall, recorded a mostly dry creek bed. This could perhaps be indicative of changed flows to Bettys Creek due to approved mining activity that has occurred since 1993.

The main creek systems within or closely adjacent to the Proposed Disturbance Area, Bettys Creek and Bowmans Creek, will have restricted impacts to their bank areas arising from the Project as both will be bridged by the proposed Mount Owen rail spur and the proposed realignment of Hebden Road respectively. Apart from these impacts, more extensive bank areas of these drainage systems are not included within the Proposed Disturbance Area.

Swamp Creek (third order) will be similarly crossed by an existing proposed road (a non-public road used for construction purposes) without further impact to its bank areas.

Also within the Proposed Disturbance Area are several, unnamed, ephemeral drainage lines that will be impacted by the Project.

The most extensive is an unnamed tributary to Main Creek, termed here the eastern drainage (**Figure 13**). The eastern drainage flows in a south-easterly direction for approximately 1.3km before it joins Main Creek (the confluence is outside of the Proposed Disturbance Area). This system has extensive bank and gully erosion in its northern reaches although in its southern reaches the drainage is confined to a single channel largely free of erosion (**Figure 14. 3**). The system was largely dry at the time of survey although a few pools were evident towards the north. The eastern drainage is a first/second order system within the Proposed Disturbance Area.

A second system in the North Pit Expansion Area of Survey Unit 1 that has been included within drainage landforms is today largely devoid of water apart from in some dammed areas (**Figure 15. 1**). This broad system is a tributary to Bettys Creek although its confluence with the creek has been lost due to approved mining activity to the west. Approximately 900m of this system remains extant within the Proposed Disturbance Area and its width is variable but can

be approximately 60m. As the system is broad and low-lying, it has a morphology suggesting that it may once have contained swamps.

Otherwise, the Proposed Disturbance Area only contains first order drainage systems, better termed run-off gullies, which would only flow in times of rain (**Figure 15. 2**).

4.3.1 Historical impacts to Bowmans Creek

The entire channel of Bowmans Creek has moved over a considerable area of ground in the past 60 years. A major flood, with an estimated 100 year reoccurrence interval, occurred in 1955. It is estimated that the flood extended to between the 65m and 70m contours on the confined plains around the junction of Bowmans, Swamp and Bettys Creeks (Mitchell 2002).

The flood changed the channel morphology in Bowmans Creek and in the 1970s the state government undertook a river rehabilitation program. Bowmans Creek channels were deepened and straightened with earthmoving machinery and the outside curves of meander bends were armoured, mostly with a wire mesh. The constructed banks were planted with willows and some poplars, and fenced to keep out stock. By the 1980s the constructed channels were reasonably stable but due to lack of maintenance with the fencing, stock movement is again breaking down the bank in places (Mitchell 2002).

4.3.2 Conclusion

The hydrological resources directly within the Proposed Disturbance Area are limited in their spatial extent. The Project potentially impacts restricted bank areas on Bowmans, Bettys and Swamp Creeks but does not include extensive bank areas. Impacts to bank areas at Bowmans Creek total an easement approximately 100m wide, an easement approximately 130m wide at Bettys Creek and an easement approximately 50m wide across Swamp Creek. Thus, only these restricted areas of higher order drainage systems are included in the Proposed Disturbance Area.

Drainage systems that may be more comprehensively impacted by the proposed Project are ephemeral tributaries such as the eastern drainage and the tributary to Bettys Creek discussed above. These, along with even more ephemeral systems, characterise the hydrological resources within the Proposed Disturbance Area.

When issues such as salinity and seasonal variability of water availability are taken into account, the hydrological resources within the Proposed Disturbance Area are of low quality and this would have had an effect on the pattern of Aboriginal settlement specifically within the Proposed Disturbance Area.

Figure 15: Ephemeral water systems.

	
1. VIEW OF A BROAD DRAINAGE SYSTEM IN THE NORTH OF THE PROPOSED DISTURBANCE AREA THAT MAY WELL HAVE HELD SWAMPS BEFORE HYDROLOGICAL ALTERATIONS IN THE AREA.	2. VIEW OF AN EPHEMERAL GULLY IN THE NORTH OF THE PROPOSED DISTURBANCE AREA.

4.4 VEGETATION

Vegetation within the proposed Disturbance Area has been mapped (Umwelt 2013c: Figure 6.3) as consisting of:

- Survey Unit 1:
 - Flat and lower slope landforms: Central Hunter Bulloak Forest Regeneration, Derived Native Grassland;
 - Mid and upper slopes: Central Hunter Ironbark-Spotted Gum-Grey Box Forest; and
 - Some Central Hunter Swamp Oak Forest on the eastern drainage.
- Survey Unit 2:
 - Bettys Creek drainage: Central Hunter Swamp Oak Forest;
 - Flat and lower slope landforms: Central Hunter Bulloak Forest Regeneration, Derived Native Grassland; and
 - Some Central Hunter Box-Ironbark Woodland in the east.
- Survey Unit 3:
 - No natural vegetation communities.
- Survey Unit 4:
 - No natural vegetation communities.
- Survey Unit 5
 - Mid slopes: Central Hunter Ironbark-Spotted Gum-Grey Box Forest.

- Survey Unit 6:
 - Derived Native Grassland.

In terms of food and medicinal plants for Aboriginal use, researchers in the Bettys Creek catchment have noted food plants such as bulrush, chocolate lily, fringed lily, kangaroo grass, kurrajong, mat-rush, onion orchid, rushes and sedges, spike rush and water ribbon. All of these resources are at their best for consumption in the late spring to end of summer period. Medicinal plants included native geranium. Species providing fibre for the making of nets, bags and containers included narrow-leaved ironbark, rats tail grass, mat-rush, spike rush and other rushes and sedges (Umwelt 2013d: 3).

Today almost all woodland in the Proposed Disturbance Area is regrowth and mature trees are very rare. **Figure 16** shows the Proposed Disturbance Area superimposed on an aerial photo dating from 1958. This shows the almost complete nature of the clearing across the Proposed Disturbance Area. As noted above, this woodland, where it is regenerating, tends to be thick stands of *Casuarina* along drainage lines and open *Eucalyptus* woodland on slopes. Other extensive areas within the Proposed Disturbance Area have been previously cleared and are still open grasslands that were used until very recently for grazing. Other substantial areas have been revegetated.

In conclusion, the Proposed Disturbance Area does not include large areas of undisturbed vegetation communities and this has an impact on the rarity of certain site types, such as scarred trees, in the area.

In the past, creek corridors such as Bettys Creek or Swamp Creek would have had limited and seasonal resources that could be utilised in a sporadic manner by Aboriginal groups. Larger systems such as Bowmans Creek may have supported a more diverse resource base although, when compared to river systems such as along the nearby Hunter River, areas within the Proposed Disturbance Area would have been more limited in their appeal as locations for more intensively used camp sites.

4.5 CLIMATE

The Sydney Basin Bioregion exhibits a temperate climate. Summers are warm and there is no dry season.

The closest climate statistics are those recorded since 1886 at the Bureau of Meteorology's Jerrys Plains Post Office weather site 15km away from the Proposed Disturbance Area (BOM 2013). These records show that temperatures are highest in January (mean maximum temperature: 31.7°C) and lowest in July (mean minimum temperature: 17.4°C). Rainfall records from the site indicate that average annual rainfall is 644.5mm with the highest rainfall in January (mean monthly rainfall: 76.8mm) and lowest in August (mean monthly rainfall: 36.3mm).

4.6 LAND–USE HISTORY

The Mount Owen Complex is situated within a broader landscape subject to the following land uses:

- Coal mining operations (open cut and underground);
- Agriculture, horticulture, viticulture and pastoralism;
- Rural-residential holdings and rural towns; and
- Hospitality and tourism operations.

4.6.1 Existing levels of disturbance

The Project Area itself has experienced the following forms of disturbance:

- Agricultural clearing, periods of over-stocking and soil compaction;
- Agricultural infrastructure such as houses, sheds, fences and farm tracks;
- Gully and sheet wash erosion;
- Areas of significant topographical modification resulting from existing approved mining activities; and
- Road and rail construction, development of gas drainage facilities, modifications to hydrology (including diversions, culverts, contour banks, dams etc.), electricity easements, access tracks and other pieces of mine infrastructure.

4.6.2 Effect of disturbance on the archaeological landscape

The major disturbances within the Project Area that have altered the archaeological landscape are:

- Erosion: the impact of erosion is extensive across the Proposed Disturbance Area. The most common erosion is sheet erosion that has led to soil loss, while extensive bank and gully erosion is more confined to the east of the Proposed Disturbance Area;
- Farm and mine infrastructure: large portions of the Project Area have been modified by historical and on-going land uses including vegetation clearing, grazing and construction of mine infrastructure including drill pads and infrastructure related to the underground Integra Mine. Included in this category are large areas of revegetation; and
- Altered flow of Bettys Creek: has greatly diminished the contextual integrity of Bettys Creek.

The impact to the archaeological landscape from each of these disturbances will be discussed in more detail below.

Erosion

Erosion is not ubiquitous within the Proposed Disturbance Area in the form of large areas of erosion scalding, however, the effects of soil loss are evident and this is a good indication that there is historical and on-going sheet wash erosion that has greatly diminished the soil depth at many locations.

The texture contrast soils in the east of the Project Area are very prone to erosion and the removal of the native vegetation during past agricultural land use and the subsequent compaction of the soil have exposed extensive areas to erosion along the eastern drainage.

In this context it is illustrative to examine aerial photographs of the Project Area from 1958. When the current Proposed Disturbance Area is overlain on these photographs (**Figure 16**) the level of erosional soil loss from across the area is very evident. As this figure shows, the Project Area was almost entirely cleared of native vegetation and sheet and gully erosion was widespread. Erosion around the eastern drainage is already extensive, and although a thin band of vegetation is within the drainage area for Bettys Creek, its bank areas have been similarly cleared and subject to soil loss. In relation to the Proposed Disturbance Area, Bowmans Creek has not altered greatly although it is now more 'channelised' and vegetated.

This level of impact would have had a severe and lasting impact on the archaeological landscape in the Project Area. As the land is no longer being intensively grazed (as it is mine owned land) the landforms are stabilising and erosion is less noticeable. It was, however, during the century of land use culminating in the 1958 photographs that the damage was largely done.

The 2012 survey took place during a season characterised by above average rainfall. As a result, many of the observed examples of erosion in the Proposed Disturbance Area were still in an active phase and many examples of recent erosion activity were noted.

Even ephemeral drainage lines can supply sufficient water to create a sizeable erosion gully (**Figure 17. 1**), and when extensive, the erosion can create a 'moonscape' surrounding a drainage feature (**Figure 17. 2**).

Erosion has the capacity to completely remove archaeological sites from the landscape. However, in the process of erosion, many archaeological sites have also been freshly exposed for the survey team as the higher than usual rainfall of the past two years prior to 2012 has allowed on-going erosion.

In conclusion, erosion across the Proposed Disturbance Area has been extensive in the past and is still prevalent in areas of higher archaeological sensitivity such as along drainage lines. In terms of impact to the archaeological landscape, erosional disturbances are perhaps the greatest single disturbance that has affected the integrity of sites within the Proposed Disturbance Area.

Figure 16: Southern portions of the Proposed Disturbance Area overlain on 1958 aerial images.

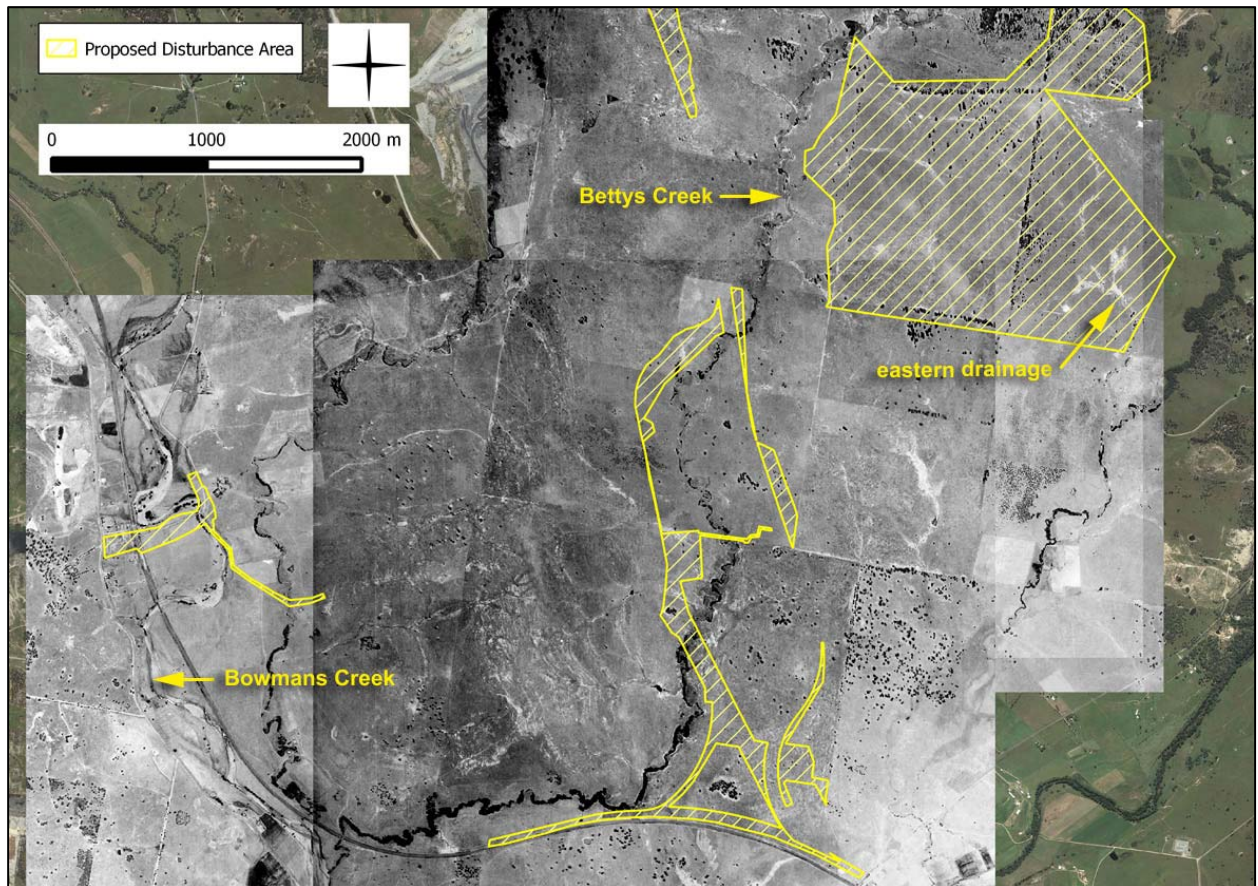
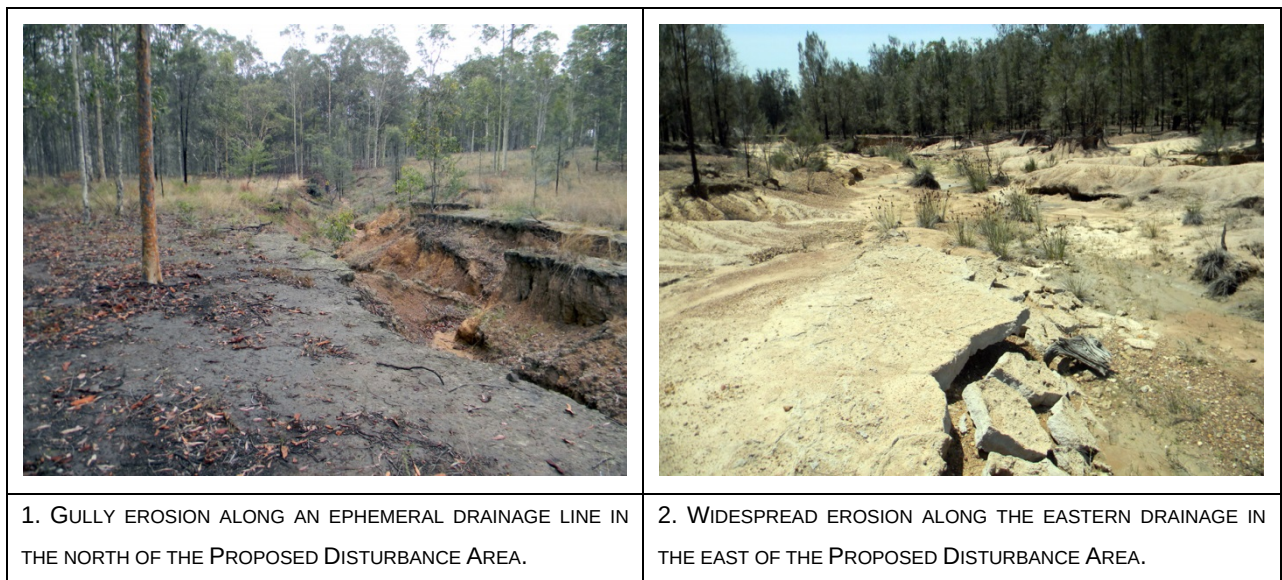


Figure 17: Erosion within the Proposed Disturbance Area.



Farm and mine infrastructure

The Proposed Disturbance Area has been heavily impacted by disturbances from past and present farm and mine activities.

Items such as farm dams (**Figure 18. 1**), fences, houses and sheds attest to the area's past use for grazing (the floodplain south of Bowmans Creek was also cultivated). In addition, there has

been wide-spread vegetation clearing for agriculture across the Proposed Disturbance Area and apart from one or two residual trees, the whole area appears to have been cleared at some point in the past (see **Figure 16**; **Figure 18. 2**). Most tree cover today has regenerated over the past 50 years. As a result of this there are few mature trees in the Proposed Disturbance Area.

Approved mine related disturbances include built infrastructure (**Figure 19. 1**), soil dumps (**Figure 19. 2**), roads, drill pads (**Figure 19. 3**), machinery, monitoring stations, culverts, bunds and some piles of rubbish. Another major mine related impact is widespread revegetation programs that are located in the north of Survey Unit 1 and in Survey Unit 2 (**Figure 19. 4**). In Survey Area 1, approximately 62ha (or 17% of the survey unit) has been revegetated and there are substantial areas of revegetation preparation in the south of Survey Area 2. Areas within Survey Unit 1 overlie underground Integra mine operations that necessitate surface infrastructure and tracks to maintain the underground workings. These contribute to relatively frequent impacts to the ground surface in Survey Unit 1.

Disturbances of this type have the ability to completely remove or cover the A Horizon soils with the possibility that archaeological deposits have, in the past, been disturbed or covered. In landforms remaining largely unmodified, there has been a loss of landscape context to the extent that it is sometimes difficult to determine the exact pre-mining landscape from what is visible today.

Figure 18: Farm related disturbances within the Proposed Disturbance Area.

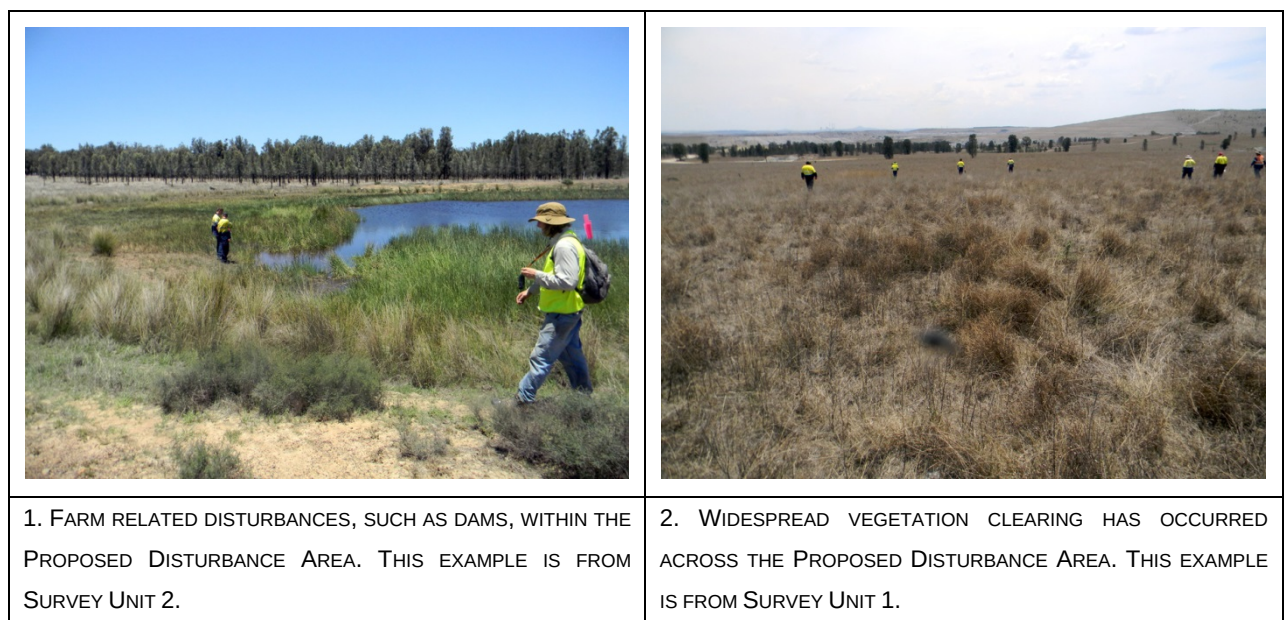


Figure 19: Mine related disturbances within and adjacent to the Proposed Disturbance Area.

	
1. AT MANY LOCATIONS WITHIN THE PROPOSED DISTURBANCE AREA, MINE INFRASTRUCTURE OR DISTURBANCES ARE CLOSE BY. THIS EXAMPLE IS FROM SURVEY UNIT 4.	2. AT SEVERAL LOCATIONS WITHIN THE PROPOSED DISTURBANCE AREA APPROVED MINE RELATED LANDFORM MODIFICATION IS APPARENT. THIS EXAMPLE IS FROM SURVEY UNIT 1.
	
3. MANY APPROVED MINE-RELATED WORKS HAVE TAKEN PLACE WITHIN THE PROPOSED DISTURBANCE AREA. THIS MORE-DISCRETE EXAMPLE IS AN OLD DRILL PAD FROM SURVEY UNIT 1.	4. LARGE AREAS OF REVEGETATION HAS TAKEN PLACE WITHIN THE PROPOSED DISTURBANCE AREA. THIS EXAMPLE IS FROM SURVEY UNIT 1.

Altered flow to Bettys Creek

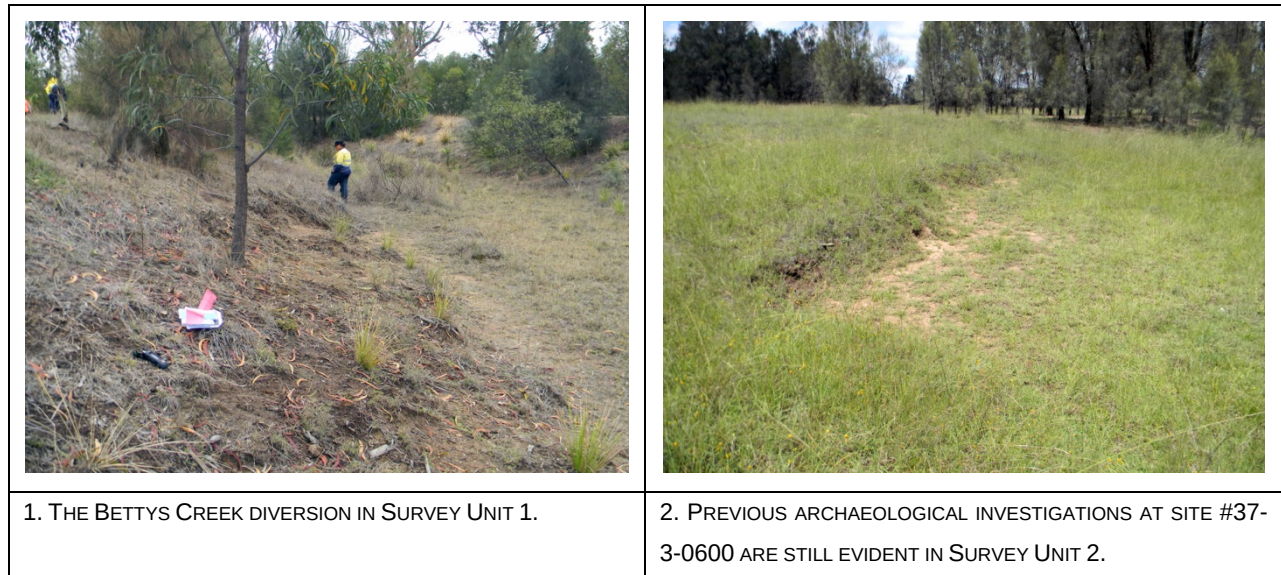
In Survey Unit 1, Bettys Creek has been diverted into an artificial channel that runs north-south in the west of the survey unit (**Figure 20. 1**).

The construction of this channel has had localised impacts to the ground surface although the greatest impact is the altered hydrology of Bettys Creek further to the south where the creek still follows its historical channel. The effect of this altered flow on the condition of the creek further south is unknown although it is unwise to regard the appearance of the creek today as indicative of what it would have been in the past. This hydrological modification has affected the

landscape context within the Bettys Creek catchment and has greatly reduced the catchment area of the extant Bettys Creek in the south of the Proposed Disturbance Area.

It has previously been noted (**Section 4.3.1**) that hydrological modifications have also occurred within the Proposed Disturbance Area at Bowmans Creek.

Figure 20: Mine related disturbances and archaeological salvage.



4.6.3 Previous Archaeological Salvage

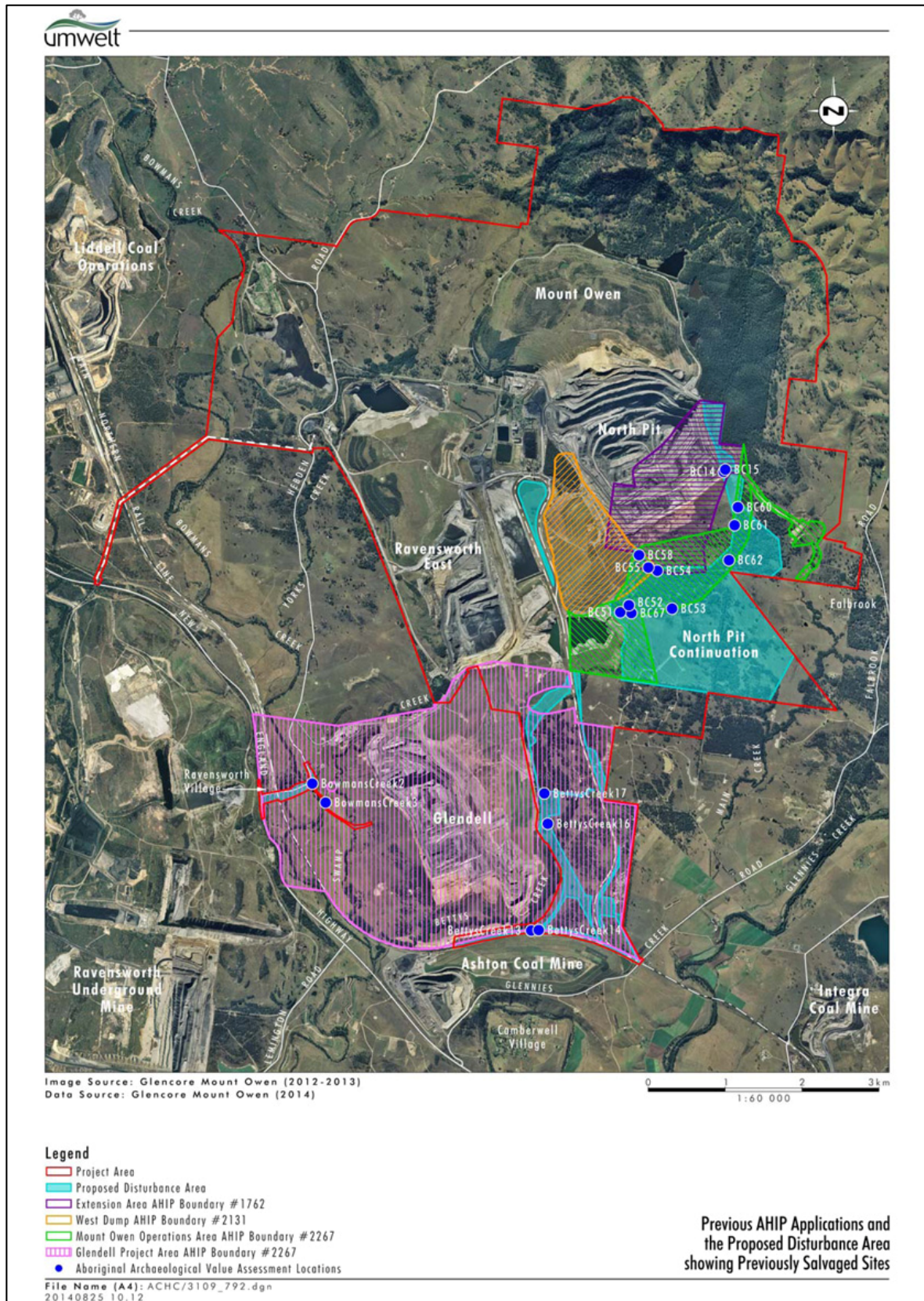
Further altering the archaeological landscape that is available for assessment today is the fact that, within the Proposed Disturbance Area, 18 recorded sites have been previously salvaged either by a surface collection of artefacts or by manual archaeological investigation (**Table 6; Figure 20. 2**). The majority of these sites were associated with Bettys Creek and its environs, although two sites associated with Bowmans Creek are also included. In addition, there have been many areas where grader scapes have occurred: primarily within Survey Unit 2 but also, to a lesser extent, within Survey Unit 1.

These salvage programs will be briefly highlighted here as much as they affect the existing archaeological landscape, although full details of these programs are provided in **Section 5.3.3**. **Figure 21** shows the areas covered by AHIPs over the years and their relationship to the current Proposed Disturbance Area and indicates that large areas of the Proposed Disturbance Area have been covered by previous AHIPs. This figure also shows the location of the 18 sites that have been salvaged within the Proposed Disturbance Area.

These approved salvage programs were conducted to mitigate the loss of archaeological values from approved mine-related impacts. This salvage work was conducted by qualified archaeologists in conjunction with Aboriginal community representatives and the works have

amassed much detailed and useful knowledge about the Aboriginal past of the Proposed Disturbance Area.

Figure 21: Previous AHIP applications and the Proposed Disturbance Area showing previously salvaged sites.



However, these salvage programs have also, in areas, legitimately removed artefacts from the landscape and this has altered the visible archaeological landscape that is assessed here.

For example, in a 2003/2004 salvage program (under Section 90 AHIP #1762), a surface collection of artefacts and grader scrapes in the north of Survey Unit 1 were undertaken; although the bulk of this salvage was to the west of the current Proposed Disturbance Area (Umwelt 2012a). A total of 8,304 artefacts were recovered from 60 exposures during this program along Bettys Creek and its tributaries.

In March 2005 another salvage program under Section 90 AHIP #2131 (Umwelt 2012b) was undertaken in what was then termed the West Dump Area. This salvage area was immediately west of Survey Unit 1. A total of 398 artefacts were salvaged as a result of this program, with 97% coming from the one site Bettys Creek 44.

In a 2005/2006 salvage program (under Section 90 AHIP #2267), a total of 2,713 artefacts were recovered from areas within and surrounding the southern portions of the Proposed Disturbance Area. This included a total of 2,604 (96%) artefacts from the Bettys Creek catchment, 52 (1.9%) from the Bowmans Creek catchment and 57 (2.1%) from the Swamp Creek catchment (Umwelt 2013a, 2013b).

The result of this previous archaeological salvage has had the effect of diminishing the numbers of artefacts extant in the Proposed Disturbance Area (and adjacent areas) and the disturbance of the ground, in discrete areas, through manual excavation (**Figure 20. 2**) and grader scrapes.

Table 6: Previously salvaged sites within the Proposed Disturbance Area.

AHIMS number	Site name	AGD Zone 56 Easting	AGD Zone 56 Northing	Site type	Landform	Artefact numbers
37-3-0603	Bettys Creek 13	320662	6407265	Artefact Scatter	Foot slope	>100
37-3-0604	Bettys Creek 14	320759	6407271	Artefact Scatter	Lower slope	20
37-3-0606	Bettys Creek 16	320877	6408654	Artefact Scatter	Lower slope	10
37-3-0607	Bettys Creek 17	320833	6409048	Artefact Scatter	Lower slope	1
37-3-0614	Bowmans Creek 2	317816	6409176	Artefact Scatter	Floodplain/lower slope	4
37-3-0615	Bowmans Creek 3	317989	6408929	Artefact Scatter	Floodplain	2
37-3-0661	BC67	321964	6411392	Artefact Scatter	Slope	2
37-3-0310	BC 14;	323165	6413229	Artefact Scatter	Creek bank/foot slope	1
37-3-0311	BC 15;	323185	6413259	Artefact Scatter	Creek bank/foot slope	1
37-3-0647	BC51	321820	6411403	Artefact Scatter	Tributary bank	3
37-3-0648	BC52	321932	6411494	Artefact Scatter	Creek bank	11

AHIMS number	Site name	AGD Zone 56 Easting	AGD Zone 56 Northing	Site type	Landform	Artefact numbers
37-3-0649	BC53	322493	6411450	Artefact Scatter	Tributary bank	3
37-3-0650	BC54	322302	6411943	Artefact Scatter	Lower slope	1
37-3-0628	BC58	322064	6412146	Artefact Scatter	Floodplain	8
37-3-0629	BC55	322185	6411985	Artefact Scatter	Lower slope	
37-3-0654	BC60	323349.041	6412769.454	Artefact Scatter	Upper slope	2
37-3-0655	BC61	323306	6412535	Artefact Scatter	Mid slope	3
37-3-0656	BC62	323232	6412080	Artefact Scatter	Mid slope	1

4.7 CONCLUSION

This review of environmental conditions shows that the Project Area would have once offered limited resources for Aboriginal use in the past. It was noted that the Proposed Disturbance Area lacks reliable water, apart from a small area where it intersects Bowmans Creek. It is also likely that this water was highly variable in its supply and, for the majority of the drainage systems within the Proposed Disturbance Area, there would have been extended periods where they held no water. The topography of the Proposed Disturbance Area is mostly comprised of mid and upper slope landforms that are located a distance from water of any type. This limits the landforms available that were suitable for prolonged camping.

The historic land use in the area has led to widespread soil and vegetation loss resulting in a landscape that has been severely modified by erosion, as well as impacted by farm and mine activities. The archaeological consequence of this is that many artefact scatters have probably been displaced from their original locations or, as in the case of scarred trees, have been removed from the landscape in the past through activities such as vegetation clearing. The erodible soils of the Proposed Disturbance Area may have the ability to reveal artefacts, although with time, their effect is more detrimental as sites continue to be subsumed by erosion.

As a result, the Proposed Disturbance Area has undergone disturbances to the degree that it is unlikely that there are any areas of non-disturbed pre-1788 landform surviving. While these disturbances are variable, the overall affect has been to leave the Proposed Disturbance Area looking very different today compared to how it would have been prior to white settlement. This change is to the degree that it is sometimes hard to extrapolate back from what is there today to what may have been there in the past.

The consequences of historic land use are manifest: the A Horizon soils have been largely lost or redeposited; drainage lines have eroded and eaten into bank areas; increased run-off has led to gully erosion and incision; and native plant and animal communities have been severely

altered. To this needs to be added a history of ground disturbing activities such as: grazing; road and track construction; building construction; and mine infrastructure construction and use. As a result, the Proposed Disturbance Area is affected by an inordinately high degree of disturbance, most of which is related to past agricultural land uses, and all of which has the ability to destroy or alter archaeological sites had they existed in the area.

Finally, many areas within the Proposed Disturbance Area have been affected by archaeological salvage work. This has removed 18 sites from the landscape and has disturbed an even wider area through the use of grader scrapes. This approved archaeological work has also contributed to the lowering of the integrity of the surviving archaeological landscape by legitimately removing artefacts and excavating sites that once were located within the proposed Disturbance Area.

As a consequence, the Proposed Disturbance Area is today a diminished archaeological resource to what it may once have been. With a history of hydrological changes, soil loss, vegetation clearing, intensive farming and nearby mining, all portions of the Proposed Disturbance Area have been affected to some degree in a manner that would alter the archaeological landscape visible today.

5 ABORIGINAL HERITAGE ASSESSMENT: BACKGROUND

5.1 ETHNO-HISTORIC SOURCES OF REGIONAL ABORIGINAL CULTURE

The ACHA that accompanies this report provides a full background on the Aboriginal connection to the Project Area and the region.

The Project Area is located in the Wonnarua tribal area of the upper Hunter Valley.

The Wonnarua people lived in an environment rich in food resources. Freshwater fish, shellfish, reptiles, mammals, birds and plant food provide a diverse diet (see Brayshaw 1981b). Brayshaw (1986b: 82) suggests that inland groups visited the coast during the summer when marine resources were plentiful, and coastal groups travelled inland to participate in the winter kangaroo hunts. Trade and/or exchange also occurred between the coastal and inland groups. Reed spears and shells were traded inland for possum skin rugs and fur cord (Brayshaw 1986b: 41). Social gatherings were a feature of Aboriginal life in this area.

Visiting by coastal and inland groups for initiations and ceremonies seemed to occur. These were conducted within earthen circles. Carved trees were associated with these sites (Brayshaw 1981b: 12).

Material culture items for this area included many items made of bark obtained from various trees. For example, tea tree bark (*Melaleuca quinquenervia*) was used for the construction of huts, and the bark of the cabbage-tree (*Livistona australis*) and Kurrajong (*Brachychiton eopulneus*) were used to make cord for the manufacture of fishing lines and nets and also for sewing up canoes (Brayshaw 1981b). Baskets, shields and canoes were also made from bark. Some shields, however, were also made from the wood of the nettle tree (*Urticaceae*) or fig (*Ficus* spp.). Boomerangs, clubs, spear throwers and hatchets were also manufactured. Spears were of composite manufacture, usually being lengths of grass tree (*Xanthorrhoea australis*) to which points of hard wood were attached. Maintenance tools included stone adzes and chisels, abrasive stones, small fishhook files, bone awls and sharpened shell knives and scrapers (Brayshaw 1981b: 10). After 1788 glass and iron hatchets became sought after items.

There is virtually no reference to flaked stone tools in the nineteenth century descriptions of Aboriginal material culture in the Hunter Valley. This paucity of information is at odds with the types of occupation evidence which are preserved in the valley. By far the most common type of Aboriginal site in the inland part of the valley is the "open campsite" or stone artefact scatter.

There are few records of the Aboriginal population of the central valley. Howe in 1819 reports five people at Jerry's Plains, Dangar in 1824 reports 15 people at Dartbrook, Mathew in 1830 reports 60 people on the Wollombi and 300 men are reported at Patricks Plains in 1834. At least 200 men were involved in the 1826 attack on Merton. Scott and McLeod in 1826 estimated a total of about 500 people at that time (Resource Planning 1991: 17) although this estimate,

and the others above, are likely to be highly inaccurate as they are based on assumptions rather than detailed censuses.

From 1825 there is documented conflict between the Aboriginal population and settlers within the Hunter Valley, including the Ravensworth/Foy Brook area (for example, *The Australian*, 9 September 1826 [<http://trove.nla.gov.au/ndp/del/page/4248909>]). Although the exact location of these conflicts is unknown, the history of raids and counter-raids demonstrate that the Wonnarua people were fierce defenders of their tribal lands.

5.2 REGIONAL ARCHAEOLOGICAL CONTEXT

The primary concern of archaeology is with the interpretation of human history and cultural evolution through the study of material remains. This archaeological record is both fragile and non-renewable and any major disturbance of the environment through landscape changing development poses a threat to this valuable cultural resource. The major cause of obliteration of much of the evidence, from which the prehistory of Australia may be constructed, is development during the historic period, with the impact by natural processes, generally, playing a minor role. Thus, that which remains is made the more valuable by its rarity.

The amount of heritage work that has been undertaken in the Hunter Valley is beyond that of almost any other part of NSW (barring possibly the Cumberland Plains of the Sydney Basin) and review of this extensive body of work would be a lengthy task that is beyond the scope of this assessment. Fortunately, an upper Hunter Valley wide scope has been attempted by other specific works such as ERM (2004). Consequently, only a brief regional archaeological context is provided here.

The earliest records of work undertaken in the Hunter region have been provided by R.H. Mathews, a surveyor working in NSW and Queensland between 1879 and 1910. While based at Singleton he recorded a number of shelter sites containing paintings and engravings in the Bulga-Milbrodale-Wollombi area (Moore 1970: 29). In 1939 McCarthy made an archaeological reconnaissance of the area as a result of which he described an assemblage of stone tools collected from eroded surfaces along the "200 foot contour" near the Hunter River to the south west of Singleton (McCarthy and Davidson 1943). In 1965 Moore commenced a long term research project in the Hunter Valley itself, and one on the divide near the headwaters of the Goulburn River. The latter part of the research program was concentrated on the location of datable archaeological sequences in the Wollombi and lower McDonald River valleys (Moore 1970, 1981). Other shelter sites have since been excavated in the Goulburn River area by Haglund (1981a, 1981b).

Evidence from the Central Lowlands sub-region of the Hunter Valley (broadly between Murrurundi in the north and Cessnock in the south-east), suggests that archaeological material is scattered almost continuously, but in varying density, along most creek banks and flats. It has

been suggested that archaeological material is primarily contained in a corridor approximately 100m wide on either side of a creek channel (Koettig 1990: 13).

In broad terms, these open artefact scatters appear to be confined to the A Horizon of the soil profile which is generally less than 50cm in depth (Hughes 1981; Stern 1981). These sites are often disturbed and stratification is unclear (Hughes 1984: 8). Artefacts are generally manufactured from indurated mudstone, with silcrete, fossilised wood and chert occurring less frequently (Hiscock and Koettig 1985). Features found at open surface scatters include hearths, pits, ovens and heat treatment areas (Burton *et al.* 1990). These sites are generally detected where some form of ground disturbance has occurred, for example erosion due to both cultural and non-cultural processes, and thus the extent of the site is often difficult to determine. Often the density of artefacts on the surface do not relate to the amount of subsurface archaeological material (see Koettig 1990: 15).

Archaeological excavations have so far determined that human occupation of the Hunter Valley has occurred since the last Glacial Maximum (approximately 27,000–17,000 years BP (HLA-Envirosciences 2005). It is hypothesised that it is likely that evidence predating this period will be unearthed/studied in the future.

A review of GHD (2005), HLA-Envirosciences (2005) and Umwelt (2007) provides the following regional synthesis:

- Archaeological sites, even where surface evidence is not present, occur on most landforms. This was confirmed by a HLA-Envirosciences (2005) excavation program, in which Aboriginal sites were encountered on alluvial terraces, flats, slopes, bench areas, spurs and ridgelines. HLA-Envirosciences acknowledges that the sample areas were biased somewhat as they were all near creek lines;
- Site frequency and density are dependent on their location in the landscape. This theme is consistent throughout NSW and is influenced by a range of factors, the most relevant of which the existing level of disturbance. More specifically, the potential for undisturbed *in situ* deposits remaining in the upper Hunter on a mining property is generally low;
- The highest concentration of Aboriginal sites on the valley floor surrounds creeks and waterways;
- Few scarred trees are recorded reflecting the high degree of tree clearing in the region;
- The most frequently recorded raw material is indurated mudstone (a fine grained siliceous material) associated with Hunter River gravels. Other frequently recorded materials include locally sourced silcrete, quartz and volcanic stones; and
- Assemblages recorded in the region consist largely of unmodified flakes with few formed tools. Backed blades comprise the characteristic diagnostic artefact in the region. The mid- to late-Holocene appears to have witnessed this move to smaller

tools, perhaps as an impetus to conserve raw material during tool manufacture or due to new functionality requirements. This impetus seems to have driven the development of what Hiscock (1993) calls the Redbank A Strategy (RAS, after three sites along Redbank Creek, near Singleton) of backed blade production. It is noted that RAS reduction has been infrequently recorded at other sites in the district and no mention of it is made for sites within the Project Area.

The archaeological context of the Hunter Valley has been established by over 100 years of research and in the past 30 to 40 years by the increasing incidence of development driven projects. **Table 7** summarises landmark studies that have occurred in the region and it is noted that this research has established the earliest date of occupation in the general vicinity of the Project Area (at Glennies Creek to the east of the Project Area) as falling within the Pleistocene epoch (i.e. >12,000 BP; Koettig 1986).

Table 7: Landmark studies within the wider region.

Investigator	Year	Location(s)	Remarks
R.H. Mathews (surveyor) In Stern 1981	1879 to 1910	Singleton: Bulga-Milbrodale-Wollombi area	Shelter sites with paintings & engravings (Mathews 1879 to 1910 in Stern 1981).
Moore (archaeologist) In Stern 1981	1965 and 1981	Hunter Valley (x2); Headwaters of Goulburn River (x1).	Sites containing <i>in situ</i> archaeological material in the lower Hunter Valley were either destroyed or obliterated by development. Wollombi and lower MacDonald Valleys contained datable archaeological sequences (Moore 1965 and 1981, both in Stern 1981).
Moore	1970, 1981	Milbrodale, Sandy Hollow Divide near headwaters of Goulburn River.	Located datable arch sequences. Excavations. Site on divide basal date of 5,000 to 6,000 BP. Assemblages recorded backed blades known as Bondi Points (5000 to 1000BP).
Haglund	1981a, 1981b	Goulburn River	Shelter site excavations. All shelter sites in Hunter Valley with basal dates of 4,000 to 2,000 BP. Bondaian assemblages: 5000 to 1000BP.
Attenbrow	1982	Mangrove Creek catchment, 10km south of watershed between Hawkesbury and Hunter Rivers	Located to the south of the Hunter Valley, most occupation evidence dated from last 5,000 years. Three of 16 shelters investigated contained older evidence, One (Loggers) dated to 11000BP.
Koettig	1986	Glennies Creek Dam	Artefacts and hearth material up to 1m below surface of colluvial / alluvial terrace: Pleistocene dates of 13000 and >20000BP. Discussed further below.

Mention will be made here of two Koettig's excavations, at Glennies Creek and Camberwell, due to their proximity to the east of the Proposed Disturbance Area (Koettig 1986, 1992).

The initial survey of the Glennies Creek to Singleton pipeline recommended that excavations be undertaken at six locations along the northern section of pipeline route where visibility was poor. This resulted in the further identification of five sites. The soils were characterised as being texture contrast soils with strongly distinctive A and B Horizons. Artefacts were recorded in the B Horizon which was estimated by a geomorphologist to date between 10,000 and 30,000 years old. A radiocarbon date was obtained from charcoal in the B Horizon that was 13020±360 Before Present (BP).

Further archaeological work concentrated on two sites SGCD 9 and 16. These are located in the valley of Foy Brook near Mount Olive. The sites are on small alluvial flats adjacent to Foy Brook and surrounded on either side by steeply rising slopes to ridge crests.

The investigation strategy was to excavate a series of pits along the pipeline route. Excavation was by using a backhoe to remove sediment and dump it on the ground where it was sorted by the archaeologists. The emphasis of the work was to obtain samples of artefacts from the B Horizon. The results of the work established that the B Horizon was dated to between 10 to 30,000 years ago and that artefacts recovered from that level in the profile must date to that age. A feature interpreted as a hearth was discovered and dated to greater than 20,000 BP (a more precise date was not able to be obtained due to the small sample of charcoal collected). The artefacts recovered from the B Horizon were made from volcanic rock and contained a greater ratio of core to flakes than from the artefacts recovered from the A Horizon. However, the analysis was limited by the low numbers of artefacts recovered. The conclusion of Koettig's work was that there were artefacts associated with the B Horizon and that these, on stylistic and dating grounds, were between 10 to 30,000 years old. This is the oldest date in the vicinity of the Proposed Disturbance Area, although it must be remarked that the results do not come from systematically excavated areas and Aboriginal occupation associated with the B Horizon levels have not been conclusively replicated elsewhere.

Also to the east of the Proposed Disturbance Area, the survey work at Camberwell Coal Mine recommended salvage archaeological work on a number of sites considered to have archaeological potential. This work was undertaken by Koettig in 1990 (reported in Koettig 1992).

Koettig's method was to lay out a series of transects around each site and to excavate 1m by 0.25m test trenches at regular intervals along the transects. This helped define the extent and nature of archaeological material. Once this was established then areas for further excavation were defined. The sites were located in three groups GCC3, 4, 5, 7, 8, 9, and 10 in a group along Martins Creek. GCC 27, 28, 29 at the lower end of Nowlands Creek and GCC 33 & 35 further up Nowlands Creek. No attempt was made to investigate sites away from the creek lines.

Koettig summarises the stone analysis as follows: "The knapping of stone within the Camberwell area indicated a variety of knapping strategies, which usually appear to be directed towards the production of flakes suitable for backing" (Koettig 1992: 45). The analysis of stone artefacts identified that two types of raw material were present: indurated mudstone and silcrete. Six reduction strategies were identified; five of these were using indurated mudstone and one on silcrete. Interestingly silcrete flakes were heat treated to improve flaking

characteristics. Koettig notes that "*other types of activities*" were also carried out on the sites but does not investigate these (Koettig 1992: 42, 45). Other archaeological features discovered were hearths, "ovens" and a heat treatment area. Seven radiocarbon dates were obtained which dated cultural features. The dates range from 2,750 BP to 270 BP.

Overall it seems that Koettig's focus was on the minutiae of the technological differences between the reduction strategies used to make backed blades. This has resulted in some of the broader patterns of Aboriginal history not being considered. Koettig's work also forms a watershed for the interest in reduction techniques that was enunciated by Hiscock in 1986 (Hiscock 1986). The patterning deduced from reduction techniques observed by Hiscock was not, however, able to be accurately replicated at other sites (for a range of reasons, including small sample sizes). During the 1990s and beyond, investigations have tended to move away from examining a minutiae of the technological differences associated with artefacts to more of a landscape/environmental approach where distribution patterning becomes more important. Given the disturbed nature of most open sites in the region, this broader approach has enabled an increased understanding of the region's past without relying on tightly stratified deposits that are a prerequisite for many technological based research questions.

It is also entirely possible, given the rate of erosion in the district, that researchers in the 1980s had access to sites less disturbed than the sites that survive today. Thus, fine analyses of artefact assemblages may have been more warranted in the past than they are today given the present poor condition of most open sites in the area.

From those previous investigations summarised above, the following generalisations can be made about archaeological patterns in the Hunter Valley region:

- Sites are commonly open artefact scatters or isolated finds;
- Sites are generally of low density;
- Most sites are situated close to drainage lines;
- Archaeological material is densest within 30m of the creek edge but continues at a lower density away from the creek;
- Some artefact concentrations are virtually continuous along larger creek lines and associated foot slopes;
- The most common raw materials were indurated mudstone and silcrete with smaller quantities of chert, siltstone, quartzite and quartz also identified;
- Flakes and flaked pieces accounted for the bulk of assemblages. Proportions of cores and backed blades are low;
- There is evidence of heat-treated artefacts; and

- Many recorded artefacts are characteristic of the Small Tool Tradition (Bondaian) of the late Holocene.

5.3 LOCAL ARCHAEOLOGICAL CONTEXT

5.3.1 AHIMS Registrations

A search of the OEH AHIMS was made on 27 August 2014 under seven quadrants that cover the Project Area (all GDA Zone 56):

- Eastings: 314500 to 320000; Northings: 6406500 to 6410500 (no buffer)
- Eastings: 314500 to 320000; Northings: 6410500 to 6414500 (no buffer)
- Eastings: 314500 to 320000; Northings: 6414500 to 6418500 (no buffer)
- Eastings: 320000 to 325500; Northings: 6406500 to 6410500 (no buffer)
- Eastings 320000 to 322750; Northings 6410500 to 6414500 (no buffer)
- Eastings 322750 to 325500; Northings 6410500 to 6414500 (no buffer)
- Eastings: 320000 to 325500; Northings: 6414500 to 6418500 (no buffer)

This search returned 448 sites from the 12km (north-south) by 11km (east-west) area². Unfortunately, many of the AHIMS registrations are not complete or are out of date. For example, 52% of entries (n=231) do not have a detailed site description (i.e. artefact scatter, isolated find etc.; **Figure 22**) and while the site type can sometimes be deduced from other entries, this makes discussion of the sites difficult. Further, AHIMS records that 80% (n=359) of these sites are still extant whereas the true figure is much lower (many sites within the Proposed Disturbance Area that are known to have been salvaged still appear as 'valid' [or extant] on the AHIMS register).

During the feasibility stage of the current Project, the Proponent engaged Umwelt to cross-check all AHIMS entries against known facts (such as a report) in order to remedy the issues with AHIMS. This not only corrected the status of all sites within and adjacent to the Proposed Disturbance Area but ensured that a correct site description was entered. This study will therefore use this database, rather than AHIMS, in the following discussion³. In the revised database (that excludes some sites in the southern Ravensworth area), there are 302 sites registered with AHIMS within or immediately adjacent to the Project Area (see **Figure 23** for a comparison between the site status as recorded by AHIMS and the site status from the revised

² This figure does not include the sites recorded as part of this assessment although they have been registered and appeared in the August 2014 site search.

³ The results of the August 2014 search show that 'valid' sites, that are known to have been salvaged, are still located on AHIMS within the Proposed Disturbance Area (**Figure 23**).

AHIMS database; **Appendix 5**). 71 of these sites are listed as extant (23.5%), 229 are not extant (salvaged; 75.8%) and two sites are partially extant (0.7%).

Somewhat diminishing the number of extant sites, one site is known not to exist and nine sites are suspected as having been salvaged although this is not recorded in the revised AHIMS database. Site #37-3-0018 (stone arrangement) does not exist and is the same site as site #37-3-0637 (stone arrangement) at the location given in AHIMS for #37-3-0637. The existence of only one stone arrangement was ascertained during a targeted assessment by OzArk archaeologist Ben Churcher on 15 May 2013 (**Section 3.3**)⁴.

Sites #37-3-0274 to #37-3-0281 (eight sites) and site #37-3-0727 plot to highly modified areas within the mining lease and are likely to have been previously salvaged under appropriate approvals⁵.

With the reduction of these ten sites, it can be recalculated that there are 301 actual sites registered with AHIMS that are located within or immediately adjacent to the Project Area. These constitute: 61 extant sites (20.3%); 238 non-extant sites (79%) and two partially extant sites.

242 or 80.4% of the previously recorded sites are artefact scatters (18 with associated PADs and one with an associated quarry). Of these artefact scatters, 49 (20.3%) are extant and 191 (78.9%) are not extant and two are partially extant.

56 or 18.6% of the previously recorded sites are isolated finds of which 10 (17.8%) are extant and 46 (82.2%) are not extant.

There are two PADs (one extant and one not extant) and there is one extant stone arrangement.

5.3.1.1 Previously recorded sites within the Proposed Disturbance Area

There are three extant AHIMS registered sites that are within the Proposed Disturbance Area. All sites, #37-3-0611, #37-3-0985 (artefact scatters) and #37-3-0527 (isolated find), are completely within the Proposed Disturbance Area (**Figure 24**). The two extant artefact scatters within the Proposed Disturbance Area (#37-3-0611 and #37-3-0985) are both low density artefact scatters with low numbers of artefacts recorded at each site.

- #37-3-0611 is located approximately 200m west of Bettys Creek on a minor, ephemeral tributary that flows into Bettys Creek. The landform is generally flat to gently rising.

⁴ Site #37-3-0018 has been removed from **Figures 22** and **23**.

⁵ These sites are shown in **Figure 23** (bottom) using the data supplied in the revised AHIMS database (i.e. that they are extant) although, as the sites are in an area unaffected by the Project, their status was not researched during the revision process. Because the precise status of these sites was not investigated during this assessment either, as they are located at a distance from the Proposed Disturbance Area, the determination of the status of these sites should form part of the revised ACHMP for the Mount Owen Complex.

- #37-3-0985 is located immediately south/west of Hebden Road and approximately 130m east of Bowmans Creek. It is located on the lower slope of a low rise above the floodplain for Bowmans Creek.
- #37-3-0527 is located to the south of the Main Northern Rail Line within the railway corridor in an area that has had significant modification from the building of the railway.

Details of these sites are shown in **Table 8**.

Table 8: Extant AHIMS registered sites within the Proposed Disturbance Area.

AHIMS #	Site name	MGA (East) Zone 56	MGA (North) Zone 56	Protection?	Recorders
#37-3-0611	Bettys Creek 21	320893	6410239	General area fenced with signs	Umwelt (Australia) Pty Limited
#37-3-0985	REA89	317742	6409391	Fenced as part of Ravensworth North Project	Umwelt (Australia) Pty Limited
#37-3-0527	Ashton EWA17	320079	6407152	None known.	Dan Witter

Figure 22: Site types of all AHIMS registered sites within or adjacent to the Project Area.

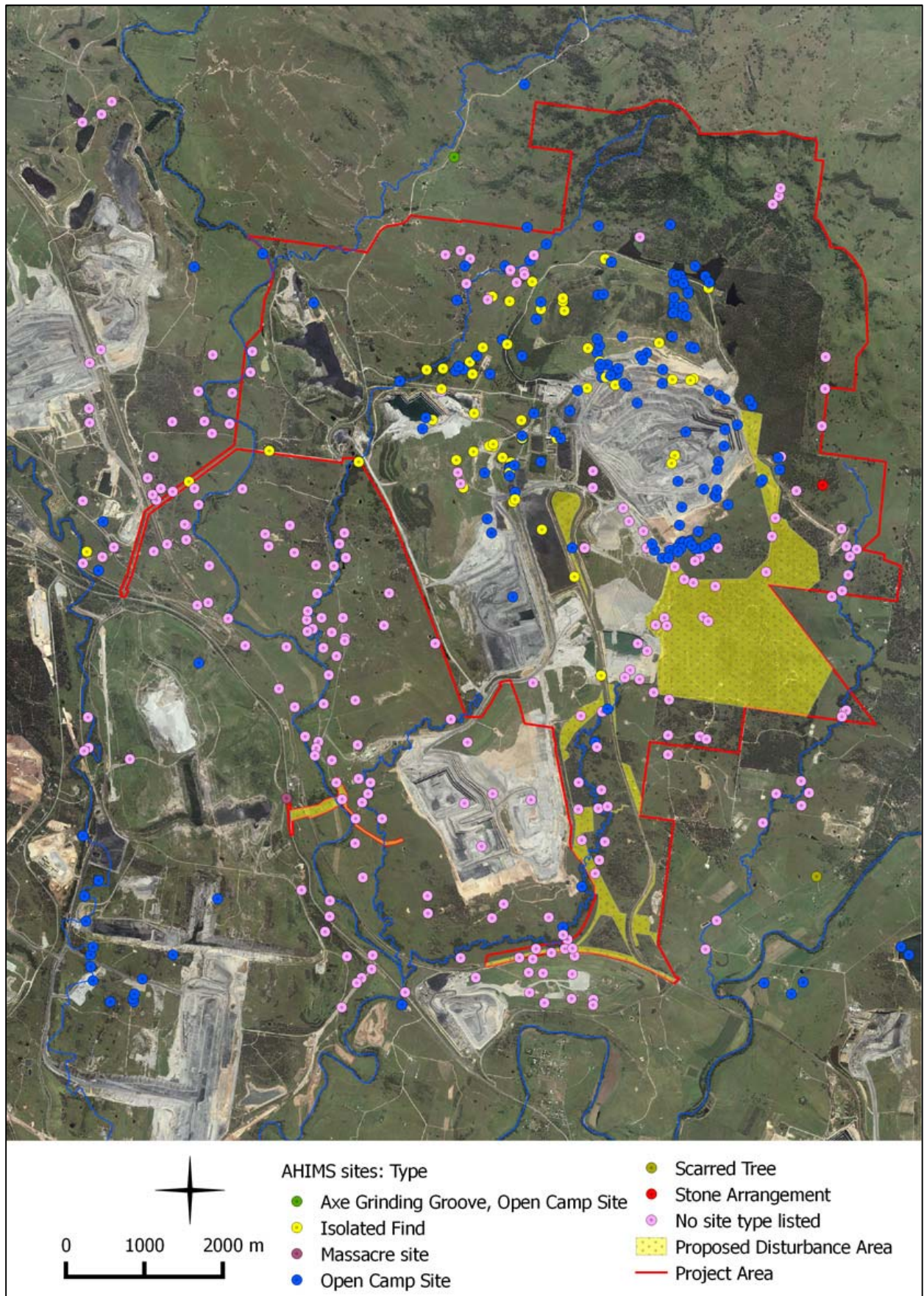


Figure 23: Status of all AHIMS registered sites in the vicinity of the Proposed Disturbance Area. Top: data from AHIMS database; bottom: data from revised AHIMS database showing correct site status.

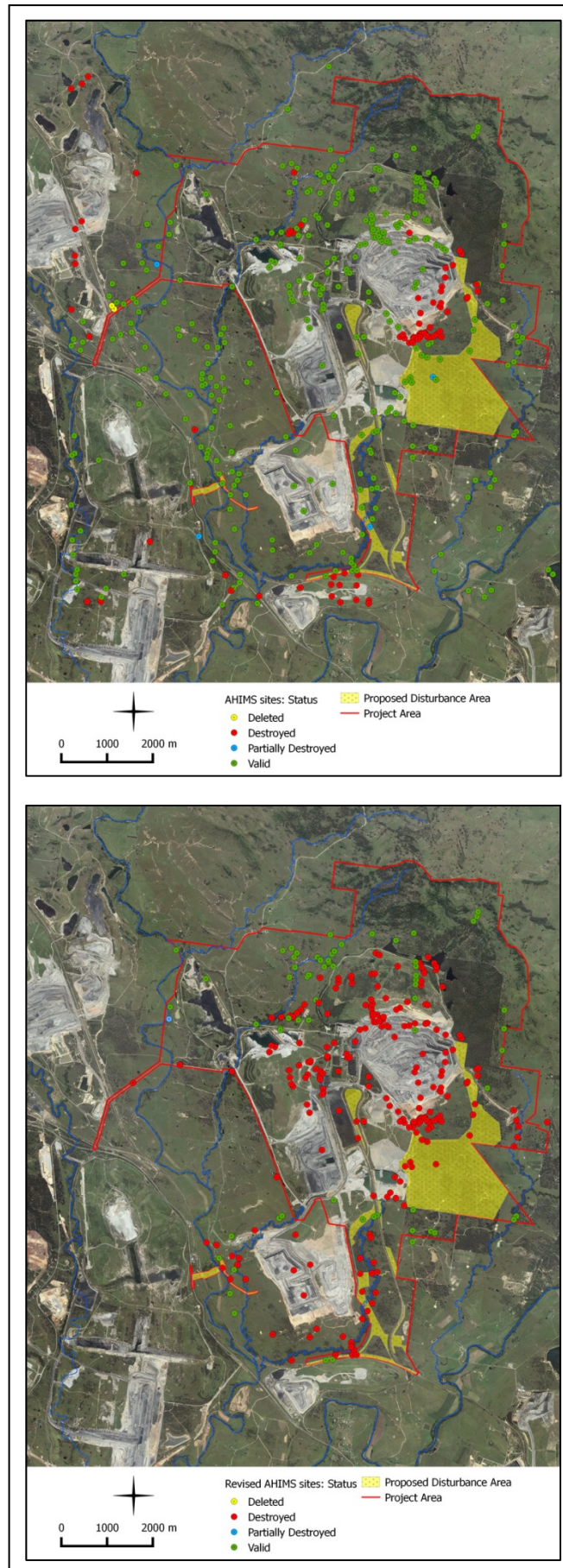
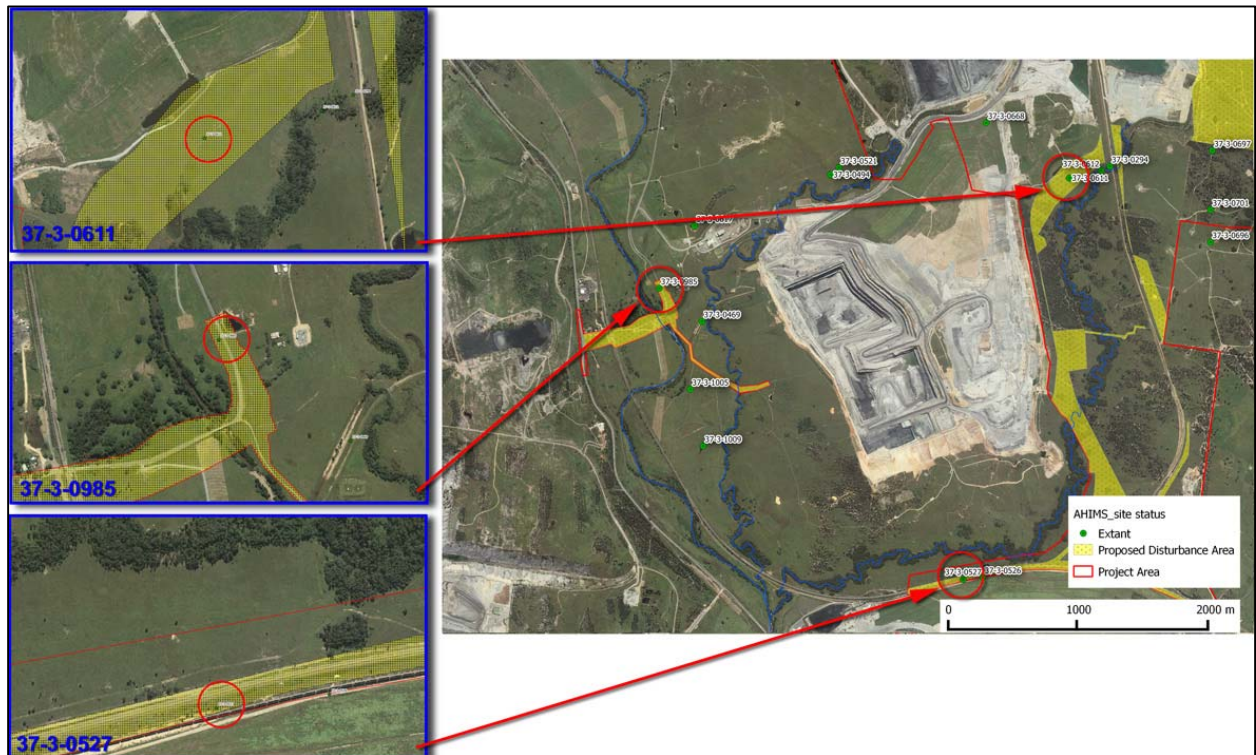


Figure 24: Extant AHIMS registered sites highlighting those within the Proposed Disturbance Area.



5.3.2 Pre year 2000 archaeological investigations

The site recordings have arisen from over 30 years of archaeological research within the Proposed Disturbance Area and adjacent areas.

The first survey to interact with the current Proposed Disturbance Area was by Helen Brayshaw in 1982 (Brayshaw 1982b). Brayshaw's survey area included areas within the southern portions of the Proposed Disturbance Area including the southern 6km of Bettys Creek and 5km of Bowmans Creek. As a result of this assessment, three open sites and two isolated artefacts were recorded. The three open sites (artefact scatters) were recorded as follows:

Site A: Artefact Scatter. 30 metres west of Bettys Creek, principally on the southern bank of a tributary. 43 artefacts were recorded, occurring at an average density of $1/17\text{m}^2$. Raw materials present included indurated mudstone 75%, siltstone 2.5%, quartz 2.5% and silcrete 20%;

Site B. Artefact scatter. On the western bank of Bettys Creek, about 300 metres north of the main northern railway. Four flakes were found here at an average density of $1/30\text{m}^2$; and

Site C. Artefact scatter. East of a tributary of Bettys Creek about 200 metres north of the confluence. Five artefacts recorded, occurring at an average density of $1/24\text{m}^2$.

Immediately west of the Proposed Study Area, along the northern reaches of Bowmans Creek, Len Dyall (Dyall 1982) recorded 18 artefact scatters and two grinding groove sites. The artefact scatters were small with the exception of one that contained over 150 artefacts. One grinding groove site was suggestive of a seed processing location rather than for axe grinding.

Also along the same area of Bowmans Creek and to the west of the Proposed Disturbance Area, Laila Hagland (Hagland 1982) recorded two artefact scatters:

Site 1: Aboriginal stone artefacts were noted in a number of exposures within, and along, the edge of a river terrace west of Bowmans Creek. It was noted that the artefacts seen varied in type, size range and density between the exposures. Small thin flakes and small, well-made artefacts such as Bondi-points were noted only close to the southern end. Artefact density appeared greater in this part. These observations may reflect real distribution trends, but may also result from the smaller and more shallow areas of exposure further north; and

Site 2: Aboriginal stone artefacts were noted in two exposures along the northeast bank of Bowmans Creek, northwest of its junction with Stringybark Creek, and within a minor erosion gully on the slope above.

In 1991 Resource Planning undertook a large assessment for the Mount Owen Coal Project that was focussed on Swamp and Yorks Creeks, located immediately west of the Proposed Disturbance Area (Resource Planning 1991). This study included twenty five kilometres of drainage line (including left and right banks) along Swamp Creek and Yorks Creek. Traverses were also made across side slopes and along ridge lines. The survey area totalled 370ha. 98 Aboriginal archaeological sites, ranging from isolated artefacts to dense concentrations of more than 100 pieces of flaked stone, were mapped and recorded. **Table 9** presents the artefact densities recorded by Resource Planning and this shows clearly that Swamp Creek (a small portion of which is in the Proposed Disturbance Area) displays a lower artefact density when compared to Yorks Creek (that is outside the Proposed Disturbance Area). In the case of Swamp Creek over 75% of sites were isolated finds or very low density artefact scatters while along Yorks Creek 54% of sites recorded over 50 artefacts at each site (a moderate artefact density). Resource Planning noted that the sites in the Swamp Creek catchment are regarded as an excellent representative assemblage of occupational evidence in the small tributary valleys of the Hunter River (Resource Planning 1991: 5). This report recommends, based on the survey evidence *“that part of the Yorks Creek drainage line would be set aside as an archaeological conservation zone”* (Pacific Resources 1991: 5): a recommendation that was followed as the northern reaches of Yorks Creek are now within a permanent Voluntary Conservation Area (VCA).

Table 9: Artefact densities at sites recorded by Resource Planning 1991.

Artefact Numbers	Swamp Creek (%)	Yorks Creek (%)
Isolated Artefact	27.6	9
<10 Flakes	50.0	18
10-20	14.5	18
20-50	6.6	27
50-100	1.3	18
>100		9

In 1993 Matthew Barber, archaeologist with Resource Planning, surveyed areas along Bettys Creek: locations that are now within the current Mount Owen mine void or dump areas to the immediate west of the Proposed Disturbance Area (Resource Planning 1993). The western boundary of Barber's survey area was defined by the drainage divide between Bettys Creek and Swamp Creek (now no longer extant). The southern boundary was formed by the proposed lease extension boundary. The proposed extension resulted in the disturbance of an additional 260ha of land, including approximately 100ha of the then Ravensworth State Forest.

The survey recorded 39 archaeological sites, of which 34 were recorded in detail. It was found that the majority of sites were situated close to the drainage lines and that their location was a real distribution and not the bias of survey coverage. It was, however, noted that erosion plays a vital role in the identification of sites. This is because, the report argued, the majority of sites are actually subsurface in origin.

All of the sites recorded were open artefact scatters although their content varied from one artefact to several hundred artefacts. The artefact types appear in the main to be the product of backed blade manufacture (Resource Planning 1993: 4). There were some sites, in the report's opinion, which had a high potential for further archaeological investigations due to their potential to contain subsurface deposits and the quantity of artefacts present. A number of artefacts revealed retouch, the majority of which were classed as part of the backed blade industry. As with other sites in the Swamp Creek area, and other parts of the Hunter Valley, the dominant raw material was indurated mudstone/tuff (IMT⁶) followed by silcrete.

Some raw statistics from Barber's assessment will help place the Proposed Disturbance Area in its context, as landforms assessed by Barber are identical to those areas of Bettys Creek in the

⁶ Hughes, Hiscock and Watchman (Hughes *et al.* 2011) published the results of thin-section analyses of four samples drawn from the upper Hunter Valley. This brief article concluded, on the basis of the lithological diversity of the samples, that the term 'tuff'—whilst accurate in some cases—is too restrictive, noting that at least two of the samples examined contained no volcanic material, and recommended that the more inclusive 'indurated mudstone / tuff' (IMT) be adopted. As the current study has not included petrographic analyses of stone samples, the authors follow Hughes *et al.* (2011) and use the term 'indurated mudstone / tuff' (IMT) to refer to all artefacts recorded during the current assessments that bear the following description: 'fine-textured, very hard, yellowish, orange, reddish-brown or grey rocks' (Hughes *et al.* 2011: 45). It is also noted that references to 'mudstone' or 'indurated mudstone' in previous reports have been retained here rather than adjusted to IMT. Finally it is also worthy of note that, in contrast to studies throughout the wider Hunter Valley, all studies at in the Project Area itself have consistently retained the term 'mudstone' or 'indurated mudstone' rather than 'tuff'.

Proposed Disturbance Area. **Table 10** shows that 73.5% of Barber's sites are either isolated artefacts or very low density artefact scatters with less than 10 visible artefacts. There are very few sites recorded that approach moderate densities of artefacts. **Table 11** confirms the fact that most of these low density artefact scatters are in close association to water and are most often located adjacent to creeks and associated flats/lower slopes. **Table 11** indicates that either flat land or gently sloping land was most sought after for camping and **Table 12** records that IMT (or here termed indurated mudstone) was the stone type most frequently used across the 34 recorded sites.

The report noted that, as a complex, the sites on Bettys Creek have the potential to have high scientific significance in both local and regional terms. Barber notes that in the local context (from a 1993 perspective), Resource Planning 1991 recorded 78 artefact scatters on Swamp Creek and 22 on Yorks Creek. The sites on Swamp Creek were considered as having the potential to address questions regarding the preservation of sites and the effect of surface processes such as erosion on artefact scatters (Dean-Jones in Resource Planning 1991). Barber notes subsurface investigations were conducted at some of these sites (Dean-Jones 1992) and a Consent to Destroy permit was issued by the NPWS for all of the 78 sites within the Swamp Creek survey area. The establishment of a VCA on Yorks Creek was provided as an offset for the destruction of sites within the Swamp Creek catchment. The sites on Bettys Creek were considered by Barber as being important as those along Swamp Creek. The geomorphological environment is similar and the presence of less eroded surfaces compared to other areas of the valley indicates that there is the same potential to address the issues identified by Dean-Jones (Resource Planning 1991).

Table 10: Recorded artefact densities (Resource Planning 1993: 23).

Recorded artefact density	Number of sites
Isolated Finds	9
<10 artefacts	16
10-20 artefacts	5
20-50 artefacts	2
50-100 artefacts	1
>100 artefacts	1
Total	34

Table 11: Site distribution in relation to landform (Resource Planning 1993: 25).

Degree of slope	Ridge	Mid slope	Foot slope	Creek	Flats	Gully	Total
Number of sites	1	3	5	21	4	0	34
%	2.9	8.8	14.7	61.7	11.6	0	100

Table 12: Site distribution in relation to slope (Resource Planning 1993: 23).

Degree of slope	0	1	2	3	4	5
Number of sites	16	3	8	4	2	1
%	47	8.8	23.5	11.8	5.9	2.9

Table 13: Raw materials recorded (Resource Planning 1993: 31).

	Sites where present	%	Total Artefacts	%
Indurated mudstone (IMT)	26	76	249	63
Silcrete	17	50	100	25
Chert	10	29	27	7
Volcanic	7	20	10	3
Quartz	7	20	8	2

In 1996, for an application to modify a previous consent, Jill Ruig surveyed an area of land on the Mount Owen lease but to the northwest of the Proposed Disturbance Area, in the environs of Yorks Creek (Ruig 1996). A total of 26 sites were identified within the survey area, 13 of which were within the Lease Application Area following redefinition of the proposed development's boundaries. These sites consisted of 19 artefact scatters and nine isolated finds. When tabulated (**Table 14**), sites recorded by Ruig show a generally low artefact density with only six sites recording in excess of 10 artefacts and no site recording more than 42 artefacts. The sites recording greater artefact numbers are mostly located adjacent to waterways although Mt Owen 3 (1996) is located on sloping landforms that afford a good vantage point.

Table 14: Site types recorded by Ruig 1996.

Site name	Site type	Numbers of artefacts/notable features	Landform
Mt Owen 1 (1996)	Artefact scatter	11. Mudstone (82%), silcrete (18%)	Drainage
Mt Owen 2 (1996)	Isolated find	1. Mudstone	Drainage
Mt Owen 3 (1996)	Artefact scatter	36. Silcrete (58%), mudstone (38.8% and quartz (2.7%)	Slopes with good views/aspect
Mt Owen 4 (1996)	Artefact scatter	2. Mudstone	Slopes
Mt Owen 5 (1996)	Isolated find	1. Mudstone	Slopes
Mt Owen 6 (1996)	Isolated find	1. Mudstone	Slopes
Mt Owen 7 (1996)	Artefact scatter	33. 21 mudstone, 9 silcrete, two sedimentary and one volcanic artefacts	Slopes
Mt Owen 8 (1996)	Isolated find	1. Mudstone	Slopes
Mt Owen 9 (1996)	Artefact scatter	4. One axe, two flakes and a flaked piece	Lower slopes
Mt Owen 10 (1996)	Isolated find	1. Mudstone	Drainage
Mt Owen 11 (1996)	Artefact scatter	10. Mudstone (60%), silcrete (30%) and quartzite (10%)	Slopes
Mt Owen 12 (1996)	Artefact scatter	3. 2 mudstone (60%), one clear quartz	Drainage
Mt Owen 13 (1996)	Artefact scatter	2. One mudstone, one silcrete	Slopes
Mt Owen 14 (1996)	Artefact scatter	12. High cortical count	Slopes
Mt Owen 15 (1996)	Artefact scatter	3. Mudstone	Slopes
Mt Owen 16 (1996)	Artefact scatter	42. Mudstone (64.2%), silcrete (33.3%) and volcanic (2.38%)	Drainage

Site name	Site type	Numbers of artefacts/notable features	Landform
Mt Owen 17 (1996)	Artefact scatter	21. Mudstone (71.4%), silcrete (19%) and volcanic (4.7%)	Drainage
Mt Owen 18 (1996)	Artefact scatter	8. Five mudstone, three silcrete	Drainage
Mt Owen 19 (1996)	Artefact scatter	18. Mudstone (83.3%), porcellanite (11%) and volcanic (5.5%)	Drainage
Mt Owen 20 (1996)	Artefact scatter	4. Mudstone	Slopes
Mt Owen 21 (1996)	Artefact scatter	2. Silcrete	Slopes (within fill)
Mt Owen 22 (1996)	Artefact scatter	10. Nine mudstone, one silcrete	Drainage
Mt Owen 23 (1996)	Artefact scatter	9. Silcrete	Slopes
Mt Owen 24 (1996)	Isolated find	1. Silcrete	Slopes
Mt Owen 25 (1996)	Artefact scatter	11. Nine mudstone, two silcrete	Slopes
Mt Owen 26 (1996)	Isolated find	1. Mudstone	Slopes

In 1996 Rex Silcox surveyed two routes for proposed haul roads for the Glendell Mine (Silcox 1996). These routes were located to the northwest of the Proposed Disturbance Area and include portions of Bowmans Creek and surrounding landforms. A total of seven sites (G1-G7) and two isolated finds (IF1, IF2) were recorded during the survey (**Table 15**).

As has been seen with previous investigations, the overall characteristics are a low artefact density and the proximity of the larger sites to water.

Table 15: Site types recorded by Silcox 1996.

Site name	Site type	Numbers of artefacts/notable features	Landform
G 1	Artefact scatter	9. Six silcrete, two mudstone and one quartz	Drainage
G 2	Artefact scatter	3. Two mudstone and one quartzite	Slopes
G 3	Artefact scatter	19. Large silcrete core, anvil	Slopes adjacent to drainage
G 4	Artefact scatter	4. Two silcrete, one mudstone and one 'other'	Drainage
G 5	Artefact scatter	7. Six mudstone and one 'other'	Crest
G 6	Artefact scatter	3. Two volcanic pieces: a chopper and an anvil and a mudstone flake	Crest
G 7	Artefact scatter	34. Maximum density estimated at 5m ²	Drainage

5.3.3 Post year 2000 archaeological investigations

In 2002 ERM conducted archaeological excavations and salvage grader scrapes over areas of the Ravensworth East Mine that are located to the west of the Proposed Disturbance Area in areas along Swamp Creek (ERM 2002).

The combined geomorphological investigations undertaken by ERM highlighted the Swamp Creek valley as the key area likely to yield archaeological evidence of Aboriginal occupation within the study area. However, these studies also showed that although buried land surfaces were apparent within the valley, evidence of Pleistocene Aboriginal occupation was unlikely to be recovered. Archaeological sampling of soil from these land surfaces failed to yield any archaeological material, confirming this view. In light of this, no further pursuit of Pleistocene archaeological deposits was undertaken within the scope of the excavation program.

The initial archaeological component of ERM's investigation, which included grader scrapes spread over three different landscapes across the valley, at varying distances from water sources, yielded little archaeological evidence. Of the three grader scrapes, three artefacts were recovered over a total area of 560m².

A low rise adjacent to the swampy meadow channel west of Swamp Creek in the vicinity of surface sites RE 12-14, revealed substantial archaeological material with several artefact concentrations located approximately 40m to 60m away from the channel. Test pit excavation yielded an artefact spread up slope of the channel from approximately 10m from the current channel edge, extending across the rise in all directions. A total of 87 artefacts were recovered from the 11 test pits. Over a combined excavated area of 11m², this represents an artefact density of 7.9 artefacts/m². The largest artefact concentration (44 pieces or 50.57% of the total assemblage) was excavated from Test Pit 4 located on the peak of the rise. Without the Test Pit 4 artefact concentration, artefact density would have been substantially lower, at 4.3 artefacts/m², as the majority of test pits contained five artefacts or less. 82.75% of the assemblage was mudstone and 17.25% was silcrete.

Open excavation of the site complex RE 12-14 recovered a concentrated artefact scatter across the peak of the rise within the very shallow A Horizon soil. Open excavation on this rise was proposed by Margrit Koettig (then at DECC) to define the apparent spread of artefacts from TP4, and to further establish the nature of this subsurface deposit, specifically to investigate whether it contained hearths and identifiable activity areas. The open area excavation of 86m² (including TP4) was conducted in July-August 2001 by ERM. 1,168 artefacts were excavated in the open excavation and the investigations revealed a continuation of artefacts over the low rise, rather than what was originally recorded as three individual surface sites. Within this scatter, several distinct areas of artefact concentration were recorded, all with quantities of associated charcoal and burnt earth. The assemblage comprised backed artefacts and associated manufacturing debitage, mostly of mudstone.

Seven raw materials were represented in the open excavation. Mudstone was the dominant raw material observed, accounting for almost 80% of the total artefact numbers. This mirrored the initial trend set in testing phase. Silcrete was the next most common material and comprised nearly 20% of the assemblage. The remainder of the artefacts (less than 2%) was produced from six other raw material types.

Five artefact types were identified in the assemblage. The majority of artefacts were whole flakes accounting for more than 50% of the assemblage with broken flakes (almost 30%) and flaked pieces (approximately 15%) making up much of the remaining assemblage numbers. All modified artefacts, consisting of cores and retouched flakes, made up fewer than 2% of the assemblage.

As a result of the archaeological investigations along Bettys Creek, two theories on settlement patterns were advanced. The first of these was formulated by AMBS (1997) on the basis of excavations at Bettys Creek within the Mount Owen lease area. Based on the results of the excavations, AMBS (1997: Appendix A: 10B) argued that sites along the creek line were occupied for short periods of time during the winter months. The sites represented field camps that were utilised only briefly and in which the primary subsistence activity was high-risk hunting of animals, with the subsidiary use of gathering winter plant foods. Risk in this instance refers to the likelihood that foraging activities would result in the expenditure of energy but would not result in the recovery of adequate food.

Umwelt (2005) argued that floral, faunal and water resources were most concentrated and reliable in the Bettys Creek area during the summer months and, based on modern rainfall patterns, water availability would also have been greater in summer. During winter, reduced rainfall would have resulted in limited water flow and the stagnation of permanent water supplies in all but swampy areas, whilst plant foods were limited in their nutritional value due to the diminishment of starch reserves (Umwelt 2005: 3.6). The Umwelt (2005: 3.7) model proposes that Aboriginal use of the upland portion of Bettys Creek consisted of a risk averse strategy whereby people moved between several short-term camp sites within the area before relocating to another area with similar resources. The essential differences between the two models therefore relate to the season and length of occupation of the area, not the length of use of individual sites. Umwelt (2005: 3.7-3.9) listed a series of hypothesised archaeological signatures to distinguish between the two models. The AMBS (1997) model suggested that people travelled away from the concentrated resources of the Hunter River and associated floodplain for short periods of time only, carrying with them minimal stone resources that were conserved and curated. Due to the limited availability of water resources during the winter months, occupation focussed on the permanent sources of potable water, namely swamps. Although the Umwelt model also maintained that site use was brief, use of the entire area was longer-term in comparison to the AMBS (1997) model. Consequently, it was necessary to carry larger quantities of stone resources in order to maintain the supply of artefacts throughout the occupation period. However, as the length of occupation increased, manufacturing practices would have involved conserving diminishing raw material resources.

A tabulation of the main archaeological signatures indicating each settlement strategy is shown in **Table 16** (after ERM 2009). An examination of this table shows that with the exception of heat treatment pits (which are relatively rare within the Hunter Valley), under the Umwelt (2005) model, sites occupied towards the end of a sequence of use of the Bettys Creek area may present the same archaeological signatures as the AMBS risk prone sites.

A series of archaeological salvage programs that began in 2004 to mitigate proposed impacts to Aboriginal cultural heritage, were carried out by Umwelt (see below). As one of the research

aims of this program, the AMBS/Umwelt model was to be tested to see if the archaeological signatures shown in **Table 16** manifested themselves during the excavations.

Table 16: Proposed settlement patterns for Bettys Creek: archaeological signatures.

Risk Prone Winter Occupation (based on AMBS 1997: Appendix A)	Risk Averse Late Spring/Summer Occupation (Umwelt 2005)
Cortical material will be predominantly absent from artefacts.	Cortical material will be present on some artefacts other than cores.
Cores will be used to exhaustion.	Cores will be used to exhaustion.
Flakes will be small (<50mm) and thin (<10mm).	Flakes will be a range of sizes and include primary, secondary and tertiary flakes.
Artefact assemblage will include retouched flakes, backed blades and points.	Artefact assemblage will include retouched flakes, backed blades and points.
Flake attributes will include platform faceting, overhang removal and multiple dorsal scars. Cores will show evidence of rotation.	Flake attributes will include platform faceting, overhang removal and multiple dorsal scars. Cores will show evidence of rotation.
Sites will be concentrated on swamp locations, with limited evidence elsewhere.	Sites will be located near swamps and also along the main tributaries. Sites on minor tributaries will also be present but artefact densities will be lower.
Heat treatment pits will not be present.	Heat treatment pits may be present at sites on main tributaries and close to swamps.

The following sections detail the work by Umwelt within and adjacent to the Proposed Disturbance Area.

These sections use the following terms to describe Umwelt study area:

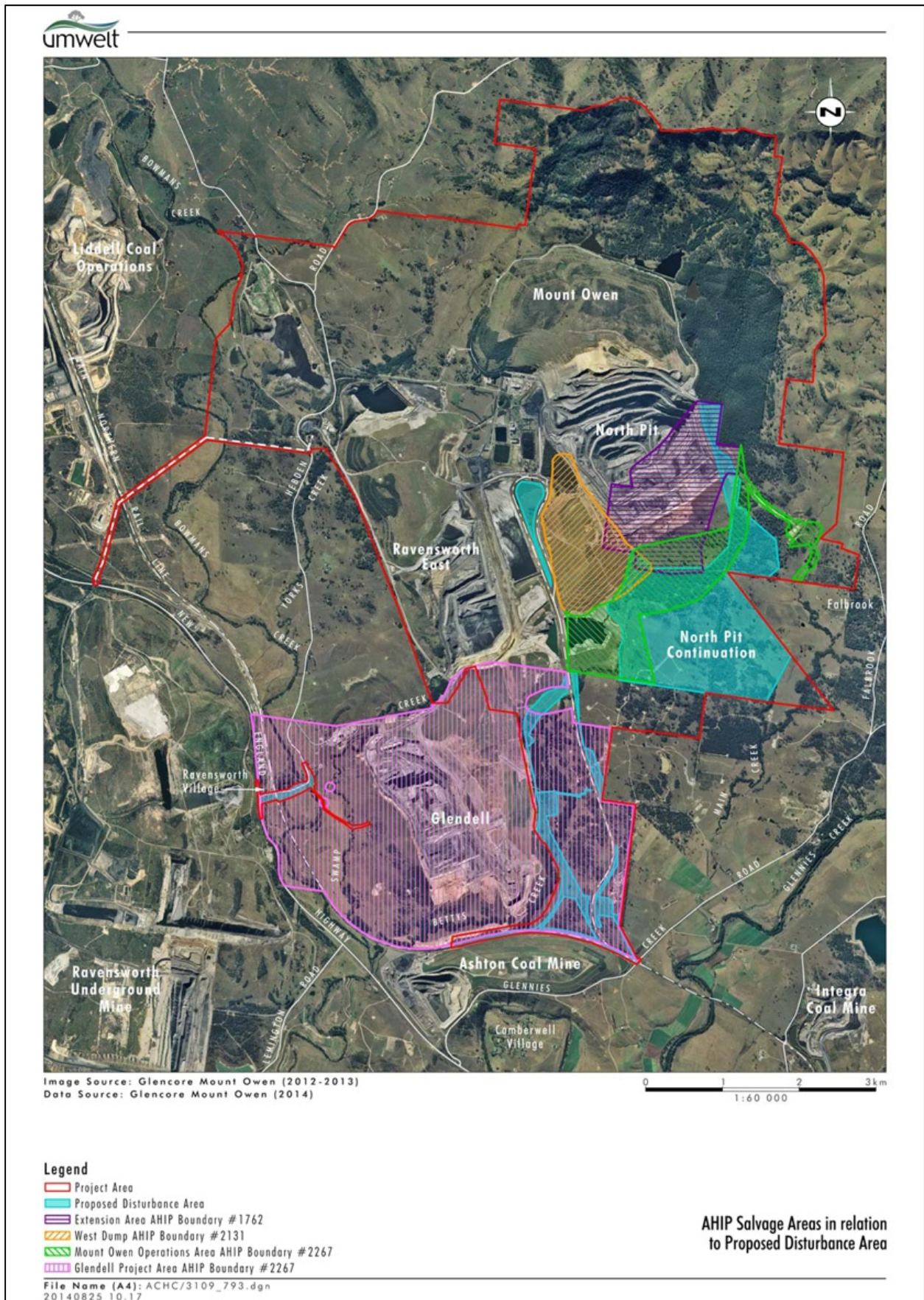
- Glendell Project Area;
- Mount Owen Operations Area;
- Mount Owen Extension Area; and
- the West Dump Area

Figure 25 shows the location of these various study areas in relation to the proposed Disturbance Area.

Sites in the Glendell Project Area were salvaged under AHIP #2267, sites in the Mount Owen Operations Area were also salvaged under AHIP # 2267, Sites in the Mount Owen Extension Area under AHIP #1762 and the West Dump Area under AHIP #2131.

As can be seen in **Figure 25**, at least half of the Proposed Disturbance Area falls within areas that have had AHIPs over them and where salvage works have been carried out in the past. It should be noted that the current assessment included all areas within the Proposed Disturbance Area, including areas where former AHIPs have been enacted. The current survey methodology included the former AHIP areas due the time that has lapsed since these salvage works were undertaken and the chance that new sites have become evident. It should be further noted that these AHIPs contained consent to impact particular sites, or particular areas in the case of grader scrapes, rather than 'salvaging' the entire AHIP area.

Figure 25: AHIP salvage areas in relation to the Proposed Disturbance Area.



5.3.3.1 Umwelt (Australia) Pty Limited 2004 (Umwelt 2004)

Umwelt conducted an Aboriginal Archaeological Assessment for the Glendell Project Area involving survey during September, October and December 2001, as well as geomorphic investigations during May 2002.

The Glendell survey area incorporated sections of Bowmans Creek, Swamp Creek and Bettys Creek. As part of the archaeological brief, a desk-top study and an in-field reconnaissance were undertaken with the aim of identifying areas within the Glendell Project Area that contained Aboriginal resources. The resources sought for identification within the Glendell Project Area included fresh water supplies, food and medicine plants, faunal prey species, stone suitable for implement manufacture, areas suitable for camping, areas that provided an extensive outlook, areas with major and minor creek confluences that had often been found to have Aboriginal camp sites and the terrain units that may have acted as pathways between resource locations.

The information compiled was then used to assist in the preparation of a predictive model related to the location and nature of sites within the Glendell Project Area. In addition, past land-use practices and geomorphic studies were used to determine areas where artefactual material may remain in a relatively undisturbed context. Geomorphic studies were also used to investigate a buried soil profile within the shared Bowmans Creek/Swamp Creek floodplain and to determine the likelihood of this soil profile containing artefactual material from the late Pleistocene to early Holocene periods.

As a result of the research it was concluded that the entire Glendell Project Area would have supplied adequate resources for small groups of hunter-gatherers living a mobile lifestyle. Bowmans Creek was highlighted as an area that should have formed the focus of camping activities of longer duration, possibly by larger numbers of people, due to an increased abundance and reliability of the resource base.

Other areas, such as the lower western slopes adjacent to Bettys Creek were assessed as having attracted groups of people for short-term visits to harvest abundant seasonal foods. Bowmans Creek was therefore cited as likely to have the largest sites in terms of areal extent and numbers of artefacts.

Such sites were predicted as likely to be found on the lower slopes, terraces and floodplains along Bowmans Creek, spreading further across the Bowmans Creek/Swamp Creek floodplain. Bettys Creek and Swamp Creek were listed as likely to have evidence of more sporadic and short-term use as overnight camping locations.

A pattern of site distribution was evident from the previously recorded sites in the locale with the majority of sites located along the watercourses (58%). More of these were associated with ephemeral tributaries (30%) than major creek lines and their associated floodplains and terraces (30%). A little more than half (54%) of the sites were within 30m of the closest

watercourse and 66% within 100m. In relation to the slopes, sites were more commonly located on the foot slopes/lower slopes (18.5%), than the crest/upper slopes (16.6%) and mid slopes (8%).

A total of 37 previously unrecorded sites were located during the 2001 fieldwork survey of the Glendell Project Area. The sites consisted of 30 artefact scatters, including one small quarry site with an associated artefact scatter, one scatter in an area with a buried soil profile and seven isolated finds. The Bowmans Creek 5 quarry site was recorded as having an associated artefact scatter as the majority of the artefacts in the site were manufactured from mudstone and silcrete rather than the quartz and quartzite materials available at the site.

The artefact scatter in the area with the buried soil profile (Bowmans Creek/Swamp Creek Trench) was located on the shared floodplain between Bowmans Creek and Swamp Creek. In this area a trench approximately 300m in length was constructed during the 1980s to divert Swamp Creek into Bowmans Creek. At the time of the 2001 survey the trench was not connected to the creeks. The artefact scatter eroding from the A Horizon of the floodplain was observed to be approximately one metre above the buried soil profile. This profile was later determined through geomorphic investigation to be of early Pleistocene to Tertiary age and did not contain any artefactual material (Mitchell 2002).

Artefact analysis of the salvage assemblage recorded:

- flakes and broken flakes dominated the assemblage (78%), followed by flaked pieces (15%) and cores (3%). Within the flake category, 4% were retouched and half of the retouched flakes were backed. Heat shatter accounted for 3% of the artefacts;
- the mudstone and silcrete flakes were of similar size. Volcanic flakes were generally larger and heavier than flakes composed of other raw materials;
- volcanic flakes had a significantly higher percentage of cortex than silcrete or mudstone, and mudstone artefacts had a higher percentage of cortex than silcrete;
- silcrete artefacts had a higher overall rate of retouch than mudstone artefacts (8.2% and 6.3% respectively), and silcrete retouched artefacts were more likely to be backed than retouched mudstone artefacts; and
- a number of artefacts relating to post-European occupation of the area were also recovered, including fragments of glass and pottery. The location of this material closely correlated with concentrations of Aboriginal stone artefacts. Additionally, at least one Aboriginal artefact manufactured from glass was salvaged, suggesting that the area was used by Aboriginal people in the post-contact period.

5.3.3.2 Mount Owen Extension Area (Umwelt 2012a)

The Mount Owen Extension Area salvage was undertaken under National Parks and Wildlife Service (NPWS) s.90 Consent #1762 and formed Part 1 of the salvage program for the Bettys Creek valley. The salvage included the surface collection of 21 sites within broader surface

collection areas, manual excavation in five locations and grader scrapes of all landform units following surface and subsurface salvage.

The fieldwork was conducted in December 2003 through to February 2004 with the involvement of all Aboriginal stakeholder groups registered at the time fieldwork commenced. The research design for the project posed a number of questions about the Aboriginal use of the Mount Owen Extension Area to be addressed through the archaeological salvage program and discussed two possible risk based scenarios – a risk prone winter occupation of the area - and a late/spring summer risk averse occupation of the area.

A total of 8,304 artefacts were recovered during the Mount Owen Extension Area salvage including 1,151 (13.9%) from the surface collection, 5,999 (72.2%) from the manual excavations and 1,154 (13.9%) from the grader scrapes. The artefact assemblages were subject to intra-assemblage analysis and the results of these analyses were then subject to inter-assemblage comparative analysis between the Mount Owen Extension Area assemblages and those salvaged from a number of mine sites in the Singleton, Broke and Muswellbrook area. As a result of the comparative analysis a number of the artefact attributes were chosen for more detailed investigation. All of the data was then collated and used to answer the questions posed as part of the research design.

The investigations in the Mount Owen Extension Area indicated that neither of the seasonal risk models were proven or disproven by the evidence acquired through the analysis of the spatial distribution of the artefacts recovered, or by the nature of the artefacts recovered. The residue and use-wear analysis, however, identified likely late spring and summer occupation in association with the former swamp on Bettys Creek (at Excavation 5; this swamp area of Bettys Creek has since been removed by approved mining).

From the interpretation of all the evidence accumulated it was assessed that very small groups of Aboriginal people (most likely single family groups) hunted and gathered across the whole of the Mount Owen Extension Area. They camped on rare occasions near the swamps in the Excavation 1 (on Bettys Creek) and 3 (on a westerly tributary to Bettys Creek) areas and in the areas where the tributary systems entered the main channel of Bettys Creek. They also had even smaller camps with less intensive occupation along the main channel of Bettys Creek but these were much smaller and indicated especially brief visits by small groups of people over time.

The main camping location was in the vicinity of the Excavation 5 area (north Bettys Creek and west of the Proposed Disturbance Area) and beside a large swamp. In this area, small groups of Aboriginal people appeared to have stayed for longer periods of time - but even these visits would have been in terms of days and not weeks. While in the area they used plant foods from the swamps and worked hardwoods and softwoods available locally. They made composite

hunting tools and butchered animals, most likely macropods. Visitation to this area extended sporadically over at least 3000 years.

The lack of large camp sites within the Mount Owen Extension Area raised the question of whether these sites may be located downstream and within the West Dump Area, Mount Owen Operations Area, or the Glendell Project Area.

5.3.3.3 West Dump Area (*Umwelt 2012b*)

The West Dump Area salvage was undertaken under NPWS s.90 Consent #2131 and formed Part 2 of the salvage program for the Bettys Creek valley (the West Dump is now known as the Western Out-Of-Pit Dump). The salvage included the surface collection of nine sites within the West Dump Area and grader scrapes of the banks of a section of Bettys Creek associated with site BC44 following the surface salvage of this area. The fieldwork was conducted in March 2005 with the involvement of 13 Aboriginal stakeholder groups registered with NPWS at the time fieldwork commenced. The same research design as that proposed for the Mount Owen Extension Area was used for the West Dump Area salvage in order to allow comparability of results and to provide a more detailed interpretation of the Aboriginal use of the upper and mid reaches of the Bettys Creek valley.

A total of 398 stone artefacts were recovered during the West Dump Area salvage including 385 (96.7%) from site BC44 (surface collection 273 and grader scrapes 112), while the remaining 13 artefacts (3.4%) came from the other Bettys Creek sites (BC46 = 1 artefact, BC47 = 3 artefacts, BC48 = 1 artefact, BC50 = 1 artefact, BC55 = 2 artefacts and BC58 = 5 artefacts).

The artefact assemblages were subject to intra-assemblage and inter-assemblage analysis and the results of these analyses were then subject to inter-assemblage analysis with the Mount Owen Extension Area assemblages and those salvaged from a number of mine sites in the Singleton, Broke and Muswellbrook area. All of the data was then collated and used to answer the questions posed as part of the research design.

From the interpretation of all the evidence accumulated from both the West Dump Area and the Mount Owen Extension Area it was assessed that very small groups of Aboriginal people hunted and gathered across both areas sporadically over an extended time period of at least 3,000 years. Within the West Dump Area Aboriginal people appeared to have had short-term stop-overs (day-time camps/activity areas) near where a tributary had a confluence with Bettys Creek. These areas within the BC44 site were probably used while out hunting and gathering. No camp sites were identified within the West Dump Area.

5.3.3.4 Mount Owen Operations Area (Umwelt 2013a)

The Mount Owen Operations Area salvage was undertaken under NPWS s.90 Consent #2267 and formed Part 3 of the salvage program for the Bettys Creek valley. This salvage also included sites associated with Main Creek in the adjacent valley to the east.

The salvage included the surface collection of 17 sites in the Bettys Creek valley and six sites in the Main Creek valley and the mechanical excavation of three sites and manual excavation of two of the sites associated with Main Creek.

The fieldwork was conducted in September 2005 with the participation of 10 of the Aboriginal stakeholder groups registered at the time fieldwork commenced.

The same research design as that proposed for the Mount Owen Extension Area and the West Dump Area was used for the Mount Owen Operations Area salvage in order to allow comparability of results and to provide a more detailed interpretation of the Aboriginal use of the upper and mid reaches of the Bettys Creek valley.

In total, 1,205 artefacts were recovered during the s.90 #2267 surface collection and subsurface salvage program for the Mount Owen Operations Area. Of the 1,205 stone artefacts salvaged from the Bettys Creek and Main Creek catchments, 292 were from surface collection with the remaining 913 artefacts recovered during subsurface investigation and salvage at MC-2, MC-3 and MC-6 (Main Creek).

Sites within the Main Creek catchment (MC-1 to MC-6) contained over 80% of all artefacts recovered during the salvage program. It was recognised that this result had been biased by the landscape context of the sites salvaged. The salvage program concentrated on the main channel of Main Creek and in areas where tributaries had confluences with the main channel of Main Creek. The minor salvage program within the Bettys Creek catchment was mostly at a distance from the main channel of Bettys Creek and associated with slopes and crests.

The artefact assemblages were subject to intra-assemblage and inter-assemblage analysis and the results of these analyses were then subject to inter-assemblage analysis with the Mount Owen Extension Area and West Dump Area assemblages and those salvaged from a number of mine sites in the Singleton, Broke and Muswellbrook area. All of the data was then collated and used to answer the questions posed as part of the research design (i.e. could seasonality be identified in the artefact distribution).

From the interpretation of all the evidence accumulated from the Mount Owen Extension Area, West Dump Area and Mount Owen Operations Area it was further reinforced that neither occupation model was supported wholly by the evidence gathered from the stone artefact analysis or the analysis of the distribution of the artefacts within the landscape. The evidence from the residue analysis suggested that Aboriginal people were in the Mount Owen Extension

Area and in the Mount Owen Operations Area/Main Creek Area in late spring and summer and the seasonal plants foods available in both areas suggested that this would be the best time of year to visit. Grindstones in the Mount Owen Extension Area and Mount Owen Operations Area/Main Creek Area assemblages also suggested late spring/summer occupation. However, once again this evidence did not definitively show that Aboriginal people were not in these areas at other times of the year.

In all areas the slopes and crests appear to have been used only for transient hunting and gathering activities with the most intensive use of a spur crest related to site BC59 that was on the highest spur crest within the Mount Owen Operations Area and thus afforded the best view across the Bettys Creek valley.

5.3.3.5 Glendell Project Area (Umwelt 2013b)

Salvage of the Glendell Project Area was undertaken under NPWS s.90 Consent #2267 and formed Part 4 of the salvage program for the Bettys Creek valley. This archaeological salvage within the Glendell Project Area was conducted by Umwelt and the registered Aboriginal stakeholders between November 2005 and February 2006 on behalf of Glendell Joint Venture, now Mount Owen.

A total of 2,713 artefacts were recovered from the Glendell Project Area salvage including 829 (30.6%) from the surface collection, 274 (10.1%) from Excavation 1 (Bettys Creek 10), 19 (0.7%) from Excavation 2 (Bettys Creek 9), 1,414 (52.1%) from Excavation 3 (Bettys Creek 2) and 177 (6.5%) from the grader scrapes. A total of 2,604 (96%) of the artefacts were recovered from the Bettys Creek catchment, 52 (1.9%) from the Bowmans Creek catchment and 57 (2.1%) from the Swamp Creek catchment.

The artefact assemblages were subject to intra-assemblage and inter-assemblage analysis and the results of these analyses were then subject to inter-assemblage analysis with the Mount Owen Extension Area, Mount Owen Operations Area and the West Dump Area assemblages and those salvaged from a number of mine sites in the Singleton, Broke and Muswellbrook area. These results are detailed below and combine the information from the Glendell Project Area, Mount Owen Operations Area, Mount Owen Extension Area and the West Dump Area salvages to provide a more detailed picture of Aboriginal occupation of these adjacent parts of the landscape that encompass the Bettys Creek valley:

- Water would have been available year round from the three spring-fed swamps within the Mount Owen Extension Area and in pools in Bowmans Creek in the Glendell Project Area. Larger pools that were semi-permanent in nature were also likely at the tributary confluences with the main creek channels. While less reliable water would have been available after heavy rain in chains of ponds in the main channel of Bettys Creek, Swamp Creek and Main Creek and some of their tributaries.

- Petrified wood for artefact manufacture was available locally in the Mount Owen Extension Area, West Dump Area and the Mount Owen Operations Area, however, it did not seem to have been used with the petrified wood discarded in the sites that retained cortex indicating it was being accessed from cobble beds and most likely from the Hunter River. Quartz and quartzite pebbles were available from an exposed conglomerate outcrop on the ridge crest between Bowmans Creek and Swamp Creek in the Glendell Project Area. Tuff (ignimbrite) was available as pebbles and small cobbles from Bowmans Creek. This was usually transported into the sites as grindstones and was sometimes used for knapping after breakage occurred.
- Silcrete, mudstone, chert, petrified wood, volcanic, quartz, quartzite, silicified sandstone, silicified siltstone and chalcedony were being obtained from the gravel beds of the Hunter River approximately 3.5km to 9.5km away dependant on whether the stone knappers were in the upper or lower Bettys Creek valley.
- Within the upper (Mount Owen Extension Area), mid (West Dump Area and Mount Owen Operations Area) and lower Bettys Creek catchment the ridge and spur crests and the upper and mid slopes were generally only being used for transient hunting and gathering activities with very small artefact concentrations/activity areas on the highest points that afforded good visibility of the Bettys Creek valley.
- In the lower Bettys Creek catchment (Glendell Project Area) the tributaries draining the lower slopes and foot slopes indicated low levels of occupation that did not overlap spatially along the length of the watercourses except where the tributaries had a confluence with the main channel of Bettys Creek where there was a low to moderate level of overlapping occupation/activity areas.
- The floodplain/terrace system of Bettys Creek in the upper Bettys Creek catchment (Mount Owen Extension Area) and the lower Bettys Creek catchment (Glendell Project Area) had widely spaced locations where activities such as knapping were taking place. They also exhibited the deposition of small numbers of artefacts washed from sites along the main channel of Bettys Creek.
- The main channel of Bettys Creek within the upper catchment (Mount Owen Extension Area), the mid catchment (West Dump Area) and lower catchment (Glendell Project Area) exhibited patchy artefact *loci* with some areas having relatively moderate to high artefact numbers, some having low artefact numbers and much of the creek line having no artefacts.
- The areas with former swamps within the Mount Owen Extension Area had the highest artefact numbers and artefact densities in the upper Bettys Creek catchment. However, even these areas were assessed as reflecting only low levels of occupation by small groups of people over an extended period of time.
- Within the Mount Owen Extension Area the knapping of stone was identified by the surface collections, the grader scrapes and Excavations 1, 3, 4 and 5. The most extensive stone knapping and the manufacture of backed flakes was noted in Excavations 4 and 5. Within the West Dump Area the knapping of stone was identified by the surface collections and the grader scrapes within BC44 only (main channel of Bettys Creek associated with a tributary confluence). The evidence for stone knapping was very limited with small amounts of silcrete being knapped on the eastern bank of

Bettys Creek and small amounts of mudstone being knapped on the western bank of Bettys Creek. Very limited backed flake manufacture was assessed as occurring in the East Bank Southern Scatter area within BC44. Within the Mount Owen Operations Area the knapping of stone was identified in the subsurface assemblage of MC-2 and MC-3 and the surface assemblages of MC-4, MC-5 and MC-6 (all Main Creek sites). Backed flake manufacture was not observed in any of the assemblages from the Mount Owen Operations Area. Within the Glendell Project Area, stone knapping was identified in Bettys Creek 2, Bettys Creek 8, Bettys Creek 10, in the combined Bettys Creek 11 to 14 site area and Bettys Creek 18.

- The residue and use-wear analysis from the Mount Owen Extension Area indicated that in the there was evidence for the working of soft woods, soft starchy materials, grass and possibly even the cutting of reeds. Blood residue was also recorded on some artefacts. This indicates that soft starchy plant foods such as bulrush and water ribbons were most likely obtained from the swamps within the Mount Owen Extension Area and some form of prey (meat), most probably macropod within the Glendell Project Area, Mount Owen Extension Area and the Mount Owen Operations Area associated with Main Creek.
- The various seasonal plant foods available in all four areas also indicates that the optimal time for a visit to the area for harvest would have been in the late spring and early summer. While plant food availability suggests that late spring and summer were optimal times to be in the Bettys Creek valley the use of the area at other times of the year cannot be discounted.
- At the request of the Aboriginal stakeholders numerous grader scrapes were undertaken within the floodplains of Bettys, Swamp and Bowmans Creek. The rationale was to understand if Aboriginal people may have been buried in the alluvial deposits. There were no burials located during the subsurface investigations within the Glendell Project Area, Mount Owen Operations Area, Mount Owen Extension Area or the West Dump Area. No other evidence such as carved trees or stone arrangements were observed that may have indicated a former burial within the areas subject to salvage.
- At the request of NPWS, Excavation 2 was specifically included in the Excavation program for the Mount Owen Extension Area to investigate if there was evidence of 'pre-Bondaian' artefacts at this location. No evidence of any artefactual material was recovered that suggested it was not typical of those assemblages generally associated with the mid to late Holocene within the Hunter Valley in the Excavation 2 assemblage or any other assemblage from the Glendell Project Area, Mount Owen Operations Area, Mount Owen Extension Area or within the West Dump Area.
- It was possible to obtain one radiocarbon date of 3077 ± 40 BP (calibrated-Wk-20912) from Square K Spit 3 of Excavation 3 within the Mount Owen Extension Area. The date was relative in nature as it belonged to a large piece of burnt wood that was associated with artefacts both above and below it. Thus the artefacts above it must be dated to later than 3077 ± 40 BP and those below it to earlier. How much earlier or later is unknown.
- A ground oven was located within the Glendell Project Area in Excavation 3 (Bettys Creek 2) in Squares CF and DC. A sample of the charcoal from the base of the ground oven returned a calibrated date of 2188 ± 39 BP (Wk-20991).

- The only other dating evidence for the assemblages came from the location of backed flakes within the assemblages. This brackets these particular artefacts to being discarded sometime between 7000 BP and 1500 BP and most likely between 3500 BP and 1500 BP as this is the era of greatest backed artefact manufacture (Robertson *et al.* 2009) and sits comfortably within the timeframe suggested by the two radiocarbon dates.
- Neither model (winter risk prone, spring/summer risk averse) was supported wholly by the evidence gathered from the stone artefact analyses or the analyses of the distribution of the artefacts within the landscape of the Glendell Project Area, Mount Owen Operations Area, Mount Owen Extension Area or the West Dump Area. There were aspects of both scenarios that fitted with the evidence and aspects that did not. In general both were too simplistic and had too many areas of overlap for a definitive decision to be made about which was correct – if either.

As a result of the archaeological work outlined above, 18 AHIMS registered sites have been salvaged from within the Proposed Disturbance Area (see **Section 4.6.3**) and over 11,000 artefacts have been recovered from within the Proposed Disturbance Area or close environs. This salvage has therefore diminished today's archaeological landscape, particularly along Bettys Creek, but also along Swamp Creek and Bowmans Creek in the vicinity of the Proposed Disturbance Area.

5.4 PREDICTIVE MODEL FOR SITE LOCATION

As has been noted in **Section 5.3**, the archaeological characteristics of the Project Area have been comprehensively studied in two main areas: along Bettys Creek and, to a lesser degree, along Bowmans Creek. However, the eastern portions of Survey Unit 1, as well as Survey Unit 5 (North Pit Continuation), have had no previous archaeological assessment (the unassessed area of Survey Unit 1 comprises 170ha of the total 360ha of Survey Unit 1). Survey Area 6 was last assessed in 1996 by Jill Ruig (Ruig 1996).

The Project Area lies within a region that has been extensively studied (**Section 5.2**) and this, along with the previous archaeological work in the Project Area, allows a high degree of prediction as to the location of sites within the Proposed Disturbance Area. Given that the landforms within the Proposed Disturbance Area (**Section 4.1**) contain sizeable areas of flat and lower slope landforms, it is expected that the incidence of site recordings will be high in these landforms. It is also noted (**Section 4.6.2**) that past land use, both mining and pre-mining, has had a profound impact on some landforms within the Project Area that has had the effect of modifying the archaeological landscape.

The previous archaeological research within the Project Area enables a characterisation of the most typical site likely to be recorded within the Proposed Disturbance Area. This 'most frequent' site type:

- Will be an artefact scatter of low–moderate artefact density within 200m of a drainage feature;
- Will consist of defined sites separated by areas only displaying the general background of artefacts that is expected in these landforms;
- Will have an artefact assemblage dominated by flakes from IMT and silcrete and will have few chronological markers in the typology apart from the presence of backed blades;
- Will date to the late Holocene Period, principally to the past 3,000 years (although this may be difficult to determine if suitable datable features are not present); and
- Will be affected by erosion and thus may not retain a high degree of integrity.

The existing regional and local archaeological information, together with the Project Area's environment, indicate that the possibility that certain types of sites occur within the Proposed Disturbance Area is as follows:

- **Artefact Scatters:** the predominant site type occurring in the region. The expected location of these sites is on eroded exposures most commonly adjacent to creek lines but also on slopes and ridges. Artefacts and hearth material could be expected within these sites; they might occur *in situ* and be exposed in section - such sites are described as stratified.
- **Axe Grinding Grooves:** produced during the manufacture and maintenance of edge ground tools. They occur on flat areas of sandstone, generally adjacent to waterholes or in creek beds. With a low total length of waterways within the Proposed Disturbance Area this site type is unlikely to be recorded.
- **Quarries:** where outcrops of bedrock [e.g. chert] have been used by Aborigines as raw materials for the manufacture of stone artefacts. In this region raw materials were obtained from gravel beds along the Hunter or from cobbles eroding out of the Unit B clay sediments. Quarry sites have been identified in the vicinity and these site types are possible within the Proposed Disturbance Area if outcrops of suitable rock are present
- **Modified Trees:** where the scar is the result of the removal of bark for the manufacture of shields, water containers, canoes and shelters. Scars may also result from the exploitation of possums or honey and be in the form of toe holds in the trunks or larger branches. Given the near-total clearance of native vegetation from all areas of the Proposed Disturbance Area, this site type would be extremely unlikely.
- **Burials:** in association with campsites or in burial grounds, and generally in soft dry deposits. These are generally only found by accident as a result of excavation or erosion, as they are rarely associated with enduring surface features. The Project Area does not contain landforms that are normally associated with burials (raised sandy benches/terraces close to long-term occupation areas) and this site type is unlikely to occur in the Proposed Disturbance Area.
- **Ceremonial Sites:** these can occur in any landform and a stone arrangement has been recorded in proximity to the Proposed Disturbance Area. However these sites are easily

damaged by the past land use of the area and it is unlikely that this type of site will be located within the Proposed Disturbance Area.

- **Isolated Finds:** These can be located in any landform although they are more common in the landforms typified by the Proposed Disturbance Area: upper headwaters and slopes. These are likely to be recorded within the Proposed Disturbance Area.

It would be expected that most sites located would be late Holocene to recent (i.e. less than 4,000 years old), the age attributed to the A Horizon artefact bearing deposits, although Pleistocene sites contained within B Horizon sediments may also occur although there have been only one or two instances of Pleistocene deposits being identified in the district.

5.5 SAMPLING STRATEGY

The methodology for the survey component of the scientific values assessment stated that all areas within the Proposed Disturbance Area would be assessed by pedestrian survey.

Although substantial portions of the Proposed Disturbance Area have been subject to previous survey and/or archaeological salvage, all of this work was over five years ago and most was more than 10 years ago. Therefore, with the passing of so much time, the sampling strategy was to reassess all areas of the Proposed Disturbance Area in order to assess current conditions and whether further sites have become evident during the intervening years.

5.6 FIELD METHODS

The survey took the form of teams working together to cover a broad swath of land with each foot transect. Within this area, all available exposures were examined and all areas of greater archaeological sensitivity (such as along creek lines) was intensively examined by a team that was very experienced in their work.

Rarely were transects able to be conducted in regimented straight lines as topography and vegetation often prevented this from happening.

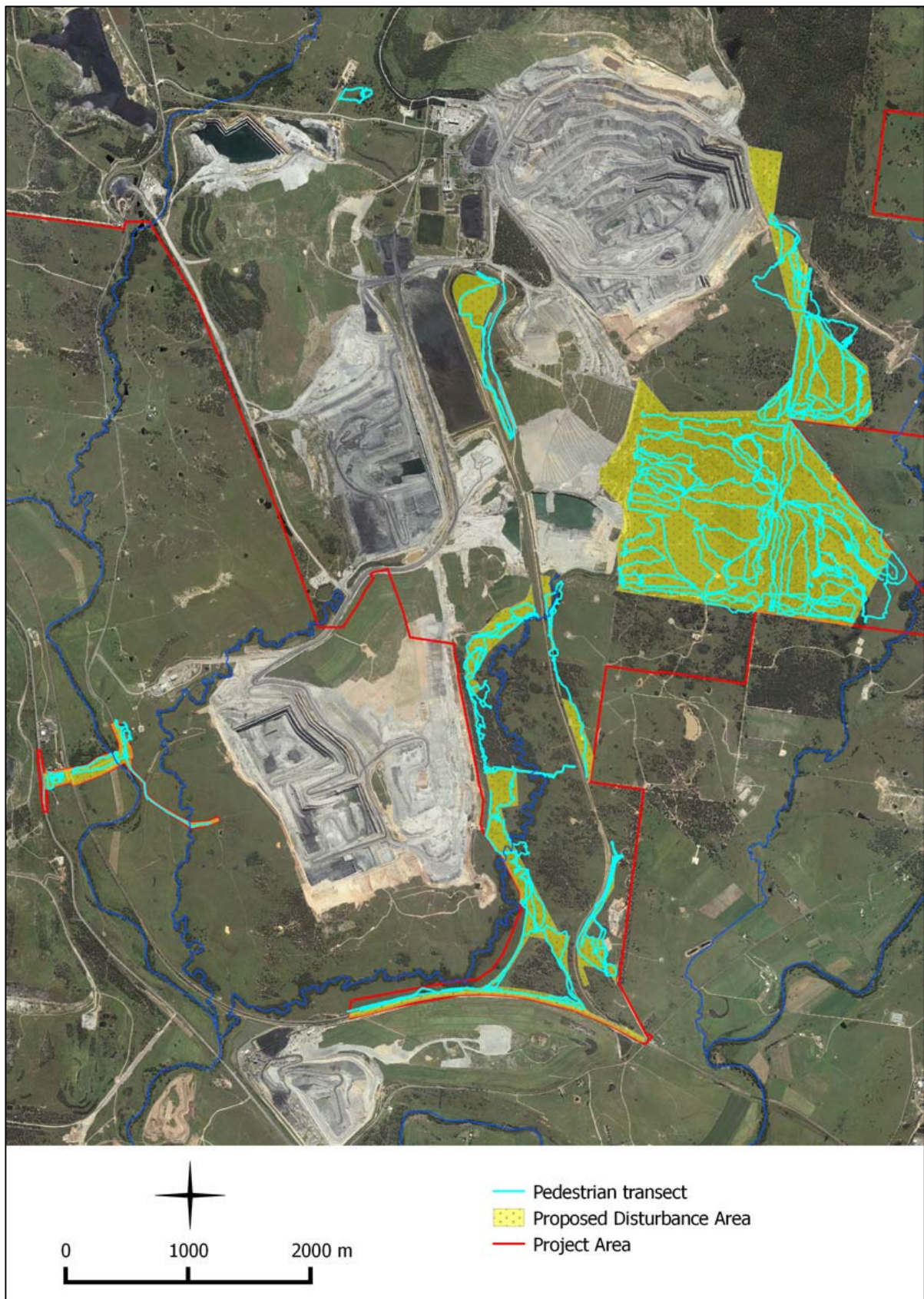
The survey transects undertaken during the survey are shown in **Figure 26**. It needs to be borne in mind when viewing this figure that the recorded data was captured by two hand-held GIS mappers operated by the senior archaeologist and his assistant. However, at any transect the team itself covered an area of up to 100m with surveyors spaced out at 5m to 10m intervals. This breadth of coverage must be extrapolated from the single track shown in **Figure 26**.

Additionally, some small areas within the Proposed Disturbance Area, such as in the very north and west of Survey Unit 1, were not surveyed as the landforms have been substantially modified by existing approved mining activities.

On most days of the survey there were at least 12 RAPs or representatives of RAPs and two archaeologists. This made a total field team of 14. As the survey was carried out over 11 days

(2012 and 2014 surveys), this equates to 154 person days of assessment within the Proposed Disturbance Area.

Figure 26: Recorded foot transects from the 2012 and 2014 surveys.



6 RESULTS OF ABORIGINAL HERITAGE ASSESSMENT

6.1 EFFECTIVE SURVEY COVERAGE

When effective survey coverage is examined (**Table 17**), the coverage is generally low due to thick grass cover or leaf litter/Casuarina needles preventing observation of the ground surface. Generally, across the Proposed Disturbance Area, exposures were in low numbers and extensive erosion scalds were rare; a fact that also lowers the effective survey coverage⁷.

What statistics such these do not express is that the distribution of exposures, both erosional and from items such as roads, dams and stock tracks, allowed a representative and meaningful sample of the ground surface to be assessed in all landform types. Further, as visibility and exposure frequency were higher along drainage features, the greatest survey coverage was associated with those landforms usually associated with past Aboriginal occupation. Finally, the experience of both the archaeologists and RAP representatives who accompanied the survey meant that all archaeologically sensitive landforms were examined more closely, with greater survey efficiency than shown by the data in **Table 17**.

Table 17: Survey coverage data.

Survey Unit	Landform	Landform Area (ha)	Visibility %	Exposure %	Effective Coverage Area (ha) (= Survey Unit Area x Visibility % x Exposure %)	Effective Coverage % (= Effective Coverage Area / Survey Unit Area x 100)
1 (360ha)	Drainage	14.5	65	50	4.7	32.4
	Flat	24.8	12	10	0.3	1.2
	Lower slope	142.6	15	15	3.2	2.5
	Mid slope	158.3	15	15	3.6	2.3
	Upper slope	19.8	10	10	0.2	1
2 (78ha)	Drainage	4.3	20	10	0.3	7
	Flat	43.5	7	15	0.5	1
	Lower slope	29.5	10	15	0.4	1.5
	Mid slope	0.7	10	15	0.01	1.4
3 (10ha)	Drainage	0.6	5	5	0.001	0.1
	Floodplain	4.5	10	5	0.02	0.4
	Flat	1.8	5	5	0.005	0.3
	Lower slope	1.3	10	10	0.02	1.5
	Mid slope	1.8	20	10	0.04	2.2
4 (16ha)	Flat	9.5	15	15	0.3	1.9
	Lower slope	4.1	15	10	0.06	0.4
	Mid slope	2.4	10	10	0.03	0.3

⁷ It should be noted that the low incidence of exposures and erosion scalds represents the state of the Proposed Disturbance Area at the time of the assessment. This does not contradict the fact that in the past, as evidenced by historic aerial photography, erosion was far more widespread. It is only in recent decades that the landforms within the Proposed Disturbance Area have begun to stabilise from this erosional regime, mostly due to the de-stocking of these areas as they came under mine ownership.

Survey Unit	Landform	Landform Area (ha)	Visibility %	Exposure %	Effective Coverage Area (ha) (= Survey Unit Area x Visibility % x Exposure %)	Effective Coverage % (= Effective Coverage Area / Survey Unit Area x 100)
5 (21ha)	Mid slope	21	15	15	0.47	2.2
6 (7.5ha)	Lower slope	5	10	10	0.05	1
	Flat	2.5	50	50	0.63	25.2

Table 18 combines all similar landform types from across all survey units. The results indicate that while drainage features (bearing in mind that this landform is the in-stream portion of a drainage line and its immediate banks) did not record the most sites, those sites tend to have a larger number of artefacts than sites further away from water. The next most favoured landform is flat landforms and although 14 sites were recorded in this landform, these sites tended to have a low artefact density. Lower slope landforms also recorded a number of sites (roughly equal to flat landforms) although artefact densities are higher when compared to flat landforms, and lower when compared to drainage landforms. This indicates that there are more numerous although smaller sites in lower slope landforms when compared to drainage landforms. Mid slope sites exist but they have a very low artefact density and no sites were recorded in upper slope landforms. **Table 18** also indicates that the low effective survey coverage in landforms such as lower or mid slopes did not hinder the detection of sites in these landforms.

In summary the tabulation of data in **Table 18** shows:

- Sites with high artefact densities are likely to be associated with drainage landforms;
- Sites are located in flat landforms although the artefact density is lower particularly as it is noted that over half of these sites were located further than 250m from water;
- Lower slopes was a favoured occupation landform and although the sites tend to have lower artefact densities when compared with drainage landforms, they have a higher artefact density when compared with flat landforms;
- Mid slope landforms contain sites with a very low artefact density and primarily consist of isolated finds.

The only point of discussion in this data is the low artefact density noted on flat landforms where the predictive model would indicate that artefact numbers should be higher. While it is noted that the sites in this category are often distant to water, the data has also been skewed by previous archaeological salvage that was concentrated on the flat landforms adjoining Bettys Creek. As noted in **Section 4.6.3** this has had the effect of 'removing' some of the larger artefact concentrations associated with this type of landform and reducing the overall site and artefact count assessed during the current survey. While the results of the salvage excavations in these landforms (**Section 5.3.3**) did not record sites with high artefact densities they do,

however, indicate that flat landforms were more intensively used for occupation than the data from the current assessment may indicate.

Table 18: Landform summary.

Landform	Landform area (ha)	Area Effectively Surveyed (ha) (= Effective Coverage Area)	% of Landform Effectively Surveyed (= Area Effectively Surveyed / Landform x 100)	Number of Sites (recorded during this survey)	Number of Artefacts (recorded during this survey)	Sites further than 250m from water
Drainage	19.4	5	25.8	3	116	0
Floodplain	4.5	0.02	0.4	0	0	0
Flat	82.1	1.7	2	14	111	8*
Lower slope	182.5	3.7	2	12	115	3
Mid slope	184.2	4.1	2.2	10	10	9
Upper slope	19.8	0.2	1	0	0	0

* THE PRECISE RELATIONSHIP OF FIVE OF THESE SITES TO THE CLOSEST WATER IS DIFFICULT TO DETERMINE AS AREAS TO THE WEST OF SURVEY UNIT 1 AND SURROUNDING SURVEY UNIT 4 HAVE BEEN HEAVILY MODIFIED AND THE COURSE OF FORMER WATERWAYS CAN ONLY BE ESTIMATED.

6.2 ABORIGINAL SITES RECORDED

The current survey recorded 11 open sites (artefact scatters) and 25 isolated artefacts. In addition, further artefacts were recorded at the location of three previously recorded sites, two of which have been salvaged in the past. Although these salvaged 'extension sites' carry the name of the original recording they will be registered with AHIMS as 'new' sites to take into account the current findings. **Table 19** lists the artefact scatter sites recorded during the survey and these will be discussed in detail below.

Table 19: Survey results. Artefact scatters recorded during the current survey.

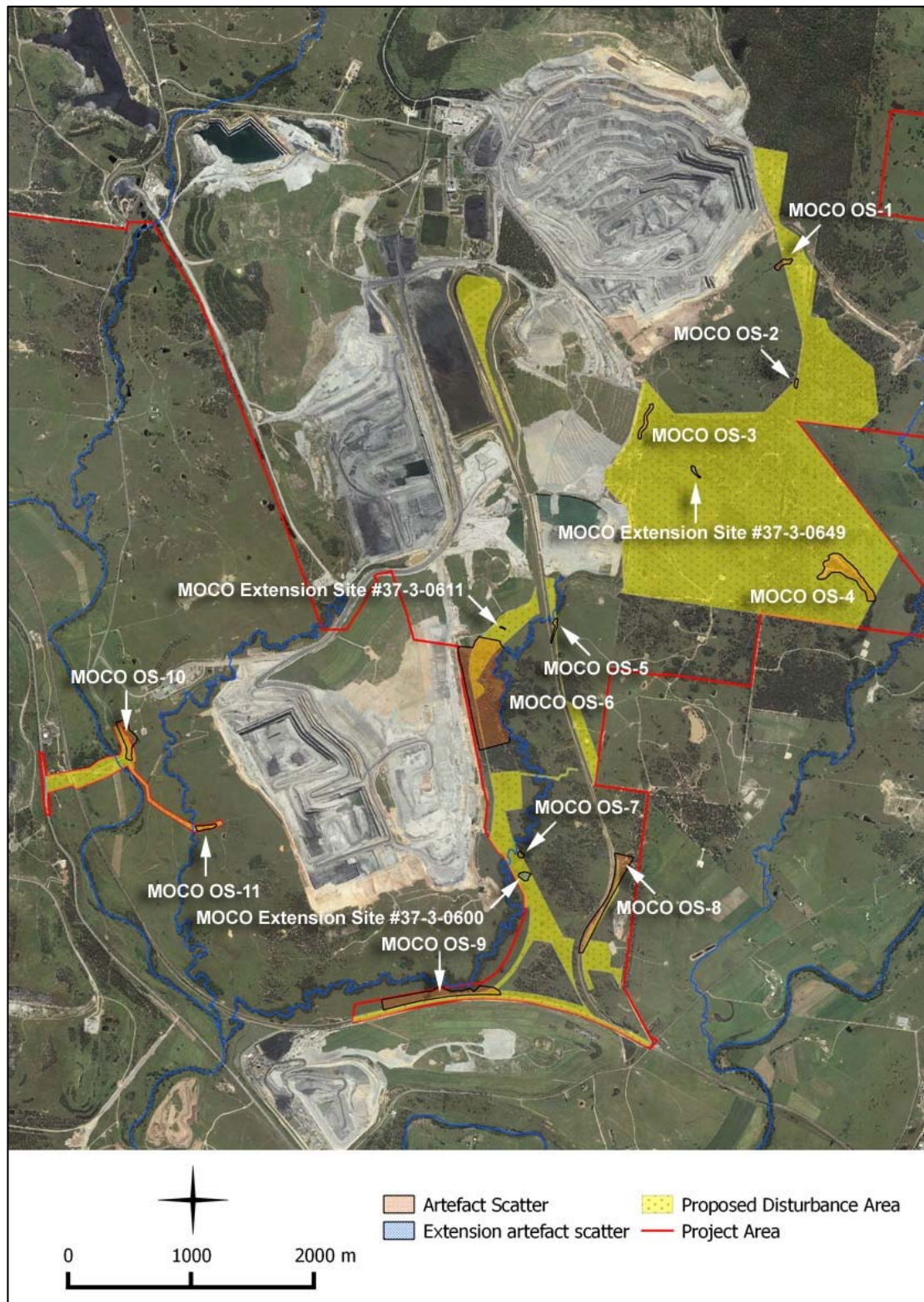
Site Number	Feature(s)	Site Area	Survey Unit	Landform
MOCO OS-1	Artefact scatter covering approximately 157m by 40m along minor ephemeral tributaries to Bettys Creek. Located in the north of the Proposed Disturbance Area. Extends outside the Proposed Disturbance Area.	0.58ha	1	Drainage/ Flat
MOCO OS-2	Artefact scatter covering approximately 78m by 24m in a flat portion of a lower slope landform. Not associated with any obvious waterways. Located in the north of the Proposed Disturbance Area.	0.17ha	1	Lower slope
MOCO OS-3	Artefact scatter covering approximately 305m by 28m along the approved Bettys Creek diversion. Re-deposited site. Located in the northwest of the Proposed Disturbance Area.	0.78ha	1	Flat/Lower slope
MOCO OS-4	Artefact scatter extending approximately 525m by up to 263m on both banks of the eastern drainage. Located in the northeast of the Proposed Disturbance Area.	5.3ha	1	Drainage/ Flat
MOCO OS-5	Artefact scatter extending approximately 208m by up to 30m along a water drain to the east of the Mount Owen rail spur. Located in the centre east of the Proposed Disturbance Area.	0.36ha	2	Flat
MOCO OS-6	Diffuse artefact scatter on the west bank of Bettys Creek. The site spans the Proposed Disturbance Area (rail spur).	24.5ha	2	Flat

Site Number	Feature(s)	Site Area	Survey Unit	Landform
MOCO OS-7	Low density artefact scatter on the east bank of the main channel for Bettys Creek. The site spans the Proposed Disturbance Area (rail spur).	0.19ha	2	Flat
MOCO OS-8	Low density artefact scatter in an area of general high disturbance. Located to the east of the existing Mount Owen rail spur. The site spans the Proposed Disturbance Area (rail spur).	5.4ha	2	Lower slopes
MOCO OS-9	Medium density artefact scatter located along a service track immediately north of the Main Northern Rail Line. The site is immediately adjacent to Bettys Creek that is located to the north of the site. The site spans the Proposed Disturbance Area (rail spur).	5.9ha	2	Flat/Lower slopes
MOCO OS-10	Low density artefact scatter located on a rocky rise adjacent to the northern bank of Bowmans Creek. The site spans the Proposed Disturbance Area (Hebden Road realignment).	2.5ha	3	Lower/Mid slopes
MOCO OS-11	Very low density artefact scatter on the east bank of Swamp Creek.	0.55ha	3	Lower slope
MOCO Extension to site #37-3-0649	Located on the northern bank of a tributary to Bettys Creek.	0.24ha	1	Lower slope
MOCO Extension to site #37-3-0611	Located along a minor, ephemeral tributary to Bettys Creek.	448m ²	2	Lower slope
MOCO Extension to site #37-3-0600	Located 30m from the eastern bank of Bettys Creek.	0.48ha	2	Flat/Lower slope

6.2.1 Open sites (artefact scatters)

Details of the 11 artefact scatters and the three extensions recorded during the current survey follow. **Figure 27** shows the location of all newly recorded artefact scatters within the Proposed Disturbance Area.

Figure 27: Location of all newly recorded artefact scatters.



MOCO OS-1 (#37-3-1189)

Site type: Artefact scatter

GPS Coordinates: GDA Zone 56: 323218E, 6413234N (north-eastern extent); 323077E, 6413164N (south-western extent).

Location of site: MOCO OS-1 is located in the northeast of the Proposed Disturbance Area (North Pit Continuation) and it extends to the west to within the current approved pit shell area.

Description of site: MOCO OS-1 extends for 157m along a minor tributary to Bettys Creek (termed Tributary 5 [Umwelt 2012a, Figure 6.1a]). The eastern portion of the site includes the confluence of this tributary and a more-minor waterway that flows into the tributary from the north (termed Tributary 3 [Umwelt 2012a, Figure 6.1a]). The site includes both banks of these tributaries (site width is variable but is approximately 40m wide). **Figure 28** shows the extent of MOCO OS-1 and **Figure 29** shows two views of MOCO OS-1.

A Horizon soil depth across MOCO OS-1 is very shallow.

Figure 28: MOCO OS-1. Site extent.

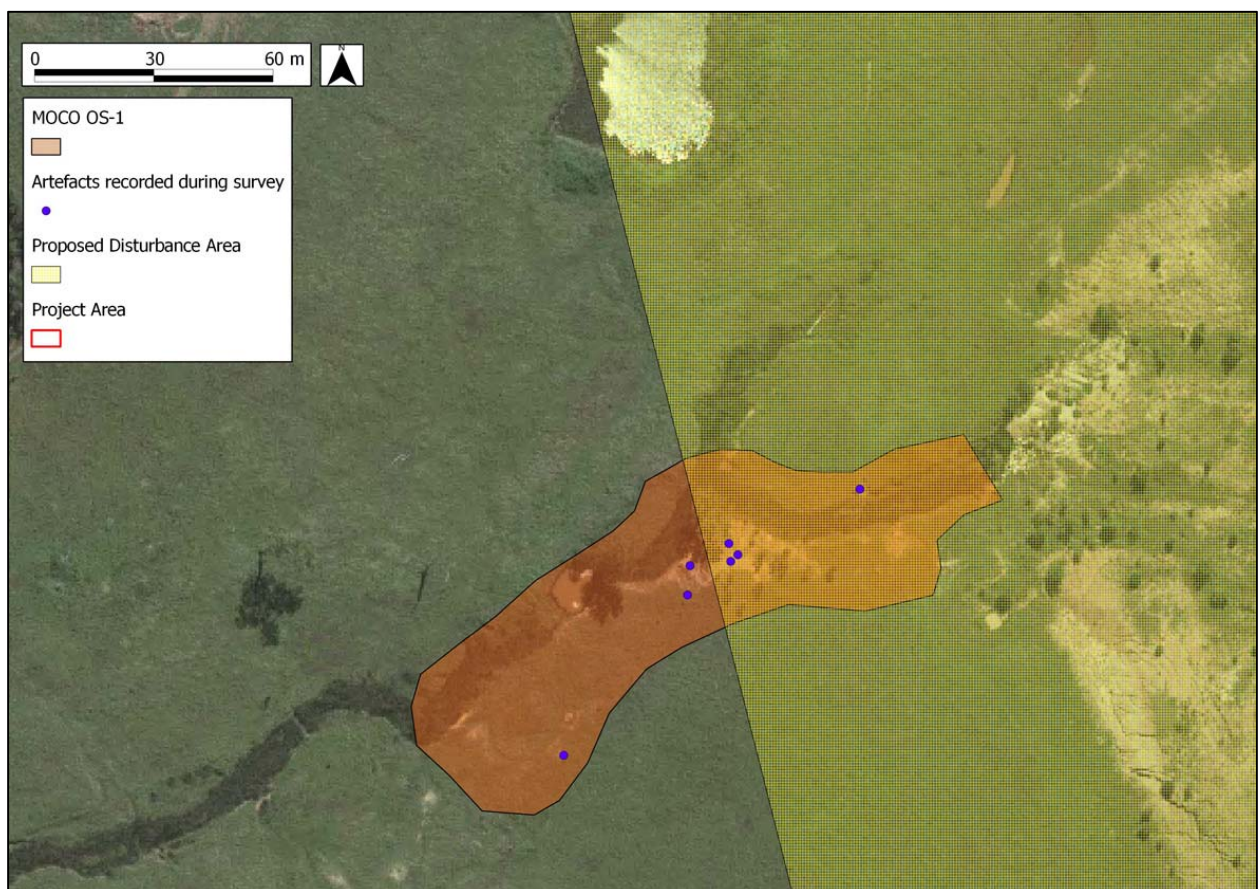
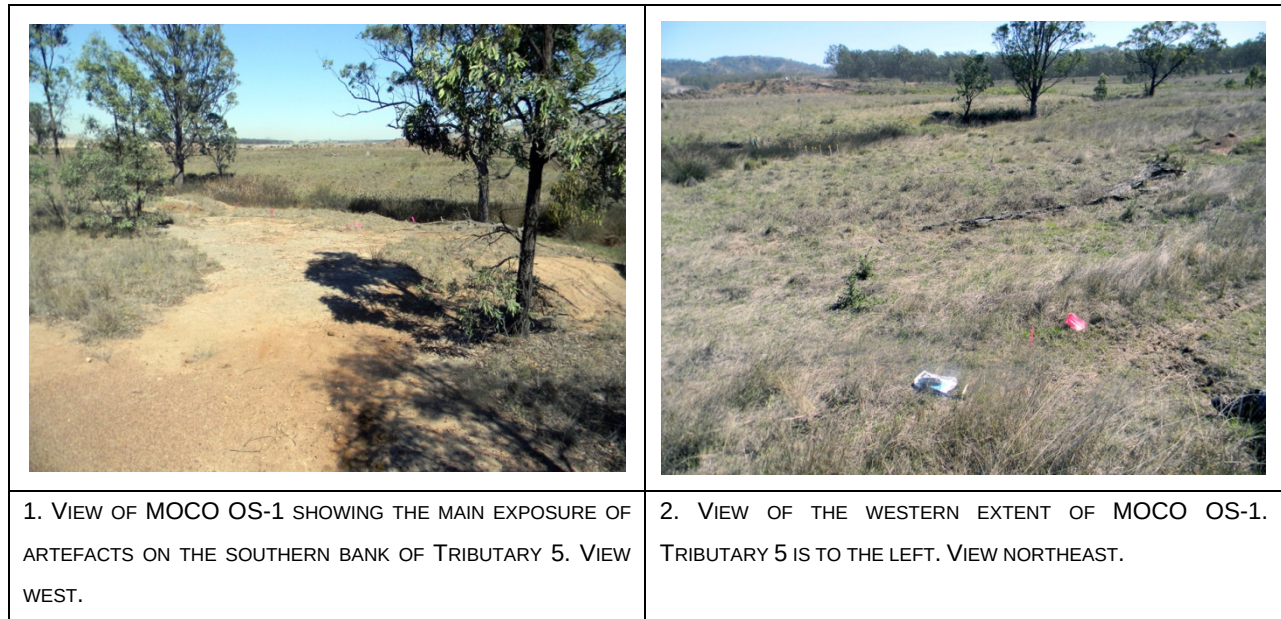


Figure 29: MOCO OS-1. Views of site location.

The site is located in a generally flat to gently rising landform in an area where there has been a high degree of previous disturbance by approved mine related activities as well as previous archaeological salvage. Mine related activities include large soil dumps in the area and other earth moving activities.

MOCO OS-1 includes the previously recorded site #37-3-0310 (Bettys Creek 14; isolated artefact) and is 27m south of site #37-3-0311 (Bettys Creek 15; isolated artefact).

In December 2003 through to February 2004 Umwelt (Umwelt 2012a) the area adjacent to and within MOCO OS-1 was salvaged either through surface collection of artefacts or a grader scape along the southern bank of Tributary 5. The results of this salvage program (AHIP #1762) are presented in **Table 20**.

Table 20: Salvaged sites (under DEC s.90 Consent #1762) within MOCO OS-1.

NPWS Site #	Site ID/No. of Recorded Artefacts	Site Description	Approved Salvage Methodology	Salvage Results
37-3-0310	BC14 - isolated find	Artefact on stock track of foot slope/creek bank. Slope 2°, aspect W. Artefact located in area of slight sheet erosion in area 80m².	Surface Collection and Grader Scrapes	At Collection Area 57 = BC15 = 9 artefacts At Collection Area 59 = grader scape south of Tributary 5 = 12 artefacts

During the current survey 12 artefacts were recorded within the area of MOCO OS-1 including one core, eight broken flakes and three unmodified flakes. All artefacts recorded were manufactured from IMT sources (**Figure 30; Table 21**). During the 2003/2004 salvage works in the vicinity of MOCO OS-1, collection area 57 recorded five IMT artefacts, one silcrete artefact and three 'indeterminate' artefacts, while collection area 59 recorded seven IMT artefacts and five silcrete artefacts (Umwelt 2012a: 6.17). The 2003/2004 salvage recorded that in the area of

BC15 (collection area 57), one flake, four broken flakes, one retouched piece, one core and two heat shatters were recorded (Umwelt 2012a: 6.10). At collection area 59 (along the southern bank of Tributary 5), 10 flakes, one broken flake and one flaked piece were recorded (Umwelt 3013a: 6.10). Combining the results of both the 2003/2004 salvage and the results of the current survey indicates that knapping events were taking place in the area of MOCO OS-1 (as evidenced by the recordings of cores, and possibly the heat shatter) and, possibly, tool manufacture as evidenced by the retouched and flaked pieces. However this activity appears to have been infrequent.

The low artefact density recorded during the current survey mirrors the low artefact density which was previously salvaged from the area by Umwelt in 2003/2004. The combination of results shows that MOCO OS-1 is a diffuse artefact scatter with a low density of artefacts. Due to very thin A Horizon soils (as seen in the soil profiles on the banks of the tributaries), it is assessed that there is a very low likelihood that these artefacts are associated with further, undetected subsurface deposits.

Figure 30: MOCO OS-1. Artefacts.

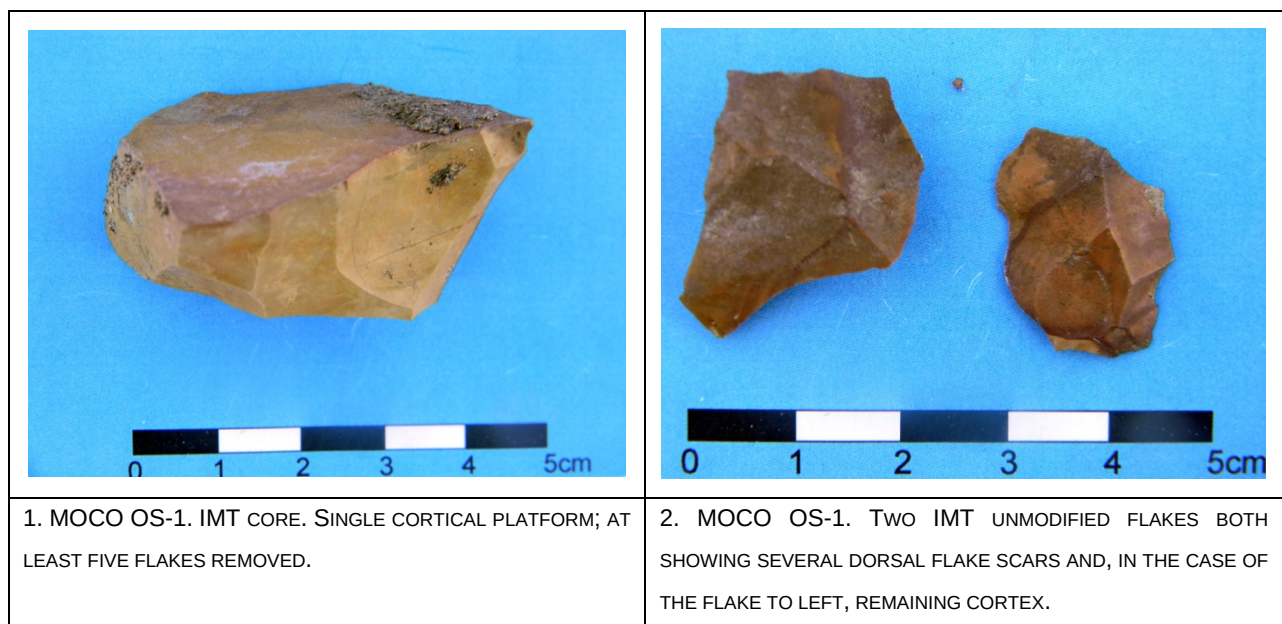


Table 21: MOCO OS-1. Artefacts recorded during the current survey.

GDA coordinates	Artefact Class	Artefact Type	Artefact Material	Artefact Number
POINT(323189.236327 6413227.227042)	broken flake		IMT	1 artefact
POINT(323158.547497 6413210.732839)	broken flake		IMT	6-10 artefacts
POINT(323156.277490 6413213.546047)	core		IMT	1 artefact
POINT(323156.739838 6413209.059575)	flake		IMT	1 artefact
POINT(323146.502716 6413208.000503)	flake		IMT	1 artefact

GDA coordinates	Artefact Class	Artefact Type	Artefact Material	Artefact Number
POINT(323145.875260 6413200.613982)	flake		IMT	1 artefact
POINT(323114.722905 6413160.343572)	broken flake		IMT	1 artefact

MOCO OS-2 (#37-3-1190)

Site type: Artefact scatter

GPS Coordinates: GDA Zone 56: 323262E, 6412264N (northern extent); 323250E, 6412186N (southern extent).

Location of site: MOCO OS-2 is located in the northeast of the Proposed Disturbance Area (North Pit Continuation).

Description of site: MOCO OS-2 extends for 78m by 24m in a patch of revegetated woodland in a lower slope landform unassociated with any obvious waterway; although the area contains several shallow gullies that would carry rain run-off only. To the east the slopes rise to a ridge that separates the Bettys Creek catchment, of which MOCO OS-2 is part, from that of Main Creek. **Figure 31** shows the site extent of MOCO OS-2 and **Figure 32** shows two views of MOCO OS-2.

Figure 31: MOCO OS-2. Site extent.



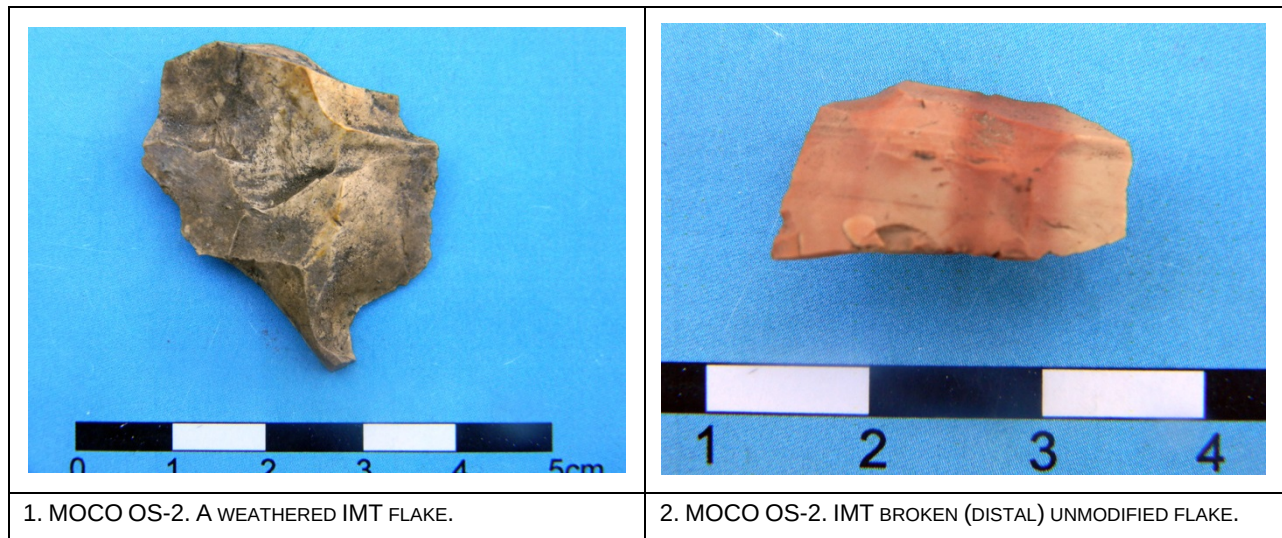
Figure 32: MOCO OS-2. Views of site location.

	
1. VIEW OF MOCO OS-2 SHOWING THE WIDESPREAD EXPOSURE. VIEW SOUTH. FLAGS MARK THE POSITION OF RECORDED ARTEFACTS.	2. VIEW OF MOCO OS-2. VIEW SOUTH.

There has been a limited degree of previous disturbance by agriculture related activities at MOCO OS-2 including tree clearing and grazing uses. The site is located along a boundary fence and the extensive exposure at the site has probably been aided by stock movement along the fence. There are some mine related disturbances in the area but these are limited to preparation of the ground for tree planting. The site has not been subject to previous archaeological salvage and there are no previously recorded sites in the immediate vicinity. A Horizon soil depth across MOCO OS-2 is very limited and sizable areas have been affected by sheet wash erosion and subsequent soil loss.

During the current survey three artefacts were recorded within the area of MOCO OS-2 including one unmodified flake a broken flake and one fragment. All artefacts recorded were manufactured from IMT sources (**Figure 33; Table 22**).

The results show that MOCO OS-2 is a diffuse artefact scatter with a very low density of artefacts. Due to very thin A Horizon soils due to prevalent sheet wash erosion and subsequent soil loss, it is assessed that there is a very low likelihood that these artefacts are associated with further, undetected subsurface deposits.

Figure 33: MOCO OS-2. Artefacts.**Table 22: MOCO OS-2. Artefacts recorded during the current survey.**

GDA coordinates	Artefact Class	Artefact Type	Artefact Material	Artefact Number
POINT(323242.024241 6412205.170556)	fragment		IMT	1 artefact
POINT(323251.250731 6412198.642238)	broken flake		IMT	1 artefact
POINT(323251.472410 6412244.471204)	flake		IMT	1 artefact

MOCO OS-3 (#37-3-1191)

Site type: Artefact scatter

GPS Coordinates: GDA Zone 56: 322073E, 6412058N (northern extent); 321983E, 6411779N (southern extent).

Location of site: MOCO OS-3 is located in the northwest of the Proposed Disturbance Area (North Pit Continuation) on either side of the Bettys Creek diversion.

Description of site: MOCO OS-3 is a highly modified site that was identified along both banks of the artificial Bettys Creek diversion. 25 artefacts were recorded on these now-raised banks, although, prior to the construction of the Bettys Creek diversion, this would have been a flat landform to the east of Bettys Creek. The site extends for approximately 305m along the diversion channel and has a nominal width of 28m that includes both banks of the channel. However, the bed of the channel itself (that is within this width calculation) is not considered to be part of the 'site'. **Figure 34** shows the site extent of MOCO OS-3 and **Figures 35** and **36** show four views of MOCO OS-3.

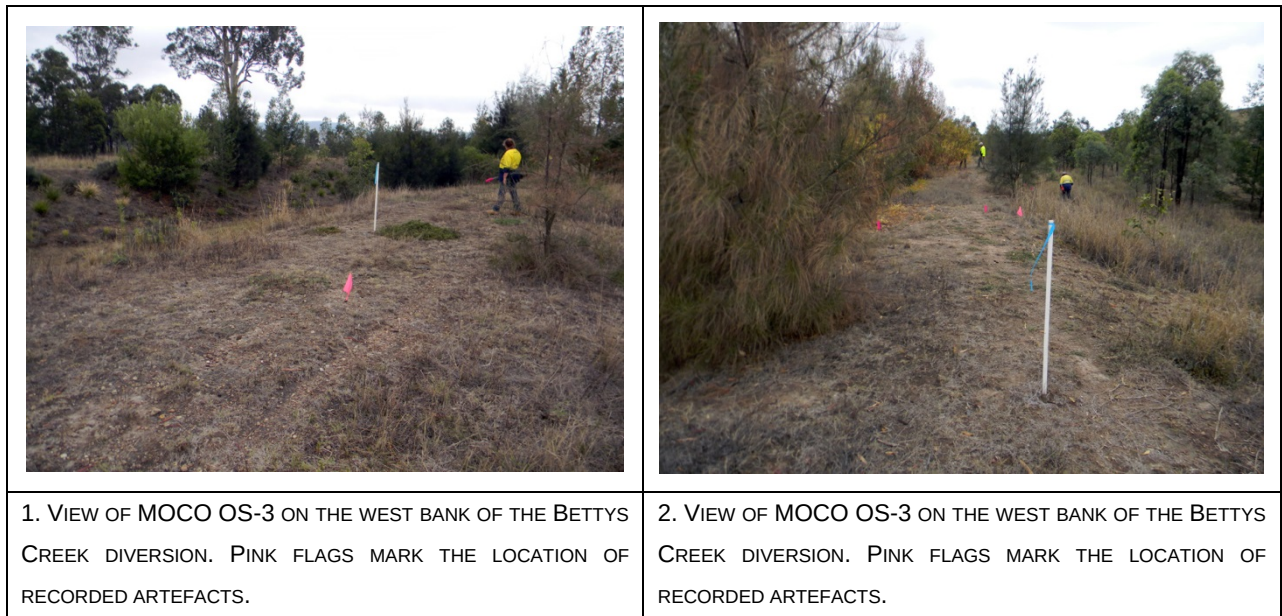
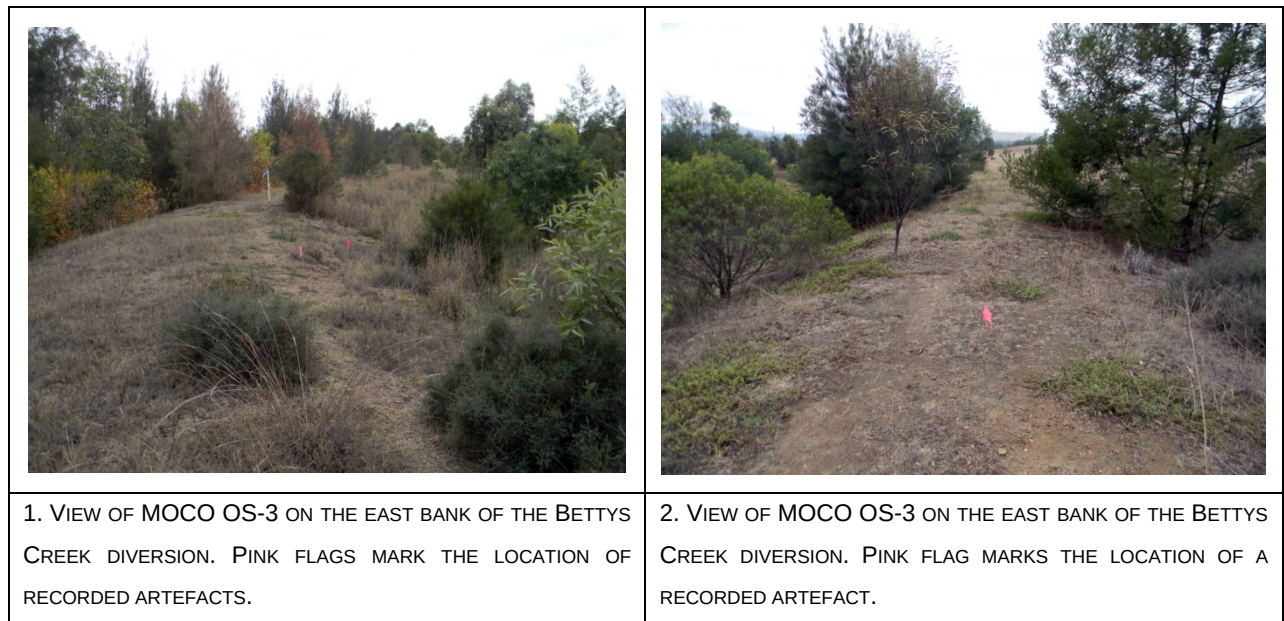
Figure 34: MOCO OS-3. Site extent.**Figure 35: MOCO OS-3. Views of site location.**

Figure 36: MOCO OS-3. Views of site location (continued).

MOCO OS-3 is a re-deposited site without any stratigraphic integrity. At the time of survey it was thought that the artefacts recorded at MOCO OS-3 were a sample of artefacts existing in the surrounding landscape that had been locally disturbed during the construction of the Bettys Creek diversion. In order to test this hypothesis, a test excavation program was carried out in both the flat landform to the west of MOCO OS-3, as well as the lower slope landform to the east of MOCO OS-3 (see **Section 7**). Although 30 0.5m by 0.5m excavation squares were excavated in these adjoining landforms, no artefacts were recorded. In the flat landforms to the west it is suspected that much of the A Horizon soils have been graded to form the banks of the diversion channel as the excavation squares displayed very thin A Horizon soils. To the east, on a lower slope landform, the ground surface has been ripped for revegetation but is largely *in situ*; although this area also displayed thin A Horizon soils and a lack of cultural material.

As a result, it is difficult to hazard a guess as to the original location of the artefacts recorded at MOCO OS-3; although it is clear they are re-deposited in what is a heavily modified landscape.

During the current survey 30 artefacts were recorded within the area of MOCO OS-3 including two cores (one a bladelet core), a backed blade (**Figure 37. 3**), two blades, 10 flakes, five broken flakes, one broken blade, and the remainder fragments (**Figure 37. 1** and **37.2**; **Table 23**). 11 of the artefacts were from silcrete sources, one from a fine-grained volcanic source (**Figure 37. 4**) and the remainder from IMT sources. The volcanic flake is of the type identified at Glennies Creek (**Section 5.2**) as associated with earlier, possibly Pleistocene, occupation.

The results show that MOCO OS-3 is a re-deposited artefact scatter with a low to moderate density of artefacts. Due to the disturbed nature of the site and the results of the test excavation

program, it is assessed that there is no likelihood that these artefacts are associated with further, undetected subsurface deposits.

Figure 37: MOCO OS-3. Artefacts.



Table 23: MOCO OS-3. Artefacts recorded during the current survey.

GDA coordinates	Artefact Class	Artefact Type	Artefact Material	Artefact Number
POINT(322047.208711 6411976.767268)	flake		IMT	1 artefact
POINT(322040.889610 6411983.104787)	flake		Silcrete	1 artefact
POINT(322040.618899 6411962.004825)	core		Silcrete	1 artefact
POINT(322040.410698 6411960.082387)	broken flake		IMT	1 artefact
POINT(322074.698080 6412017.434184)	fragment		Silcrete	1 artefact
POINT(322074.762197 6412012.219757)	blade		Silcrete	1 artefact
POINT(322058.086868 6411990.030726)	flake		Volcanic	1 artefact
POINT(322040.171762 6411962.285273)	broken blade	retouched blade	IMT	1 artefact

GDA coordinates	Artefact Class	Artefact Type	Artefact Material	Artefact Number
POINT(322037.930012 6411933.622351)	fragment		IMT	1 artefact
POINT(322041.334216 6411907.943105)	fragment		Silcrete	1 artefact
POINT(322016.535612 6411894.643756)	broken flake		IMT	1 artefact
POINT(322017.805905 6411894.630214)	broken flake		IMT	1 artefact
POINT(322019.151456 6411900.989811)	fragment		IMT	1 artefact
POINT(322019.158432 6411903.915198)	broken flake	other	Silcrete	1 artefact
POINT(322019.799548 6411904.633609)	flake		IMT	1 artefact
POINT(322019.284470 6411903.837021)	broken flake		Silcrete	1 artefact
POINT(322007.865167 6411876.919161)	blade		Silcrete	1 artefact
POINT(322009.436004 6411878.394371)	core		Silcrete	1 artefact
POINT(322011.379471 6411877.422289)	fragment		IMT	1 artefact
POINT(321987.591895 6411854.854791)	fragment		IMT	1 artefact
POINT(321982.293274 6411845.147739)	fragment		IMT	1 artefact
POINT(321999.869497 6411871.157116)	flake		IMT	1 artefact
POINT(322000.689073 6411869.369341)	fragment		IMT	1 artefact
POINT(321979.568163 6411837.271943)	fragment		IMT	1 artefact
POINT(321977.425464 6411830.507254)	flake		IMT	1 artefact
POINT(321970.780464 6411796.705981)	flake		IMT	1 artefact
POINT(322081.348818 6412041.379209)	fragment		IMT	1 artefact
POINT(322081.714093 6412024.647449)	flake		IMT	1 artefact
POINT(322076.830633 6412020.793715)	flake		Silcrete	1 artefact
POINT(322079.879861 6412018.342985)	flake		Silcrete	1 artefact

MOCO OS-4 (#37-3-1192)

Site type: Artefact scatter

GPS Coordinates: GDA Zone 56: 323525E, 6410835N (north-western extent); 323870E, 6410460N (south-eastern extent).

Location of site: MOCO OS-4 is located in the east of the Proposed Disturbance Area (North Pit Continuation) along an ephemeral tributary to Main Creek.

Description of site: The site is located along two arms on an unnamed ephemeral tributary to Main Creek. For convenience, this tributary will be termed the 'eastern drainage'. The site extends for 525m along the eastern drainage and is up to 263m wide although is more commonly 80m wide. The site occupies flat land surrounding the eastern drainage although to the west the lower slopes rise almost immediately from the present banks of the drainage. The eastern drainage flows to the southeast where it exits the Proposed Disturbance Area, and after 550m, joins Main Creek. In this south-eastern direction, following the eastern drainage, there is easy access from the floodplain to the vicinity of MOCO OS-4. **Figure 38** shows the site extent for MOCO OS-4 and **Figure 39** shows four views of the site.

Figure 38: MOCO OS-4. Site extent.



Figure 39: MOCO OS-4. Views of site location.

	
1. VIEW OF THE LOCATION OF A CLUSTER OF ARTEFACTS WITHIN MOCO OS-4 ON THE EAST BANK OF THE EASTERN DRAINAGE. PINK FLAGS MARK THE LOCATION OF RECORDED ARTEFACTS.	2. VIEW OF MOCO OS-4 SHOWING THE EXTENSIVE IN-STREAM EROSION ON THE WESTERN ARM OF THE EASTERN DRAINAGE.
	
3. VIEW OF MOCO OS-4 AT THE CONFLUENCE OF THE TWO ARMS OF THE EASTERN DRAINAGE. PINK FLAGS MARK THE LOCATION OF ARTEFACT RECORDINGS.	4. VIEW OF MOCO OS-4 ON THE EASTERN ARM OF THE EASTERN DRAINAGE.

Although there is extensive bank and gully erosion caused by increased water flows into the eastern drainage, further disturbances at MOCO OS-4 are limited to its former land use as a grazing property (vegetation clearing, soil loss) Beyond the Proposed Disturbance Area, to the east of MOCO OS-4, is the remains of a farm cottage dating to the early twentieth century. This ruin indicates that the area of MOCO OS-4 has been intensively utilised as agricultural land for many years. Additionally, also to the east of MOCO OS-4, are water diversion bunds constructed to restrict the flow of water to the eastern drainage and thereby limit the prevalent erosion. These bunds also indicate intensive agricultural use and modification in the area of MOCO OS-4.

MOCO OS-4 recorded over 100 artefacts, all of which were displaced and located in the extensive in-stream erosion along both arms of the eastern drainage. No artefacts were recorded outside of the in-stream erosion zone although Casuarina needles thickly carpeted these ground surfaces.

The hypothesis during the survey was that these artefacts had been locally displaced from immediate bank areas. To determine this, MOCO OS-4 was the location of a test excavation program (see **Section 7**). During this program 58 0.5m by 0.5m excavation squares were completed in transects placed on both the eastern and western bank of the eastern drainage, as well as transects placed between the two arms of the eastern drainage. The results of this program showed that there was a low density of artefacts away from the erosion edge of the eastern drainage apart from one location that recorded a moderate concentration of artefacts: of the 114 artefacts recorded in the excavations at MOCO OS-4, 94 came from this one concentration that covered an area of 1.25m². This concentration was an isolated phenomenon and squares within 5m of the concentration recorded low numbers of artefacts or no artefacts. The results of the test excavation program therefore indicate a general low density background of artefacts across MOCO OS-4 with only one known concentration at the location mentioned above. This would indicate that MOCO OS-4 may once have been a more extensive site but it has been largely lost due to the prevalent erosion in the area.

The 106 artefacts recorded during the current survey included IMT, silcrete and quartzite flakes (**Figure 40**; **Table 24**). Of these, four are blades, 45 unmodified flakes (**Figure 40. 3** and **40. 4**), 32 broken flakes, two broken flakes, one a silcrete core (**Figure 38. 1**) and one quartzite side scraper (**Figure 40. 2**). The remainder are fragments.

In summary, MOCO OS-4 is an extensive artefact scatter displaying a generally low artefact density except at one known location where a low to moderate concentration of artefacts was recorded during the test excavation program (**Section 7**). Further, the test excavation program indicated that archaeological deposits do not extend with any meaningful artefact density into non-eroded areas away from the bank edges of the eastern drainage. The majority of the 100+ artefacts recorded during the survey were located within the in-stream erosion zone of the eastern drainage and represent displaced artefacts that have concentrated in this area following dispersal via erosion from their original locations within the bank systems. The types and raw materials of the artefacts are typical for the area although a very low incidence of cores and modified tools was recorded.

The test excavation program indicated that the site has the potential for subsurface deposits although these deposits are likely to have a low artefact density and minimal opportunity to add to our knowledge concerning the archaeology of the region.

Additionally, the coverage of test pits at MOCO OS-4 is considered adequate and that the site has been adequately sampled.

Figure 40: MOCO OS-4. Artefacts.



Table 24: MOCO OS-4. Artefacts recorded during the current survey.

GDA coordinates	Artefact Class	Artefact Type	Artefact Material	Artefact Number
POINT(323612.524763 6410714.730689)	blade		IMT	1 artefact
POINT(323613.745135 6410714.738259)	fragment		IMT	1 artefact
POINT(323615.127208 6410712.233794)	flake		Silcrete	2-5 artefacts
POINT(323607.913480 6410715.115517)	fragment		IMT	1 artefact
POINT(323606.008524 6410713.917507)	flake		Silcrete	1 artefact
POINT(323595.986330 6410718.707448)	flake		IMT	1 artefact

GDA coordinates	Artefact Class	Artefact Type	Artefact Material	Artefact Number
POINT(323594.254060 6410722.137399)	blade		IMT	2-5 artefacts
POINT(323595.022756 6410722.555722)	flake		Silcrete	1 artefact
POINT(323592.484027 6410716.605191)	broken flake		IMT	1 artefact
POINT(323574.853102 6410718.782626)	flake		IMT	1 artefact
POINT(323576.546045 6410718.662639)	fragment		IMT	2-5 artefacts
POINT(323549.993108 6410727.523644)	fragment		IMT	2-5 artefacts
POINT(323554.986091 6410708.626412)	flake		Silcrete	2-5 artefacts
POINT(323480.193341 6410691.155302)	flake		Silcrete	1 artefact
POINT(323556.930447 6410705.707604)	flake		IMT	2-5 artefacts
POINT(323481.501995 6410700.455900)	broken flake		Silcrete	1 artefact
POINT(323554.876938 6410702.926511)	broken flake		Silcrete	6-10 artefacts
POINT(323501.331561 6410716.886322)	flake		IMT	1 artefact
POINT(323555.303823 6410703.391514)	broken flake		IMT	6-10 artefacts
POINT(323544.601028 6410711.715782)	broken flake		Silcrete	1 artefact
POINT(323539.834120 6410719.351336)	broken flake		IMT	2-5 artefacts
POINT(323540.062246 6410721.224172)	fragment		IMT	2-5 artefacts
POINT(323493.681170 6410731.364216)	flake		Silcrete	1 artefact
POINT(323483.681295 6410747.858184)	flake		IMT	2-5 artefacts
POINT(323838.022074 6410477.823845)	broken blade		IMT	1 artefact
POINT(323792.051953 6410569.565743)	flake		Silcrete	1 artefact
POINT(323785.243902 6410636.582575)	broken flake		IMT	2-5 artefacts
POINT(323784.292745 6410639.995762)	broken flake		IMT	2-5 artefacts
POINT(323784.312930 6410639.247477)	broken flake		Silcrete	2-5 artefacts
POINT(323782.072164 6410641.908804)	flake		IMT	1 artefact
POINT(323786.131589 6410641.611261)	flake		Silcrete	2-5 artefacts
POINT(323785.888766 6410642.449912)	broken blade		Silcrete	1 artefact
POINT(323786.509664 6410643.786175)	flake		Quartz	1 artefact
POINT(323658.980237 6410740.384704)	flake		IMT	1 artefact

GDA coordinates	Artefact Class	Artefact Type	Artefact Material	Artefact Number
POINT(323647.923841 6410731.351068)	flake		IMT	1 artefact
POINT(323647.790826 6410732.765602)	flake		IMT	2-5 artefacts
POINT(323646.851352 6410731.091006)	flake		IMT	2-5 artefacts
POINT(323638.314128 6410742.783458)	flake		Silcrete	1 artefact
POINT(323637.292787 6410744.029892)	flake		Silcrete	1 artefact
POINT(323639.898641 6410749.909496)	broken flake		IMT	1 artefact
POINT(323619.382788 6410751.115801)	core		Silcrete	1 artefact
POINT(323621.147808 6410748.498833)	flake	side scraper	Quartzite	1 artefact
POINT(323623.351881 6410746.055940)	fragment		IMT	2-5 artefacts
POINT(323625.293751 6410744.750810)	broken flake		Silcrete	1 artefact
POINT(323612.935572 6410716.914505)	broken flake		Silcrete	1 artefact
POINT(323613.275982 6410716.144116)	flake		Silcrete	1 artefact
POINT(323613.560635 6410714.263653)	flake		IMT	1 artefact
POINT(323578.560318 6410802.348826)	flake		IMT	1 artefact
POINT(323574.703817 6410800.282858)	flake		IMT	1 artefact
POINT(323622.514079 6410746.135499)	flake		IMT	1 artefact
POINT(323655.318470 6410694.149678)	flake		IMT	2-5 artefacts

MOCO OS-5 (#37-3-1193)

Site type: Artefact scatter

GPS Coordinates: GDA Zone 56: 321311E, 6410319N (northern extent); 321264E, 6410115N (southern extent).

Location of site: MOCO OS-5 is located to the east of the existing Mount Owen rail spur and south of Betty Creek. The site extends beyond the Proposed Disturbance Area (rail spur).

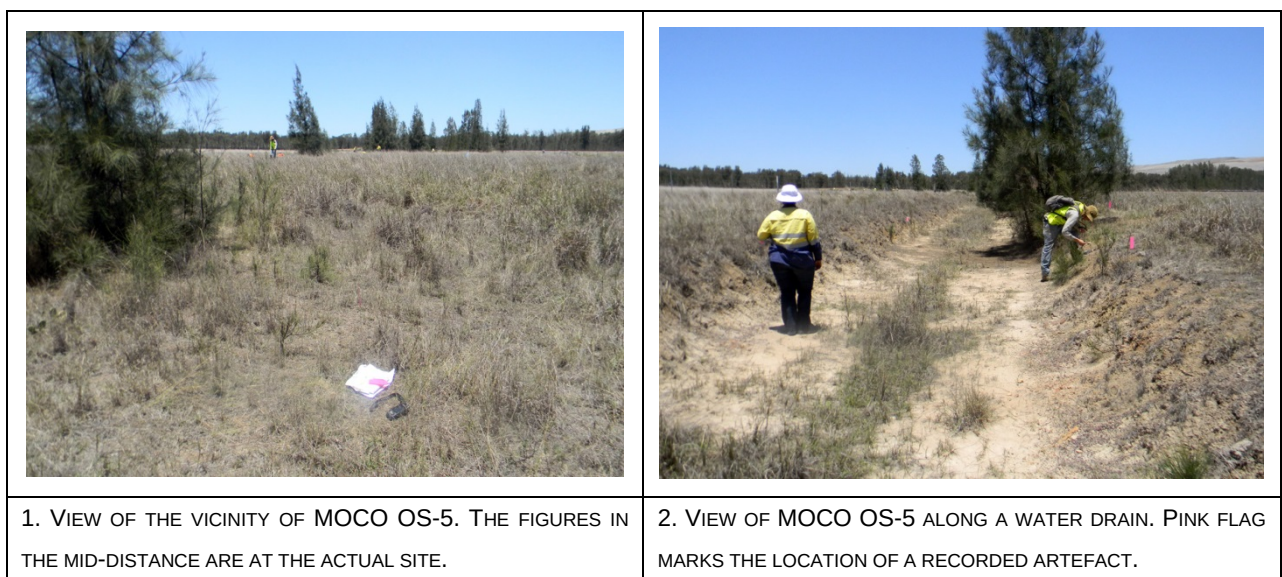
Description of site: MOCO OS-5 is a diffuse and low density artefact scatter recorded along a water drain to the east of the existing Mount Owen rail spur. The northern extent of the site is adjacent to Bettys Creek and the site is elongated in form. However, this site area is more a reflection of where exposures (due to the construction of the water drain) were available rather than a reflection of a discreet site boundary. It is assessed that the recorded artefacts were displaced during the construction of the water drain and

that they represent the general background density of artefacts in areas adjacent to Bettys Creek. It is expected that a low density of artefacts would extend to the west from MOCO OS-4 towards Bettys Creek. These areas are outside the Proposed Disturbance Area. **Figure 41** shows the extent of MOCO OS-5 and **Figure 42** shows two views of the site that extends 208m along the water drain and is between 15m to 30m wide.

Figure 41: MOCO OS-5. Site extent.



Figure 42: MOCO OS-5. Views of site location.



17 artefacts were recorded at MOCO OS-5: all IMT unmodified flakes, broken flakes or fragments (**Figure 43; Table 25**). This represents a low artefact density.

It was assessed that these artefacts represent the general background density of artefacts in the vicinity of Bettys Creek, and without formal tool types being present, there is little evidence determined by stone tool types alone to enlighten us about past activity in this area.

It is assessed that the area of MOCO OS-5 has suffered disturbance in the form of the construction of the water drain and that the thin A Horizon soils at the site lower the likelihood that the site contains further, undetected archaeological deposits.

Figure 43: MOCO OS-5. Artefacts.

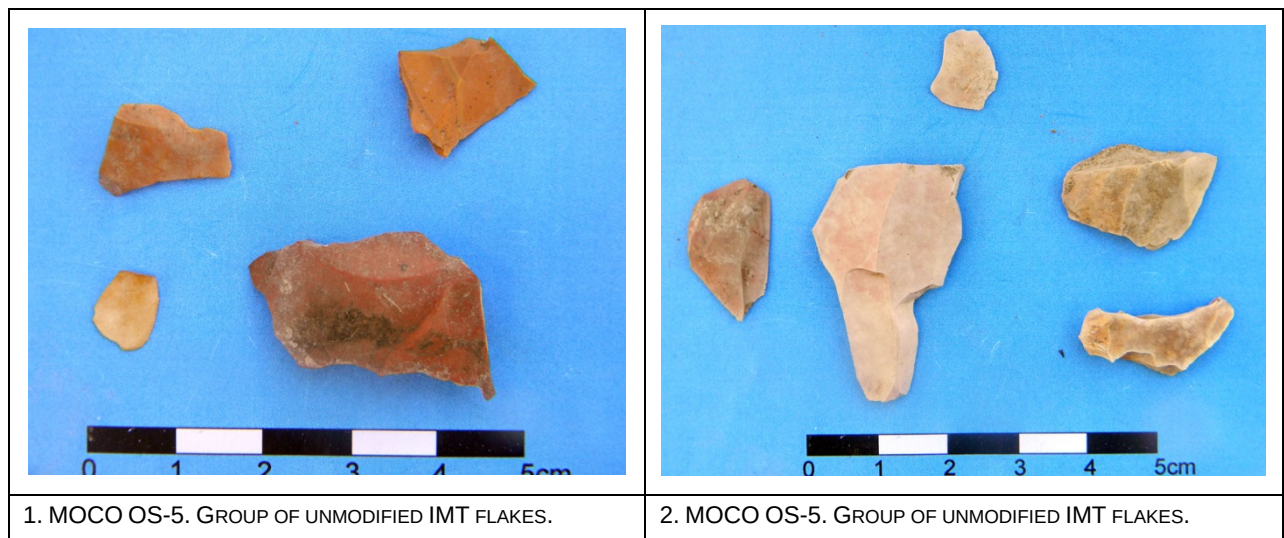


Table 25: MOCO OS-5. Artefacts recorded during the current survey.

GDA coordinates	Artefact Class	Artefact Type	Artefact Material	Artefact Number
POINT(321288.194132 6410230.747247)	broken flake		IMT	1 artefact
POINT(321293.262124 6410229.010182)	flake		IMT	2-5 artefacts
POINT(321288.246011 6410225.718345)	broken flake		IMT	1 artefact
POINT(321287.450952 6410225.995336)	fragment		IMT	1 artefact
POINT(321289.341132 6410217.962956)	flake		IMT	2-5 artefacts
POINT(321282.958059 6410207.179686)	flake		IMT	1 artefact
POINT(321267.878475 6410159.033653)	flake		IMT	1 artefact
POINT(321281.101388 6410273.180430)	flake		IMT	1 artefact
POINT(321299.690970 6410272.943781)	flake		Silcrete	2-5 artefacts
POINT(321295.531135 6410253.689498)	flake		IMT	1 artefact

MOCO OS-6 (#37-3-1194)

Site type: Diffuse artefact scatter

GPS Coordinates: GDA Zone 56: 320668E, 6410170N (northern extent); 320688E, 6409254N (southern extent).

Location of site: MOCO OS-6 is located within the Bettys Creek Habitat Management Area between Bettys Creek and existing mining operations. The site extends beyond the Proposed Disturbance Area (rail spur).

Description of site: This large area encompasses 913m (north-south) by 325m (east-west) and is termed a diffuse artefact scatter although more correctly it is a number of isolated finds located within the one landform unit. No concentrations of artefacts were noted and the artefact assemblage from MOCO OS-6 is best characterised as a low density background of artefacts in areas adjacent to Bettys Creek. The landform containing MOCO OS-6 is flat and is largely covered with Casuarina regrowth. Soils are poor in nutrition and sandy.

Figure 44 shows the site extent of MOCO OS-6 and **Figure 45** shows two views of the site.

Figure 44: MOCO OS-6. Site extent.

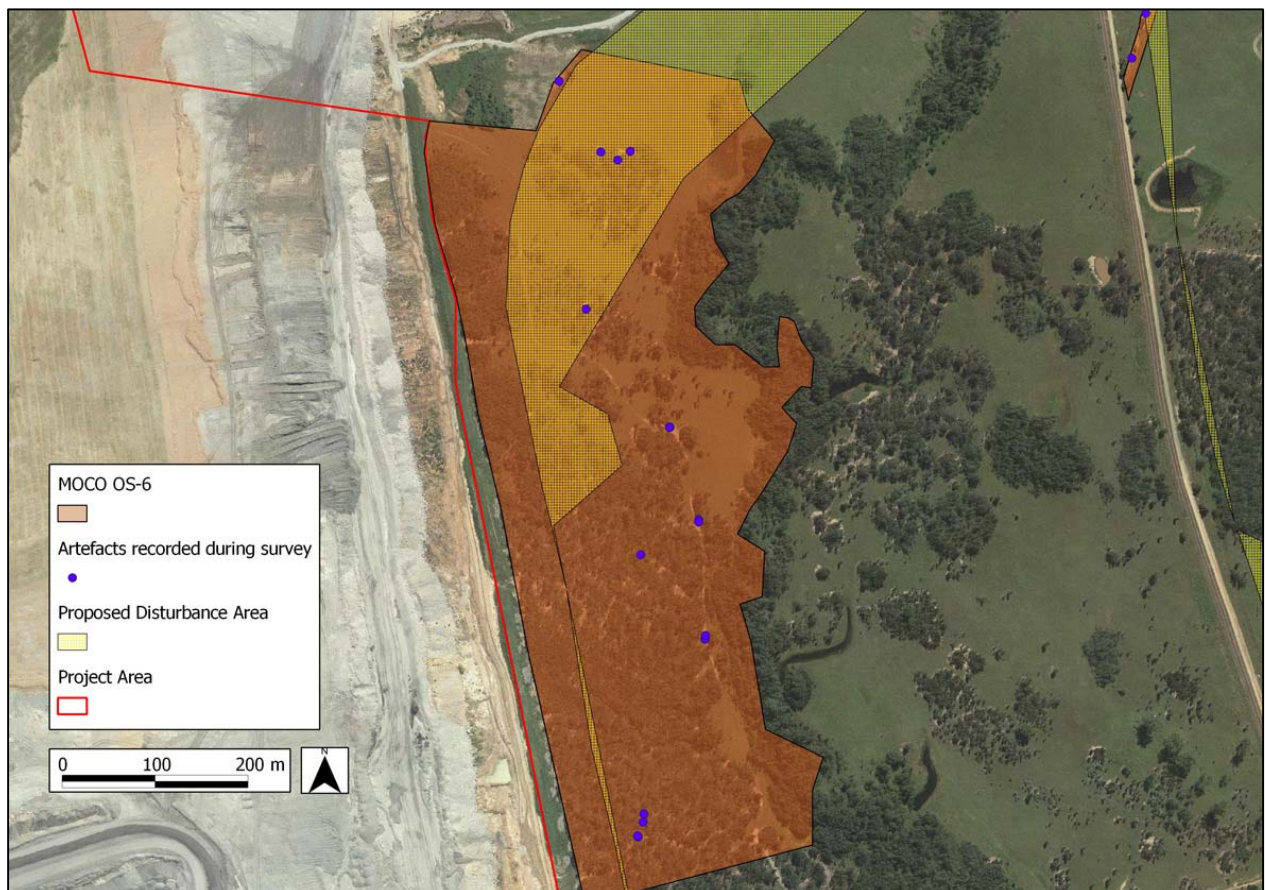
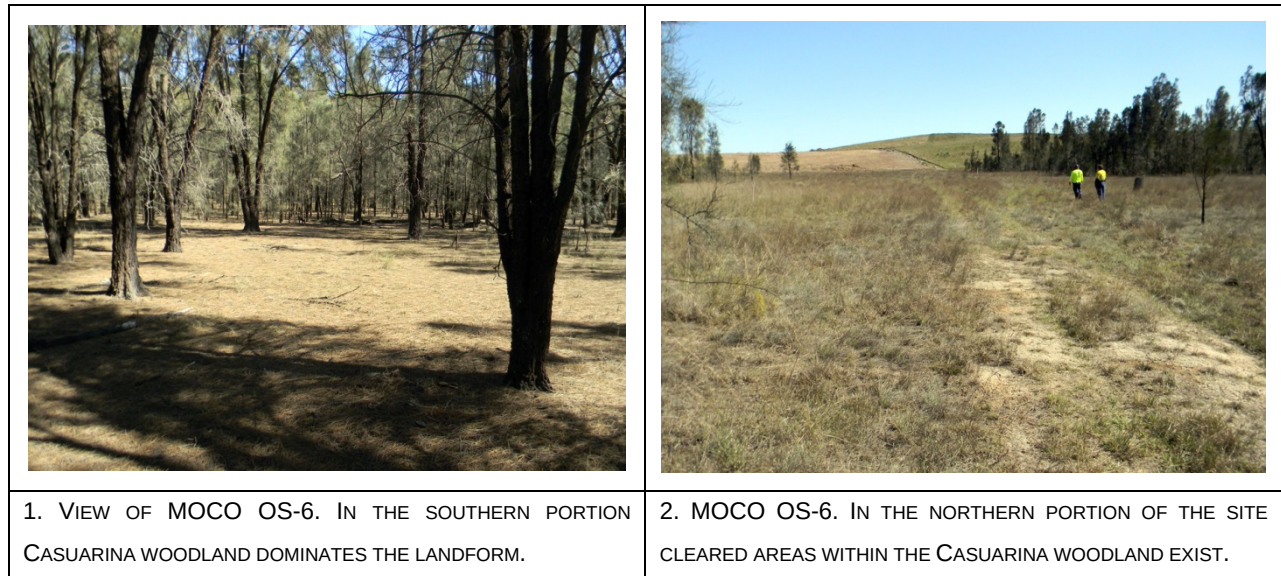


Figure 45: MOCO OS-6. Views of site location.

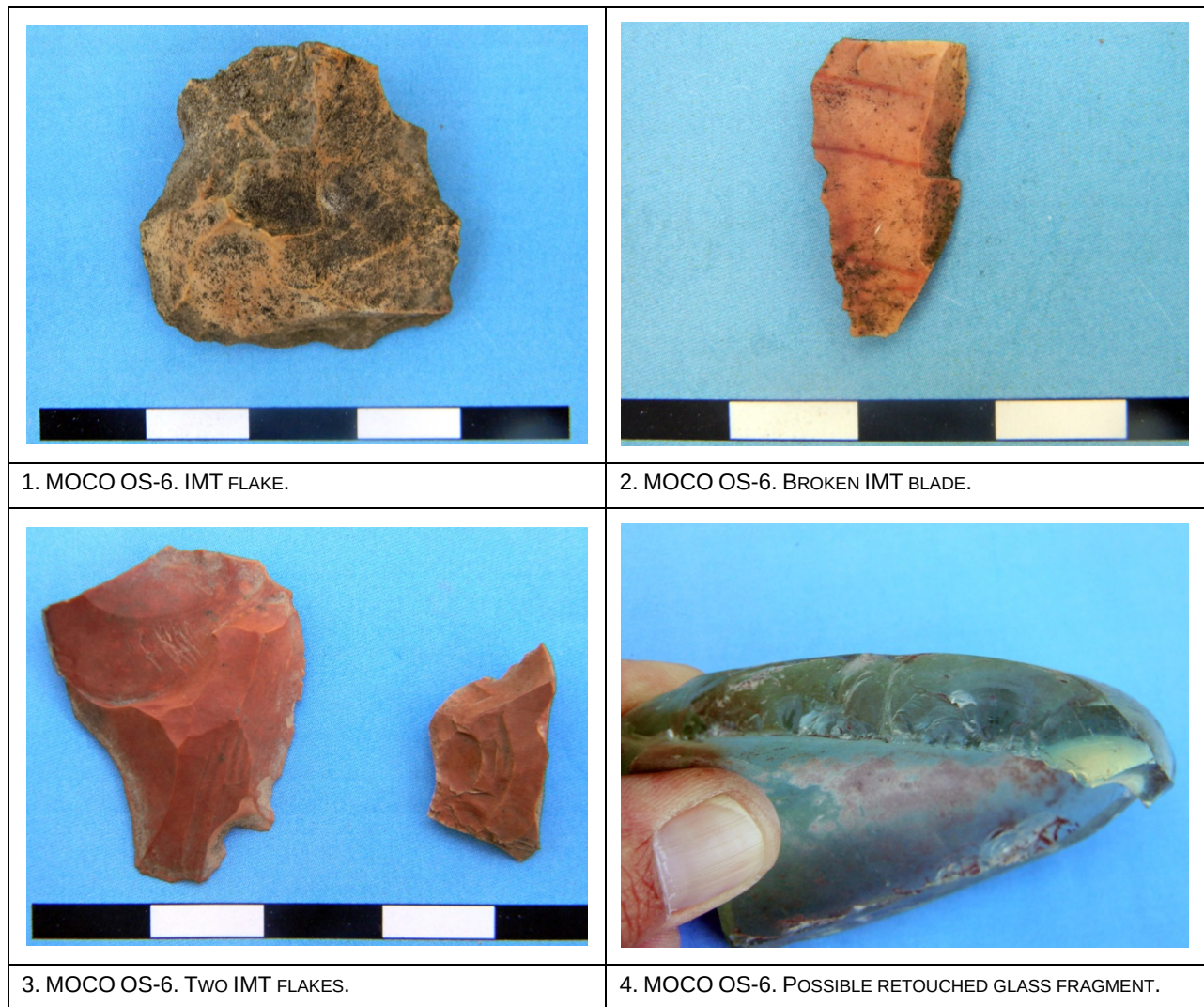
MOCO OS-6 is within an area that has been maintained as a habitat management zone and consequently there are few mine related disturbances within the site. The Casuarina woodland that now dominates the site is relatively immature and indicates that the entire area was cleared in the past for agricultural purposes. Exposures were relatively frequent allowing a good proportion of the ground surface to be viewed. A Horizon soils appear to be thin or non-existent.

There has been a small amount of archaeological salvage within MOCO OS-6 with the artefact scatter Bettys Creek 4 (#37-3-0594) having been salvaged by surface collection in 2005/2006 (Umwelt 2013b). **Table 26** shows that two artefacts were recovered from this site. No grader scapes have taken place within MOCO OS-6.

Table 26: Salvaged sites (under DEC s.90 Consent #2267) within MOCO OS-6.

Site #	Site Name	AMG Easting	AMG Northing	Site Type	Salvage Type	Landform	Salvage results
37-3-0594	Bettys Creek 4	320732	6409202	Artefact scatter	Surface Collection	End of low spur 50m from Bettys Creek adjacent to swampy floodplain.	Two artefacts collected

14 artefacts were recorded during the current survey including an IMT core, two broken flakes, two broken blades, eight flakes and one fragment (**Figure 46; Table 27**). At GDA Zone 56: 320714E; 6410049N a possible retouched glass fragment was recorded (**Figure 46. 4**). It should be noted that the current survey concentrated on the Proposed Disturbance Area that does not include the immediate banks of Bettys Creek within MOCO OS-6. Therefore, this bank area of the site was not intensively investigated and the lack of artefact recordings along the bank is a factor of survey bias rather than a true reflection of artefact distribution.

Figure 46: MOCO OS-6. Artefacts.**Table 27: MOCO OS-6. Artefacts recorded during current survey.**

GDA coordinates	Artefact Class	Artefact Type	Artefact Material	Artefact Number
POINT(320770.385249 6409761.919495)	flake		IMT	1 artefact
POINT(320801.818144 6409662.549177)	flake		IMT	1 artefact
POINT(320801.650468 6409660.086718)	flake		IMT	1 artefact
POINT(320808.578541 6409533.976239)	flake		IMT	1 artefact
POINT(320809.190373 6409537.902343)	broken flake		IMT	1 artefact
POINT(320739.372979 6409624.753063)	broken blade		IMT	1 artefact
POINT(320696.415409 6410058.149861)	broken flake		IMT	1 artefact
POINT(320714.578330 6410049.482032)	other	end scraper	Other (glass)	1 artefact
POINT(320728.260399 6410058.920909)	flake		IMT	1 artefact

GDA coordinates	Artefact Class	Artefact Type	Artefact Material	Artefact Number
POINT(320680.524512 6409889.044577)	fragment		IMT	1 artefact
POINT(320651.646149 6410134.140001)	flake		IMT	1 artefact
POINT(320770.905206 6409761.903822)	flake		IMT	1 artefact
POINT(320736.712811 6409321.102175)	core		IMT	1 artefact
POINT(320735.909187 6409322.476069)	blade		Silcrete	1 artefact
POINT(320741.971781 6409337.093446)	broken blade		Silcrete	1 artefact
POINT(320742.705943 6409346.105199)	flake		IMT	1 artefact

MOCO OS-7 (#37-3-1195)

Site type: Artefact scatter

GPS Coordinates: GDA Zone 56: 321007E, 6408426N (northern extent); 321018E, 6408374N (southern extent).

Location of site: MOCO OS-7 is located on the east bank of Bettys Creek between the main channel and an anabranch of the creek that flows to the east of the main channel.

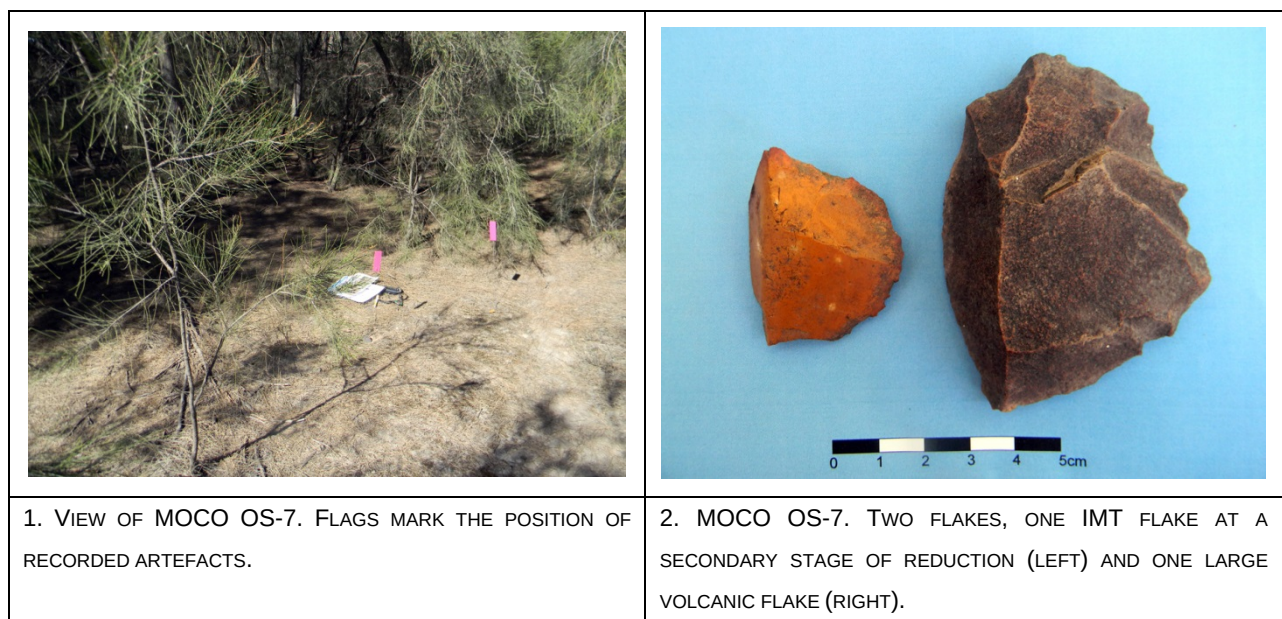
Description of site: MOCO OS-7 is a low density artefact scatter extending approximately 55m by 55m (**Figure 47**). At the site, only two artefacts were recorded in an area of exposure among Casuarina regrowth (**Figure 48. 2; Table 28**). The site area of MOCO OS-7 extends beyond the Proposed Disturbance Area (proposed rail spur) and the recorded artefacts are located directly on the boundary of the Proposed Disturbance Area.

Previous archaeological investigations in the environs of MOCO OS-7 show that the landform surrounding Bettys Creek has a low to moderate artefact density. 88m east of MOCO OS-7 site #37-3-0599 was salvaged by Umwelt in 2005/2006 (Umwelt 2013b). This salvage consisted of a surface collection that recorded 21 artefacts (seven flakes, 13 broken flakes and a heat shatter; Umwelt 2013b: 6.6). 174m south of MOCO OS-7 site 37-3-0600 was salvaged by Umwelt in 2005/2006 by manual excavation (Umwelt 2013b: 6.14 ff). A total of 274 artefacts were recovered from 40m² excavated at #37-3-0600, a density of 6.85 artefacts a square metre. These excavations indicated that the only A Horizon remaining was a 'truncated A2 Horizon' extending to a depth of 15cm before basal clays were reached (Umwelt 2013b: 6.15).

Given the results of these investigations, it can be extrapolated that MOCO OS-7 is also, similarly, a low density scatter where there is a limited likelihood of the site containing further intact subsurface deposits.

Table 28: MOCO OS-7. Artefacts recorded during current survey.

GDA coordinates	Artefact Class	Artefact Type	Artefact Material	Artefact Number
POINT(321015.366365 6408401.289380)	flake		Volcanic	1 artefact
POINT(321013.523437 6408400.477353)	flake		IMT	1 artefact

Figure 47: MOCO OS-7. Site extent.**Figure 48: MOCO OS-7. View of site location and recorded artefacts.**

MOCO OS-8 (#37-3-1196)

Site type: Artefact scatter

GPS Coordinates: GDA Zone 56: 321855E, 6408394N (northern extent); 321502E, 6407604N (southern extent).

Location of site: MOCO OS-8 is located immediately to the east of the existing Mount Owen rail spur.

Description of site: MOCO OS-8 is located in lower slope landforms and is distant to any obvious water sources (Bettys Creek is 600m to the west of MOCO OS-8). The site is heavily disturbed and generally consists of artefacts located along an artificial bank/mound created during the construction of the Mount Owen rail spur that is located immediately to the west of the site. Some artefacts were located off this bank in areas of skeletal soils and it is possible that the construction of the rail spur intersected a low density artefact scatter, some of which was displaced and some of which, in the north of the site, is still largely *in situ*. **Figure 49** shows the site extent of MOCO OS-8 and **Figure 50** shows two views of the site.

MOCO OS-8 extends for 865m (north-south) and approximately 60m (east-west).

Figure 49: MOCO OS-8. Site extent.

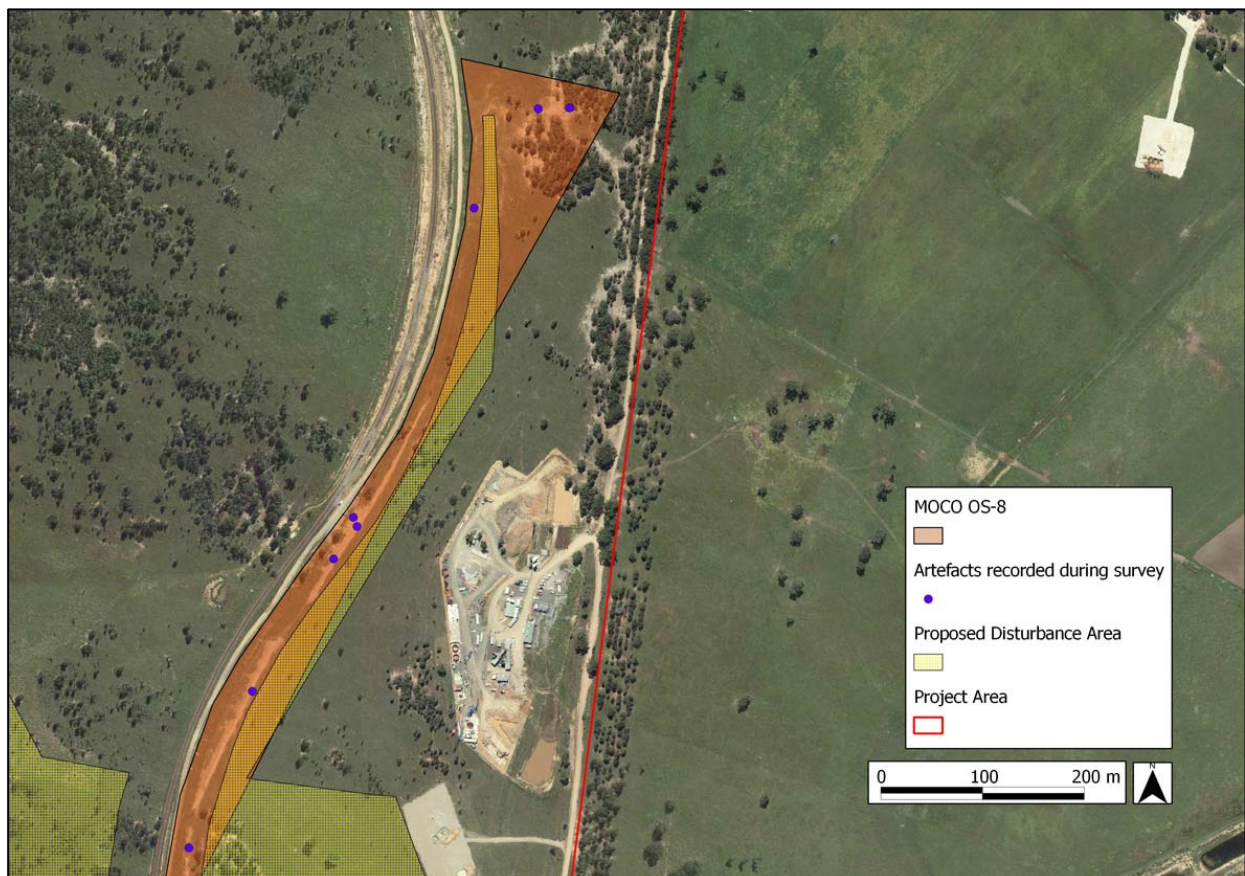
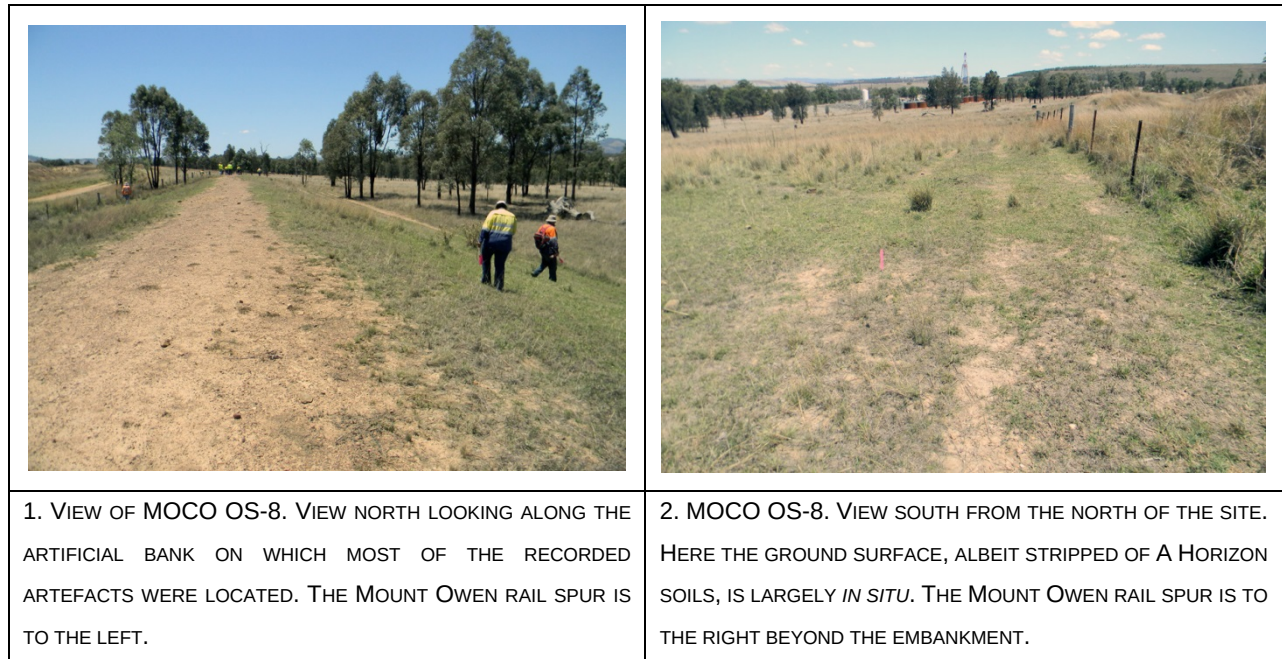


Figure 50: MOCO OS-8. View of site location.

Eight artefacts were recorded at MOCO OS-8, and of these, all but three are located on the artificial bank (**Figure 51; Table 29**). Artefacts consisted of a silcrete core (**Figure 51. 1**), five flakes (**Figure 51. 2**) and two broken flakes. The three artefacts located to the north of the bank are located on skeletal soils where most of the A Horizon has been lost due to sheet wash erosion.

Due to the prior disturbance that dominates most of MOCO OS-8 and the surrounding skeletal soils, it is assessed that there is a low likelihood that the site contains further intact subsurface archaeological deposits.

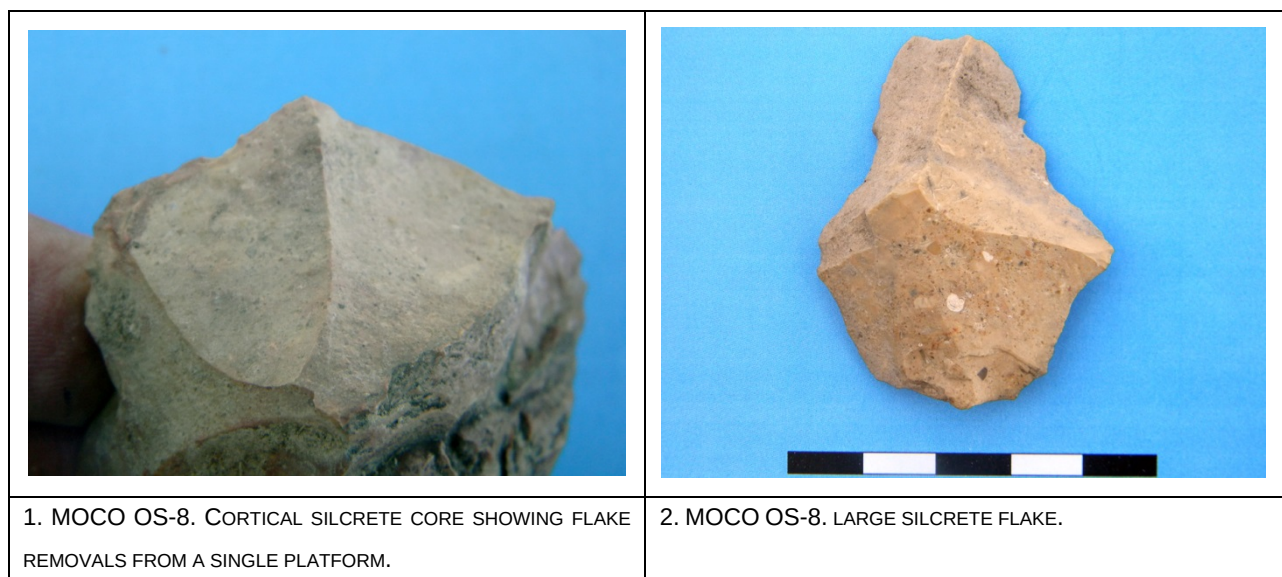
Figure 51: MOCO OS-8. Artefacts.

Table 29: MOCO OS-8. Artefacts recorded during current survey.

GDA coordinates	Artefact Class	Artefact Type	Artefact Material	Artefact Number
POINT(321674.459754 6407952.378276)	flake		Silcrete	1 artefact
POINT(321670.814937 6407961.280680)	broken flake		IMT	1 artefact
POINT(321852.552959 6408363.151883)	core		Silcrete	1 artefact
POINT(321651.360714 6407920.377359)	broken flake		IMT	1 artefact
POINT(321571.472197 6407790.183500)	flake		silcrete	1 artefact
POINT(321509.103277 6407636.293127)	flake		IMT	1 artefact
POINT(321789.573455 6408265.528799)	flake		IMT	1 artefact
POINT(321883.613270 6408363.972216)	flake		Silcrete	1 artefact

MOCO OS-9 (#37-3-1197)

Site type: Artefact scatter

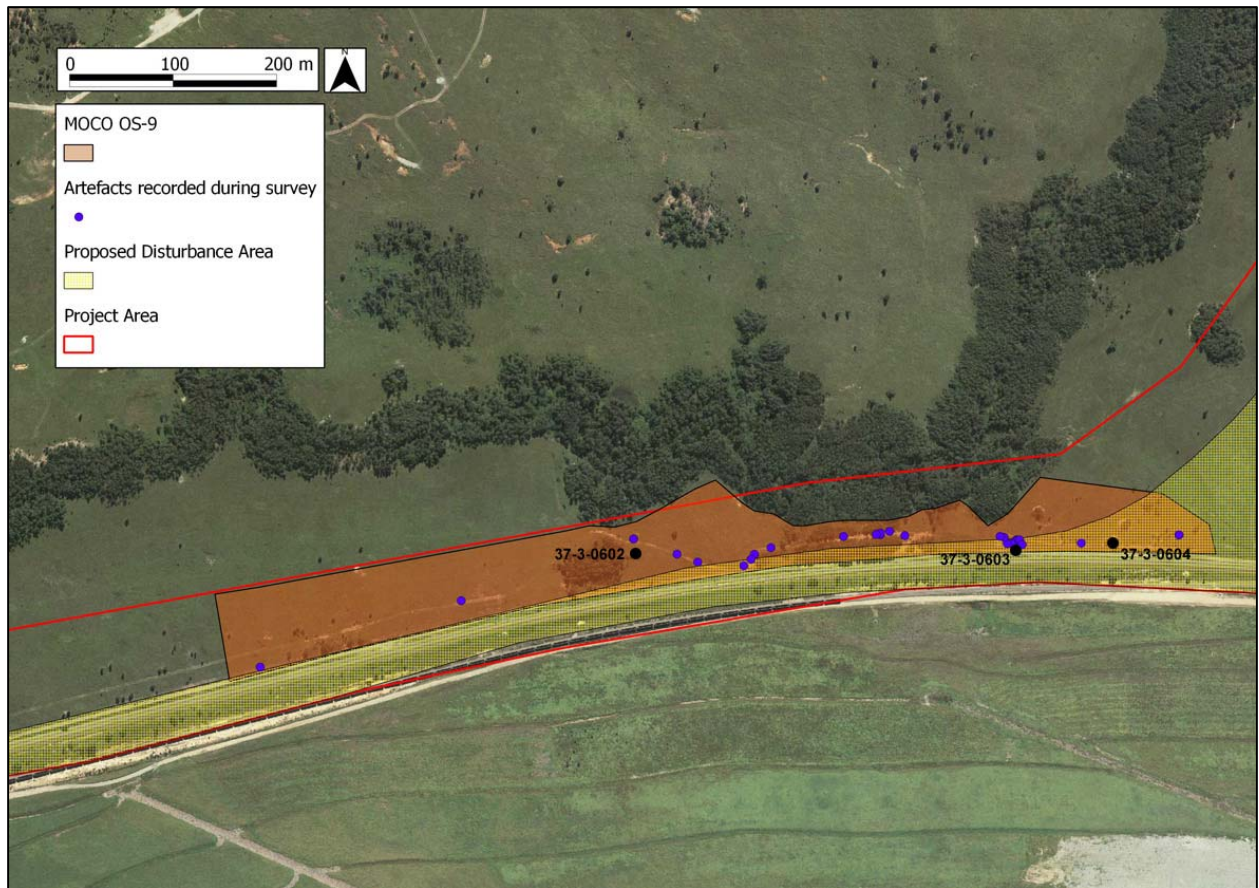
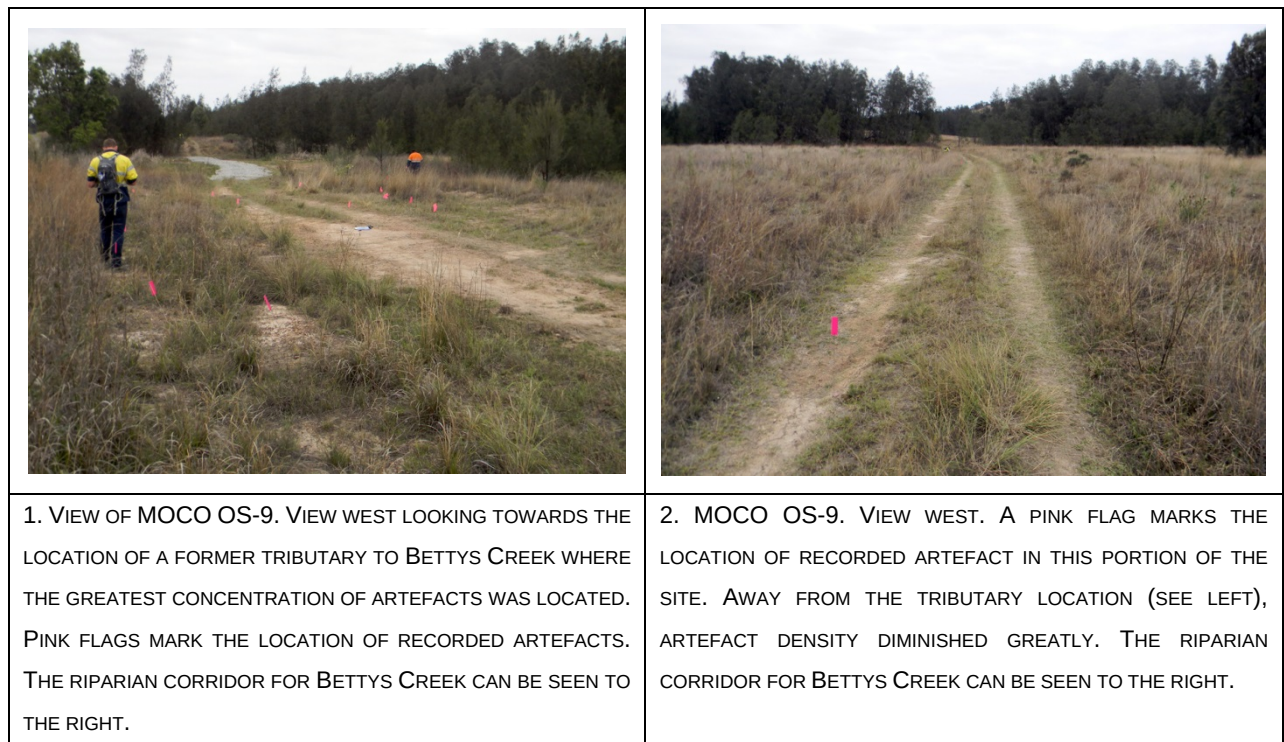
GPS Coordinates: GDA Zone 56: 320849E, 6407273N (eastern extent); 319891E, 6407183N (western extent).

Location of site: MOCO OS-9 is located along a service track to the north of the Main Northern Rail Line and to the south of Bettys Creek.

Description of site: MOCO OS-9 is a diffuse artefact scatter, although in the centre of the site, there is a moderate concentration of artefacts at a location where a tributary to Bettys Creek would have once joined Bettys Creek from the south. This tributary is now confined to a culvert below the Main Northern Rail Line and on the other side of the railway line (to the south) the landform has been greatly modified as a dump area for the Ashton mine.

MOCO OS-9 extends for 966m along a service track that parallels the Main Northern Rail Line to the north. Site width is variable but, on average, the site is approximately 70m wide. To the north of the site is Bettys Creek that has an east-west orientation in this area. The site does not include the riparian vegetation along Bettys Creek as inspection showed that this area contains many anabranches to Bettys Creek where water movement and erosion have likely removed or greatly disturbed any cultural material in this area. Instead, MOCO OS-9 occupies the gentle lower slopes to the south of Bettys Creek.

Figure 52 shows the site extent of BOP OS-9 and **Figure 53** shows two views of the site.

Figure 52: MOCO OS-9. Site extent.**Figure 53: MOCO OS-9. View of site location.**

The area within MOCO OS-9 has already been subject to a degree of archaeological salvage undertaken by Umwelt during 2005/2006 (Umwelt 2013b). The salvage consisted of the surface

collection of artefacts from three sites (#37-3-0602, #37-3-0603 and #37-3-0604), and within the bounds of MOCO OS-9, five grader scrapes. As shown in **Table 30** the surface collection at sites #37-3-0602 and #37-3-0603 recorded 21 and 35 artefacts respectively. The surface collection at site #37-3-0604 recorded 221 artefacts.

The results of the five grader scrapes within MOCO OS-9 are shown in **Table 31**. These scrapes were located between the service track and the riparian corridor along Bettys Creek and generally resulted in a low number of artefacts being recorded.

It is interesting to note that the current artefact recordings shown in **Figure 52** indicate that the salvage of sites #37-3-0602 and #37-3-0604 was largely successful with no or very few artefacts being visible at the sites' locations today. However, at site #37-3-0603 where 35 artefacts were collected during the salvage, 26 artefacts remained to be recorded during the current survey. This shows that site #37-3-0603 contained further subsurface artefacts that have been exposed during the five/six years that separate the salvage and the current survey. This result, however, is not surprising as the salvage program was a surface artefact collection only and no salvage program can hope to recover all artefacts in an area unless there is broad scale manual excavation.

Table 30: Salvaged sites (under DEC s.90 Consent #2267) within MOCO OS-9.

Site #	Site Name	AMG Easting	AMG Northing	Site Type	Salvage Type	Site Description	Salvage Result
37-3-0602	Bettys Creek 12	320188	6407077	Artefact scatter	Surface Collection with Subsurface Investigation (grader scrapes)	Foot slope on a graded road beside a tributary and 50m S of the main channel of Bettys Creek.	21 artefacts collected.
37-3-0603	Bettys Creek 13	320557	6407076	Artefact scatter	Surface Collection with Subsurface Investigation (grader scrapes)	Foot slope of low spur on a graded road between a tributary and the main channel of Bettys Creek.	35 artefacts collected.
37-3-0604	Bettys Creek 14	320654	6407082	Artefact scatter	Surface Collection with Subsurface Investigation (grader scrapes)	Lower slope on a graded road 100m E of Bettys Creek and on both sides of a tributary of Bettys Creek.	221 artefacts collected

Table 31: Grader scrapes (under DEC s.90 Consent #2267) within MOCO OS-9.

Grader Scrape	Landform	Start (AMG)	End (AMG)	No. of spits	Approx. depth (cm)	Artefact recorded
Bettys Creek GS 5	lower slope	319969E 6407096N	320120E 3407093N	5	18	1
Bettys Creek GS 6	floodplain	320188E 6407103N	320273E 6407136N	15	54	12
Bettys Creek GS 7	lower slope	320189E 6407093N	320259E 6407076N	7	28	0
Bettys Creek GS 8	lower slope	320677E 6407090N	320581E 6407103N	12	52	6
Bettys Creek GS 9	lower slope	320822E 6407196N	320747E 6407125N	8	36	2

During the current survey 56 artefacts were recorded at MOCO OS-9 with a concentration of 26 artefacts adjacent to a former tributary to Bettys Creek (**Table 32**). The artefacts were predominantly from IMT sources with only a single silcrete flake being recorded. Two milky quartz flakes were recorded including a large, broken flake (**Figure 54. 2**). A single volcanic blade was recorded (**Figure 54. 3**). No formal tool types were noted, although a well-reduced (exhausted) IMT multi-directional core was recorded (**Figure 54. 1**). Otherwise the blades and flakes at MOCO OS-9 were constructed from a fine-grained IMT very suited for knapping (**Figure 54. 4**).

Current infrastructure disturbances are evident at MOCO OS-9 including the construction and use of the service track (including the existing importation of fill to construct creek crossings) and the construction of the Main Northern Rail Line that has artificially truncated the southern extent of the site. The greatest impact to the ground surface within MOCO OS-9, however, is from former agricultural clearing and subsequent soil loss due to sheet wash erosion. While areas closer to Bettys Creek probably have some recent A Horizon accumulation, those areas where Project disturbances will be concentrated (i.e. close to the existing Main Northern Rail Line and further upslope away from the creek) are largely devoid of A Horizon soils. As the service track provides a cross-section of the site with continuous exposure, the nature of the soils at MOCO OS-9 could be assessed with some accuracy.

Given the thin A Horizon soils and the results of previous subsurface investigation (grader scrapes) within MOCO OS-9 that recovered very few artefacts, it is assessed that MOCO OS-9 is predominantly a surface manifestation and that there is a low likelihood of there being further intact archaeological deposits at the site.

Figure 54: MOCO OS-9. Artefacts.

	
1. MOCO OS-9. IMT REDUCED, ROTATED CORE.	2. MOCO OS-9. LARGE, BROKEN QUARTZ FLAKE.
	
3. MOCO OS-9. GROUP OF PREDOMINANTLY IMT FLAKES AND BROKEN FLAKES WITH A FINE-GRAINED VOLCANIC BLADE (BOTTOM LEFT).	4. MOCO OS-9. GROUP OF IMT FLAKES AND BLADE.

Table 32: MOCO OS-9. Artefacts recorded during current survey.

GDA coordinates	Artefact Class	Artefact Type	Artefact Material	Artefact Number
POINT(320659.498328 6407274.485034)	flake		IMT	2-5 artefacts
POINT(320660.040868 6407273.593572)	broken flake		IMT	2-5 artefacts
POINT(320662.398932 6407274.376070)	flake		IMT	2-5 artefacts
POINT(320654.777810 6407270.798762)	flake		IMT	2-5 artefacts
POINT(320650.501806 6407270.783311)	flake		IMT	6-10 artefacts
POINT(320647.548628 6407276.725312)	broken flake		IMT	2-5 artefacts
POINT(320665.022399 6407269.781299)	broken flake		Quartz	1 artefact
POINT(320643.713899 6407277.668820)	flake		Quartz	1 artefact

GDA coordinates	Artefact Class	Artefact Type	Artefact Material	Artefact Number
POINT(320551.660056 6407278.440326)	flake		IMT	2-5 artefacts
POINT(320536.924572 6407282.516146)	core		IMT	1 artefact
POINT(320528.193674 6407279.343124)	flake		IMT	1 artefact
POINT(320528.209840 6407280.804682)	blade		IMT	1 artefact
POINT(320523.990289 6407279.473104)	flake		IMT	2-5 artefacts
POINT(320492.507365 6407277.614851)	fragment		IMT	1 artefact
POINT(320406.307054 6407260.402741)	flake		IMT	1 artefact
POINT(320403.083247 6407255.453785)	fragment		IMT	2-5 artefacts
POINT(320396.069813 6407249.322306)	broken flake		IMT	2-5 artefacts
POINT(320351.502727 6407252.930217)	flake		IMT	1 artefact
POINT(320331.580925 6407260.559099)	broken flake		IMT	1 artefact
POINT(320289.592565 6407275.196034)	broken flake		IMT	2-5 artefacts
POINT(320289.557313 6407275.195402)	blade		Volcanic	1 artefact
POINT(320123.065282 6407215.595879)	flake		IMT	1 artefact
POINT(319928.888206 6407151.439862)	fragment		IMT	1 artefact
POINT(320422.297880 6407266.836348)	broken flake		IMT	1 artefact
POINT(320816.607169 6407279.175460)	fragment		IMT	1 artefact
POINT(320816.703476 6407279.179953)	flake		Silcrete	1 artefact
POINT(320722.163429 6407271.218642)	flake		IMT	2-5 artefacts

MOCO OS-10 (#37-3-1198)

Site type: Artefact scatter

GPS Coordinates: GDA Zone 56: 317789E, 64094923N (northern extent); 317832E, 6409169N (southern extent).

Location of site: MOCO OS-10 is located on a slight rise on the northern side of Bowmans Creek and Hebden Road.

Description of site: MOCO OS-10 is located on a rise to the north of Bowmans Creek. At its southern extent MOCO OS-10 is 60m from Bowmans Creek. Rock outcropping is frequent across the site and soil depths are minimal. The site contains silcrete outcrops (**Figure 56. 4**) but none appeared to have been utilised for quarrying (although

extensive, contiguous areas of this outcropping were not visible). The site extends for 325m in a northwest-southeast direction and is up to 115m wide. The site is artificially cut by Hebden Road on its westerly extent. **Figure 55** shows the extent of MOCO OS-10 and **Figure 56** shows four views of the site.

Figure 55: MOCO OS-10. Site extent.

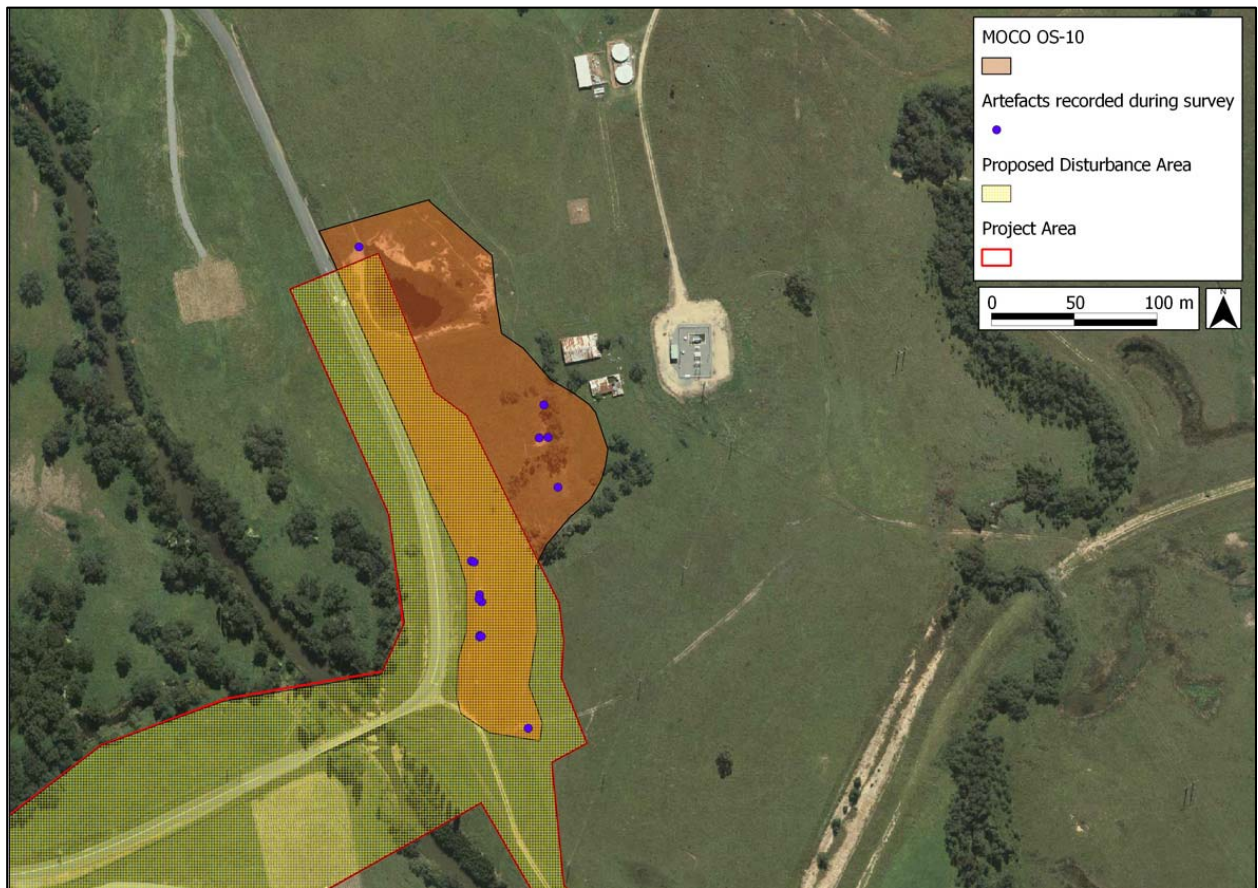


Figure 56: MOCO OS-10. Views of site location.

	
1. MOCO OS-10. VIEW WEST AT THE SOUTHERN EXTENT OF THE SITE WHERE THE TOPOGRAPHY HAS DROPPED DOWN OFF THE RISE TO THE LEVEL OF THE BENCH ADJACENT TO BOWMANS CREEK. #37-3-0614 IS ON THE OPPOSITE SIDE OF THE TRACK AND CLOSER TO BOWMANS CREEK THAT IS MARKED BY THE POPLARS.	2. MOCO OS-10. VIEW SOUTHWEST FROM AROUND THE MIDDLE OF THE SITE. THE ELEVATION HAS INCREASED ABOVE BOWMANS CREEK (MARKED BY THE POPLARS) AS THE SITE EXTENDS UP ON TO THE RISE.
	
3. MOCO OS-10. THE TOP OF THE RISE CONTAINS A FARM HOUSE AND ASSOCIATED SHEDS. PINK FLAGS MARK THE LOCATION OF RECORDED ARTEFACTS.	4. MOCO OS-10. AN EXAMPLE OF THE OUTCROPPING SILCRETE BEDROCK THAT WAS OBSERVED ACROSS THE SITE, PARTICULARLY AT THE TOP OF THE RISE.

No previous archaeological work has taken place within MOCO OS-10, although salvage work has taken place at some nearby sites.

Bowmans Creek 2 (#37-3-0614) is immediately adjacent to MOCO OS-10 on the other side of a farm track and on the flat bench adjacent to Bowmans Creek (see **Figure 56. 1**). This site was salvaged by Umwelt in 2005/2006 by a surface collection of six visible artefacts. Interestingly, of these six artefacts, three were cores, one an 'amorphous broken retouched flake' (Umwelt 1013d: 6.8) and the remaining being unmodified flakes (one broken; Umwelt 2013b: 6.6). Three artefacts were from silcrete sources, two from mudstone and one from quartz. The high

incidence of cores (albeit from a small sample) is suggestive that knapping was taking place in the vicinity.

MOCO OS-10 is approximately 600m southeast from site Bowmans Creek 5 (#37-3-0617): a small quarry and artefact scatter. The quarry was a decomposed conglomerate outcrop providing quartz and quartzite pebbles. This site was assessed as an activity area rather than a camp site (Umwelt 2013b: 7.32). During Umwelt's 2005/2006 salvage (Umwelt 2013b), 42 artefacts were salvaged from the site including 12 retouched flakes and two flaked pieces (Umwelt 2013b: 6.6). However only four of these artefacts were sourced from the quarry material, the remainder being silcrete or mudstone imports that may have been knapped at the site (Umwelt 2013b: 6.12). Like Bowmans Creek 2, this indicates that tool production was taking place in this area.

Also in the context of MOCO OS-10 are four grader scrapes carried out by Umwelt in the 2005/2006 salvage program (Umwelt 2013b: 6.36ff). These grader scrapes (Bowmans Creek GS 1 to GS4) were located on the southern floodplain adjacent to Bowmans Creek (on the opposite side of the creek to MOCO OS-10). The results showed that although the grader scrapes went to a depth of between 37cm and 60cm that only one artefact (an amorphous retouched flake) was recorded (Umwelt 2013b: 6.38). This indicates that cultural material has been largely removed from the southern floodplain areas through flooding events while sites, such as MOCO OS-10 that are located above flooding events, remain largely *in situ*.

In addition, #37-3-0985 (REA89: an extant low density artefact scatter) is located directly across Hebden Road from MOCO OS-10 in a landform that would have once been contiguous with MOCO OS-10 prior to the construction of Hebden Road (**Section 5.3.1**). This site has been fenced.

20 artefacts were recorded at MOCO OS-10 including two IMT cortical cores (**Figure 57. 2** and **57. 4; Table 33**). The remaining artefacts were flakes or broken flakes sourced from IMT, silcrete (**Figure 57. 3**), banded chert (**Figure 57. 1**) and quartzite. The incidence of cores is reflective of the results from Bowmans Creek 2 and gives further weight to the area being used for artefact production. No formal tool types were recorded in contrast to results from nearby sites such as Bowmans Creek 5 where this activity seems to have been concentrated.

The site has been impacted by the construction of a farm house and sheds at the top of the rise (**Figure 56. 3**) as well as the farm track leading to this house. Hebden Road forms an artificial westerly boundary to the site. In addition, soil loss is evident across the site and rock outcropping is frequent indicating that the remaining soils are thin.

It is therefore assessed that there is a low likelihood that MOCO OS-10 contains further, undetected, subsurface archaeological deposits.

Figure 57: MOCO OS-10. Artefacts.

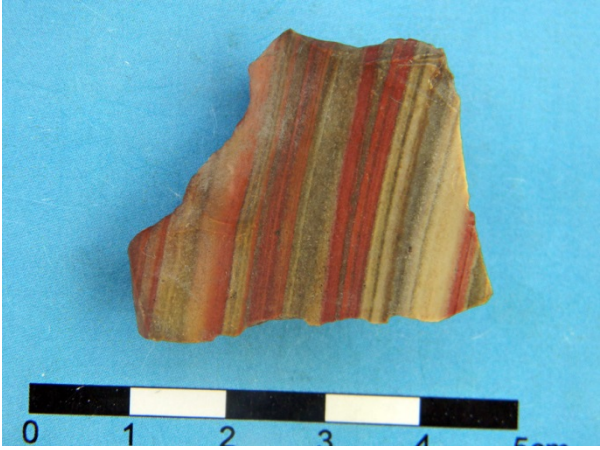
	
1. MOCO OS-10. BANDED CHERT FLAKE.	2. MOCO OS-10. VARIOUS IMT ARTEFACTS INCLUDING, TO LEFT, A CORTICAL IMT CORE.
	
3. MOCO OS-10. PINK SILCRETE FLAKE. THIS ROCK TYPE COULD HAVE BEEN SOURCED IN THE IMMEDIATE VICINITY (SEE FIGURE 54. 4).	4. MOCO OS-10. IMT CORTICAL CORE.

Table 33: MOCO OS-10. Artefacts recorded during current survey.

GDA coordinates	Artefact Class	Artefact Type	Artefact Material	Artefact Number
POINT(317821.878292 6409227.832012)	flake		IMT	1 artefact
POINT(317823.070488 6409228.089341)	fragment		IMT	2-5 artefacts
POINT(317823.287084 6409248.933978)	broken flake		Silcrete	2-5 artefacts
POINT(317821.928699 6409253.298739)	broken flake		Banded chert	1 artefact
POINT(317821.512762 6409250.693034)	fragment		IMT	1 artefact
POINT(317817.034047 6409273.584771)	flake		Quartzite	1 artefact
POINT(317818.612505 6409272.900798)	fragment		IMT	2-5 artefacts

GDA coordinates	Artefact Class	Artefact Type	Artefact Material	Artefact Number
POINT(317857.973847 6409347.880194)	fragment		IMT	1 artefact
POINT(317869.302304 6409318.114070)	broken flake		Silcrete	1 artefact
POINT(317749.197489 6409463.222204)	flake		Silcrete	1 artefact
POINT(317822.098888 6409228.590230)	flake		IMT	1 artefact
POINT(317863.343703 6409348.184667)	flake		IMT	1 artefact
POINT(317860.778383 6409367.834557)	core		IMT	1 artefact
POINT(317851.318381 6409172.648737)	core		IMT	1 artefact

MOCO OS-11 (#37-3-1199)

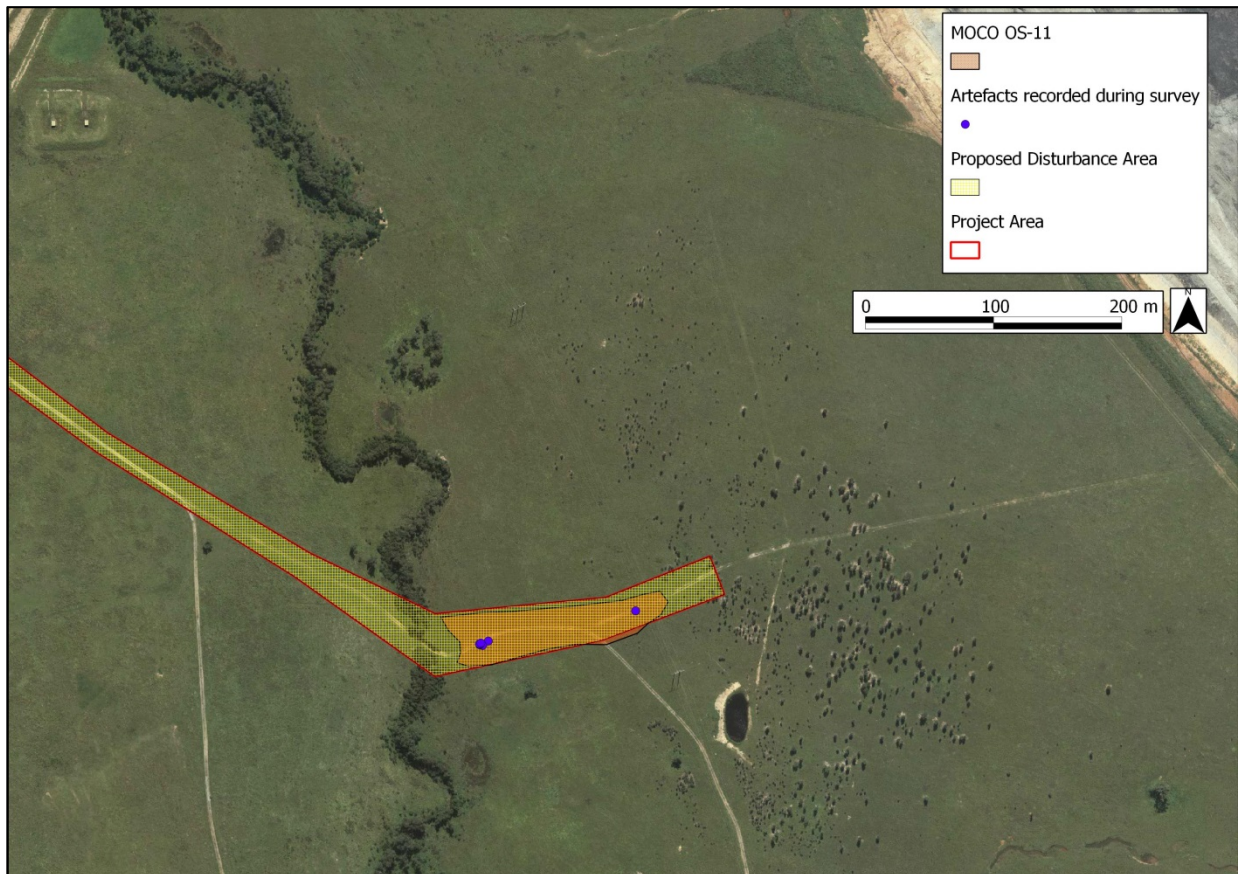
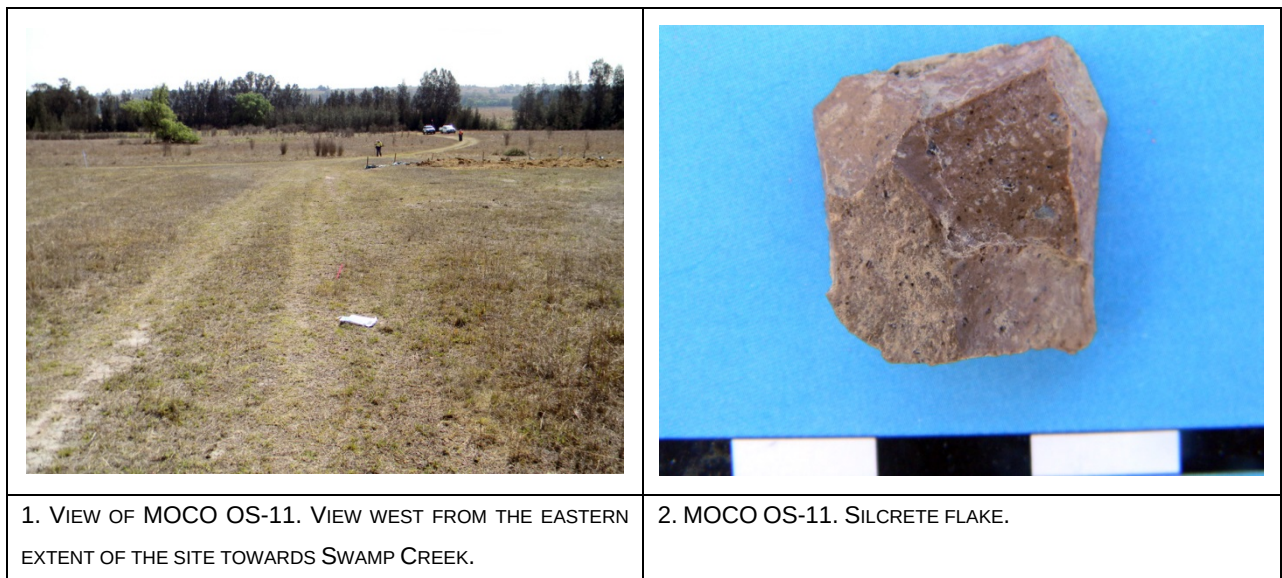
Site type: Artefact scatter

GPS Coordinates: GDA Zone 56: 318375E, 6408624N (western extent); 318541E, 6408645N (eastern extent).

Location of site: MOCO OS-11 is located on the east bank of Swamp Creek.

Description of site: MOCO OS-11 is a low density artefact scatter visible along a farm track just after the track has crossed to the eastern side of Swamp Creek. It is located mainly on the flat land immediately adjacent to Swamp Creek but also extends east on to the lower slopes (**Figure 59. 1**). MOCO OS-11 extends for 169m along the farm track (east-west) and is approximately 32m wide. This site extent is more determined by the available exposures along the track as identical and contiguous landforms are located adjacent to the site where there is little ground surface visibility.

Figure 58 shows the site extent of MOCO OS-11.

Figure 58: MOCO OS-11. Site extent.**Figure 59: MOCO OS-11. View of site location and artefact.**

No previous archaeological work has taken place within MOCO OS-11 although site #37-3-0619 is located 320m north of MOCO OS-11 in an identical landform on the east bank of Swamp Creek. This site (Swamp Creek 2) was salvaged by Umwelt in 2005/2006 through a surface collection. This collection recorded 15 artefacts (three flakes, seven broken flakes, two

broken amorphous retouched flakes, one flaked piece and two cores: 13 from mudstone, one from silcrete and the final artefact from quartz. Umwelt 2013b: 6.7 and 6.12).

11 artefacts were recorded at MOCO OS-11, the majority from IMT sources and two from silcrete sources (**Figure 59. 2; Table 34**). No formal tools or cores were recorded. Due to the location of artefacts on the farm track, most of the recorded artefacts are broken.

This low density artefact scatter is reflected in the results obtained by Umwelt at #37-3-0619 and indicates that this area of Swamp Creek was not intensively occupied and that the recorded artefacts are probably part of a general background of artefacts in such topographic areas rather than being discrete sites.

Disturbances at MOCO OS-11 are limited to vegetation clearing, stock trampling and vehicle use of the farm track.

A Horizon soil depth at MOCO OS-11 appears to be very thin due to sheet wash erosion and soil loss and it is assessed that there is a low likelihood that the site contains further subsurface archaeological deposits.

Table 34: MOCO OS-11. Artefacts recorded during current survey.

GDA coordinates	Artefact Class	Artefact Type	Artefact Material	Artefact Number
POINT(318520.644011 6408634.722472)	broken flake		IMT	1 artefact
POINT(318405.691527 6408611.178542)	broken flake		IMT	2-5 artefacts
POINT(318401.281953 6408607.724206)	broken flake		Silcrete	1 artefact
POINT(318399.023162 6408608.201852)	broken flake		IMT	2-5 artefacts
POINT(318398.907365 6408608.624001)	flake		IMT	1 artefact
POINT(318398.769769 6408608.951479)	flake		Silcrete	1 artefact
POINT(318399.904566 6408609.648586)	flake		IMT	1 artefact

6.2.2 Extensions to previously recorded sites

During the course of the survey, three locations recorded artefacts directly at the location of a previously recorded site. Two of these locations have been previously the subject of salvage programs by Umwelt that were designed to mitigate the then proposed impacts to Aboriginal cultural material by researching the sites further. The aim was never to remove every artefact from the area. Therefore, it is understandable that, with the lapse of at least five years, that further artefacts would be exposed in the vicinity of where these sites were once located. New site cards have been submitted to OEH for these sites and the information has been appended to the original site cards.

MOCO Extension to site #37-3-0649

On the lower slope landform to the north of a tributary to Bettys Creek further artefacts were recorded 25m west of the recorded location of #37-3-0649. As the new artefact recordings are in an identical, contiguous and adjacent landform, these artefacts are considered to be part of an extended #37-3-0649.

The site is along the bank of the tributary that, in this area, is broad (50m) and is better described as a former swampy depression. While much of the swamp vegetation has gone due to changes in the area's hydrology, it is not unreasonable to assume that the site bordered a swampy area located approximately 1km east of the tributary's confluence with Bettys Creek.

In September 2005 #37-3-0649 was visited to undertake a surface collection of artefacts but no artefacts were visible at the time and it was assumed that the three previously recorded artefacts had been moved off site by natural processes (**Table 35**; Umwelt 2013a: 6.7). The site was therefore listed as 'destroyed'.

Table 35: Salvaged sites (under DEC s.90 Consent #2267) within MOCO extension to site #37-3-0649.

Site #	Site Name	MGA Easting	MGA Northing	Site Type	Salvage Type	Site Description and Landscape Context
37-3-0649	BC53	322493	6411450	Artefact Scatter	Surface Collection	This site consisted of three stone artefacts spread over 50m within an area of rill erosion 100m by 10m, on the lower slope on the southern bank of a tributary of Bettys Creek. The tributary was unusually broad, forming swampy meadows at several locations, most notably at the junction with another tributary.

The results of the current survey indicate that perhaps the original coordinates for #37-3-0649 are slightly wrong or that the site extends further to the west to include the location where the artefacts were recorded during this assessment (**Figures 60 and 61**). MOCO Extension to site #37-3-0649 is therefore a continuation of a site along the northern bank of the drainage depression that is contiguous with site #37-3-0649.

A low density of 11 artefacts were recorded at MOCO Extension to site #37-3-0649 including a retouched blade (**Figure 62. 1**) and a range of broken flakes and fragments (**Figure 62. 2**; **Table 36**).

The site is located on the edge of a revegetation area and there have been ground disturbances in the form of ground preparation for planting and from vehicle movements. In the past the area would have been cleared for agricultural use and A Horizon soils across the site appear to be thin. The site is completely within the Proposed Disturbance Area.

It is therefore assessed that there is a low likelihood of there being further subsurface archaeological deposits at MOCO Extension to site #37-3-0649.

Figure 60: MOCO Extension to site #37-3-0649. Site extent.

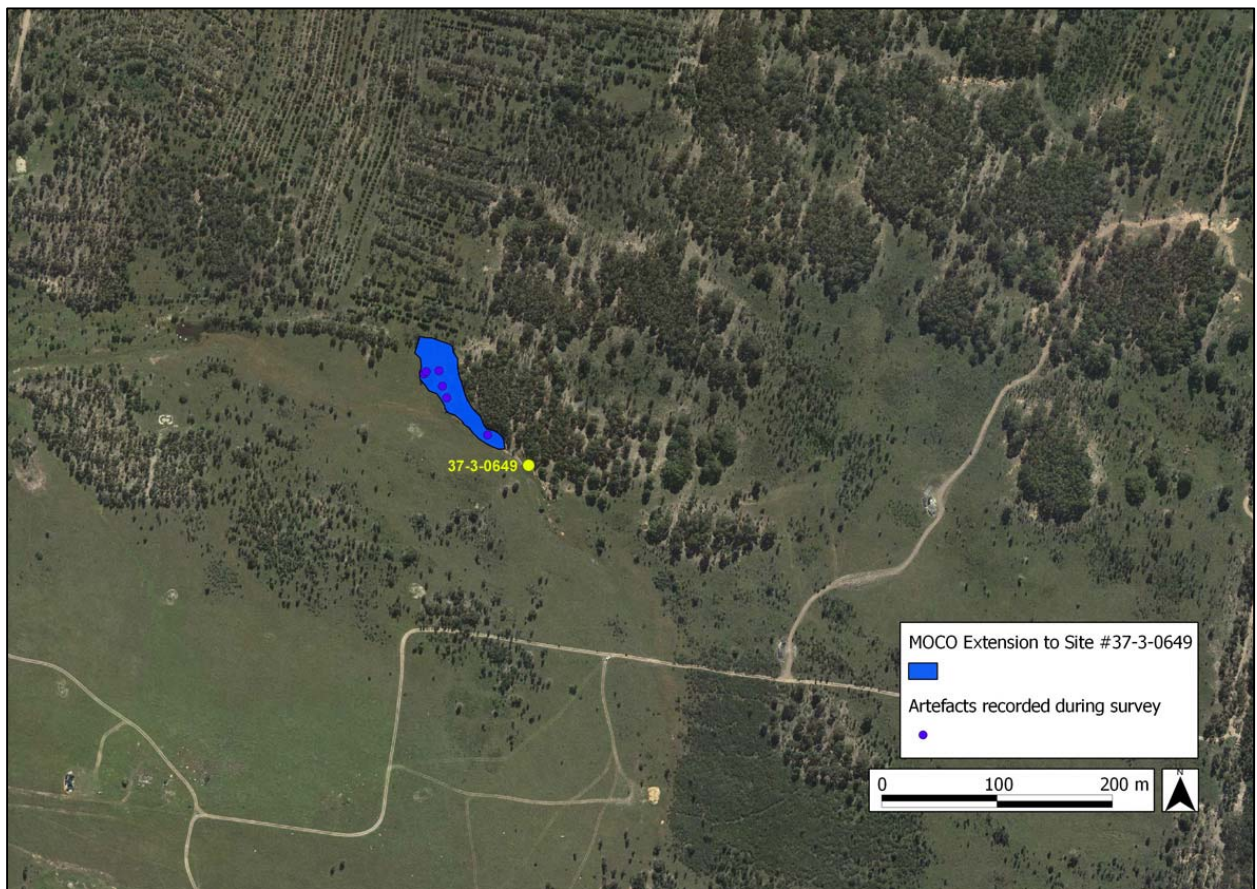


Figure 61: MOCO Extension to site #37-3-0649. View of site location.

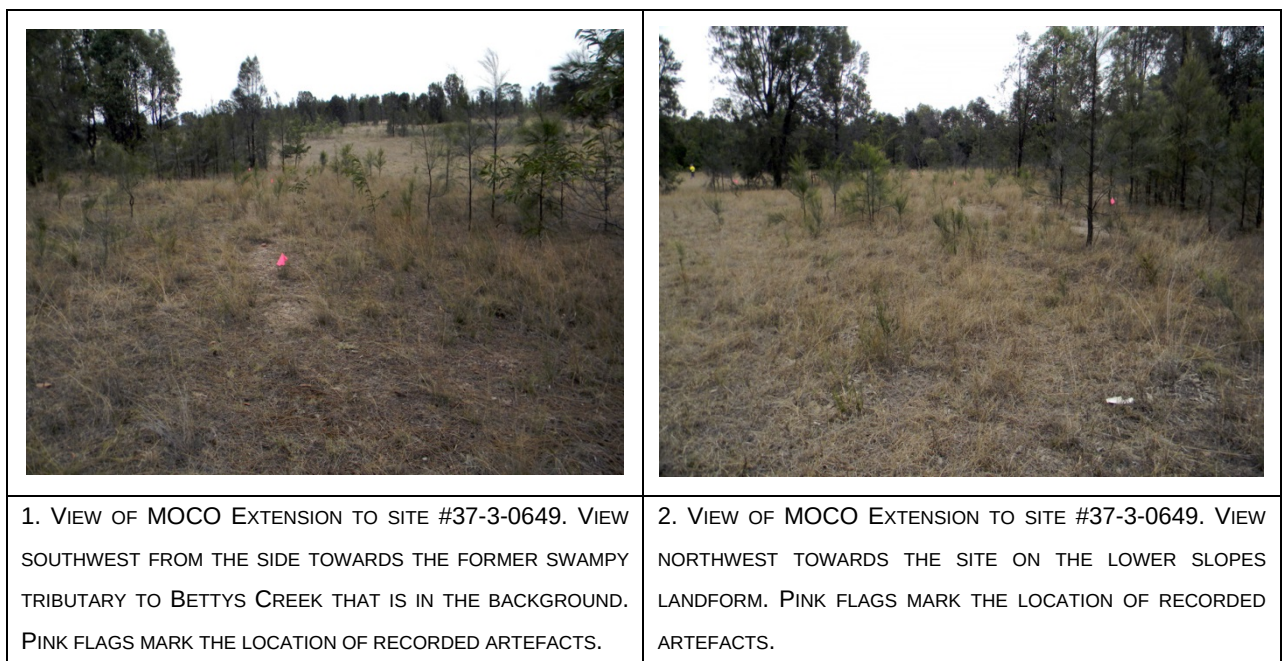


Figure 62: MOCO Extension to site #37-3-0649. Artefacts.

	
1. MOCO EXTENSION TO SITE #37-3-0649. BACKED BLADE SOURCED FROM AN INDETERMINATE ROCK SOURCE (PORCELLANITE?).	2. MOCO EXTENSION TO SITE #37-3-0649. Two IMT BROKEN FLAKES.

Table 36: MOCO Extension to site #37-3-0649. Artefacts recorded during the current survey.

GDA coordinates	Artefact Class	Artefact Type	Artefact Material	Artefact Number
POINT(322418.381056 6411527.490674)	retouched flake/blade	retouched blade	Other	1 artefact
POINT(322421.364668 6411514.103865)	broken flake		Silcrete	1 artefact
POINT(322425.096447 6411504.027089)	broken flake		Silcrete	2-5 artefacts
POINT(322405.433878 6411524.708084)	broken flake		IMT	1 artefact
POINT(322407.324509 6411526.718483)	fragment		IMT	2-5 artefacts
POINT(322460.562711 6411471.805120)	fragment		IMT	1 artefact

MOCO Extension to site #37-3-0611

Within the Proposed Disturbance Area are two previously recorded sites that are still extant. One of these is #37-3-0611: an artefact scatter on a lower slope landform where one artefact was reported to be located (**Figure 64. 1**). Two other extant artefact scatters (#37-3-0612 and #37-3-0294) to the east of #37-3-0611 are located 250m and 320m away respectively and outside the Proposed Disturbance Area.

The current survey recorded three artefacts, all broken flakes (two IMT, one silcrete), on the banks of an ephemeral tributary to Bettys Creek very close to the recorded location of #37-3-0611 (**Table 37; Figure 64 . 2**).

As the site appears to be more extensive than the original recording of #37-3-0611 these recording of these artefacts have been grouped into MOCO Extension to site #37-3-0611 (**Figure 63**).

MOCO Extension to site #37-3-0611 is a site with a very low artefact density. Approximately 15cm of A Horizon soil appears to exist at the site and while there is a possibility of further subsurface archaeological deposits, it is considered unlikely that these will be intact.

Figure 63: MOCO Extension to site #37-3-0611. Site extent.



Figure 64: MOCO Extension to site #37-3-0611. Site location and artefact.

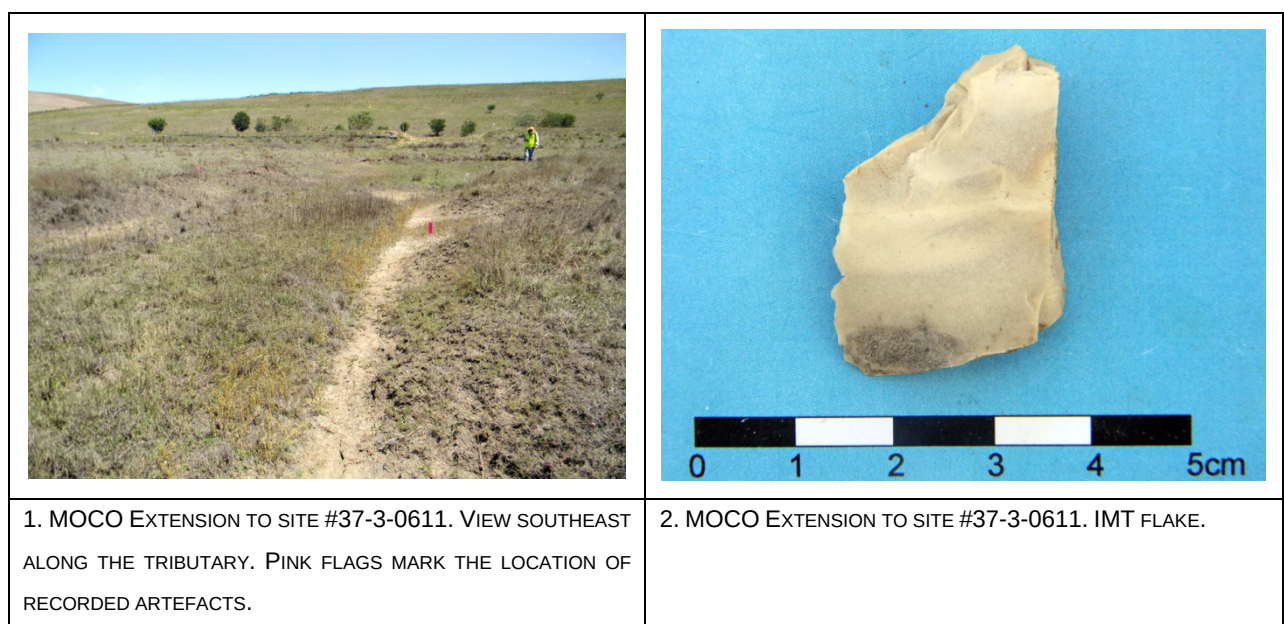


Table 37: MOCO Extension to site #37-3-0611. Artefacts recorded during the current survey.

GDA coordinates	Artefact Class	Artefact Type	Artefact Material	Artefact Number
POINT(320885.106582 6410230.266858)	broken flake		IMT	1 artefact
POINT(320859.062600 6410244.908403)	broken flake		Silcrete	1 artefact
POINT(320848.960216 6410245.828963)	broken flake		IMT	1 artefact

MOCO Extension to site #37-3-0600

On the east bank of Bettys Creek site #37-3-0600 (Bettys Creek 10) was salvaged by manual excavation during 2005/2006 (Umwelt 2013b). Site #37-3-0600 had, in its turn, incorporated Brayshaw's site GC-D.

The salvage program collected 162 artefacts from the surface artefact collection component of the study, and in an archaeological excavation that covered 40m², 274 artefacts were recorded (Table 38).

During the current survey, a further 19 artefacts were recorded in adjacent areas to the Umwelt excavation that was still visible in the field. Artefacts were also recorded on lower slope landforms up to 50m from the edge of the riparian corridor where #37-3-0600 is located (Figure 65 and 66). With the evidence of extant artefacts at #37-3-0600 and a larger site area, these artefacts are grouped as part of MOCO Extension to site #37-3-0600.

Figure 65: MOCO Extension to site #37-3-0600. View of site location.

	
1. MOCO EXTENSION TO SITE #37-3-0600. VIEW SOUTH AT THE EDGE OF THE RIPARIAN CORRIDOR WHERE #37-3-0600 IS LOCATED. UMWELT'S 2005/2006 TRENCH IS LOCATED AT THE EXPOSURE IN THE MID-DISTANCE BEYOND WHERE PINK FLAGS MARK THE LOCATION OF RECORDED ARTEFACTS IN 2012.	2. MOCO EXTENSION TO SITE #37-3-0600. THE LOCATION OF A RECORDED ARTEFACT IS MARKED BY A PINK FLAG. THIS IS AN EXAMPLE OF THE LOW DENSITY OF ARTEFACTS LOCATED UP TO 50M EAST FROM THE RIPARIAN CORRIDOR.

Figure 66: MOCO Extension to site #37-3-0600. Site extent.**Table 38: Salvaged sites (under DEC s.90 Consent #2267) within MOCO Extension to site #37-3-0600.**

Site #	Site Name	MGA Easting	MGA Northing	Site Type	Salvage Type	Landform	Salvage results
37-3-0600 (incorporating Brayshaw's [1981, 1982] Site GC-D)	Bettys Creek 10	320994	6408230	Artefact Scatter	Surface Collection with Subsurface Investigation (manual excavation)	Elevated area between Bettys Creek and a tributary – 30m from main channel.	Surface collection at BC10 = 162 artefacts Manual excavation = total of 274 artefacts were recovered from 40m ² excavated at Bettys Creek 10, a density of 6.85 artefacts a square metre. The square with the highest artefact density was U with 65 artefacts. In general the rest of the squares excavated had low artefact numbers.

Artefacts recorded during the current survey included a range of IMT, quartz and quartzite flakes and broken flakes (**Figure 67; Table 39**). Most of the artefacts recorded along the edge of the riparian corridor were located in sizeable exposures created by localised erosion. Away from the riparian corridor the ground surface visibility was much lower due to grass cover although farm tracks and natural bare patches afforded infrequent views of the ground surface.

The 2005/2006 excavations by Umwelt demonstrated that a shallow (15cm) soil depth remains in the area and that there is the possibility for subsurface deposits. However, the Umwelt excavations recorded that the average artefact density of just under seven artefacts per square metre: a low artefact density. So while there may be remaining subsurface archaeological deposits at MOCO Extension to site #37-3-0600, these deposits are likely to contain a low artefact density and, from the evidence of the previous archaeological excavation, are likely to lack stratigraphy and integrity.

Figure 67: MOCO Extension to site #37-3-0600. Artefacts.

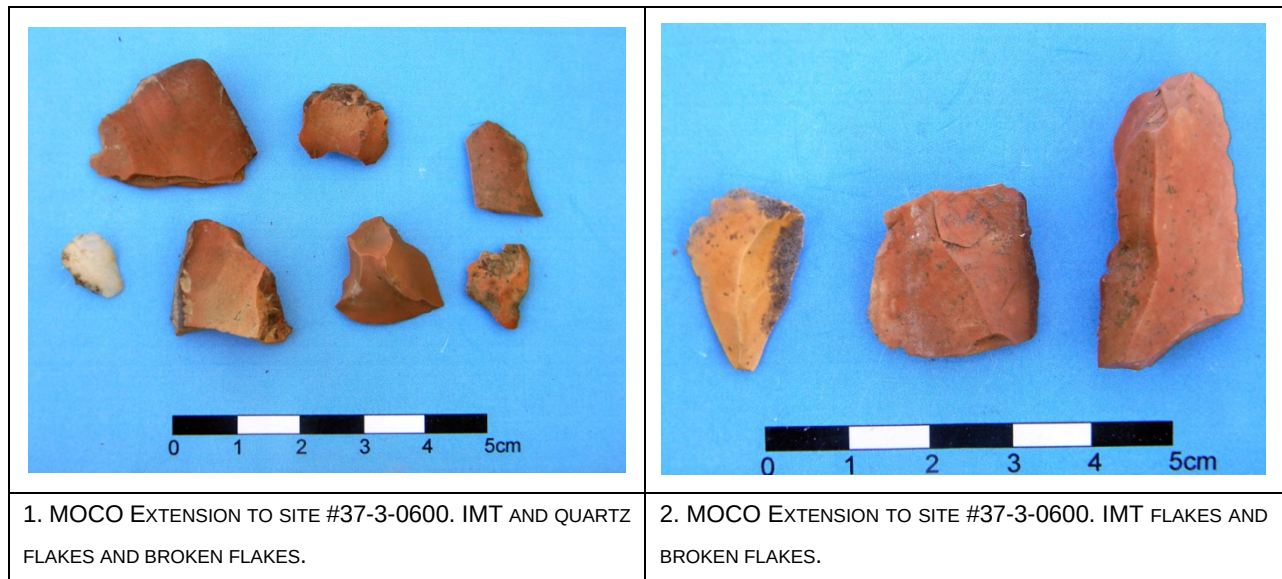


Table 39: MOCO Extension to site #37-3-0600. Artefacts recorded during the current survey.

GDA coordinates	Artefact Class	Artefact Type	Artefact Material	Artefact Number
POINT(321080.651477 6408223.769284)	flake		IMT	1 artefact
POINT(321062.653675 6408209.664791)	flake		IMT	1 artefact
POINT(321060.873820 6408206.108830)	flake		IMT	1 artefact
POINT(321053.581107 6408196.329452)	flake		IMT	1 artefact
POINT(321030.982212 6408249.851706)	flake		IMT	1 artefact
POINT(321001.387735 6408235.407164)	flake		Quartz	1 artefact
POINT(321002.412812 6408236.989306)	broken flake		IMT	2-5 artefacts
POINT(321002.697882 6408237.615498)	fragment		IMT	2-5 artefacts
POINT(321006.651716 6408245.169801)	flake		IMT	1 artefact
POINT(321015.729682 6408248.711768)	fragment		Quartzite	2-5 artefacts
POINT(321052.177582 6408259.385485)	flake		IMT	1 artefact

6.2.3 Isolated finds

25 isolated finds were recorded as a result of the current survey. The location of these sites is shown in **Figure 68** and **Table 40**. Details concerning these sites follow.

Figure 68: Location of all newly recorded isolated finds.

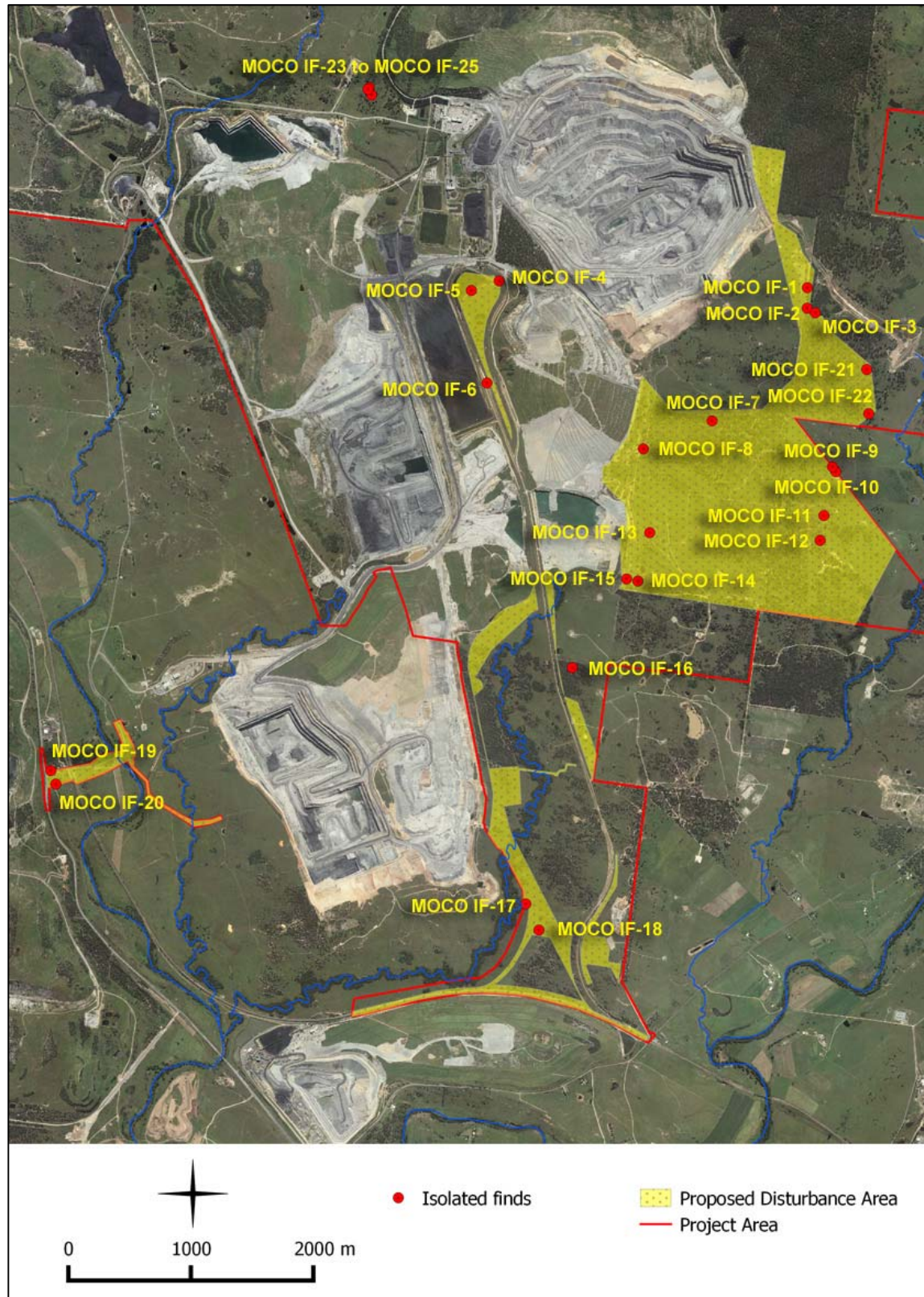


Table 40: Isolated finds recorded during the current survey.

Site designation	GDA Zone 56 Easting	GDA Zone 56 Northing	Survey unit	Landform
MOCO IF-1	323360	6412985	1	Mid slope
MOCO IF-2	323359	6412818	1	Mid slope
MOCO IF-3	323425	6412780	1	Mid slope
MOCO IF-4	320849	6413041	4	Flat
MOCO IF-5	320622	6412962	4	Flat
MOCO IF-6	320749	6412208	4	Flat
MOCO IF-7	322584	6411899	1	Mid slope
MOCO IF-8	322024	6411670	1	Lower slope
MOCO IF-9	323565	6411524	1	Lower slope
MOCO IF-10	323593	6411485	1	Lower slope
MOCO IF-11	323496	6411126	1	Mid slope
MOCO IF-12	323465	6410924	1	Mid slope
MOCO IF-13	322076	6410987	1	Lower slope
MOCO IF-14	321888	6410609	1	Flat
MOCO IF-15	321979	6410591	1	Flat
MOCO IF-16	321445	6409885	2	Flat
MOCO IF-17	321066	6407957	2	Flat
MOCO IF-18	321173	6407744	2	Lower slope
MOCO IF-19	317195	6409045	3	Mid slope
MOCO IF-20	317236	6408936	3	Mid slope
MOCO IF-21	323845	6412318	5	Mid slope
MOCO IF-22	323861	6411957	5	Mid slope
MOCO IF-23	319809	6414557	6	Lower slope
MOCO IF-24	319791	6414618	6	Flat
MOCO IF-25	319780	6414604	6	Flat

MOCO IF-1 (#37-3-1170)

MOCO IF-1 is a well-worked IMT single platform core that was noted, largely buried, on a track that gives access to the northern parts of the mining lease. The core has over fifteen flake removals although the core is not completely exhausted (**Figure 69**; for location see **Table 40** and **Figure 68**).

MOCO IF-1 is located in an area of generally high disturbance where large areas near the site are modified. The site is on mid slopes and within 150m of the ridge line. Further artefacts (MOCO IF-2 and MOCO IF-3) were recorded closer to the ridge. These sites indicate use of this ridge area that would have been traversed when moving from the Bettys Creek catchment to the more-easterly Main Creek catchment.

It is assessed that there is A Horizon soil depth at the site, although due to the disturbances in the area, it is unlikely that the site is associated with intact archaeological deposits. It is also possible that the artefact has been redeposited at its present location from further upslope.

Figure 69: MOCO IF-1. Location and Artefact.

	
1. THE LOCATION OF MOCO IF-1 IS MARKED BY THE PINK FLAG.	2. MOCO IF-1. IMT SINGLE PLATFORM CORE.

MOCO IF-2 (#37-3-1171)

MOCO IF-2 is a silcrete flake that was recorded in an area of converging tracks in mid slope landforms close to a localised ridge area (**Figure 70**; for location see **Table 40** and **Figure 68**).

MOCO IF-2 is located in an area of generally high disturbance where large areas near the site are much modified. Further artefacts (MOCO IF-1 and MOCO IF-3) were recorded on or near this location. These sites indicate use of this ridge area that would have been traversed when moving from the Bettys Creek catchment to the more-easterly Main Creek catchment.

It is assessed that there is A Horizon soil depth at the site, although due to the disturbances in the area, it is unlikely that the site is associated with intact archaeological deposits.

Figure 70: MOCO IF-2. Location and Artefact.

	
1. THE LOCATION OF MOCO IF-2 IS MARKED BY THE PINK FLAG.	2. MOCO IF-2. SILCRETE FLAKE.

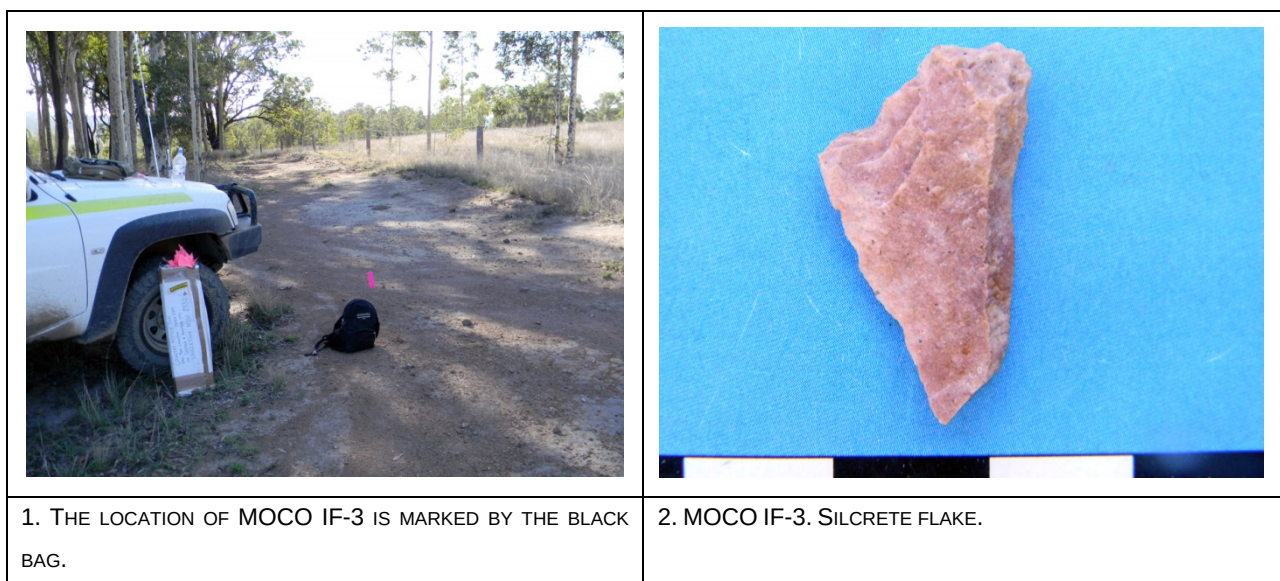
MOCO IF-3 (#37-3-1172)

MOCO IF-3 is a silcrete flake that was recorded on a track on a crest within mid slope landforms (**Figure 71**; for location see **Table 40** and **Figure 68**).

MOCO IF-3 is located in an area of generally high disturbance as the track is well-used and graded. Further artefacts (MOCO IF-1 and MOCO IF-2) were recorded on or near this location. These sites indicate use of this ridge area that would have been traversed when moving from the Bettys Creek catchment to the more-easterly Main Creek catchment.

It is assessed that there is A Horizon soil depth at the site, although it is unlikely that the site is associated with intact subsurface archaeological deposits.

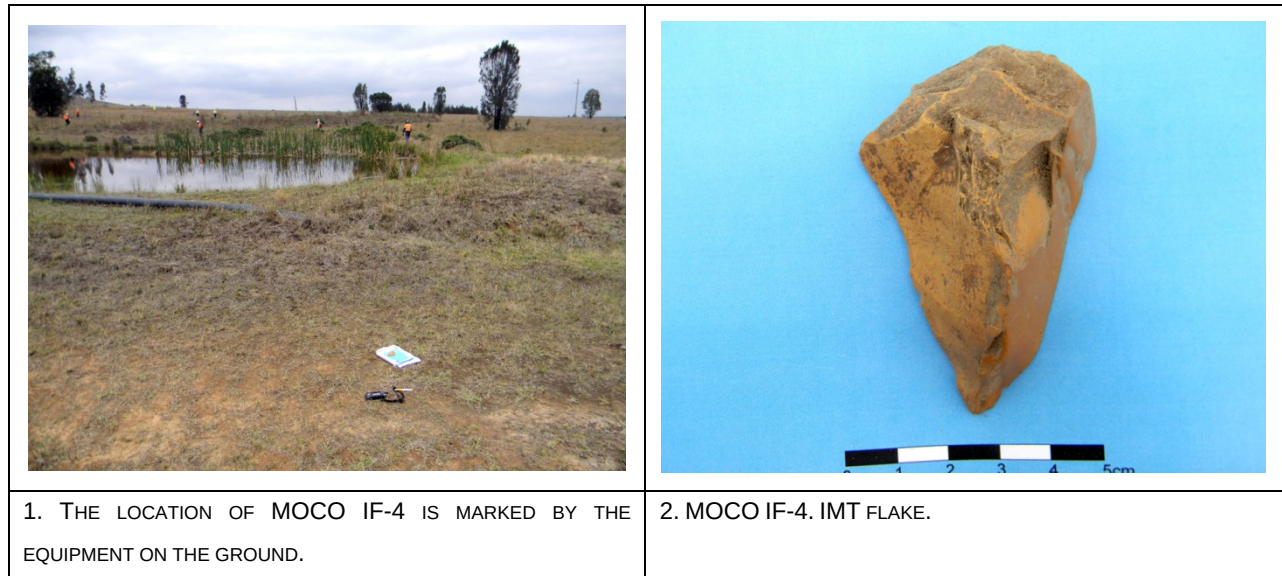
Figure 71: MOCO IF-3. Location and Artefact.

**MOCO IF-4 (#37-3-1173)**

MOCO IF-4 is an IMT flake that was recorded on generally flat land at the north of the existing Mount Owen rail spur in the bank area of a large storage dam (**Figure 72**; for location see **Table 40** and **Figure 68**).

MOCO IF-4 is located in an area of high disturbance due to the construction of a nearby dam and the Mount Owen rail spur. Before modification by mining activities the area of MOCO IF-4 would have been an ephemeral waterway. MOCO IF-4 is in the same landform as MOCO IF-5.

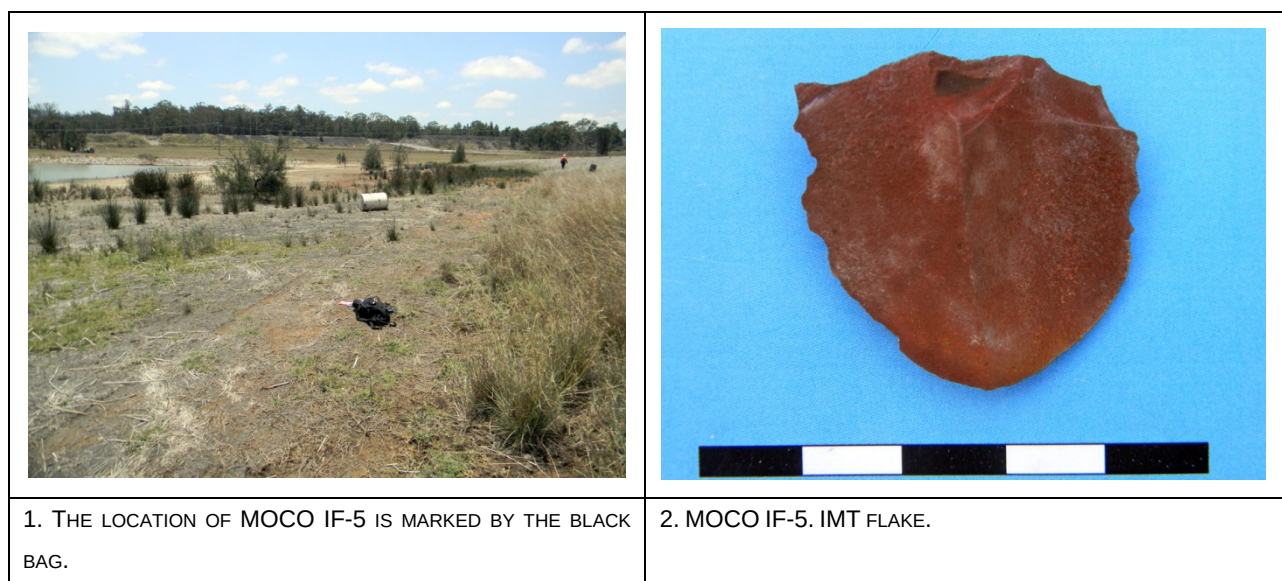
It is assessed that there is little A Horizon soil depth at the site and it is unlikely that the site is associated with intact subsurface archaeological deposits due to the disturbances that have occurred in the area.

Figure 72: MOCO IF-4. Location and Artefact.**MOCO IF-5 (#37-3-1174)**

MOCO IF-5 is an IMT flake that was recorded on generally flat land at the north of the existing Mount Owen rail spur in the bank area of a large storage dam (**Figure 73**; for location see **Table 40** and **Figure 68**).

MOCO IF-5 is located in an area of high disturbance due to the construction of a nearby dam and the Mount Owen rail spur. Before modification by mining activities the area of MOCO IF-5 would have been an ephemeral waterway. MOCO IF-5 is in the same landform as MOCO IF-4.

There is little A Horizon soil depth at the site and it is subject to erosion from variable dam levels. It is assessed that the site is not associated with subsurface archaeological deposits.

Figure 73: MOCO IF-5. Location and Artefact.

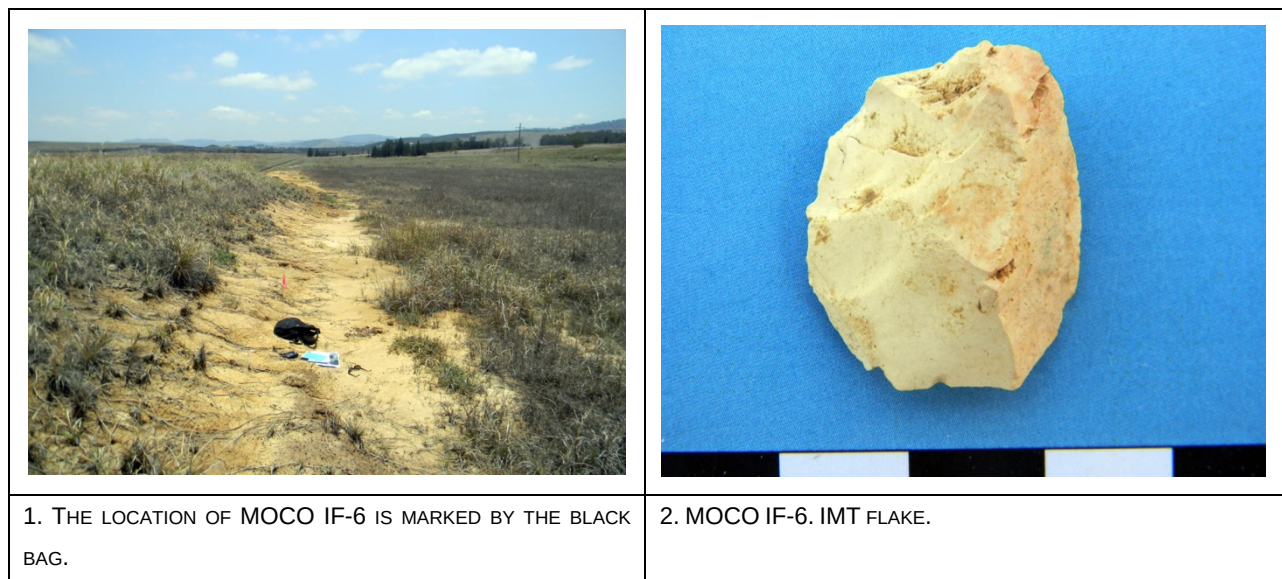
MOCO IF-6 (#37-3-1175)

MOCO IF-6 is an IMT flake that was recorded in flat landform at the edge of a bank for the existing Mount Owen rail spur (**Figure 74**; for location see **Table 40** and **Figure 68**).

MOCO IF-6 is located in an area of high disturbance due to the construction of the Mount Owen rail spur.

There is little A Horizon soil depth at the site and the general area has been subject modification by mining activities and erosion. It is assessed that the site is not associated with subsurface archaeological deposits.

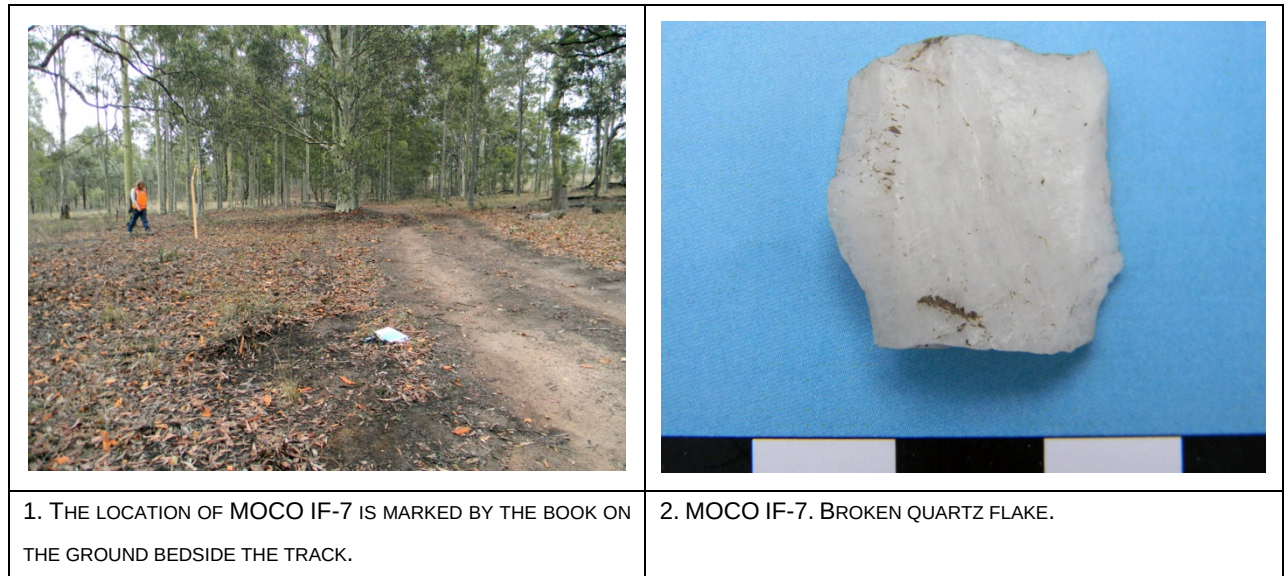
Figure 74: MOCO IF-6. Location and Artefact.

**MOCO IF-7 (#37-3-1176)**

MOCO IF-7 is a broken quartz flake recorded in a mid slope landform at the edge of a vehicle track (**Figure 75**; for location see **Table 40** and **Figure 68**). The flake is well-knapped from a fine-grained milky quartz and displays parallel dorsal ridge lines.

MOCO IF-7 is located in an area of low disturbance although the area has been cleared in the past and is now within revegetated woodland. The track nearby to MOCO IF-7 is reasonably well-used and occasionally graded.

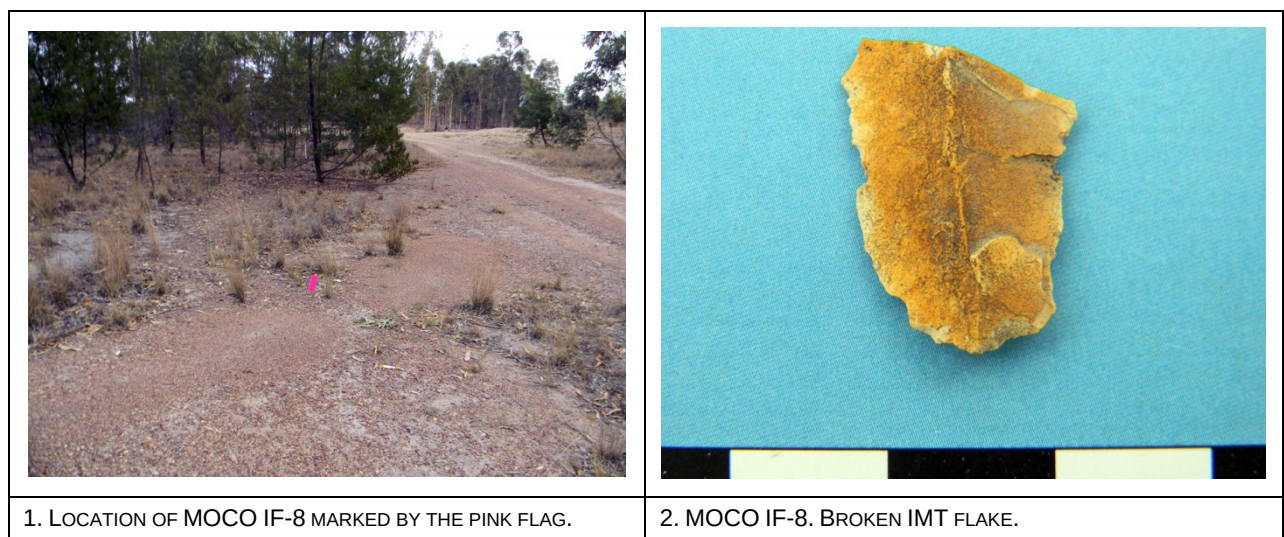
There is A Horizon soil depth at the site although a concerted examination of adjacent areas failed to locate further artefacts. It is therefore assessed that the site is not associated with further artefacts or subsurface archaeological deposits.

Figure 75: MOCO IF-7. Location and Artefact.**MOCO IF-8 (#37-3-1177)**

MOCO IF-8 is a broken IMT flake recorded in a lower slope landform at the edge of a vehicle track 40m east of the Bettys Creek diversion (**Figure 76**; for location see **Table 40** and **Figure 68**). The site is approximately 120m southeast of MOCO OS-3. MOCO IF-8 is located at the base of slopes that would have overlooked Bettys Creek from the east.

MOCO IF-8 is located in an area of moderate disturbance as it is adjacent to a well-used vehicle track (the track is a gazetted road and a nearby European blaze tree suggests a long history of use for this track). Nearby areas have been revegetated although the immediate area around MOCO IF-8 has not been planted.

There is thin A Horizon soil depth at the site and it is assessed that the site is not associated with further artefacts or subsurface archaeological deposits.

Figure 76: MOCO IF-8. Location and Artefact.

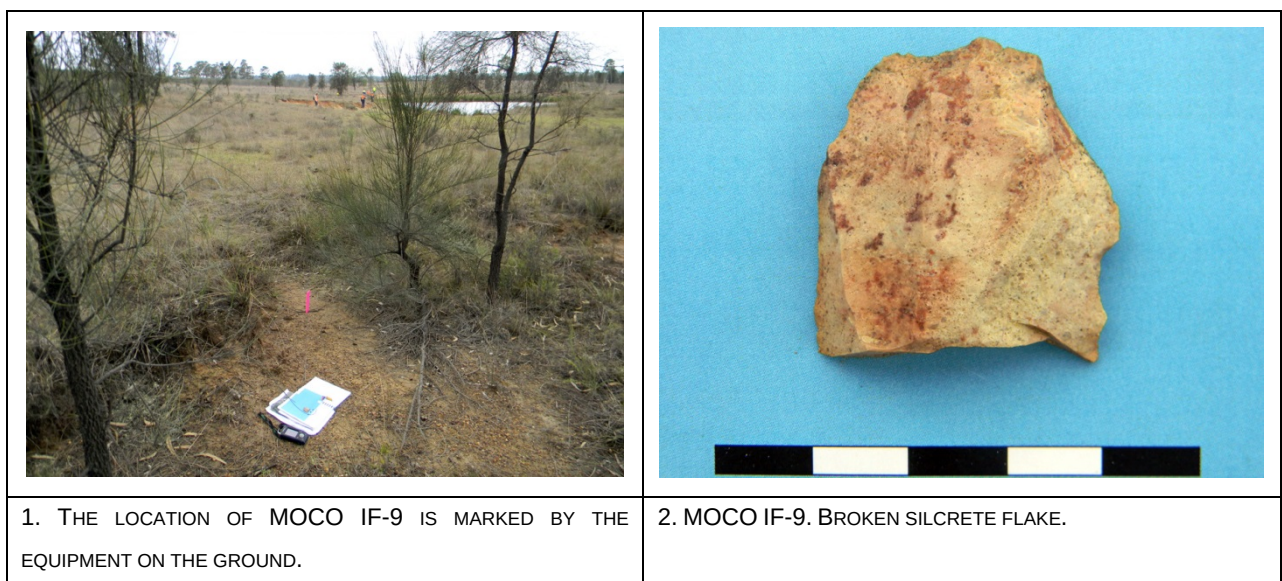
MOCO IF-9 (#37-3-1178)

MOCO IF-9 is a broken silcrete flake recorded in a lower slope landform on the bank of a dry gully leading to a farm dam (**Figure 77**; for location see **Table 40** and **Figure 68**).

MOCO IF-9 is located in an area of low disturbance apart from vegetation clearing and use by stock.

There is up to 15cm of A Horizon soil depth at the site and although an intensive examination of surrounding areas with good exposure visibility was undertaken, no further artefacts were recorded. It is therefore assessed that the site is not associated with further artefacts or subsurface archaeological deposits.

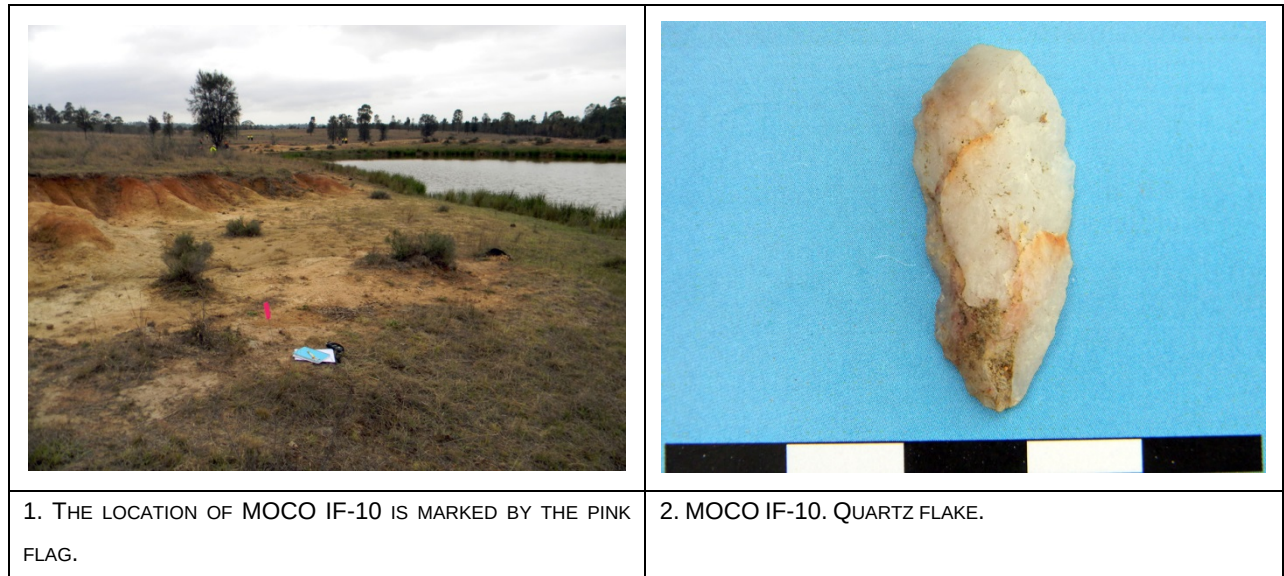
Figure 77: MOCO IF-9. Location and Artefact.

**MOCO IF-10 (#37-3-1179)**

MOCO IF-10 is a quartz flake recorded in a lower slope landform on the banks of a farm dam (**Figure 78**; for location see **Table 40** and **Figure 68**).

MOCO IF-10 is located in an area of high disturbance from water that flows into the dam and it is likely the artefact is redeposited at its present location.

There is no A Horizon soil depth at the site and it is assessed that the site is not associated with further artefacts or subsurface archaeological deposits.

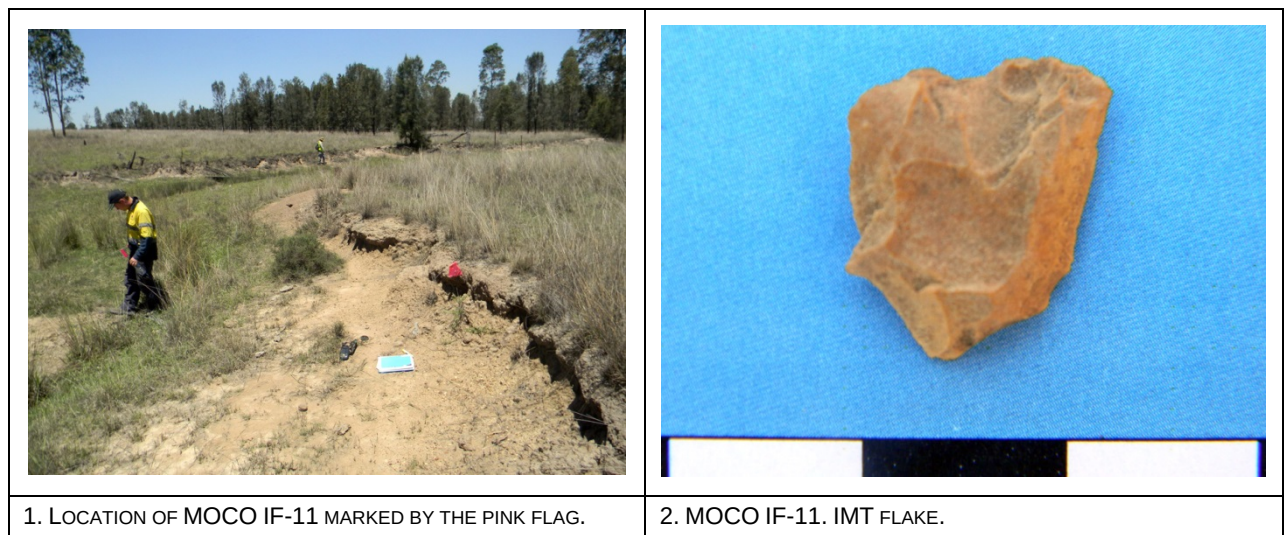
Figure 78: MOCO IF-10. Location and Artefact.

MOCO IF-11 (#37-3-1180)

MOCO IF-11 is an IMT flake recorded in a mid slope landform on the banks of what is now a gully that forms the headwaters for the eastern drainage on which, to the south, MOCO OS-4 is located (**Figure 79**; for location see **Table 40** and **Figure 68**). This gully is a result of recent erosion and formerly the area would have been a depression without a banked drainage feature as appears today.

MOCO IF-11 is located in an area of moderate disturbance from past agricultural use of the area including vegetation clearing, stock use and erosion.

There is shallow A Horizon soil depth at the site and although a targeted inspection of surrounding areas was made, no further artefacts were recorded. It is therefore assessed that the site is not associated with further artefacts or subsurface archaeological deposits.

Figure 79: MOCO IF-11. Location and Artefact.

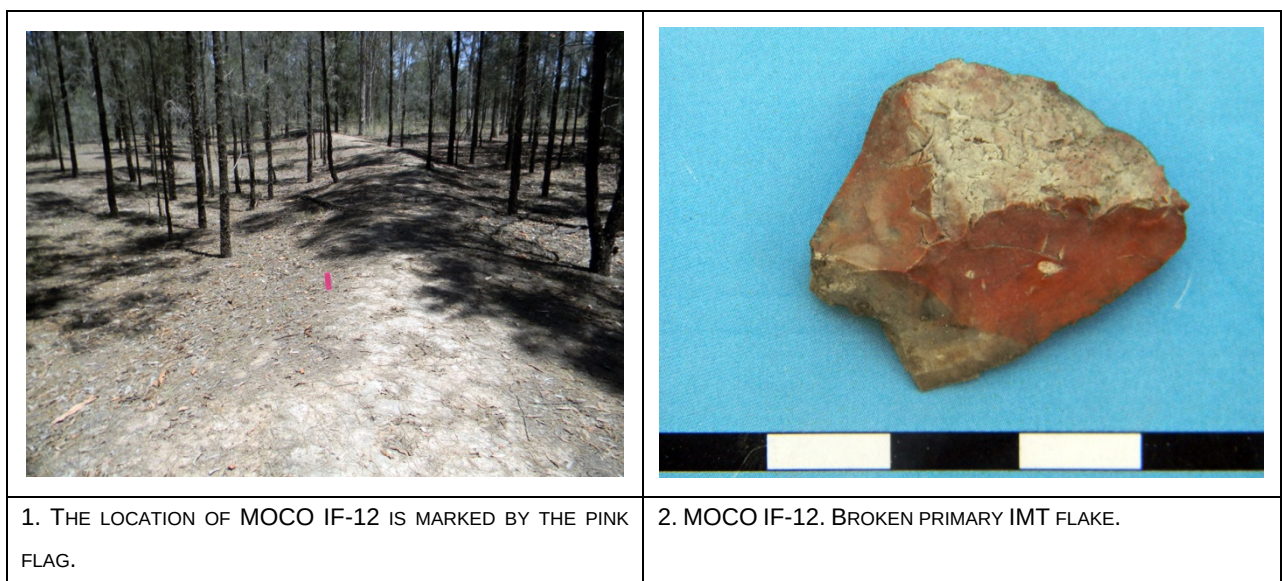
MOCO IF-12 (#37-3-1181)

MOCO IF-12 is a broken IMT primary flake recorded in a mid slope landform on the banks of an water conservation bund in the headwater regions for the eastern drainage (**Figure 80**; for location see **Table 40** and **Figure 68**).

MOCO IF-12 is located in an area of generally low disturbance apart from past agricultural use of the area including vegetation clearing, stock use and bund construction.

There is shallow A Horizon soil depth at the site and although a targeted inspection of surrounding areas was made, no further artefacts were recorded. It is therefore assessed that the site is not associated with further artefacts or subsurface archaeological deposits.

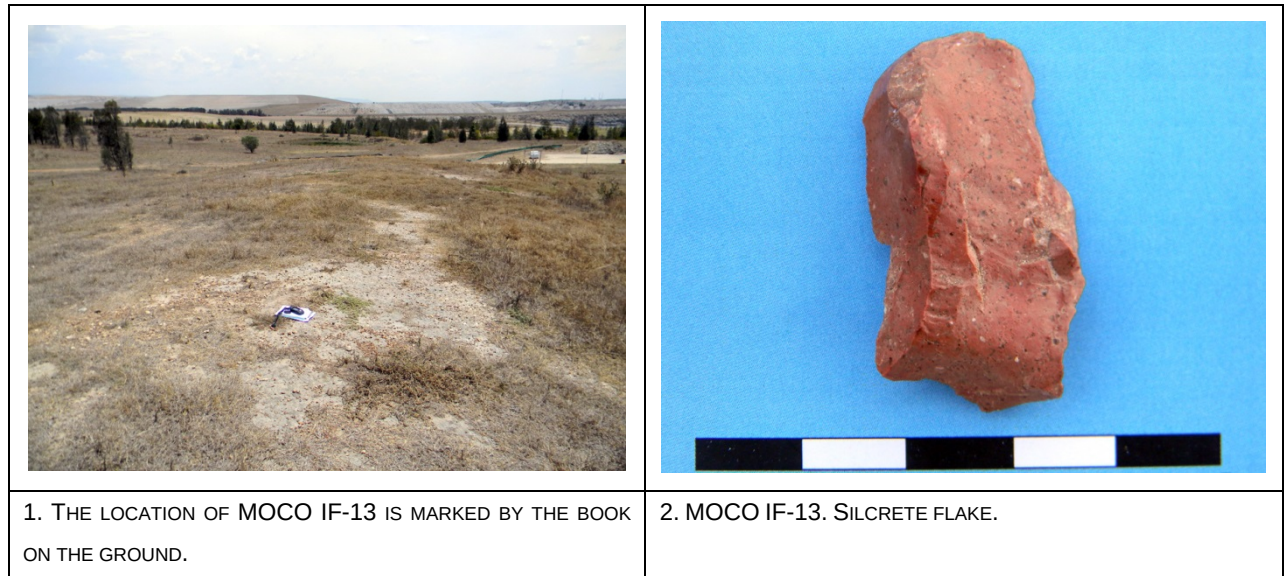
Figure 80: MOCO IF-12. Location and Artefact.

**MOCO IF-13 (#37-3-1182)**

MOCO IF-13 is a silcrete flake recorded in a lower slope landform approximately 500m east of Bettys Creek (**Figure 81**; for location see **Table 40** and **Figure 68**).

MOCO IF-13 is located in an area of generally low disturbance apart from past agricultural use of the area including vegetation clearing, stock use and sheet wash erosion leading to soil loss.

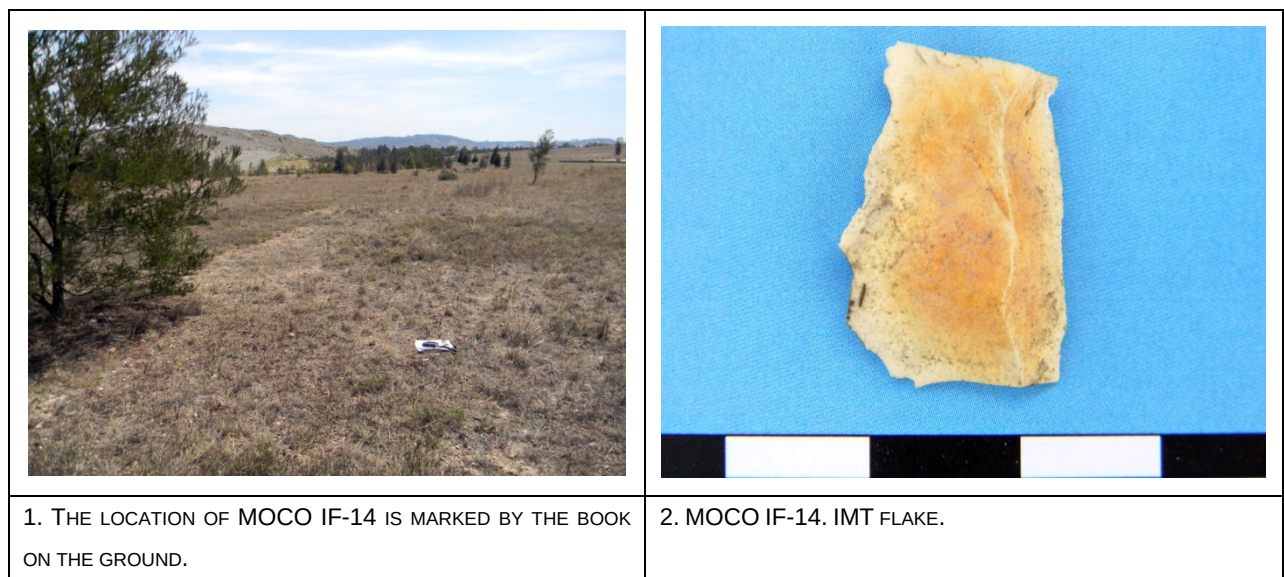
There is thin A Horizon soil depth at the site and it is assessed that the site is not associated with further artefacts or subsurface archaeological deposits.

Figure 81: MOCO IF-13. Location and Artefact.**MOCO IF-14 (#37-3-1183)**

MOCO IF-14 is an IMT flake recorded in a generally flat landform approximately 500m east of Bettys Creek (**Figure 82**; for location see **Table 40** and **Figure 68**).

MOCO IF-14 is located in an area of generally low disturbance apart from past agricultural use of the area including vegetation clearing, stock use and sheet wash erosion leading to soil loss.

There is thin A Horizon soil depth at the site and it is assessed that the site is not associated with further artefacts or subsurface archaeological deposits.

Figure 82: MOCO IF-14. Location and Artefact.

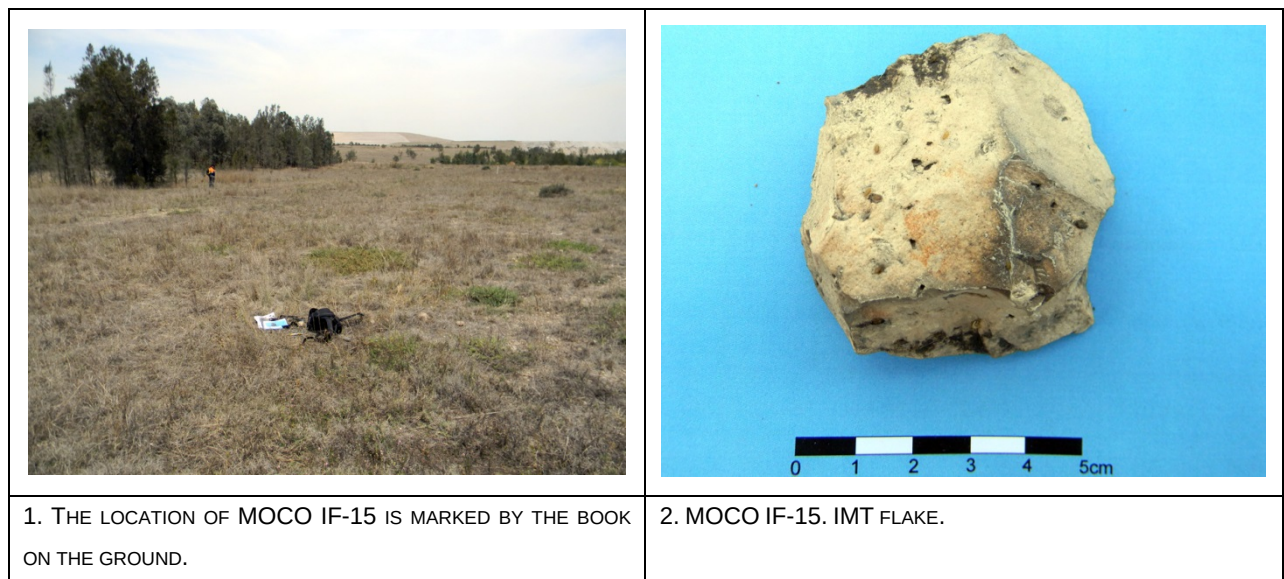
MOCO IF-15 (#37-3-1184)

MOCO IF-15 is a large silcrete flake (or possibly a core fragment) recorded in a flat landform close to lower slopes approximately 600m east of Bettys Creek (**Figure 83**; for location see **Table 40** and **Figure 68**).

MOCO IF-15 is located in an area of generally low disturbance apart from past agricultural use of the area including vegetation clearing, stock use and sheet wash erosion leading to soil loss.

There is thin A Horizon soil depth at the site and it is assessed that the site is not associated with further artefacts or subsurface archaeological deposits.

Figure 83: MOCO IF-15. Location and Artefact.

**MOCO IF-16 (#37-3-1185)**

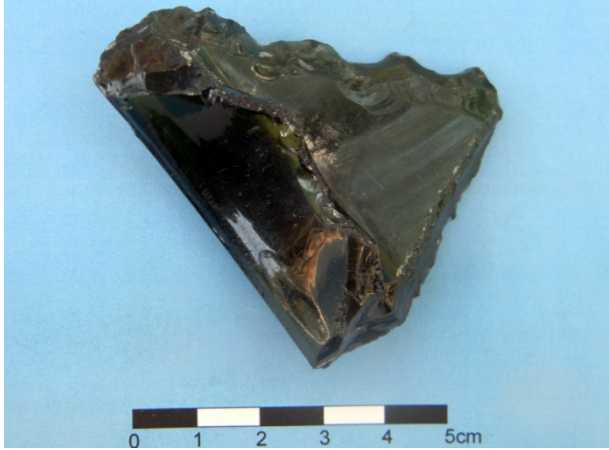
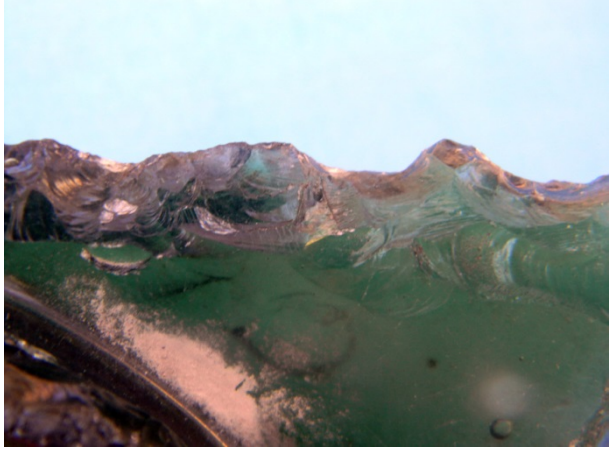
MOCO IF-16 is a fine example of a knapped glass artefact. It was recorded in a flat landform approximately 550m east of Bettys Creek (**Figure 84**; for location see **Table 40** and **Figure 68**).

MOCO IF-16 is located in an area of generally low disturbance arising from past agricultural use of the area and today the site is within regenerating Casuarina woodland.

The artefact is undeniably knapped and has an intensively knapped scraping edge and 'nibble' retouch along both margins to blunt these edges for ease of use. The antiquity of the green glass is unknown and the artefact remains in the field precluding further studies at this time.

There is thin A Horizon soil depth at the site and although an intensive inspection was made no further glass (knapped or otherwise) or stone artefacts were observed. It is therefore assessed that the site is not associated with further artefacts or subsurface archaeological deposits.

Figure 84: MOCO IF-16. Location and artefact.

	
1. THE LOCATION OF MOCO IF-16 IS MARKED BY THE GROUP OF PEOPLE.	2. MOCO IF-16. FULL VIEW. NOTE BLUNTING ALONG BOTH MARGINS TO ENABLE THE TOOL TO BE HELD WHILE USING THE SCRAPING EDGE AT TOP.
	
3. MOCO IF-16. DETAIL VIEW OF RETOUCH. BLUNTING ON LEFT MARGIN IS CLOSEST TO CAMERA (LEFT).	4. MOCO IF-16. DETAIL OF RETOUCH ALONG THE SCRAPING EDGE.

MOCO IF-17 (#37-3-1186)

MOCO IF-17 is a moderately sized IMT cortical core recorded in a flat landform immediately adjacent to the riparian corridor of Bettys Creek (**Figure 85**; for location see **Table 40** and **Figure 68**). The core has at least five flake removals and it has been rotated to utilise available platforms.

MOCO IF-17 is located in an area of moderate disturbance including past agricultural use and recent ground disturbances (ripping) for revegetation.

There is A Horizon soil depth at the site although this stratum has been extensively impacted by ripping / ploughing. It is therefore assessed that the site is not associated with further artefacts or intact subsurface archaeological deposits.

Figure 85: MOCO IF-17. Location and Artefact.

	
1. THE LOCATION OF MOCO IF-17 IS MARKED BY THE BOOK ON THE GROUND.	2. MOCO IF-17. IMT CORE.

MOCO IF-18 (#37-3-1211)

MOCO IF-18 is a large IMT flake recorded in a lower slope landform approximately 250m east of Bettys Creek (**Figure 86**; for location see **Table 40** and **Figure 68**).

MOCO IF-18 is located in an area of moderate disturbance including past agricultural use and recent ground disturbances (ripping) for revegetation.

There is A Horizon soil depth at the site although this stratum has been extensively impacted by ripping / ploughing. It is therefore assessed that the site is not associated with further artefacts or intact subsurface archaeological deposits.

Figure 86: MOCO IF-18. Location and Artefact.

	
1. THE LOCATION OF MOCO IF-18 IS MARKED BY THE PINK FLAG.	2. MOCO IF-18. SILCRETE FLAKE.

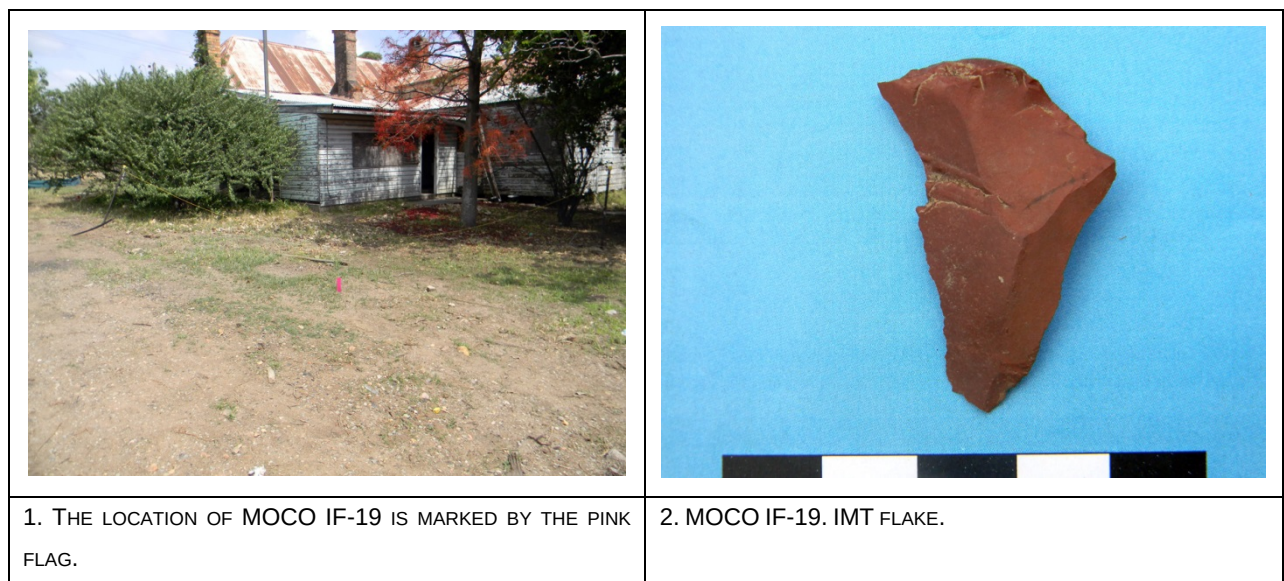
MOCO IF-19 (#37-3-1187)

MOCO IF-19 is a IMT flake recorded in a mid slope landform approximately 600m west of Bowmans Creek and 35m east of the New England Highway (**Figure 87**; for location see **Table 40** and **Figure 68**).

MOCO IF-19 is located in an area of high disturbance as it is located in the yard for the old Ravensworth school building. This area has had repeated use over many years and it is entirely possible that the artefact has been redeposited here at some point. However, it should be noted that MOCO IF-20 is located in the same landform on the other side of Hebden Road so perhaps the small settlement of Ravensworth (of which only two buildings and various foundations remain) was constructed within a low density artefact scatter on the low slopes overlooking the Bowmans Creek floodplain.

There is A Horizon soil depth at the site although, due to disturbances at the site, it is assessed that the site is not associated with further artefacts or intact subsurface archaeological deposits.

Figure 87: MOCO IF-19. Location and Artefact.

**MOCO IF-20 (#37-3-1188)**

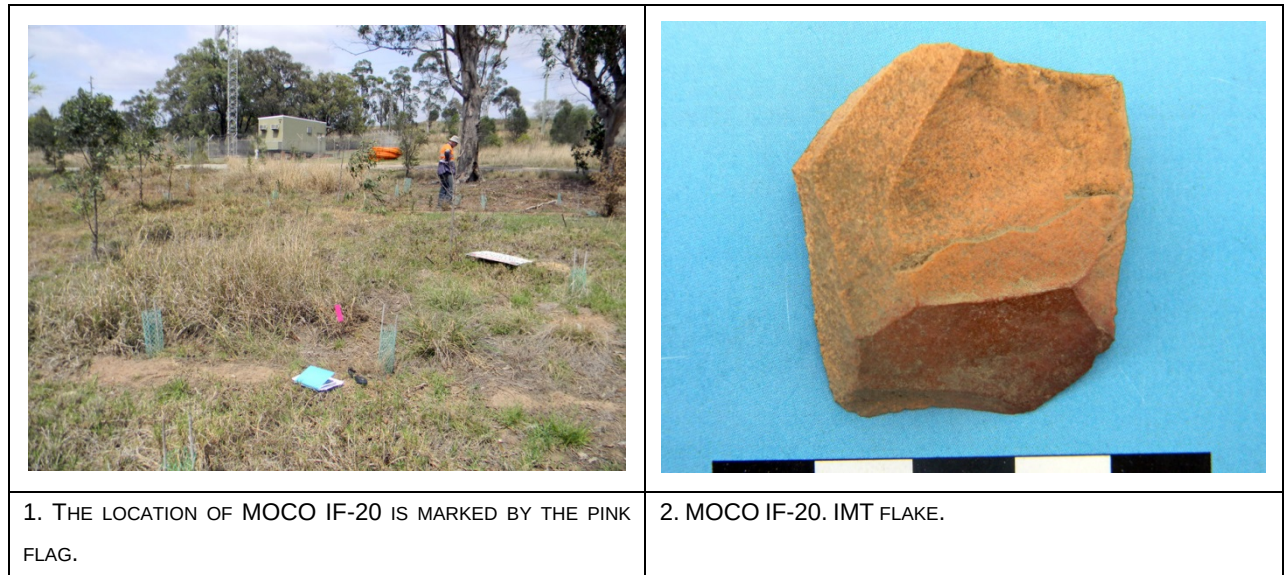
MOCO IF-20 is a IMT flake recorded in a mid slope landform approximately 600m west of Bowmans Creek and 35m east of the New England Highway (**Figure 88**; for location see **Table 40** and **Figure 68**).

MOCO IF-20 is located in an area of high disturbance as it is located within the foundations of the old Ravensworth village. This area has had repeated use over many years and it is entirely possible that the artefact has been redeposited here at some point. However, it should be noted that MOCO IF-19 is located in the same landform on the other side of Hebden Road so perhaps the small settlement of Ravensworth (of which only two buildings and various foundations

remain) was constructed within a low density artefact scatter on the low slopes overlooking the Bowmans Creek floodplain.

There is A Horizon soil depth at the site although, due to disturbances at the site, it is assessed that the site is not associated with further artefacts or intact subsurface archaeological deposits.

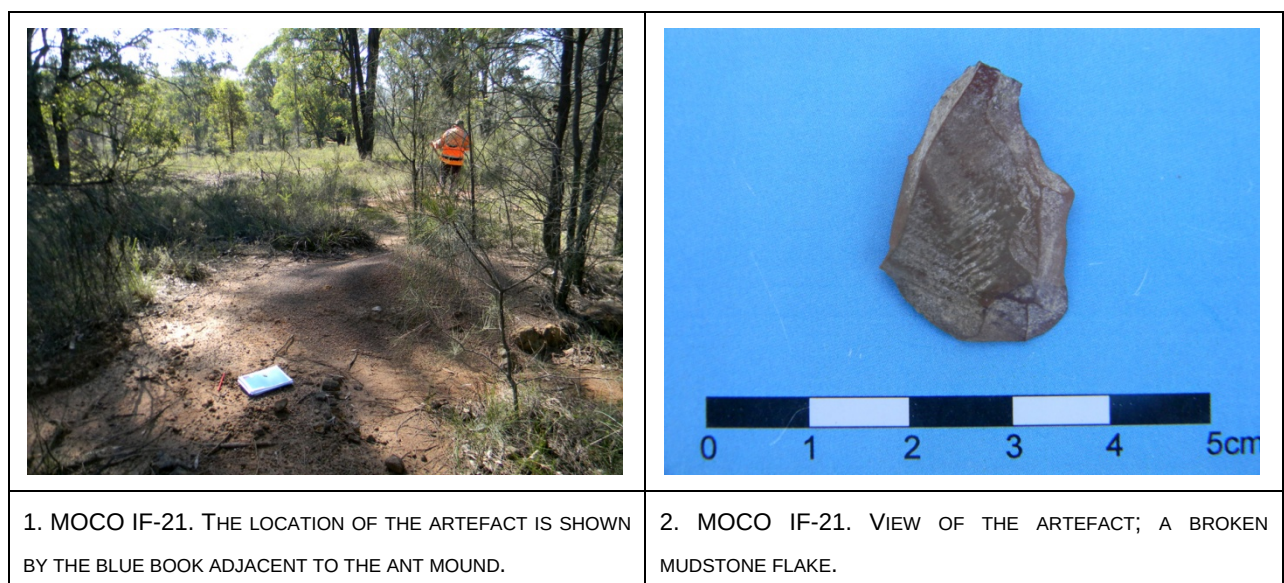
Figure 88: MOCO IF-20. Location and Artefact.



MOCO IF-21 (#37-3-1212)

MOCO IF-21 is a broken mudstone flake that was located on an ant mound in a sloping landform that is generally overlooking an ephemeral gully (**Figure 89**; for location see **Table 40** and **Figure 68**). It is likely the artefact has been displaced from its original location due to bioturbation. The site is within an Ironbark woodland.

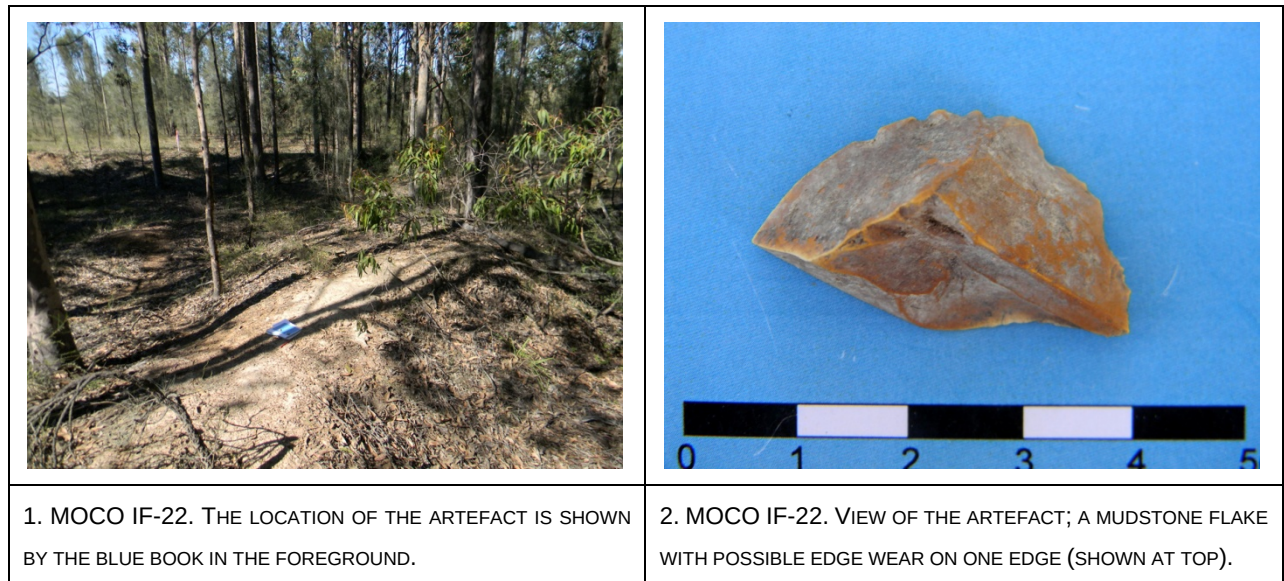
Figure 89: MOCO IF-21. Location and Artefact.



MOCO IF-22 (#37-3-1213)

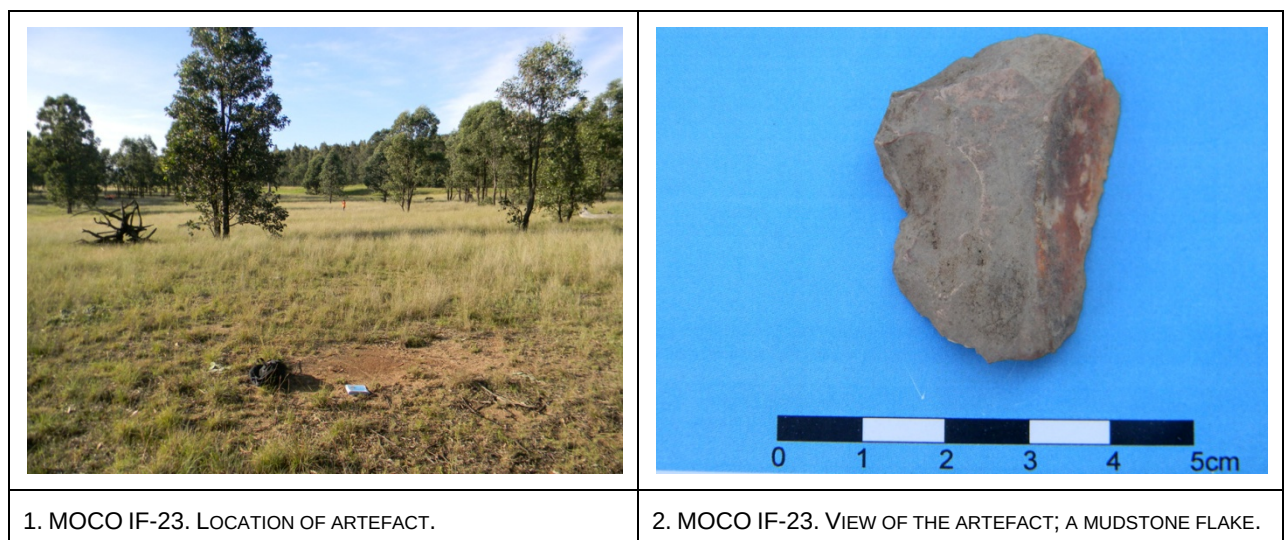
MOCO IF-22 is a mudstone flake located on the banks of an ephemeral drainage line where there has been sheet wash erosion and soil loss (**Figure 90**; for location see **Table 40** and **Figure 68**). It is likely the artefact has been displaced from its original location due to erosion. The site is within a Spotted Gum woodland. The artefact displayed evidence of non-recent edge wear at the distal end.

Figure 90: MOCO IF-22. Location and Artefact.

**MOCO IF-23 (#37-3-1214)**

MOCO IF-23 is a mudstone flake located on the edge of open woodland in a small area of exposure (**Figure 91**; for location see **Table 40** and **Figure 68**). The immediate vicinity of the site has been cleared and is currently grassed. It is likely the artefact has been displaced from its original location due to vegetation removal and erosion.

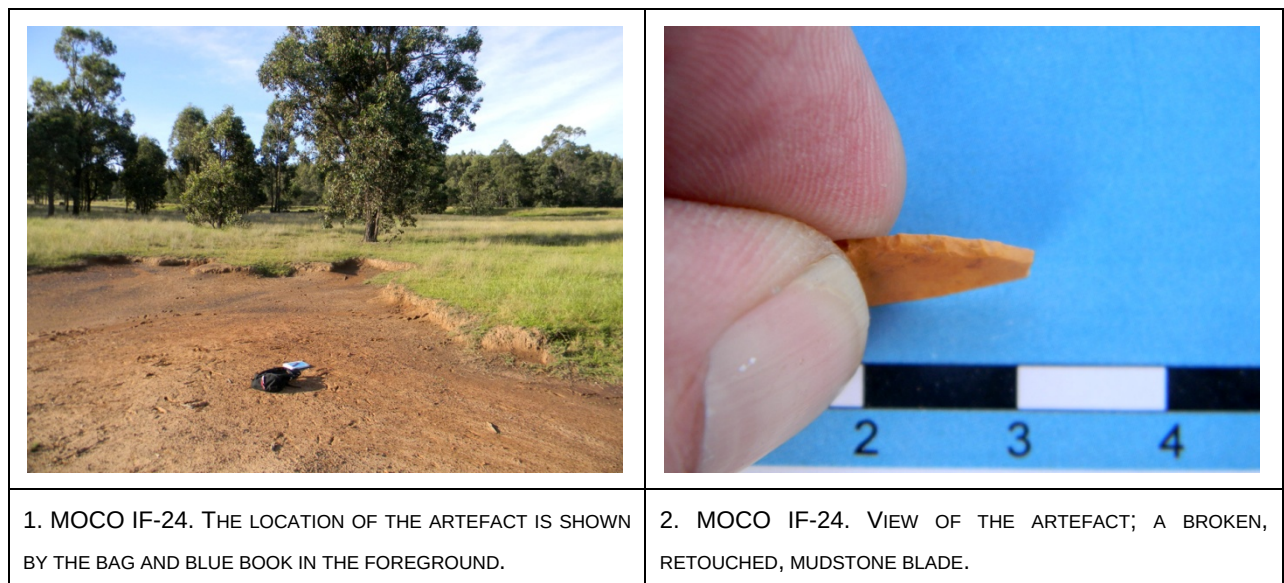
Figure 91: MOCO IF-23. Location and Artefact.



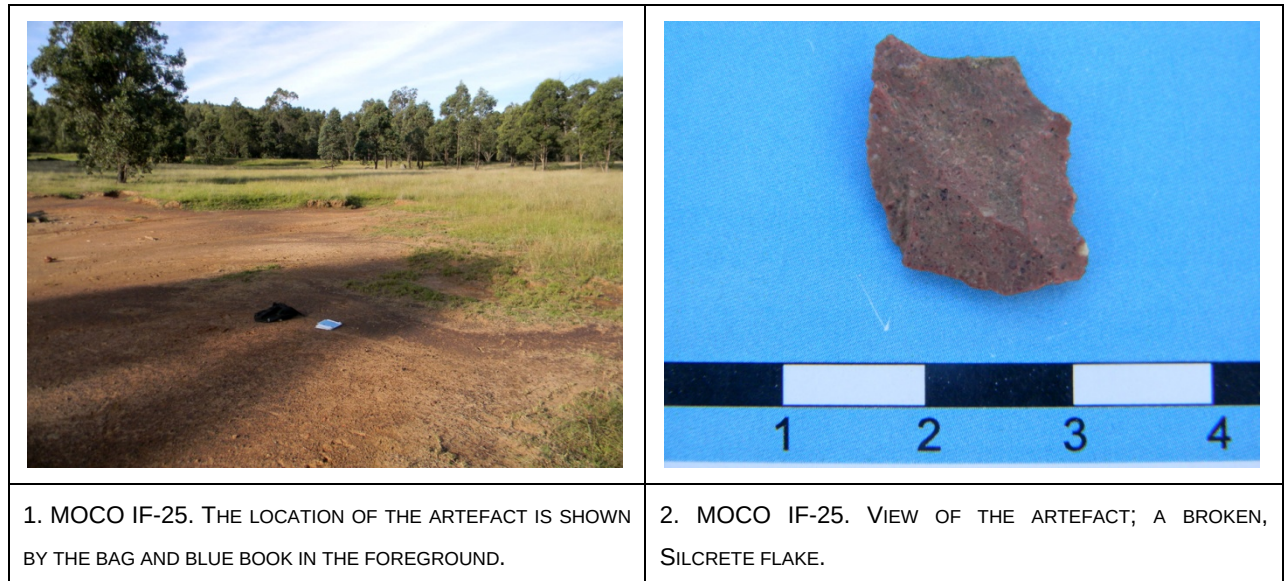
MOCO IF-24 (#37-3-1215)

MOCO IF-24 is a broken, retouched mudstone blade located within a large erosion scald (**Figure 92**; for location see **Table 40** and **Figure 68**). The artefact, of which only 1.5cm remains, displayed fine, uni-facial retouch along one lateral edge. The site is located in an area of heavy modification by erosion and the artefact has been definitely displaced from its original position by erosion. No evidence of further artefacts were observed eroding from the nearby bank of the erosion scald suggesting that the artefact has not come from the immediate vicinity.

Figure 92: MOCO IF-24. Location and Artefact.

**MOCO IF-25 (#37-3-1216)**

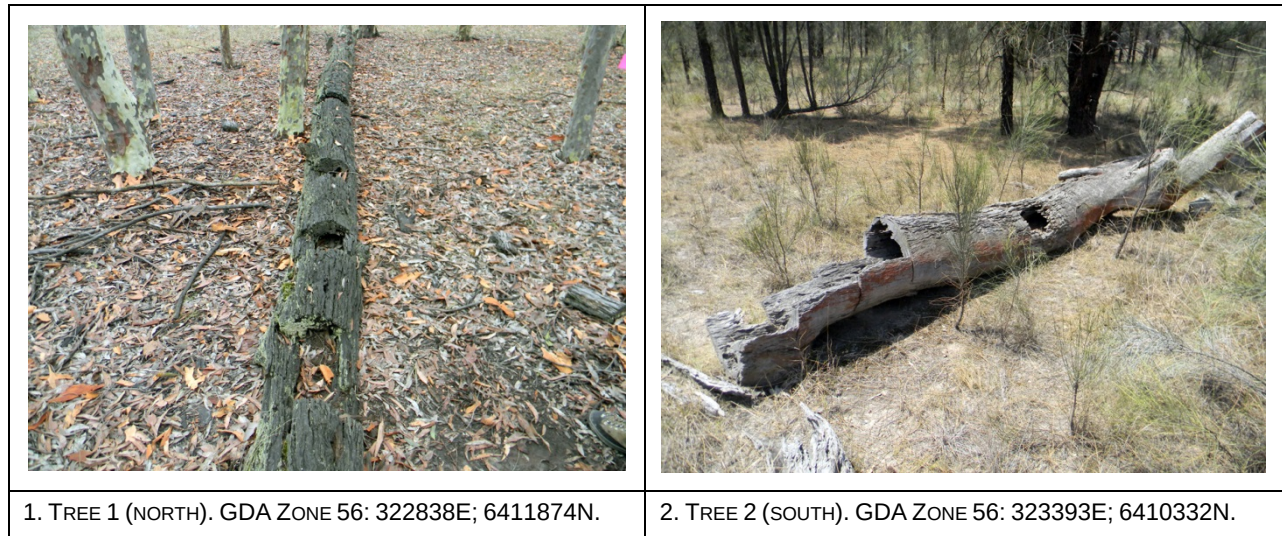
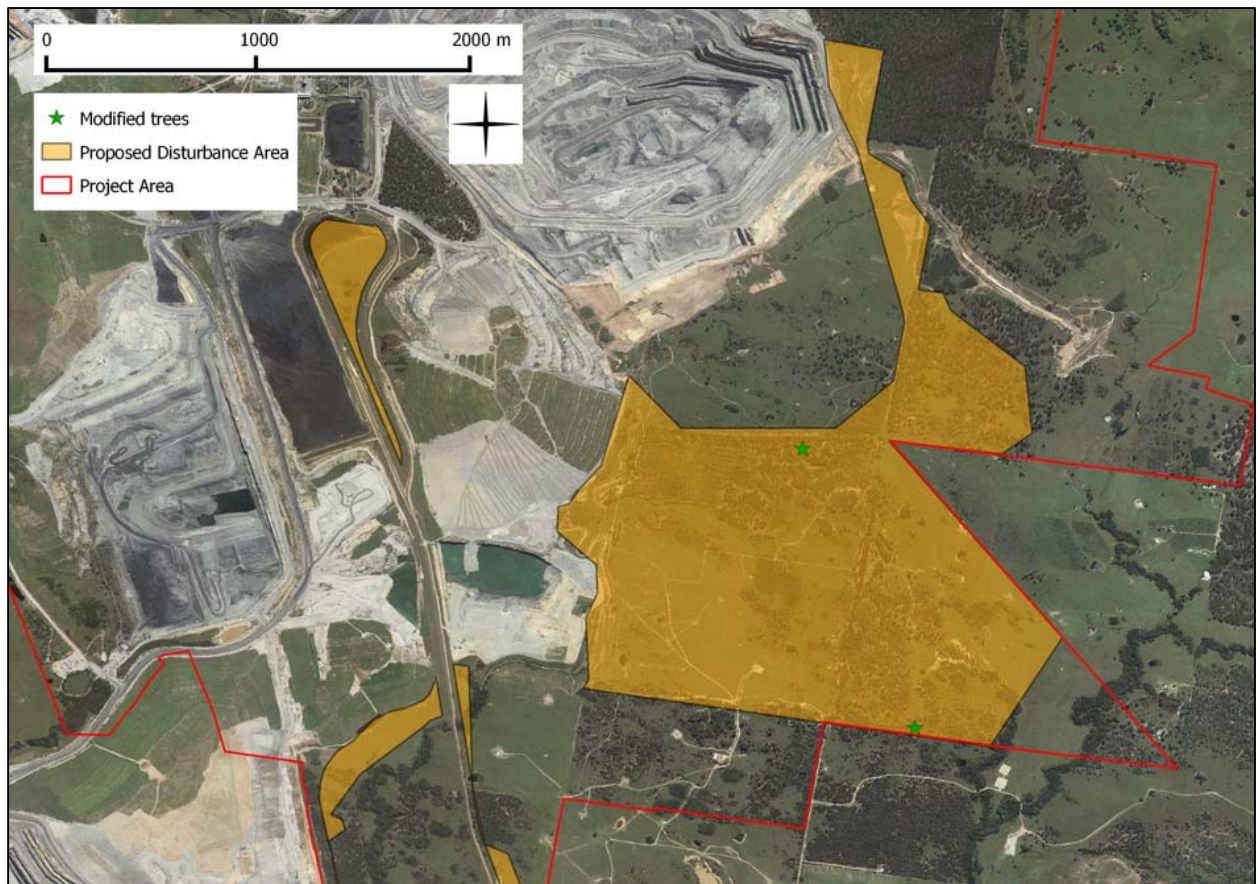
MOCO IF-25 is a broken silcrete flake located within a large erosion scald (**Figure 93**; for location see **Table 40** and **Figure 68**). The site is located in an area of heavy modification by erosion and the artefact has been displaced from its original position by erosion. No evidence of further artefacts was observed in the area suggesting that the artefact has not come from the immediate vicinity.

Figure 93: MOCO IF-25. Location and Artefact.

6.2.4 Non-archaeological items noted

At two locations trees with a series of holes cut into them were noted. These trees had both been felled and a series of rectangular holes measuring up to 40cm cut into them by either a metal saw or possibly a chainsaw (there were no axe marks; **Figure 94**). It was suggested by certain RAPs at the time of the survey that these trees may represent a historic Aboriginal resource gathering event whereby the holes were made to extract honey or animals from the hollow tree. Other RAPs thought that the cuts were for fencing material such as for post and rail system.

Primarily because the holes are regularly spaced, the archaeological opinion is that these items are probably related to the farming phase of the area. For these reasons it is not intended to register these locations as Aboriginal sites on AHIMS, however, their presence and location is noted here (**Figure 95**).

Figure 94: Photographs of modified trees.**Figure 95: Location of modified trees.**

7 TEST EXCAVATION PROGRAM

7.1 BACKGROUND

From 11 March to 15 March 2013 a test excavation program was conducted at two locations within the Proposed Disturbance Area.

The methodology for the test excavation program was sent to all RAPs on 6 February 2013 and comments invited. A copy of the methodology was also sent to OEH on 15 February 2013. The test excavation methodology is presented in **Appendix 3**.

At the close of the 28 day review period, three comments on the test excavation methodology were received from RAPs. All comments supported the test excavation methodology.

Archaeological results from the survey were presented to a meeting consisting of representatives of the three Native Title Claimant groups on Monday 4 March 2013 (for the status of the Native Title Claimant Groups within the consultation process for the Project, please see the accompanying ACHA). At this meeting the forthcoming test excavation was discussed and no direct comment on the methodology was raised.

The Project received an email from Rosalie Neve (OEH: Aboriginal Heritage Planning Officer) on 21 February 2013, stating:

OEH notes that Point 18 of the Section entitled Personnel and Methods refers to 'a negotiated agreement between the RAPs and OEH'. This sentence requires more clarity as it is unclear what it refers to.

In reply, OzArk stated that this referred to the artefacts that could possibly be gained as a result of the test excavation.

In point 16 under *Personnel and Methods* of the test excavation methodology it is stated:

Artefacts will remain in the care of OzArk EHM until such time as the analysis is complete. Once complete, the artefacts will be returned to Xstrata Mount Owen offices where they will be kept in a locked location until point 18 below is enacted.

Point 18 states:

Once all salvage activities for this Project are complete, artefacts will be amalgamated and their ultimate fate will be a negotiated agreement between the RAPs and OEH.

OzArk clarified with OEH (email 2 May 2013) that Point 18 would be included in the Mount Owen ACHMP that will be revised to include the findings of the current survey. This ACHMP would be agreed to between the Proponent, RAPs and OEH. An important aspect of this ACHMP would be to determine the ultimate fate of all artefacts that have been recovered from Mount Owen as a result of the test excavation program and any salvage that could follow

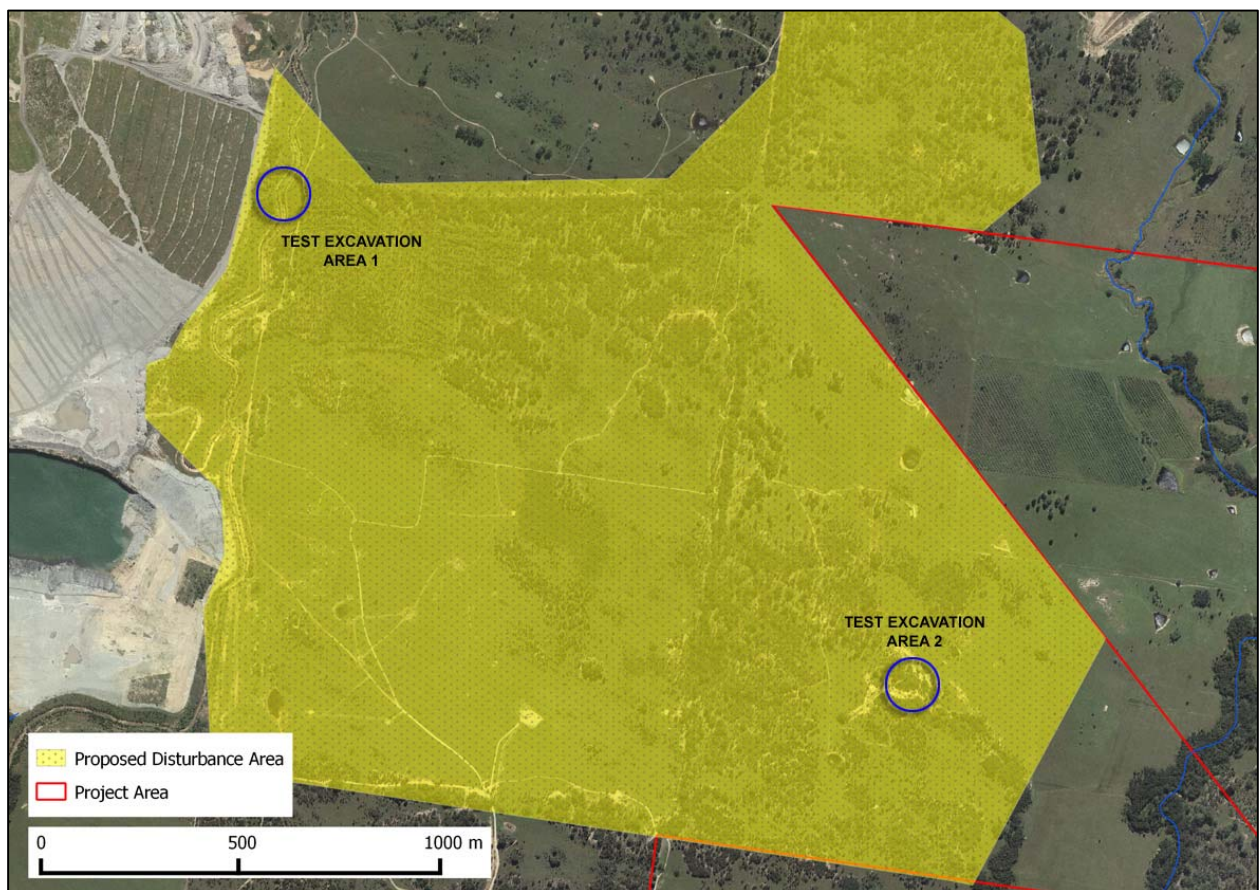
Project approval. There are also the many thousands of artefacts that have been recovered from previous salvage work at Mount Owen that would need to be included in this process⁸.

The results of the 2014 survey did not warrant further investigation by means of test excavation as only isolated finds were recorded.

7.2 PROPOSED SAMPLING STRATEGY

Two areas were assessed during the survey phase of investigation to require test excavation to determine the nature and integrity of any archaeological deposits in those areas. These areas, Test Excavation Area 1 and Test Excavation Area 2, are shown in **Figure 96**. Test Excavation Area 1 is on either side of the Bettys Creek diversion adjacent to MOCO OS-3 and Test Excavation Area 2 is adjacent to the eastern drainage within and adjacent to MOCO OS-4.

Figure 96: Proposed locations of the test excavation program.



The sampling strategy determined by the test excavation methodology was to take the form of first excavating 0.5m by 0.5m excavation squares at 10m intervals to create a linear transect of 50m (called here the 'initial transect'). These transects were placed directly adjacent to known concentrations of artefacts (i.e. out of erosion areas) that have been identified in both Test Excavation Areas 1 and 2.

⁸ It is acknowledged that, in the past, agreement has been sought from the Aboriginal community concerning these artefacts although, to date, no agreed decision on the artefact's fate has been reached.

At Test Excavation Area 1 (MOCO OS-3), the transects were positioned to sample the landforms adjacent to the already existing Bettys Creek diversion channel. While this is an artificial feature, the recording of artefacts on the banks of the diversion channel suggested that their original location may have been close-by. The transects in this area are therefore to determine the nature and integrity of archaeological deposits in areas adjacent to the diversion channel.

In Test Excavation Area 2 (MOCO OS-4), the transects were laid out, in the most part, so as to run roughly parallel to the eastern drainage. A series of transects in Test Excavation Area 2 also sampled the lower slope landforms to the east of the eastern drainage.

The test excavation methodology determined that if the final pit of a particular transect records reasonable numbers of artefacts (i.e. more than 5 – equivalent to 20 artefacts per m²) the initial transect should be expanded linearly, in 10m intervals, until such time as it is clear that the site boundary has been passed (i.e. test excavation pits are recording no artefacts or very low artefact densities of less than five artefacts per pit), the extent of potential impact has been reached or the transect has been expanded to a maximum linear distance of 100m.

If, along the initial transect, reasonable numbers of artefacts (i.e. more than 5 – equivalent to 20 artefacts per m²) or archaeological features are encountered, then a further transect (also at 10m intervals) would be placed at right angles to the pit containing the artefacts/features so that it runs away from the watercourse at that location. An archaeological feature could be such things as a hearth or an unusually high concentration of artefacts. This transect would continue until it is clear the site boundary has been passed. Along any one initial transect these perpendicular transects were limited to a maximum of two.

Should notable concentrations of artefacts (i.e. in excess of 20 artefacts per square metre) and/or archaeological features such as hearths be encountered in any pit along any transect, the methodology allowed for additional 0.5m by 0.5m pits to be placed immediately adjacent to the pit containing the artefacts/feature to allow a full examination of the feature (up to the maximum of 3m² allowed under the *Code of Practice*).

In this way transects, particularly in Test Excavation Area 2, not only investigated the distribution of artefacts along a watercourse, but also the distribution away from the watercourse to determine site boundaries.

It should be noted that no test excavation was proposed in areas adjacent to the actual course of Bettys Creek further south in the Proposed Disturbance Area, nor adjacent to Bowmans Creek where there is potential impact from the Project. This is due to the fact that a number of previously recorded sites have already been excavated and/or salvaged in these areas allowing

the archaeological character of these areas to be understood without the need for further test excavation.

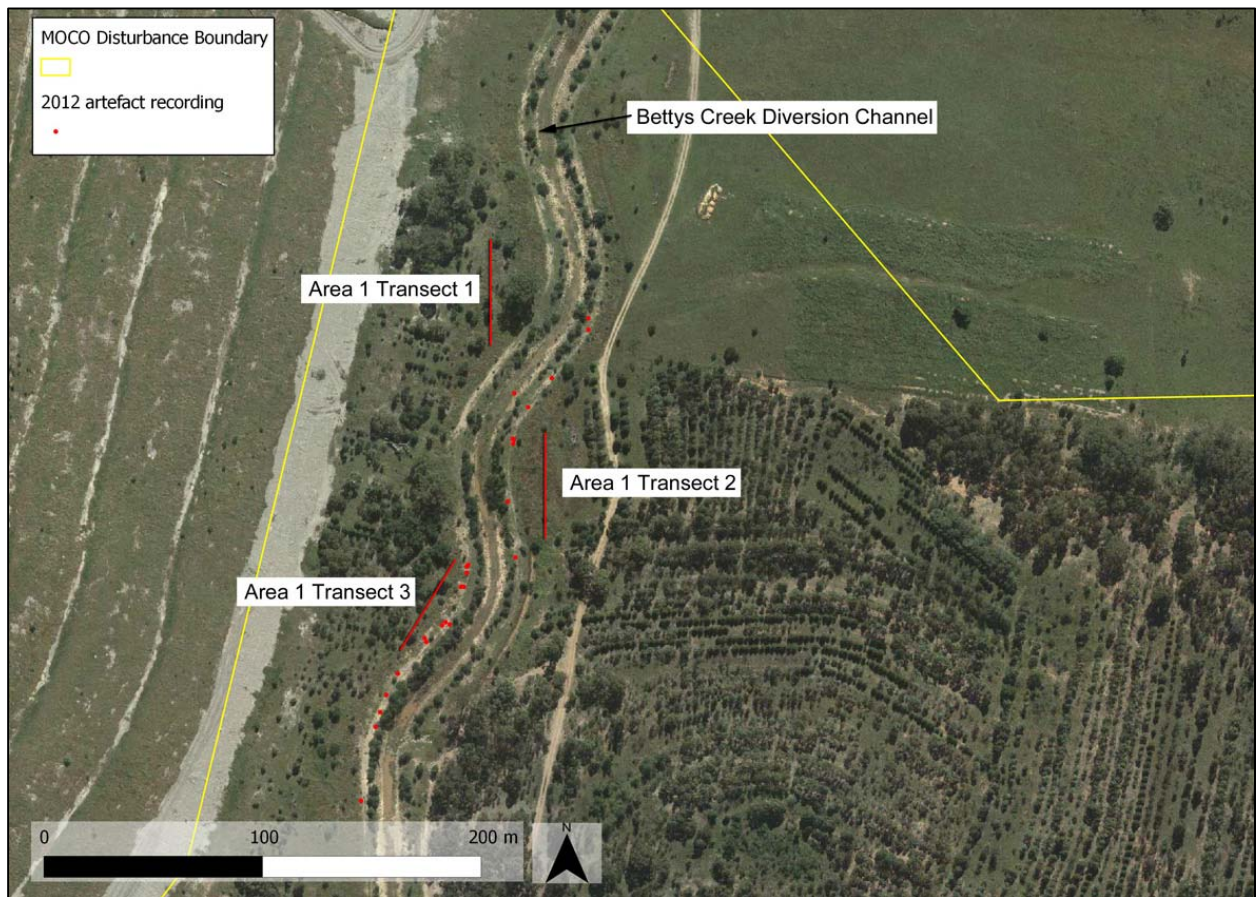
The following sections examine each test excavation area in turn.

7.2.1 Test Excavation Area 1

The current survey identified a low density scatter of artefacts along the banks of the Bettys Creek diversion channel (MOCO OS-3). Although this is an artificial feature, the recorded artefacts were assumed to have originated in the general vicinity of the channel that has been created in the flat landform that would have once been adjacent to the original location of Bettys Creek (which would have once flowed further to the west in areas now heavily modified by approved mining activity). It was noted in the test excavation methodology that previous artefact scatters (BC51, BC52 and BC67 approximately 500m south; BC54 and BC55 between 130m and 250m east and BC58 approximately 160m north) have been recorded in identical landforms. All these sites have been previously salvaged. No previously recorded sites are recorded within 130m of Test Excavation Area 1. The test excavation in this area was therefore designed to assess the archaeological nature of the flat and lower slope landforms on either side of the diversion channel. During the assessment there was low ground surface visibility in these areas and the test excavation program was to determine if the landform continues to contain intact archaeological deposits.

Figure 97 shows the proposed location of the 50m initial transects in this area. It was proposed that three 50m initial transects be excavated to determine if the recorded artefacts along the Bettys Creek diversion channel are representative of deposits that may still exist on either side of the artificial channel. The test excavation methodology outlined that should these transects display concentrations of artefacts then the additional perpendicular transects (as discussed above) should determine the east-west extent of these deposits.

Figure 97: Proposed locations of transects in Test Excavation Area 1 from the test excavation methodology document.

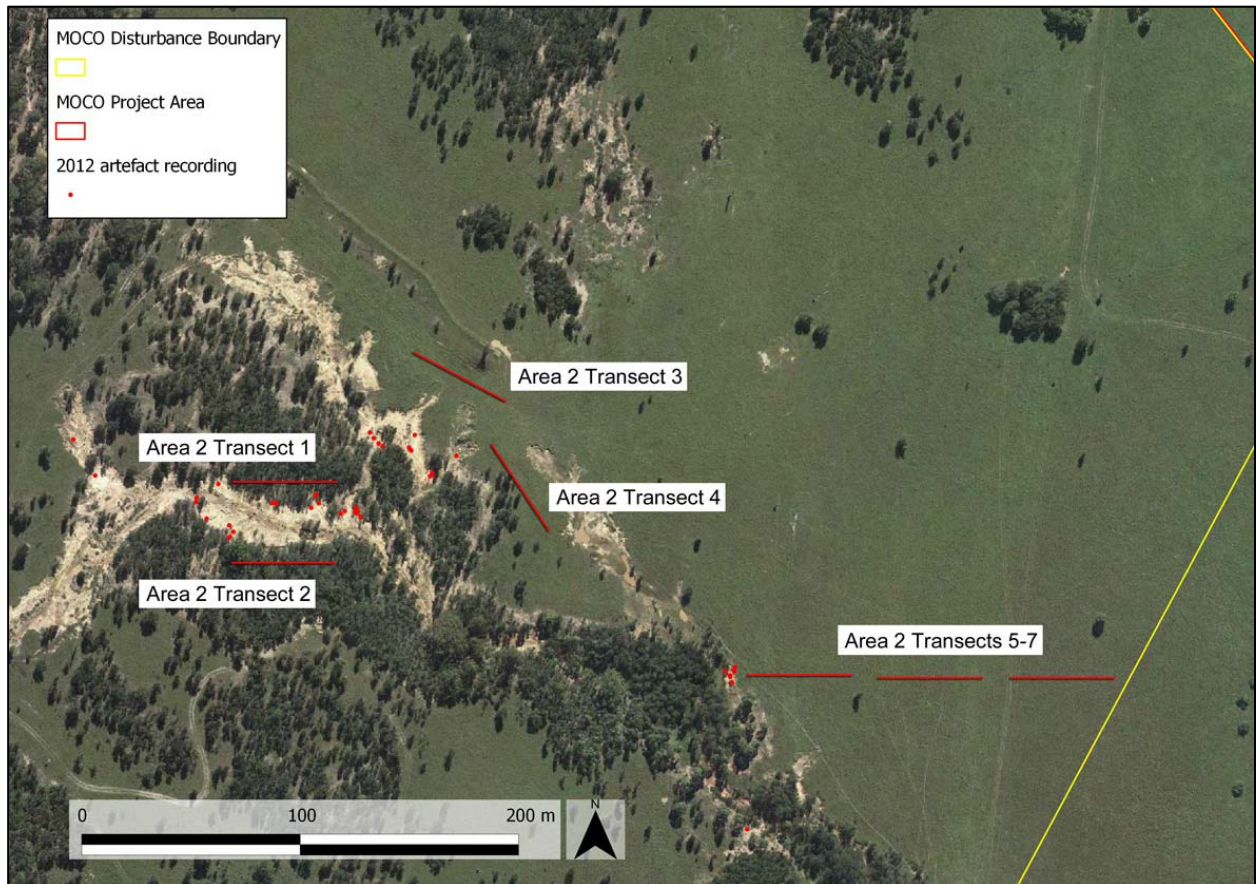


7.2.2 Test Excavation Area 2

The excavation strategy was designed to test two aspects of this area. In the test excavation methodology, Transects 1 to 4 were placed to test the nature and extent of archaeological deposits adjacent to the known location of artefacts along the eastern drainage (**Figure 98**). These transects were proposed to be located just beyond the erosion edge to determine if the observed artefacts are associated with further archaeological deposits that may exist further away from the current erosion edge in areas where there was relatively low ground surface visibility. Transects 5 to 7, together, form a longer linear transect that was designed to test the nature and integrity of deposits in the landform that extends to the east of the eastern drainage towards the floodplain of Main Creek. This landform consists of a gentle rise that, beyond the Proposed Disturbance Area, terminates in a relatively steep (but short) drop to the floodplain of Main Creek. Main Creek has several previously recorded sites along its length. MCIS01, MCIS02 and MCIS03, all isolated finds, are recorded approximately 600m southeast from Test Excavation Area 2, while further north along Main Creek, MC1, MC2, MC4, MC5 and MC6, all artefact scatters, have been recorded. Given the archaeological potential of landforms adjacent to the floodplain of Main Creek and the observed artefact scatters along the eastern drainage,

Transects 5 to 7 were placed to investigate the nature of deposits between these two nodal points.

Figure 98: Proposed locations of transects in Test Excavation Area 2 from the test excavation methodology document.



7.3 THE ARTEFACT CATALOGUE

The artefact catalogue of the excavation assemblage forms the basis of the presentation and discussion of test excavation results that follow. The full catalogue is presented in **Tables 45** and **46**.

Preliminary examination of the assemblage prior to cataloguing noted that it was not a complex assemblage with almost all artefacts being unmodified flakes. As a result, a tailored analysis was carried out on the assemblage that allowed the site's characteristics to be captured. The flake attributes that were analysed for the assemblage are shown in **Table 41**.

Table 41: Description of artefact catalogue.

Catalogue entry	Description of catalogue entry
Square	All Squares in Table 45 are from Transect 3. Recordings from outside Transect 3 are recorded in Table 46 . This table also gives the transect number.
Spit	All spits were 5cm. Therefore Spit 1 is 0cm to 5cm.
Artefact type	Describes the type of artefact recorded. At this excavation, primarily flakes or broken flakes.

Catalogue entry	Description of catalogue entry
Raw Material	Silcrete, IMT (mudstone), quartzite, quartz, volcanics and petrified wood were recorded at the site.
Max. dimension	Most often this measurement is along the plane of percussion. In some instances, such as when a flake is inordinately wide, measurement along the largest plane is taken.
Break?	Records whether the break is to the top (proximal) end of a flake, or to the bottom (distal) end.
Previous flake scars	Records the number of previous flake scars on the dorsal surface of a flake.
Rotation	A parallel rotation is one where the dorsal scars are in the same direction as the flake's plane of percussion. A rotated flake is one where the dorsal flake scars are at a varying angle to the flake's plane of percussion. Cortical refers to flakes with cortical dorsal surfaces where rotation cannot be determined.
Platform type	Terms used to describe platforms are 'point' for very small platforms, 'previous flake' for where the platform has been prepared by removing a flake to create a striking platform and 'faceted' for when there are several flake scars on the platform showing a greater degree of platform preparation. When a platform is wider than average it is noted. Some platforms were 'crushed' and some were 'cortical' where cortex covered the platform.
Termination type	Records the distal characteristics of a flake. At this excavation 'feather' terminations were common where a flake terminates in a smooth, triangular cross-section.
Reduction phase	The percentage of cortex in comparison to the full artefact was catalogued according to the following scale. Primary reduction: 50% or more cortex; Secondary reduction: 1% to 50% cortex; Tertiary reduction: no cortex.
Notes	Comments of tools type, retouch type are given here.

A discussion on why these attributes were analysed follows.

Artefact type

Description: Possible artefact types include flaked pieces, elongate flakes, broken flakes, retouched flakes, cores, fragments and other (hammerstones, grindstones, ground-edge axes) although not all may be present at any one site.

Issues: Classing artefacts, generally, does not usually entail significant problems. A minority of artefacts are difficult to define such as ambiguities between flaked pieces and broken flakes, and between (retouched) flakes and flake-cores.

Uses: This category will be used to assess differences in provisioning strategies (e.g. core provisioning as opposed to flake provisioning), differences in site function/use (e.g. presence/absence of grindstones), and the taphonomic effects of past land use on the site (are more broken artefacts part of the assemblage?).

Raw Material

Description: A largely self-explanatory attribute, raw materials expected to be present include silcrete, IMT, quartz, quartzite, petrified wood and volcanics.

Issues: This category often has problems for analysts without a geological background. Even then, without breaking an artefact, the true nature of the stone will sometimes remain uncertain. Illustrations are provided in **Figure 99** to remove the ambiguity often associated with stone raw material identification. This will allow other researchers to identify the type of stone recorded here as, for example, 'silcrete'.

Uses: Raw material is an important attribute, which may broadly indicate the place of origin of an artefact. The dominance of one raw material or another may also be used to group or differentiate sites. Raw material is also frequently used in concert with attributes in the creation of analytic units for more in-depth inter and intra site comparisons.

Figure 99: Examples of raw materials from MOCO OS-4.

Silcrete. At MOCO OS-4 the silcrete ranged from a pinkish colour (as illustrated here) through to a very pale colour. At a small scale the silcrete contains many small inclusions although it is generally fine-grained of good knapping quality. The example to right comes from TR3 SQ4a Spit 5.	
IMT (mudstone). At MOCO OS-4 the IMT ranged from a light orange (as illustrated here) to a reddish colour. The IMT is fine-grained of good knapping quality. The example to right comes from TR7 SQ5 Spit 3.	

Dimensions⁹

Description: Percussive dimensions measure the maximum length of the flake in the direction of force application from the point that force was applied. In this regard it relates to the length of core face that was removed during the manufacture of the artefact.

Issues: There is some uncertainty as to what these attributes are actually measuring in terms of the flake manufacturing process.

⁹ From experience OzArk does not routinely weigh artefacts as this information has been found to closely correlate either to artefact size or the raw material from which the flake has been struck. Thus smaller artefacts are lighter than larger artefacts when made from the same material and artefacts made from denser stone (such as volcanics) are heavier than comparably sized artefacts from lighter (less-dense) stones such as IMT. In practice, the category cataloguing the maximum size of the artefact is analogous with the artefact's weight.

Use: Variations in average flake dimensions (for complete flakes only), and in the distribution of flake sizes in histograms, are expected to correlate with differences in the provisioning and reduction strategies at different places. For example, the reduction of cores at a site will produce a large number of moderate to small flakes and some larger flakes. As a result the histogram of flake length will show a relatively consistent increase in number of flakes from large to small. Contrastingly, when most flakes are the result of retouching or maintenance tasks on other flakes, the majority of the flakes remaining should be very small, with comparably few large to moderate flakes. However, it may be the case that a few moderate to large flakes will be discarded at the site as they are exhausted through excessive/heavy retouch or simply thrown away prior to a reprovisioning event. In such a case, a histogram of artefact size should show bimodality in regard to length (a small peak in the moderate range and a large peak in the small range).

Artefact Breakage

Description: At a basic level, flakes break in three different ways. Two are transverse (at 90 degrees to the direction of percussion) – proximal and distal; one is longitudinal (along the plane of percussion).

Issues: It is occasionally difficult to be certain of the breakage on an artefact. In most cases, however, the kind of breakage can be ascertained.

Use: It is important to differentiate broken from complete flakes for the purposes of analysis, as the two are not comparable in regard to a number of measures. The amount of artefact breakage in an assemblage also indicates the degree of fragmentation to which the assemblage has been subject. In highly fragmented assemblages, the actual number of artefacts represented may be significantly exaggerated. Quantifying breakage allows a more accurate approximation of artefact numbers to be made.

Dorsal Scar Count

Description: The dorsal face of a flake provides a partial record of previous flaking episodes to have occurred down the core face at or near the same point. The number of flake scars on the dorsal surface of a flake which can be oriented relative to their direction of percussion and which are clearly discernible will be recorded.

Issues: There is some ambiguity in this measure, hence the use of the term 'clearly discernible' above. Furthermore, by the nature of the flaking process, each subsequent scar will remove traces of the previous scars, resulting in an incomplete record. For these reasons, this measure needs to be treated with some caution.

Use: Dorsal scar count is a rough indication of how much flaking has occurred prior to the detachment of the flake in question.

Rotation

Description: Describes whether a particular flake was struck from a core that was rarely rotated (a unidirectional or bidirectional core), or from a core that has been rotated frequently (a multidirectional core).

Issues: There is little ambiguity in assessing this category. If the orientation of previous flakes was unclear, this category is left blank.

Use: An examination of the direction in which previous flake scars on an artefact's dorsal surface have been removed, along with the orientation in which the flake itself was removed from its core, will give evidence about the core from which the flake was struck. This enables a greater sample pool to determine the types of cores used in the Proposed Disturbance Area even if the original core may not have been recorded in the investigation.

Platform Surface

Description: Platform surface will be recorded as one of the following: cortical, single flake scar, or faceted.

Issues: This is a largely unambiguous descriptive attribute.

Use: The surface of a platform provides information about the history of the core prior to the detachment of the flake, and also about methods employed to control the flaking process.

Faceting in particular has been linked to the systematic production of 'blades'. Patterns in the spatial distribution of these attributes may be used to infer differences in reduction strategies.

Termination

Description: Termination refers to the way in which force leaves a core during the detachment of a flake. Every complete flake has a termination. There are patterns in the forms that terminations will take, with the five major categories (those to be used here) being feather, previous flake scar, hinge/step, outrepasse and bipolar.

Issues: This is a largely unambiguous descriptive attribute although care needs to be taken to distinguish terminations on a previous flake scar from hinge/step terminations or breakages.

Use: Different terminations have different implications both for flake and core morphology. A flake with a feather termination (in which force exits the core at a low or gradual angle) will have a continuous sharp edge around the periphery beneath the platform. This has advantages in terms of the amount of the flake edge that can be used for cutting and also makes the flake more amenable to subsequent retouching or resharpening activities. Detaching flakes with feather terminations also has minimal impact on the effective platform angle of the core, and so platform angle thresholds are reached relatively slowly while feather terminating flakes continue to be produced.

A termination on a previous flake scar has the same morphological advantages to a feather termination. However, instead of the flake gradually growing thinner as it detaches from the core, the force of flake removal is interrupted by a previous flake scar. This commonly occurs on multidirectional cores.

Hinge and step terminating flakes have none of these advantages. They result in edges that are amenable neither to cutting nor to retouching. Furthermore, hinge and step terminations lead to rapidly increasing effective platform angles, leading to a requirement for core rejuvenation and core exhaustion. For these reasons, such terminations are considered undesirable or *aberrant*. The number of aberrant flake terminations is expected to increase towards the end of a core's use-life, as reduction in core size and increase in core platform angle make it increasingly difficult to detach feather terminating flakes. In areas where aberrantly terminating flakes are relatively common it may be inferred that core potential was more thoroughly exploited. From this it may in turn be inferred that the pressure to realize core potential (e.g. a strategy of heavy raw material conservation) was greater. Increased mobility/emphasis on portability is one possible explanation of such a pattern.

Outrepassé flakes have the opposite effect on core morphology to step and hinge flakes, in that they remove the entire core face and part of the core bottom. As a result, such flakes may be used to rejuvenate cores in which core angles have become high but which still retain useable potential (e.g. are still quite large). The presence of outrepassé flakes may be taken to indicate core rejuvenation and the requirement to increase core use-life.

Bipolar flakes are rarely recorded in the area although it is a widely attested reduction technique whereby a core is placed on a hard surface, or anvil, and a flake removed by striking down from above. Characteristically this creates a flake with crushing at the proximal end (due to the napper's blow) and crushing on the distal end as the bottom of the flake comes into contact with the anvil. This flake termination will be recorded to determine the presence or absence of this reduction technique in the Proposed Disturbance Area.

Reduction

Description: This category refers to the level of reduction evident on an artefact. This is assessed by the amount of cortex remaining on the artefact. Cortex refers to the 'skin' of a rock – the surface that has been weathered to a different texture and colour by exposure to the elements over a long period. The amount of cortex as a percentage of surface area will be measured on all artefacts (in relation to flakes, cortex can, by definition only occur on the dorsal and platform surfaces). The nature of cortex – its shape and texture – will vary depending on where the raw material was sourced. This measurement will help determine if a particular artefact is at a primary, secondary or tertiary level of reduction.

Issues: This is a relatively unambiguous descriptive category.

Use: When a natural cobble is first selected it will usually be covered in cortex. Therefore the first artefacts produced from it will have a complete coverage of cortex on the dorsal side (primary reduction). As the cobble is increasingly reduced the amount of cortex on each artefact will rapidly decrease (secondary reduction) until it ceases to be present on artefacts (tertiary reduction). As a result of this trend, it should be possible to determine how early in the reduction sequence the artefact was produced. If large numbers of artefacts or a high proportion of the artefacts of a raw material retain cortex it may indicate that the site is located in close proximity to the source. Differences between the proportions of artefacts retaining cortex between different raw material indicates relative differences in distance to source. This does not necessarily mean distance in terms of measurable distance across the landscape; it may also reflect length of time since leaving the source. For example, the last campsite when a group is returning to the source of the raw material may be very close to the source in terms of distance, but distant in terms of time elapsed since the group left the source. If artefacts with cortex are occurring in sites a long distance from the place of origin of the natural cobble, then it is likely that cobbles were being transferred to the site when still only slightly reduced. This would imply an attempt to maximise the amount of stone being provisioned with the weight of transported material being a relatively minor concern.

7.4 TEST EXCAVATION RESULTS

7.4.1 Test Excavation Area 1 (MOCO OS-3)

According to the test excavation methodology (**Section 7.2**), three 10m transects were to be excavated at MOCO OS-3 (see **Figure 97**), however, during the course of the excavations five transects were investigated (Transects 1 to 5) with three placed to the west of the Bettys Creek diversion (Transects 1 to 3) and two to the east (Transects 4 to 5; **Figure 102**). The landform where Transects 1 to 3 were located is flat, while Transects 4 and 5 occupied lower slope landforms overlooking the flat landforms bordering Bettys Creek (**Figure 100**).

In the area of Transects 4 and 5, it was evident that extensive revegetation had taken place and that the ground surface had been impacted in preparation for this planting. In the area of Transects 1 to 3 revegetation was not so obvious, although after the excavations (and in an effort to explain the results of the excavations), additional aerial photographs were consulted. In particular, Google Earth images taken in December 2008 at the end of a long drought period, show very clearly that the area to the west of the Bettys Creek diversion has also been modified by revegetation programs under previous development consents (**Figure 101**).

Therefore the whole of Test Excavation Area 1 has been modified by past agricultural land use (vegetation clearing) and mine related activities (revegetation).

Figure 100: Test Excavation Area 1 (MOCO OS-3). Landforms.

	
1. TEST EXCAVATION AREA 1: TRANSECT 3 MARKED BY PINK FLAGS. THIS TRANSECT, ALONG WITH TRANSECT 1 AND 2, OCCUPY A FLAT LANDFORM BETWEEN THE BETTYS CREEK DIVERSION AND ACTIVE MINING AREAS TO THE WEST.	2. TEST EXCAVATION AREA 1: TRANSECT 5 MARKED BY PINK FLAGS. THIS TRANSECT IS IN A LOWER SLOPE LANDFORM TO THE EAST OF THE BETTYS CREEK DIVERSION.

Figure 101: Google Earth image from 2008 showing the revegetation to the west of the Bettys Creek diversion. Circle shows the location of Test Excavation Area 1.



Figure 102: Location of transects in Test Excavation Area 1.



7.4.1.1 Stratigraphy

Along each transect, six 0.5m by 0.5m pits were excavated to culturally sterile basal clays resulting in a total of 30 excavation squares (**Figure 102**).

On the west side of the Bettys Creek diversion, the A Horizon was largely lacking from all excavation squares that immediately (after the removal of a thin [approximately 5cm] humic layer) consisted of basal clays (**Figure 103**).

Figure 103: Test Excavation Area 1 (MOCO OS-3). Stratigraphy.

	
1. TEST EXCAVATION AREA 1: TRANSECT 2 SQUARE 2 SHOWING A VERY THIN (3CM) HUMIC STRATUM (A1) ABOVE BASAL CLAYS (B).	2. TEST EXCAVATION AREA 1: TRANSECT 3 SQUARE 5 SHOWING A VERY THIN (5CM) HUMIC STRATUM (A1) ABOVE BASAL CLAYS (B).

To the east of the Bettys Creek diversion in the lower slope landform, A Horizon strata were a little thicker (approximately 10cm) and consisted of a light brown leached loam. Beneath this basal clays were encountered (**Figure 104**).

Figure 104: Test Excavation Area 1 (MOCO OS-3). Stratigraphy.

	
1. TEST EXCAVATION AREA 1: TRANSECT 4 SQUARE 5 SHOWING 10CM LEACHED LOAM STRATUM (A2) ABOVE BASAL CLAYS (B).	2. TEST EXCAVATION AREA 1: TRANSECT 5 SQUARE 6 SHOWING 5CM TO 10CM LEACHED LOAM STRATUM (A2) ABOVE BASAL CLAYS (B).

7.4.1.2 Artefact distribution

Although 30 pits were excavated at Test Excavation Area 1, no artefacts were recorded at any location.

7.4.1.3 Conclusions

The test excavation program demonstrates that MOCO OS-3 is confined to the highly disturbed areas along the banks of the Bettys Creek diversion and does not extend into surrounding areas either on the eastern or western side of the diversion.

The lack of A Horizon soil strata in the test pits, coupled with the fact that the entire area has been revegetated, suggests that major earthmoving has taken place in the area possibly in the form of topsoil removal and landform sculpting. It is hypothesised that the banks of the Bettys Creek diversion (where MOCO OS-3 is located) consist of A Horizon soils that have been pushed up to form the bank. This contradicts the thinking before the test excavation that hypothesised that the banks were created by digging out the channel and piling the soil to the bank areas. Therefore, instead of the artefacts recorded at MOCO OS-3 coming from that immediate vicinity (i.e. out of the channel area itself), they probably originated in the surrounding areas and have been pushed up along with soil to form the banks of the diversion channel. In places, the banks are up to three metres above the surrounding ground surface indicating that a lot of soil was required during this process.

As a result of the test excavation program it is now clear that MOCO OS-3 is a redeposited site with no *in situ* portions.

7.4.2 Test Excavation Area 2 (MOCO OS-4)

The site within Test Excavation Area 2, MOCO OS-4, will be also be used when describing aspects that are specific to the site, rather than the wider area of Test Excavation Area 2.

The investigation included the excavation of seven 50m transects (Transects 1 to 4 and 6 to 8) and one 100m transect (Transect 5). This was a greater number of transects as was proposed in the test excavation methodology (see **Section 7.2.2; Figure 98**) where seven 50m transects were proposed. This expansion of transect numbers was necessary to fully sample the site as landform features became evident in the field that prompted additional transects to be excavated (the landform is much fragmented by erosion gullies and it was the logistics of placing transects among the erosion gullies to adequately sample the entire site that necessitated further transects to be investigated). The location of these transects is shown in **Figure 105**. Most of these transects were located adjacent to the eastern drainage (Transects 1 to 4 and 6 to 8) while one transect (Transect 5) was located to sample the landform to the east of the eastern drainage. Transects 1 to 6 were located in the flat landform that is adjacent to the

eastern drainage to the east, while Transects 7 and 8 were located in lower slope landforms to the west of the eastern drainage.

In all, eight transects were excavated at Test Excavation Area 2. Like the Test Excavation Area 1 transects, each Area 2 transect contained six 0.5m x 0.5m excavation squares apart from Transect 1 that contained five squares and Transect 5 that contained 10 squares. In addition, two extension squares were excavated at Transect 5 and five extension squares were excavated at Transect 3, making a total of 58 excavation squares at Test Excavation Area 2.

The landforms where transects were located are shown in **Figure 106** and **Table 42**.

Table 42: Test Excavation Area 2. Landform descriptions for all transects.

Transect number	Number of pits	Landform	Vegetation
1	5	Flat. To the east of the eastern drainage.	Cleared/grass
2	6	Flat. To the east of the eastern drainage.	Cleared/grass
3	11	Flat. Between the two arms of the eastern drainage.	Casuarina regrowth
4	6	Flat. Between the two arms of the eastern drainage.	Casuarina regrowth
5	12	Flat to very gentle lower slopes. Extends from the eastern drainage to the east.	Cleared/grass
6	6	Flat. To the east of the eastern drainage.	Casuarina regrowth
7	6	Lower slope. To the west of the eastern drainage.	Casuarina regrowth
8	6	Lower slope. To the west of the eastern drainage.	Casuarina regrowth

Figure 105: Location of transects in Test Excavation Area 2.

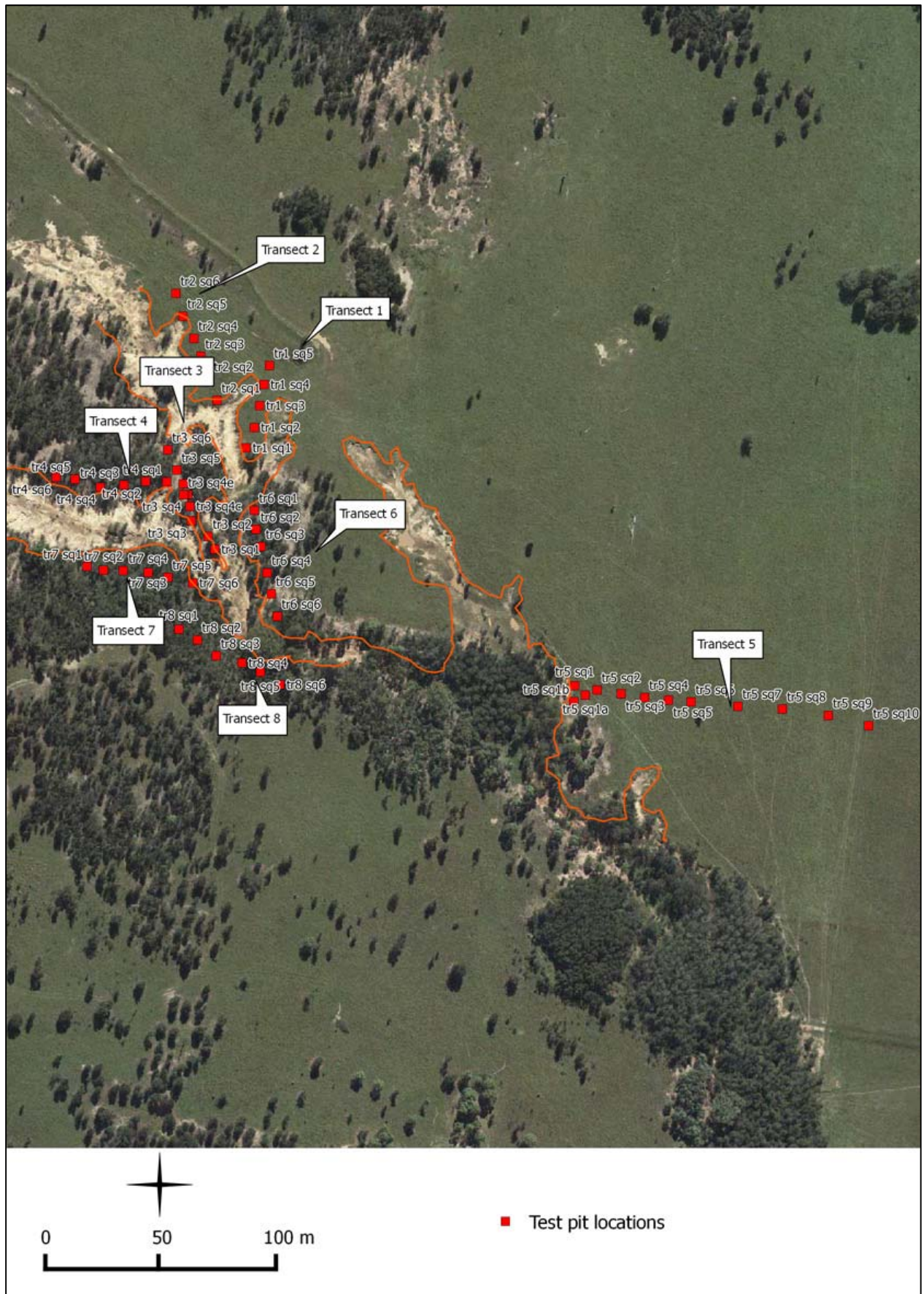


Figure 106: Test Excavation Area 2. Transect locations.

1. TEST EXCAVATION AREA 2: TRANSECT 2 ON THE EASTERN BANK OF THE EASTERN DRAINAGE. VIEW SOUTHEAST WITH THE EASTERN DRAINAGE TO THE RIGHT MARKED BY THE TREES.



2. TEST EXCAVATION AREA 2: TRANSECT 3. LOCATED BETWEEN THE TWO ARMS OF THE EASTERN DRAINAGE. VIEW SOUTH WITH THE EROSION EDGE OF EACH ARM VISIBLE ON EITHER SIDE OF THE TRANSECT.



3. TEST EXCAVATION AREA 2: TRANSECT 4. LOCATED BETWEEN THE TWO ARMS OF THE EASTERN DRAINAGE.



4. TEST EXCAVATION AREA 2: TRANSECT 5. VIEW EAST AWAY FROM THE EASTERN DRAINAGE (EROSION EDGE VISIBLE AT BOTTOM).



5. TEST EXCAVATION AREA 2: TRANSECT 7. LOCATED ON THE WESTERN BANK OF THE EASTERN DRAINAGE.



6. TEST EXCAVATION AREA 2: TRANSECT 8. LOCATED ON THE WESTERN BANK OF THE EASTERN DRAINAGE.

Along each transect, five to twelve 0.5m by 0.5m pits (see **Table 43**) were excavated to culturally sterile basal clays resulting in a total of 58 excavation squares (**Figure 105**).

Table 43 recorded the GPS location of each pit excavated within Test Excavation Area 2, as well as the total depth of each pit and the number of artefacts recorded in each pit.

Table 43: Test Excavation Area 2. Pit location, depth and artefact number.

Pit name	GDA Zone 56 easting/northing	Total pit depth (cm)	Artefact numbers
TR1 SQ1	887897/6404797	15-20	0
TR1 SQ2	887901/6404805	25-30	0
TR1 SQ3	887904/6404814	15-20	0
TR1 SQ4	887906/6404823	25-30	1
TR1 SQ5	887909/6404831	20-25	0
TR2 SQ1	887886/6404818	20-25	0
TR2 SQ2	887883/6404827	20-25	0
TR2 SQ3	887880/6404837	25-30	1
TR2 SQ4	887877/6404845	25-30	0
TR2 SQ5	887873/6404855	5-10	0
TR2 SQ6	887871/6404865	5-10	0
TR3 SQ1	887881/6404754	10-15	0
TR3 SQ2	887879/6404759	10-15	0
TR3 SQ3	887872/6404767	25-30	0
TR3 SQ4	887870/6404778	25-30	19
TR3 SQ4A	887870/6404778	25-30	39
TR3 SQ4B	887871/6404778	25-30	13
TR3 SQ4C	887871/6404773	25-30	0
TR3 SQ4D	887869/6404783	25-30	1
TR3 SQ4E	887869/6404778	25-30	19
TR3 SQ5	887867/6404789	25-30	0
TR3 SQ6	887863/6404798	25-30	0
TR4 SQ1	887862/6404784	15-20	1
TR4 SQ2	887853/6404785	15-20	0
TR4 SQ3	887844/6404784	15-20	0
TR4 SQ4	887833/6404783	10-15	0
TR4 SQ5	887823/6404787	10-15	0
TR4 SQ6	887815/6404789	10-15	0
TR5 SQ1	888033/6404686	20-25	2
TR5 SQ1A	888037/6404682	10-15	0
TR5 SQ1B	888032/6404680	20-25	5
TR5 SQ2	888042/6404684	10-15	2
TR5 SQ3	888052/6404682	10-15	4
TR5 SQ4	888062/6404680	15-20	0
TR5 SQ5	888072/6404678	15-20	0
TR5 SQ6	888082/6404677	5-10	0
TR5 SQ7	888102/6404674	10-15	0

Pit name	GDA Zone 56 easting/northing	Total pit depth (cm)	Artefact numbers
TR5 SQ8	888121/6404671	10-15	0
TR5 SQ9	888141/6404668	30-35	0
TR5 SQ10	888158/6404662	20-25	0
TR6 SQ1	887899/6404770	10-15	0
TR6 SQ2	887899/6404761	15-20	0
TR6 SQ3	887901/6404754	15-20	0
TR6 SQ4	887903/6404742	20-25	0
TR6 SQ5	887904/6404733	15-20	0
TR6 SQ6	887906/6404723	15-20	0
TR7 SQ1	887826/6404750	20-25	0
TR7 SQ2	887833/6404748	20-25	0
TR7 SQ3	887841/6404747	25-30	0
TR7 SQ4	887852/6404745	25-30	1
TR7 SQ5	887860/6404743	25-30	3
TR7 SQ6	887871/6404740	25-30	0
TR8 SQ1	887864/6404720	15-20	0
TR8 SQ2	887872/6404715	20-25	0
TR8 SQ3	887879/6404708	20-25	0
TR8 SQ4	887890/6404704	20-25	0
TR8 SQ5	887898/6404700	20-25	0
TR8 SQ6	887906/6404694	20-25	0
Total			111¹⁰

¹⁰ Three unstratified artefacts were recovered from spoil at Transect 3 bringing the total artefact number to 114.

Figure 107: Test Excavation Area 2. Stratigraphy.

1. TEST EXCAVATION AREA 2: TRANSECT 1, SQUARE 1. 5CM HUMIC STRATUM (A1) ABOVE LEACHED CLAY/LOAM (A2). BASAL CLAY (B) AT 20CM.



2. TEST EXCAVATION AREA 2: TRANSECT 2, SQUARE 1. 5CM HUMIC STRATUM (A1) ABOVE LEACHED CLAY/LOAM (A2) WITH SOME CHARCOAL FLECKS. BASAL CLAY (B) AT 20-25CM.



3. TEST EXCAVATION AREA 2: TRANSECT 3, SQUARE 4. SANDY WITH SOME HUMIC MATERIAL (A1; 10CM) ABOVE LEACHED CLAY/LOAM (A2). BASAL CLAY (B) AT 30CM.



4. TEST EXCAVATION AREA 2: TRANSECT 4, SQUARE 3. A1 HORIZON ABSENT. LEACHED CLAY/LOAM (A2) TO BASAL CLAY (B) AT 20CM.



5. TEST EXCAVATION AREA 2: TRANSECT 5, SQUARE 1B. A1 HORIZON ABSENT. LEACHED CLAY/LOAM (A2) TO BASAL CLAY (B) AT 25CM (THE BLACK 'DOTS' ARE ANTS).



6. TEST EXCAVATION AREA 2: TRANSECT 6, SQUARE 1. A1 HORIZON ABSENT. LEACHED CLAY/LOAM (A2) TO BASAL CLAY (B) AT 15CM.

Figure 108: Test Excavation Area 2. Stratigraphy (continued).

	
1. TEST EXCAVATION AREA 2: TRANSECT 7, SQUARE 4. SANDY WITH SOME HUMIC MATERIAL (A1; 5CM) ABOVE LEACHED CLAY/LOAM (A2) WITH SOME GRAVEL. BASAL CLAY (B) AT 30CM.	2. TEST EXCAVATION AREA 2: TRANSECT 8, SQUARE 5. SANDY WITH SOME HUMIC MATERIAL (A1; 10CM) ABOVE LEACHED CLAY/LOAM (A2) WITH SOME GRAVEL. BASAL CLAY (B) AT 25CM.

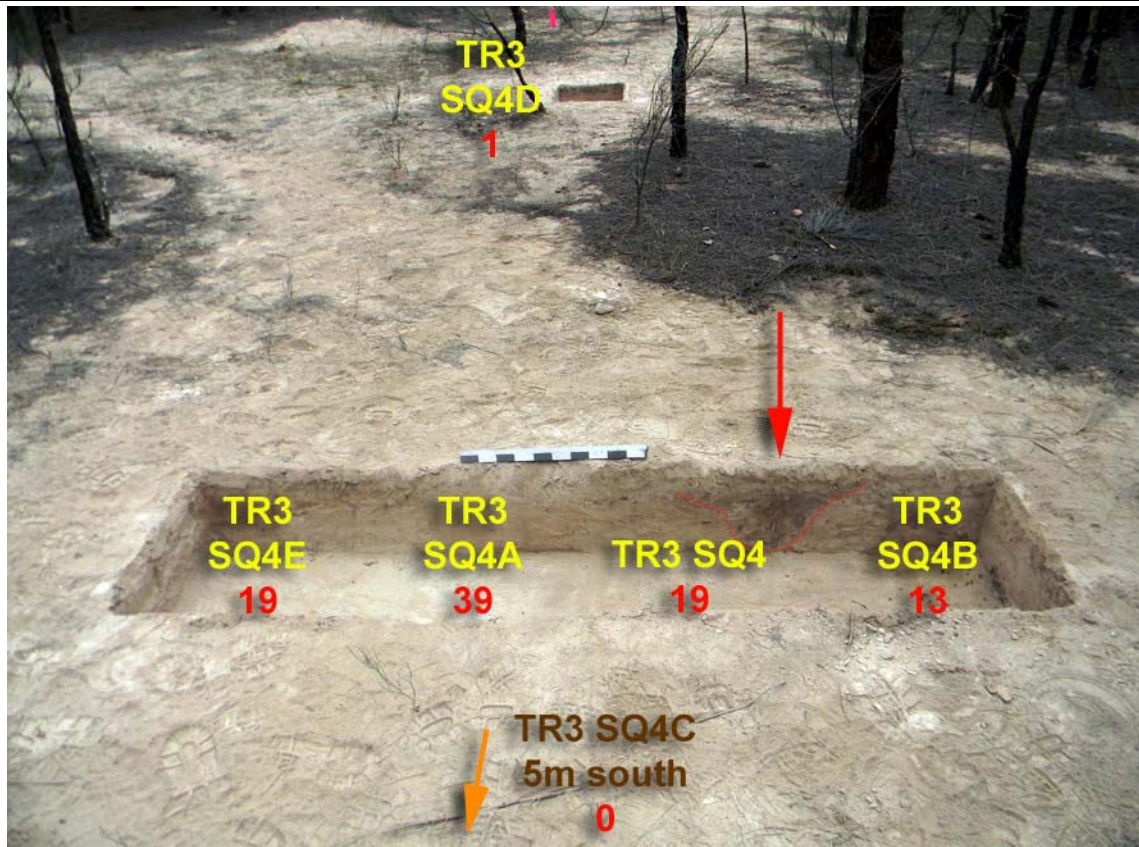
Figures 107 and **108** illustrate a range of sample pits from across Test Excavation Area 2. Generally the A Horizon, particularly the A1 Horizon, is very thin (no more than 10cm and more often less than 5cm) or non-existent across all pits. The A2 Horizon was generally a leached clay/loam. In some instances (see **Figure 107. 2**) some charcoal flecks were included within the A2 Horizon although, in all cases this charcoal was determined to be non-archaeological and probably the result of burning tree stumps/roots. B Horizon basal clays were no more than 30cm from the surface across Test Excavation Area 2.

The only stratigraphic feature recorded within Test Excavation Area 2 was at Transect 3 surrounding Square 4. This feature is a pit distinguished by a soil discolouration of darker and more-orange soil (**Figure 109**; the pit is contained in the eastern half of TR3 SQ4 and the western half of TR3 SQ4b). The pit was roughly circular in nature and 35cm to 40cm in diameter and up to 15cm deep. Although the soil within the pit is darker, no more obvious signs of burning (i.e. charcoal chunks, ash or burnt clay/stone) were present. The pit has been cut from a layer 10cm below the present soil surface. This pit is located within and immediately adjacent to the only concentration of artefacts recorded in Test Excavation Area 2. The archaeologist excavating the pit reported that the artefacts were from areas outside of the pit rather than from within the pit itself. As can be seen in **Figure 109** the main concentration of artefacts is located to the west of the pit (TR3 SQ4a), rather than from squares surrounding the pit (TR3 SQ4 and TR3 SQ4b).

Figure 109: Test Excavation Area 2 (MOCO OS-4). Pit at TR3 SQ4.



1. TEST EXCAVATION AREA 2: TRANSECT 3, SQUARE 4B BEING EXCAVATED WITH THE PIT BEING SECTIONED BY THE EXCAVATION OF TR3 SQ4 IN THE FOREGROUND. EXCAVATION OF TR3 SQ4B IS AT THE TOP OF THE PIT THAT IS CUT FROM 10CM BELOW THE CURRENT SOIL SURFACE.



2. TEST EXCAVATION AREA 2: TRANSECT 3, SQUARES 4, 4A, 4B, 4D AND 4E. THE PIT, STILL VISIBLE IN THE NORTH SECTION, IS SHOWN BY THE ARROW. NUMBERS IN RED ARE THE TOTAL NUMBER OF ARTEFACTS FROM EACH EXCAVATION SQUARE.

During 2005/2006 salvage excavations at Bettys Creek 2 (#37-3-0025; located on the west bank of Bettys Creek approximately 4km southwest from MOCO OS-4), Umwelt (2013b: 6.29) excavated a pit feature that has been assessed as a possible ground oven. This pit was roughly circular in nature and 65cm to 75cm in diameter. The pit feature was first encountered at the base of Spit 2/top of Spit 3 (i.e. 10cm) and it continued to the clay but not into the clay. It was

noted that Spits 1 and 2 were the same as the surrounding Squares and it appears that there has been a period of reworking of the deposits down to 10 centimetres. A total of 43 artefacts were recovered from around the pit and eight were recovered from directly above the pit feature. Three artefacts were recovered from within the pit feature. The stratigraphy of the pit at Bettys Creek 2 was:

- 10cm to 12cm to 22cm – Unit A – dark grey sandy silt rich in fragmented charcoal and ash;
- 13cm to 22cm – Unit B – white ash rich sandy silt;
- 18cm to 22cm – pockets of fragmented charcoal sitting on the B clay horizon and surrounded by the white ash; and
- 22+cm - B – brown clay with some orange patches related to burning.

Charcoal from the base of the pit returned a date of 2188±39BP (Umwelt 2013b: 6.30) further strengthening the hypothesis that this pit was of Aboriginal origin.

The pit feature at Test Excavation Area 2 (MOCO OS-4) is smaller in size and lacks the evidence of burning and ash recorded in the pit at Bettys Creek 2. While the Bettys Creek 2 pit was also discernible from a depth of 10cm, the excavators noted that the top-most 10cm appeared to have been disturbed and so it is uncertain at which level the pit was originally excavated. It is also noted that both pits recorded a concentration of artefacts in the immediate vicinity.

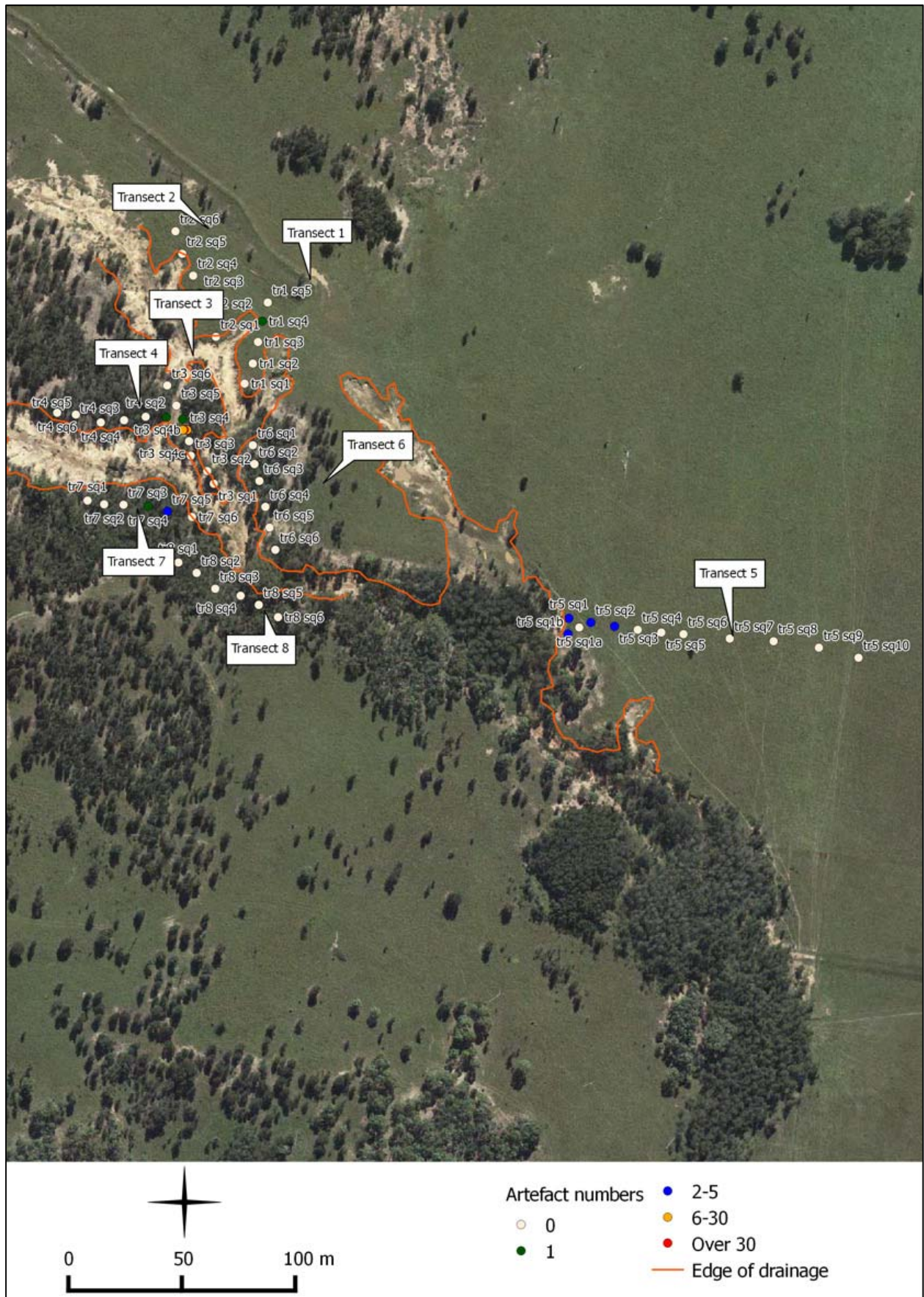
The pit feature at TR3 SQ4, lacking clear evidence of its use as an oven¹¹, is assessed as being unlikely to be of cultural origin; although the possibility cannot be entirely discounted. It is therefore probably only fortuitous that this feature coincides with the only known concentration of artefacts at MOCO OS-4, however, at our current knowledge, the pit and the artefacts are unlikely to be related. It is assumed here that the pit represents a later intrusion into an earlier deposit; possibly as a result of a tree stump burning below the ground.

It should be noted, as seen in **Figure 109**, that the concentration of artefacts recorded surrounding TR3 SQ4 did not extend either north (TR3 SQ4d; 5m north; one artefact recorded) or south (TR3 SQ4c; 5m south; no artefacts recorded) for any great distance.

7.4.2.1 Artefact distribution

The horizontal artefact distribution at Test Excavation Area 2 was very sporadic apart from the concentration of artefacts surrounding TR3 SQ4 (**Figure 110**).

¹¹ The alternative was that it could have been a pit for heat treating stone, however, this was thought unlikely based on the very low numbers of heat treated artefacts recovered from the excavation and across the general area (see Umwelt 2013d: 6.29).

Figure 110: Test Excavation Area 2. Artefact distribution.

In total 114 artefacts were recorded from the test excavation program not including small flakes, chips and shatter that was determined to be an unintentional by-product of the knapping process (**Table 44**). Apart from the squares including and immediately adjacent to TR3 SQ4 (TR3 SQ4, TR3 SQ4a, TR3 SQ4b, TR3 SQ4e), a very low artefact density was recorded with many excavation squares recording no artefacts or no more than two artefacts per square.

At the concentration surrounding TR3 SQ4, 82% (n=93) of the 114 artefacts recorded in the excavations at MOCO OS-4 came from this one concentration that covered an excavated area of 1m².

Table 44: Test Excavation Area 2 (MOCO OS-4). Recorded artefacts.

Location	Total artefacts excluding chips/shatter
Transect 1	
Area 2, Tr1, SQ 4, Spit 5	1
Transect 2	
Area 2, Tr2, SQ 3, Spit 5	1
Transect 3	
Area 2, Tr3, SQ 4, Spit 3	1
Area 2, Tr3, SQ 4, Spit 4	12
Area 2, Tr3, SQ 4, Spit 5	4
Area 2, Tr3, SQ 4, Spit 6	2
Area 2, Tr3, SQ 4A, Spit 3	2
Area 2, Tr3, SQ 4A, Spit 4	8
Area 2, Tr3, SQ 4A, Spit 5	18
Area 2, Tr3, SQ 4A, Spit 6	11
Area 2, Tr3, SQ 4B, Spit 3	4
Area 2, Tr3, SQ 4B, Spit 4	8
Area 2, Tr3, SQ 4B, Spit 5	1
Area 2, Tr3, SQ 4D, Spit 6	1
Area 2, Tr3, SQ 4E, Spit 2	0*
Area 2, Tr3, SQ 4E, Spit 3	2
Area 2, Tr3, SQ 4E, Spit 4	1
Area 2, Tr3, SQ 4E, Spit 5	13
Area 2, Tr3, SQ 4E, Spit 6	3
Area 2, Tr3, unstratified	3
Transect 4	
Area 2, Tr4, SQ 1, Spit 1	1
Transect 5	
Area 2, Tr5, SQ 1, Spit 4	2
Area 2, Tr5, SQ 1A, Spit 2	0*
Area 2, Tr5, SQ 1B, Spit 2	1
Area 2, Tr5, SQ 1B, Spit 3	1
Area 2, Tr5, SQ 1B, Spit 4	3
Area 2, Tr5, SQ 2, Spit 1	2

Location	Total artefacts excluding chips/shatter
Area 2, Tr5, SQ 3, Spit 1	2
Area 2, Tr5, SQ 3, Spit 2	1
Area 2, Tr5, SQ 3, Spit 3	1
Transect 6	
Area 2, Tr6, SQ 2, Spit 4	0*
Transect 7	
Area 2, Tr7, SQ 4, Spit 4	1
Area 2, Tr7, SQ5, Spit 3	3
Total	114

* DENOTES THAT CHIPS/SHATTER WAS RECORDED BUT NO ARTEFACTS.

All artefacts catalogued at Transect 3, Squares 4, 4a, 4b, 4d and 4e, are listed in **Table 45**. All other artefacts recorded outside this concentration are listed in **Table 46**.

Regarding those artefacts recorded outside of the concentration surrounding TR3 SQ4 (**Table 46**), 13 or 65% of the remaining 20 artefacts were recorded in the western 20m of Transect 5: leaving seven artefacts to be recorded from the remaining six transects.

In terms of artefact densities this equates to a moderate density surrounding TR3 SQ4, a low density in the western 20m of TR5 and a very low density across the remaining areas.

Table 45: Test Excavation Area 2 (MOCO OS-4). Artefact catalogue. Transect 3, Squares 4, 4a, 4b, 4d and 4e.

Square	Spit	Artefact type	Raw Material	Max. dimension (mm)	Break?	Previous flake scars	Rotation	Platform type	Termination type	Reduction phase	Notes
4	3	Broken blade	Silcrete (pale)	9	Distal	2	Parallel	Previous flake	n/a	Tertiary	
4	4	Broken Flake	Mudstone	23	Proximal + Distal	1	n/a	n/a	n/a	Secondary	
4	4	Flake	Mudstone	25	n/a	3	Rotated	Point	feather	Tertiary	
4	4	Flake	Mudstone	16	n/a	2	Rotated	Previous flake (moderate)	feather	Tertiary	
4	4	Flake	Mudstone	19	n/a	1	n/a	Previous flake	feather	Tertiary	
4	4	Flake	Mudstone	18	n/a	2	Parallel	Point	feather	Secondary	
4	4	Flake	Mudstone	14	n/a	2	Parallel	Cortical	feather	Secondary	
4	4	Broken blade	Mudstone	8	Distal	2	Parallel	Point	n/a	Tertiary	
4	4	Flake	Mudstone	13	n/a	2	Parallel	Previous Flake	feather	Tertiary	
4	4	Flake	Mudstone	11	n/a	3	Rotated	Previous Flake	feather	Tertiary	
4	4	Flake	Mudstone	14	n/a	2	Rotated	Point	feather	Tertiary	
4	4	Broken blade	Mudstone	13	Proximal	2	Parallel	n/a	feather	Tertiary	
4	4	Flake	Mudstone	12	n/a	2	Parallel	Previous flake (wide)	feather	Tertiary	
4	4	18 x angular shatter	Mudstone	<7						Tertiary	
4	4	1 x angular shatter	Mudstone	25						Tertiary	core trimming element?
4	5	Flake	Mudstone	35	n/a	5	Rotated	Previous flake (moderate)	feather	Secondary	

Square	Spit	Artefact type	Raw Material	Max. dimension (mm)	Break?	Previous flake scars	Rotation	Platform type	Termination type	Reduction phase	Notes
4	5	Broken blade	Mudstone	13	Proximal + Distal	2	Parallel	n/a	n/a	Tertiary	steep retouch to one end/end scraper?
4	5	Flake	Mudstone	13	n/a	2	Parallel	Previous flake (moderate)	feather	Tertiary	
4	5	Broken blade	Mudstone	11	Proximal	3	Parallel	n/a	feather	Tertiary	
4	5	1 x angular shatter	Mudstone							Tertiary	
4	6	Broken flake	Mudstone	21	Proximal	5	Rotated	n/a	feather	Secondary	
4	6	Broken flake	Mudstone	15	Distal	2	Rotated	Point	n/a	Secondary	
4a	3	Broken flake	Silcrete (pale)	10	Longitudinal	1	n/a	Point	feather	Tertiary	
4a	3	Blade	Petrified wood	10	n/a	2	Parallel	Point	feather	Tertiary	
4a	4	Flake	Mudstone	36	n/a	4	Rotated	Previous flake	feather	Tertiary	
4a	4	Flake	Quartz	10	n/a	2	Rotated	Previous flake	feather	Tertiary	
4a	4	Broken flake	Silcrete (pink)	14	Proximal + Distal	2	Parallel	n/a	n/a	Tertiary	
4a	4	Broken flake	Silcrete (pink)	11	Proximal	3	Parallel	n/a	feather	Tertiary	
4a	4	Broken flake	Silcrete (pink)	11	Proximal	4	Parallel	n/a	feather	Tertiary	
4a	4	Broken flake	Silcrete (pink)	6	Proximal	2	Parallel	n/a	feather	Tertiary	
4a	4	Broken flake	Silcrete (pink)	12	Proximal + Distal	2	Parallel	n/a	n/a	Tertiary	
4a	4	Broken flake	Silcrete (pink)	6	Proximal	1	n/a	n/a	feather	Tertiary	

Square	Spit	Artefact type	Raw Material	Max. dimension (mm)	Break?	Previous flake scars	Rotation	Platform type	Termination type	Reduction phase	Notes
4a	4	13 x angular shatter	Silcrete (pink)	<11						Tertiary	
4a	4	2 x angular shatter	Silcrete (pale)	<9						Tertiary	
4a	5	Flake	Silcrete (pale)	16	n/a	2	Rotated	Previous flake	feather	Tertiary	
4a	5	Broken flake	Silcrete (pink)	15	Proximal	3	Rotated	n/a	feather	Tertiary	
4a	5	Flake	Silcrete (pink)	21	n/a	2	Parallel	Point	feather	Tertiary	
4a	5	Broken flake	Silcrete (pink)	19	Distal	3	Parallel	Previous flake	n/a	Tertiary	
4a	5	Flake	Silcrete (pink)	21	n/a	3	Parallel	Previous flake	feather	Tertiary	
4a	5	Flake	Silcrete (pink)	17	n/a	2	Parallel	Previous flake	feather	Tertiary	
4a	5	Flake	Silcrete (pink)	17	n/a	2	Parallel	Previous flake	feather	Tertiary	
4a	5	Broken flake	Silcrete (pink)	19	Distal	2	Parallel	Previous flake	feather	Tertiary	
4a	5	Flake	Silcrete (pale)	21	n/a	3	Parallel	Point	feather	Tertiary	
4a	5	Broken flake	Silcrete (pink)	16	Proximal + Distal	4	Rotated	n/a	n/a	Tertiary	
4a	5	Flake	Silcrete (pink)	11	n/a	2	Rotated	Faceted	feather	Tertiary	
4a	5	Broken flake	Silcrete (pink)	12	Proximal	2	Parallel	n/a	feather	Tertiary	
4a	5	Broken flake	Silcrete (pink)	13	Proximal	3	Rotated	n/a	feather	Tertiary	
4a	5	Broken flake	Silcrete (pink)	12	Distal	4	Parallel	Previous flake	feather	Tertiary	

Square	Spit	Artefact type	Raw Material	Max. dimension (mm)	Break?	Previous flake scars	Rotation	Platform type	Termination type	Reduction phase	Notes
4a	5	Flake	Silcrete (pink)	12	n/a	1	n/a	Previous flake	feather	Tertiary	
4a	5	Broken flake	Silcrete (pink)	14	Distal	2	Parallel	Previous flake	feather	Tertiary	
4a	5	Broken blade	Quartzite	18	Proximal	2	Parallel	n/a	feather	Tertiary	
4a	5	Broken flake	Silcrete (pink)	12	Proximal	2	Parallel	n/a	feather	Tertiary	
4a	5	5 x angular shatter	Silcrete (pale)	<18						Tertiary	
4a	5	4 x angular shatter	Silcrete (pink)	<12						Tertiary	
4a	5	Cranium fragment		12x8x4							species unknown (too thin for human, sutures fused)
4a	6	Broken flake	Silcrete (pale)	30	Proximal	3	Rotated	n/a	feather	Tertiary	
4a	6	Flake	Mudstone	26	n/a	2	Parallel	Previous flake	feather	Secondary	
4a	6	Broken flake	Silcrete (pink)	23	Proximal	3	Rotated	n/a	feather	Tertiary	
4a	6	Broken flake	Silcrete (pale)	21	Proximal	1	n/a	n/a	feather	Tertiary	
4a	6	Broken flake	Silcrete (pale)	14	Distal	3	Parallel	Previous flake (wide)	n/a	Tertiary	
4a	6	Broken flake	Silcrete (pink)	24	Proximal	4	Rotated	n/a	feather	Tertiary	
4a	6	Blade	Silcrete (pale)	18	n/a	4	Parallel	Crushed	feather	Tertiary	
4a	6	Flake	Silcrete (pale)	15	n/a	3	Parallel	Previous flake	feather	Tertiary	
4a	6	Broken flake	Silcrete (pale)	11	Distal	2	Parallel	Point	n/a	Tertiary	

Square	Spit	Artefact type	Raw Material	Max. dimension (mm)	Break?	Previous flake scars	Rotation	Platform type	Termination type	Reduction phase	Notes
4a	6	Flake	Silcrete (pale)	14	n/a	2	Parallel	cortical	feather	Secondary	
4a	6	Broken flake	Silcrete (pale)	14	Proximal + Distal	2	Parallel	n/a	n/a	Tertiary	
4a	6	1 x angular shatter	Mudstone	15						Tertiary	
4a	6	2 x angular shatter	Silcrete (pale)	<8						Tertiary	
4a	6	7 x angular shatter	Silcrete (pink)	<8						Tertiary	
4b	3	Broken flake	Silcrete (pale)	12	Distal	3	Parallel	Point	n/a	Tertiary	partial retouch left margin
4b	3	Broken flake	Silcrete (pale)	9	Proximal	2	Parallel	n/a	feather	Tertiary	
4b	3	Flake	Silcrete (pale)	7	n/a	1	n/a	Point	feather	Tertiary	
4b	3	Flake	Silcrete (pale)	7	n/a	1	n/a	Point	feather	Tertiary	
4b	4	End scraper	Silcrete (pink)	29	n/a	3	Parallel	Previous flake	n/a	Tertiary	Semi-steep distal termination, fine retouch/edge wear
4b	4	Broken blade	Silcrete (pale)	30	Distal	3	Rotated	Faceted	n/a	Tertiary	
4b	4	End scraper	Silcrete (pink)	38	n/a	2	Parallel	n/a	feather	Tertiary	Steep proximal termination, invasive retouch to end
4b	4	Broken blade	Silcrete (pink)	28	Proximal + Distal	2	Parallel	n/a	n/a	Tertiary	
4b	4	Flaked piece	Silcrete (pink)	14	Distal	3	Rotated	Previous flake	n/a	Tertiary	Broken blade with flake removed from ventral

Square	Spit	Artefact type	Raw Material	Max. dimension (mm)	Break?	Previous flake scars	Rotation	Platform type	Termination type	Reduction phase	Notes
4b	4	Broken flake	Silcrete (pale)	10	Distal	2	Parallel	Point	n/a	Tertiary	
4b	4	Broken flake	Silcrete (pale)	12	Distal	2	Parallel	Point	n/a	Tertiary	
4b	4	Broken flake	Silcrete (pale)	14	Proximal + Distal	1	n/a	n/a	n/a	Tertiary	
4b	4	3 x angular shatter	Silcrete (pale)	<9						Tertiary	
4b	4	10 x angular shatter	Silcrete (pink)	<11						Tertiary	
4b	5	Broken flake	Silcrete (pink)	19	Proximal + Distal	2	Rotated	n/a	n/a	Tertiary	
4b	5	1 x angular shatter	Silcrete (pink)	5						Tertiary	
4d	6	Broken flake	Silcrete (pink)	14	Proximal	1	n/a	n/a	feather	Tertiary	
4e	2	1 x angular shatter	Silcrete (pink)	6						Tertiary	
4e	3	Blade	Silcrete (pink)	11	n/a	1	n/a	Point	feather	Tertiary	
4e	3	Broken flake	Silcrete (pink)	8	Proximal	1	n/a	n/a	feather	Tertiary	
4e	3	3 x angular shatter	Silcrete (pale)	<6						Tertiary	
4e	4	Broken flake	Silcrete (pink)	13	Proximal	2	Parallel	n/a	feather	Tertiary	
4e	4	Possible core	Quartzite	78							2 x joining fragments + 4 x primary flakes: no definitive flake attributes
4e	5	Flake	Silcrete (pale)	14	n/a	2	Parallel	Faceted	feather	Tertiary	

Square	Spit	Artefact type	Raw Material	Max. dimension (mm)	Break?	Previous flake scars	Rotation	Platform type	Termination type	Reduction phase	Notes
4e	5	Broken blade	Silcrete (pink)	21	Proximal + Distal	3	Parallel	n/a	n/a	Tertiary	
4e	5	Blade	Silcrete (pink)	24	n/a	6	Parallel	Previous flake (wide)	feather	Tertiary	
4e	5	Flake	Silcrete (pink)	18	n/a	2	Parallel	Crushed	feather	Secondary	
4e	5	Broken flake	Silcrete (pink)	12	Proximal	2	Rotated	n/a	feather	Tertiary	
4e	5	Flake	Silcrete (pink)	14	n/a	3	Rotated	Faceted	feather	Tertiary	
4e	5	Broken flake	Silcrete (pink)	17	Proximal	2	Parallel	n/a	feather	Tertiary	
4e	5	Broken flake	Silcrete (pink)	16	Proximal + Distal	2	Parallel	n/a	n/a	Tertiary	
4e	5	Flake	Silcrete (pink)	11	n/a	2	Parallel	Point	feather	Tertiary	
4e	5	Flake	Silcrete (pink)	10	n/a	1	n/a	Point	feather	Tertiary	
4e	5	Flake	Silcrete (pink)	11	n/a	1	n/a	Point	feather	Tertiary	
4e	5	Broken flake	Silcrete (pink)	13	Proximal	2	Rotated	n/a	feather	Tertiary	
4e	5	Flake	Silcrete (pink)	14	n/a	2	Parallel	Point	feather	Tertiary	
4e	5	9 x angular shatter	Silcrete (pink)	<16						Tertiary	
4e	5	5 x possible primary flakes	Quartzite								Same material as possible core in spit 4, one possible join with 'core', no definitive flake attributes.
4e	6	Flake	Silcrete (pink)	12	n/a	1	n/a	Point	feather	Tertiary	
4e	6	Flake	Silcrete (pink)	13	n/a	1	n/a	Point	feather	Tertiary	

Square	Spit	Artefact type	Raw Material	Max. dimension (mm)	Break?	Previous flake scars	Rotation	Platform type	Termination type	Reduction phase	Notes
4e	6	Flake	Silcrete (pink)	14	n/a	1	n/a	Point	feather	Tertiary	
4e	6	2 x angular shatter	Silcrete (pink)							Tertiary	
4e	6	1 x angular shatter	Silcrete (pale)							Tertiary	
4e	6	1 x angular shatter	Quartzite							Primary	
unstrat.		Flake	Mudstone	52	n/a	0	cortical	Point	feather	Primary	
unstrat.		Flake	Volcanic?	32	n/a	2	Rotated	cortical	Bipolar crushing?/ feather	Secondary	
unstrat.		Flake	Mudstone	26	n/a	2	Rotated	cortical	feather	Secondary	
unstrat.		8 x angular shatter	Silcrete (pink)							Tertiary	
unstrat.		3 x angular shatter	Mudstone							Tertiary	

Table 46: Test Excavation Area 2 (MOCO OS-4). Artefact catalogue. All other areas outside Transect 3, Squares 4, 4a, 4b, 4d and 4e.

Transect	square	Spit	Artefact type	Raw Material	Max. dimension (mm)	Break?	Previous flake scars	Rotation	Platform type	Termination type	Reduction phase	Notes
1	4	5	Broken blade	Silcrete (orange)	9	Distal	2	Parallel	Point	n/a	Tertiary	
2	3	5	Flake	Mudstone	33	n/a	5	Rotated	Previous flake (moderate)	feather	Tertiary	
4	1	1	Blade	Silcrete (pink)	35	n/a	2	Parallel	Point	feather	Tertiary	

Transect	square	Spit	Artefact type	Raw Material	Max. dimension (mm)	Break?	Previous flake scars	Rotation	Platform type	Termination type	Reduction phase	Notes
5	1	4	Flake	Mudstone	29	n/a	4	Parallel	Previous flake (wide)	feather	Tertiary	
5	1	4	Flake	Mudstone	22	n/a	2	Parallel	Previous flake (wide)	feather	Tertiary	
5	1a	2	1 x angular shatter	Silcrete (pink)							Tertiary	
5	1b	2	Flake	Mudstone	7	n/a	2	Parallel	Previous flake	feather	Tertiary	
5	1b	3	Flake	Mudstone	28	n/a	3	Rotated	Previous flake (wide)	feather	Tertiary	
5	1b	4	Flake	Mudstone	17	n/a	3	Rotated	Previous flake (moderate)	feather	Tertiary	
5	1b	4	Broken flake	Petrified wood	17	Distal	2	Parallel	Previous flake	n/a	Tertiary	
5	1b	4	Broken flake	Quartz	13	Distal	2	Parallel	Point	n/a	Tertiary	
5	2	1	Flake	Mudstone	14	n/a	3	Rotated	Point	feather	Tertiary	
5	2	1	Flake	Mudstone	8	n/a	1	Parallel	Point	feather	Secondary	
5	3	1	Broken flake	Silcrete (pale)	22	Distal	4	Parallel	Previous flake (wide)	n/a	Tertiary	
5	3	1	Flake	Silcrete (pale)	8	n/a	2	Rotated	Previous flake	feather	Tertiary	
5	3	2	Broken flake	Silcrete (pale)	20	Distal	2	Parallel	Point	n/a	Tertiary	
5	3	3	Broken flake	Silcrete (pale)	12	Proximal	2	Parallel	n/a	feather	Tertiary	
6	2	4	1 x angular shatter	Mudstone							Tertiary	
7	4	4	Flake	Mudstone	23	n/a	4	Rotated	cortical	hinged	Secondary	
7	5	3	Broken flake	Mudstone	47	Proximal	0	cortical	n/a	feather	Primary	possible edge wear on proximal break

Transect	square	Spit	Artefact type	Raw Material	Max. dimension (mm)	Break?	Previous flake scars	Rotation	Platform type	Termination type	Reduction phase	Notes
7	5	3	Flake	Mudstone	31	n/a	1	Rotated	cortical	feather	Secondary	
7	5	3	Flake	Mudstone	16	n/a	1	n/a	cortical	feather	Secondary	
7	5	3	4 x angular shatter	Mudstone	<16						Secondary	
7	5	3	5 x angular shatter	Mudstone	<7						Tertiary	
7	5	3	1 x angular shatter	Mudstone	<8						Primary	

In terms of vertical distribution, no artefacts were recorded deeper than 30cm from the surface and relatively few were recorded in the top-most 10cm of deposit (**Table 47**). The greatest concentration of artefacts is between 15cm and 25cm below the current surface.

Table 47: Test Excavation Area 2 (MOCO OS-4). Vertical distribution of artefacts.

Spit Number	Total number of artefacts
1 (0-5cm)	5
2 (5-10cm)	2
3 (10-15cm)	14
4 (15-20cm)	35
5 (20-25cm)	38
6 (25-30cm)	17
Unstratified	3
Total	114

7.4.2.2 Raw materials

The vast majority of recorded artefacts come from either IMT (mudstone) or silcrete sources. Very small numbers of artefacts from quartzite, quartz, volcanic and petrified wood sources were recorded (**Table 48**).

Table 48: Test Excavation Area 2 (MOCO OS-4). Artefact raw materials.

Raw Material	Total number	% of total assemblage (n=114)
Silcrete	74	65
IMT	34	30
Quartzite	1	<1
Quartz	2	2
Volcanic	1	<1
Petrified wood	2	2
Total	114	100

The fact that the most frequently recorded stone at Test Excavation Area 2 (MOCO OS-4) is silcrete is somewhat at odds with other excavation results in the area that often record more IMT artefacts than silcrete. For example, from recent (2005/2006) salvage programs along Bowmans, Swamp and Bettys Creeks the recorded raw materials were:

- Bettys Creek 10 (#37-3-0600; Umwelt 2013b: 6.17). Mudstone (39.1%), followed by chert (26.3%), silcrete (22.3%), quartz (9.9%), quartzite (0.7%), silicified siltstone (0.7%), indeterminate (0.7%) and petrified wood (0.4%)
- Bettys Creek 9 (#37-3-0599; Umwelt 2013b: 6.22). Silcrete (78.9%), followed by mudstone (10.5%), tuff (5.3%) and quartz (5.3%).
- Bettys Creek 2 (#37-3-0025; Umwelt 2013b: 6.26). Mudstone (59.5%), followed by silcrete (33.7%), quartz (3.4%), silicified sandstone (1.3%), indeterminate (0.8%), tuff (0.3%), quartzite and chert (0.2%), silicified siltstone, chalcedony and volcanic (0.1%).

- Surface collection (Umwelt 2013b: 6.9; 824 artefacts from 36 site areas associated with Bettys Creek, Bowmans Creek and Swamp Creek). Mudstone (58.5%), followed by silcrete (31.9 %) quartz (5.6%), tuff (1.1%), chert (0.7%), silicified siltstone (0.6%), quartzite (0.5%), silicified sandstone (0.5%), chalcedony (0.2%), volcanic (0.1%), petrified wood (0.1%), porcellanite (0.1%) and indeterminate (0.2%).
- Grader scrapes (Umwelt 2013b: 6. 43; 177 artefacts from 44 grader scrapes). Silcrete (46.3%), followed closely by mudstone (41.2%). The remaining 12.4% of the raw materials comprised quartz (4%), petrified wood (3.4%), volcanic (1.1%), indeterminate (1.1%), chert (0.6%), quartzite (0.6%), fine grained siliceous (0.6%), Hornfels (0.6%) and tuff (0.6%).

This analysis of recent data shows that, generally, IMT or mudstone is the dominant raw material used for stone tool manufacture; although some sites/programs do record a majority of artefacts manufactured from silcrete. As Test Excavation Area 2 (MOCO OS-4) has predominance of silcrete makes the site somewhat unusual, but not unique.

Reference to **Table 45** shows that the majority of artefacts recorded at the TR3 SQ4 concentration are silcrete. As this concentration does not extend with the same artefact density away from this location, it is possible that the concentration represents evidence of knapping in a reasonably restricted area. In this regard, it is noteworthy that no mudstone or silcrete cores were recorded in the excavations implying that the cores may not have been exhausted and were carried out of the area.

In this respect it is valuable to examine the small flakes, chips and shatter (termed here as debitage) that were recorded in the TR3 SQ4 concentration (**Table 49**).

Table 49: Test Excavation Area 2 (MOCO OS-4). Analysis of debitage from TR3 SQ4, 4a, 4b and 4e.

Square	IMT debitage	Silcrete debitage
4	20	0
4a	1	29
4b	0	14
4e	0	16

Table 49 shows a predominance of silcrete debitage that perhaps indicates that silcrete cores were being worked at that location, perhaps, within a small sample, leading to a predominance of silcrete artefacts across the whole assemblage.

The concentration of IMT debitage at TR3 SQ4 also indicates that IMT was being worked at this location. Interestingly, when the artefacts recorded at TR3 SQ4 are examined (**Table 45**), apart from one silcrete artefact, the remainder are IMT (**Figure 111**). However, in an immediately adjacent square to the west, TR SQ4a, silcrete dominates the debitage and artefact count (**Figure 112**). This predominance of silcrete, both as debitage as well as artefacts, is also seen in TR3 SQ4b that is immediately adjacent to TR3 SQ4 to the east (**Figure 113**). Similarly,

TR3 SQ4e, located to the west of TR3 SQ4a, recorded a majority of silcrete flakes and some primary quartzite flakes (**Figure 114**). This would indicate that the excavations may have captured several knapping events in the one relatively restricted area: one event concentrating on the manufacture of IMT stone tools (TR3 SQ4) and others on the manufacture of silcrete stone tools (TR3 SQ4a, TR3 SQ4b, TR3 SQ4e). Thus, for whatever reason, this location was a favoured knapping area and that both IMT and silcrete was knapped, although the greater evidence is for the knapping of silcrete stone tools leading to a dominance of this raw material type across the excavation assemblage.

It is also worth noting that the spatial distribution of these different raw materials is well defined with two adjacent squares recording very different raw material counts to the extent that one square is almost exclusively IMT, while the adjacent square is almost exclusively silcrete. This indicates that there is a spatial integrity to the deposits surrounding TR3 SQ4 as a general disturbance to the soil profile would result in the blurring of these distinctions.

On the western bank of the eastern drainage, TR7 SQ5 Spit 3 recorded a range of IMT artefacts and debitage with many pieces at a primary stage of reduction (**Figure 115**). This may also indicate that an IMT cobble was tested at this location although it does not appear that more worked artefacts resulted from this event.

Figure 111: MOCO OS-4. All artefacts excavated from TR3 SQ4 Spit 5.

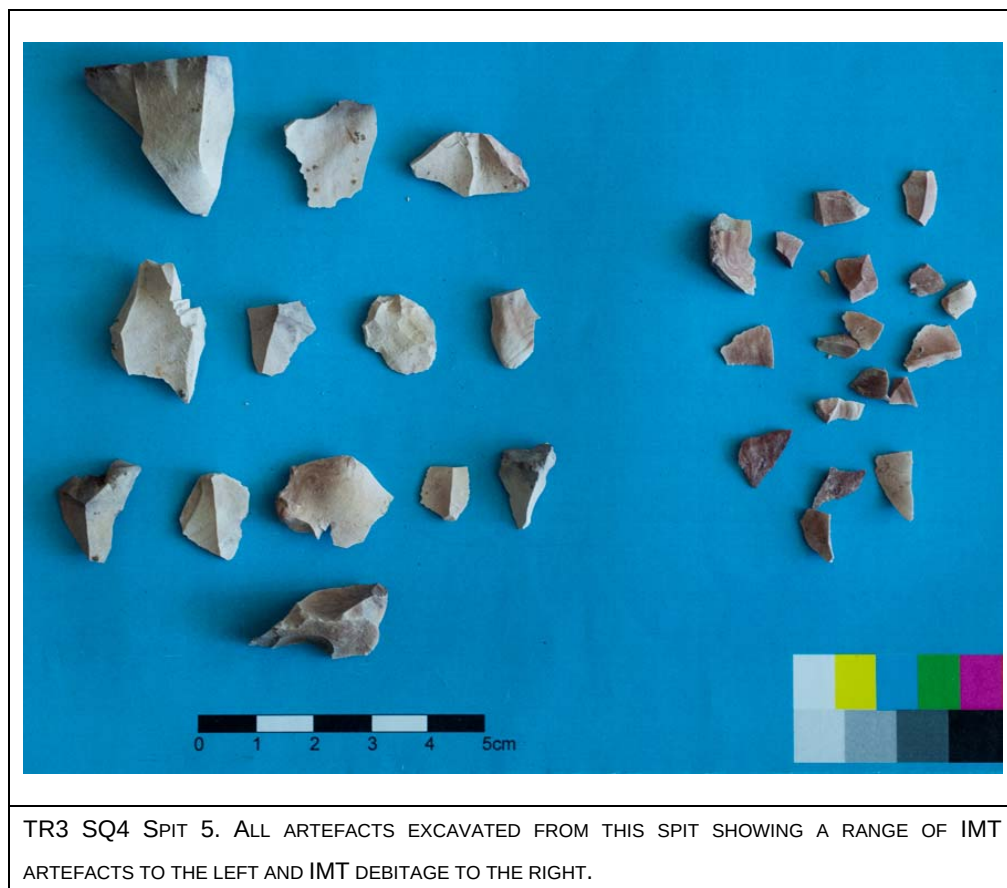


Figure 112: MOCO OS-4. All artefacts excavated from TR3 SQ4a Spit 5.

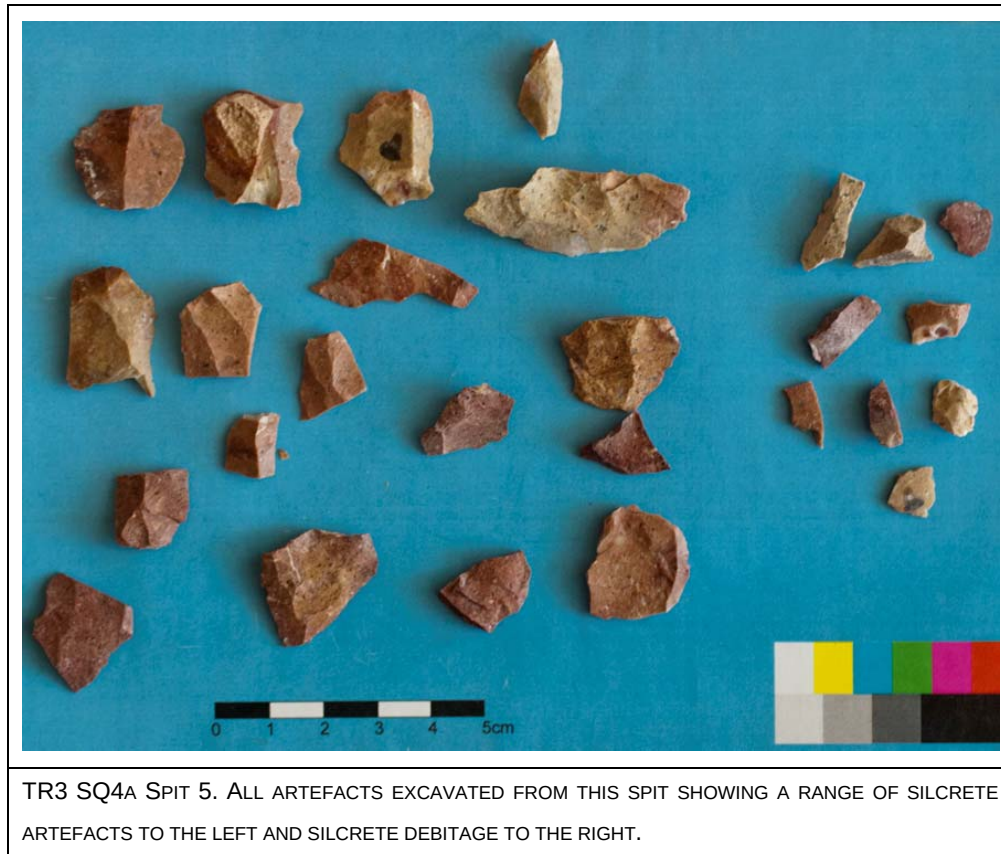


Figure 113: MOCO OS-4. All artefacts excavated from TR3 SQ4b Spit 4.



Figure 114: MOCO OS-4. All artefacts excavated from TR3 SQ4e Spit 5.



TR3 SQ4E SPIT 5. ALL ARTEFACTS EXCAVATED FROM THIS SPIT SHOWING A RANGE OF SILCRETE ARTEFACTS AT TOP LEFT AND SILCRETE DEBITAGE TO BOTTOM LEFT. TO THE RIGHT ARE SEVERAL QUARTZITE PRIMARY FLAKES WITH FEW FLAKE ATTRIBUTES.

Figure 115: MOCO OS-4. All artefacts excavated from TR7 SQ5 Spit 3.



TR7 SQ5 SPIT 3. ALL ARTEFACTS EXCAVATED FROM THIS SPIT SHOWING A RANGE OF PRIMARY IMT ARTEFACTS AND DEBITAGE.

Figure 116: MOCO OS-4. Cranium fragment excavated from TR3 SQ4a Spit 5.

7.4.2.3 Notes on the assemblage

As has been noted, no cores (apart from a possible quartzite core lacking clear flaking attributes; TR3 SQ4e, Spit 4) were recorded during the excavations.

Only two formal tools were recorded, both silcrete end scrapers and both for TR3 SQ4b, Spit 4 (**Figure 113**).

The only non-stone item noted in the excavations at Test Excavation Area 2 was a small fragment of cranium retrieved from TR3 SQ4a Spit 5 (**Figure 116**). This small fragment measures 12mm by 8mm by 4mm. The fragment includes a closed suture indicating that the skull belonged to an adult animal. The fragment, at 4mm, is too thin to be human (the human skull ranges in width from 5mm to 8mm but is more commonly between 6mm and 7mm) although the species of the cranium fragment is unknown. It should be noted that this cranium, that is unburnt, was associated with the greatest artefact concentration recorded at Test Excavation Area 2 and could possibly explain the TR3 SQ4 concentration as a butchery episode/s.

7.4.2.4 Conclusions

As discussed above, apart from the concentration surrounding TR3 SQ4, the artefact density across Test Excavation Area 2 is very low with most squares recording no artefacts or very low numbers of artefacts.

At only two locations were artefact densities higher than this. At the most westerly 20m extent of Transect 5 artefact density rose to low (13 artefacts per square metre excavated or 13 artefacts from four 0.5m by 0.5m squares) and around TR3 SQ4 the artefact density is moderate (in

excess of 90 artefacts per square metre excavated or 93 artefacts from four 0.5m by 0.5m squares).

At Transect 5, the artefacts recorded at TR5 SQ1 (two artefacts), TR5 SQ 1b (five artefacts), TR SQ2 (two artefacts) and TR5 SQ3 (four artefacts) are within 20m of the erosion edge for the eastern drainage where a concentration of artefacts was recorded on the surface during the survey. This indicates that artefact bearing deposits at this location extend at least 20m away from the erosion edge, albeit at a low artefact density. Further east beyond TR5 SQ3, no artefacts were recorded at Transect 5 indicating that artefacts, in this area, are confined to the first 20m of the non-eroded portions of the site.

At other locations artefacts were also recorded during the survey in the in-stream erosion of the eastern drainage. However, transects placed adjacent to these findings, such as Transects 1, 2, 4, 6, 7 and 8 only recorded a very low artefact density. This indicates that, for most of the area of Test Excavation Area 2, artefact bearing deposits do not extend into the non-eroded portions.

At TR3 SQ4 and immediately adjacent squares, a moderate artefact density, determined to be largely *in situ*, was recorded. This location is between the two arms of the eastern drainage and appears to represent a discrete area in which IMT and silcrete cores were knapped. Also in this area is a shallow pit feature that does not appear to be directly related to this artefact concentration. Another eleven squares were excavated in the contiguous landform to that where the TR3 SQ4 concentration was located, and these did not record any artefacts. This would indicate that the artefact density noted at TR3 SQ4 is isolated and is not representative of broader densities across this landform.

As a result of the excavations we can define MOCO OS-4 as a low density artefact scatter, already severely impacted by erosion that has the possibility of containing small concentrations of artefacts where discrete knapping events took place.

In terms of raw materials, tool types and tool frequencies, the assemblage at MOCO OS-4 is reasonably typical although it was noted that sites displaying a dominance of silcrete artefacts are less common in the area than sites displaying a dominance of IMT artefacts and the incidence of cores (none recorded) and formal tool types (two end scrapers recorded) is generally lower than nearby sites.

In summary, the results of the test excavation and the preceding survey indicate that at MOCO OS-4:

- There has been considerable disturbance to MOCO OS-4 as evidenced by the displaced artefacts within the in-stream erosion of the eastern drainage;

- Artefact densities generally range from very low to low across the non-eroded portions of the site;
- Artefact bearing deposits can extend up to 20m from the current erosion edge although, at most places, artefacts do not extend into the non-eroded portions of the site. At the one location (TR5) where artefacts were recorded away from the erosion edge, the artefact density was low;
- One concentration of artefacts was recorded surrounding TR3 SQ4 although this appears to be isolated as the artefacts do not extend beyond the immediate location of the concentration;
- Silcrete dominates the assemblage although it was noted that the sample size is small and that it is possible that one or two knapping events from silcrete cores at the TR3 SQ4 concentration could skew the data in favour of silcrete;
- The area surrounding TR3 SQ4 appears to have integrity as discrete concentrations of IMT and silcrete debitage/artefacts were recorded without a blending of the artefacts that would follow disturbance;
- The majority of artefacts were unmodified flakes with no cores and only one formal tool type (two end scrapers) being recorded; and
- One fragment of non-human cranium recorded in TR3 SQ4a could perhaps indicate that the artefact concentration surrounding TR SQ4 is connected to butchery; although the cranium is unburnt and has no cut marks.

8 DISCUSSION

This section reviews the results of both the survey and test excavation components of the assessment and places the results in the context of previous research that has happened in the area.

The review of the landscape and archaeological contexts of the Proposed Disturbance Area enabled a predictive model for site location to be made.

This model was based on a large amount of archaeological research that has occurred over 30 years within and adjacent to the Proposed Disturbance Area (**Section 5.3**). This research indicated that the landforms of the Proposed Disturbance Area would likely contain sites with the following characteristics:

- Sites are commonly open artefact scatters or isolated finds.
- Sites are generally of low density.
- Most sites are situated close to drainage lines.
- Archaeological material is densest within 30m of a creek edge but continues at a lower density away from a creek.
- The most common raw materials were indurated mudstone and silcrete with smaller quantities of chert, siltstone, quartzite and quartz also identified.
- Flakes and flaked pieces accounted for the bulk of assemblages. Proportions of cores and backed blades are low.
- There is evidence of heat-treated artefacts.
- Many recorded artefacts are characteristic of Small Tool Tradition (Bondaian) of the late Holocene.

In addition, when previous archaeological research within the Proposed Disturbance Area was examined (**Section 5.3.3**) the following site characteristics emerged:

- The main channel of Bettys Creek exhibited patchy artefact *loci* with some areas having relatively moderate to high artefact numbers, some having low artefact numbers and much of the creek line having no artefacts.
- The areas with former swamps had the highest artefact numbers and artefact densities in the upper Bettys Creek catchment. However, even these areas were assessed as reflecting only low levels of occupation by small groups of people over an extended period of time.
- The knapping of stone along Bettys Creek was identified by surface collections, grader scrapes and excavations.

- The residue and use-wear analysis from the artefacts indicated that in the there was evidence for the working of soft woods, soft starchy materials, grass and possibly even the cutting of reeds. Blood residue was also recorded on some artefacts.
- While plant food availability suggests that late spring and summer were optimal times to be in the Bettys Creek valley the use of the area at other times of the year cannot be discounted.
- The investigation of evidence of 'pre-Bondaian' artefacts revealed no evidence of any artefactual material from this period.
- One radiocarbon date of 3077±40 BP from an excavation adjacent to Bettys Creek.
- A ground oven was located adjacent to Bettys Creek returned a calibrated date of 2188±39 BP.
- The only other dating evidence for the assemblages came from the location of backed flakes within the assemblages. This brackets these particular artefacts to being discarded sometime between 7,000 BP and 1500 BP and most likely between 3500 BP and 1500 BP.
- Neither model (winter prone, spring/summer risk averse) was supported wholly by the evidence gathered from the stone artefact analyses or the analyses of the distribution of the artefacts within the landscape.

Within this archaeological context, the current landscape context of the Proposed Disturbance Area (**Section 4**) needs to be taken into account. The salient features of the landscape are:

- Topography
 - Over 35% of the Proposed Disturbance Area has mid and upper slope landforms.
 - The Proposed Disturbance Area does not include topographic features that would make obvious pathways. Bettys Creek itself is just one of several creeks (including Yorks, Swamp and Main Creeks) that flow to the south from the bordering hills. From the archaeological evidence presented in **Section 5.3.2** it would appear that Yorks Creek had a denser occupation regime; perhaps indicating a more preferred valley system to that of Bettys Creek.
 - Soils are very erodible and there is widespread evidence of severe erosion in the past and more moderate erosion today.
- Hydrology
 - Only 4% of the Proposed Disturbance Area has drainage landforms.
 - The Proposed Disturbance Area has very limited portions of higher order waterways within its boundary.
 - Some first and second order drainage systems are within the Proposed Disturbance Area.

- The great majority of the Proposed Disturbance Area is further than 100m from any form of water drainage, apart from minor ephemeral gullies etc.
- Availability of food resources
 - The Proposed Disturbance Area would have provided limited food resources for Aboriginal people in the past.
- Previous Disturbances
 - The Proposed Disturbance Area is largely based around the Bettys Creek catchment that has been greatly modified from its historic form including the construction of a diversion channel that now takes the creek's flow for a portion of the creek.
 - There has been a moderate to high level of previous disturbance to most of the Proposed Disturbance Area. There is evidence that the area was entirely cleared of native vegetation and subject to widespread sheet and gully erosion. In addition, farm and mine infrastructure have further impacted areas, including large areas (in excess of 170ha) that have been revegetated.
 - Portions of the Proposed Disturbance Area have been intensively examined and salvaged by previous archaeological work, particularly along Bettys Creek, Swamp Creek and in the area of the Proposed Disturbance Area on Bowmans Creek. This salvage work has included broad scale manual excavation, surface artefact collections, as well as grader scrapes. This work over the past 12 years in the face of approved impacts has removed over 10,000 artefacts from the Proposed Disturbance Area and immediate surrounds and has had a large impact on the surviving archaeological landscape.

The results from the current survey (**Section 6**) and test excavation (**Section 7**) are:

- The survey recorded 11 artefact scatters, 25 isolated finds and further artefacts at the location of three previously recorded sites.
- There are three further previously recorded sites within the Proposed Disturbance Area.
- 95% of the newly recorded sites are either isolated finds or low density artefact scatters without associated archaeological deposits.
- Test excavation was carried out at two locations: MOCO OS-3 and MOCO OS4.

No artefacts were recorded from the excavations at MOCO OS-3 indicating that it is a displaced site without associated deposits.

114 artefacts were recorded from the test excavation at MOCO OS-4. 82% of artefacts came from one concentration around TR3 SQ4. Beyond this concentration, there was a low density of artefacts up to 20m from the current erosion edge. However, these artefacts probably represent a general background scatter rather than a discrete site. The concentration around TR3 SQ4 showed integrity as two or three separate knapping

events, one from an IMT stone, and one/two from silcrete, were recorded. This concentration was associated with a shallow pit whose association to the artefacts is unclear. The concentration did not extend from the immediate vicinity of TR3 SQ4.

- As a result of the test excavation and field assessment, only two newly recorded sites (MOCO OS-4 and Extension to site #37-3-0611) were assessed as having the likelihood to contain subsurface artefacts although these artefacts are likely to be at a low density. At MOCO OS-4, there could be the possibility of another concentration such as excavated at TR3 SQ4 although the test excavation extensively examined both banks of the eastern drainage without an indication of a further concentration.
- One artefact, MOCO IF-16, is a fine example of a knapped glass artefact: a reasonably rare artefact type in the region.
- Widespread disturbances and thin A Horizon soils were noted across the Proposed Disturbance Area. Thin, or non-existent, A Horizon soils were also noted during the test excavation at both locations.

The summaries above show that the results of the survey and test excavation program confirm the predictive model that low density artefact scatters and isolated finds would be the main sites recorded. As set out above, the reasons for this result are that:

- The majority of the Proposed Disturbance Area is further than 100m from any form of drainage line and only limited bank areas of higher order systems are in the survey area.
- Large areas of the Proposed Disturbance Area contained mid or upper slope landforms that are not conducive as locations for overnight camping and tool making.
- The widespread disturbances including erosion, farm and mine infrastructure that have the ability to remove sites from the landscape.
- Past archaeological research indicates that areas such as the Bettys Creek catchment would never have been conducive to long-term use as a base camp area.

The results of the current assessment strongly agree with the regional archaeological context that has been established following 30 years of research. In brief, the following characteristics can be examined:

- Distribution of sites: The regional model shows a strong correlation between site size and distance to reliable water with larger, more complex, sites being located near reliable water. The current assessment shows that the largest site recorded (MOCO OS-4) was associated with the banks of the eastern drainage, one of the few lengths of drainage within the Proposed Disturbance Area. The generally low artefact density at MOCO OS-4 is reflective of the fact that the eastern drainage is unlikely to have provided permanent water. Remaining sites were located away from water and were correspondently of a low density and perhaps represent a single event rather than a site that has been used for camping and tool making in the long term.
- Site type: The regional and predictive model suggested that artefact scatters and isolated finds would be the most common site type recorded and this is supported by the survey results. As the Proposed Disturbance Area was completely cleared in the past,

scarred trees were not predicted and none were recorded. As there were not substantial lengths of drainage within the Proposed Disturbance Area, grinding groove sites were not predicted and none were identified. Further, the minor crests and ridges contained no evidence of ceremonial sites, and if these had consisted of stone arrangements, it is likely they have been removed due to past land use.

- **Artefact density:** As only low or low-moderate artefact densities were recorded this result accords with the regional model that sites in such landforms will be of a low density. This indicates Aboriginal use of all areas within the Proposed Disturbance Area although in a low intensity manner and over a long period of time. As previous researchers have suggested, areas such as Bettys Creek could have been no more than seasonal foraging locations where trips rarely involved overnight stays. This would indicate that most of the stone tools would be also carried into but then, also, out of the Proposed Disturbance Area to areas affording greater resources to support locations for larger base camps. Therefore the types of sites recorded in the Proposed Disturbance Area are the result of single events and short overnight stays: not the type of site to accumulate a rich array of artefacts. Archaeologically, it is difficult to elucidate whether the cranium fragment at MOCO OS-4 TR3 SQ4a illustrates a one-off butchery event at which IMT and silcrete flakes were produced, or evidence of several short-term stays at the same location.
- **Types of raw material:** Regional studies show that the majority of sites will have a dominance of IMT artefacts and a sizable minority of silcrete artefacts. Generally the survey results agreed with this model although the results from the test excavation at MOCO OS-4 had a dominance of silcrete artefacts. While many sites in the district have been recorded as having a majority of silcrete artefacts, the anomaly at MOCO OS-4 was explained as a single knapping event that produced numerous flakes which has biased the small sample size of 114 artefacts.
- **Artefact type:** Most artefacts recorded were unmodified flakes and this also accords with the regional model. While some backed blades and end scrapers were noted in the Proposed Disturbance Area, their numbers were low, as was the frequency of cores and other specialist tools. Bearing in mind that many artefacts have been removed from the Proposed Disturbance Area by, among others, archaeological salvage, the sample remaining today is incomplete. However, test excavation at MOCO OS-4 also supported the view that specialised tools are a low proportion of the assemblage with only two (or 1.7% of the assemblage) end scrapers being recorded from the 114 artefact assemblage.

The features of representativeness, rarity and integrity of archaeological sites within the Proposed Disturbance Area will now be discussed.

Representativeness: As seen above, the sites recorded during the survey are very representative of sites in the region that are located in landforms distant to water. In terms of site size, artefact numbers, raw materials available and artefact types the results of the survey neatly complement the regional archaeological context.

Rarity: In the past sites such as these would not have been rare and on a state-wide scale, low density artefact scatters and isolated finds would remain the most common site type recorded. In the immediate vicinity of the Proposed Disturbance Area, however, there has been a large amount of archaeological salvage over the years that has removed many

similar sites from the landscape. Although the sites recorded during this assessment are in no way remarkable, their presence alone, in albeit a much modified landscape, remains a memory of the past in a landscape that is fast changing (or has changed). This raises the rarity of these remaining sites within the context of the greater Ravensworth area where mining has been concentrated.

Integrity: Both from the results of the survey and the test excavation, general site integrity is very low. As noted, the Proposed Disturbance Area has been subject to severe erosion in the past and much archaeological context has been lost: along with the A Horizon soils at many locations. 95% of newly recorded sites were assessed to have no associated archaeological deposits and are therefore surface manifestations and possibly, on an individual artefact level, displaced.

9 ASSESSMENT OF SCIENTIFIC SIGNIFICANCE

9.1 BACKGROUND TO THE ASSESSMENT OF CULTURAL HERITAGE SIGNIFICANCE

The appropriate management of cultural heritage items is usually determined on the basis of their assessed significance as well as the likely impacts of any proposed developments. Social, Scientific, Aesthetic and Historic significance are identified as baseline elements of significance assessment, and it is through the combination of these elements that the overall cultural heritage values of a site, place or area are resolved. These assessment criteria are set out in the *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (OEH 2011: 7 ff).

Social or Cultural value

This area of assessment concerns the importance of a site or features to the relevant cultural group: in this case the RAPs. Aspects of social value include assessment of sites, items and landscapes that are traditionally significant or that have contemporary importance to the Aboriginal community. This importance involves both traditional links with specific areas, as well as an overall concern by Aboriginal people for their sites generally and the continued protection of these. This type of value may not accord with interpretations made by the archaeologist: a site may have low archaeological value but high social value, or vice versa. This value will be assessed in the ACHA.

Scientific value

Assessing a site in this context involves placing it into a broader regional framework, as well as assessing the site's individual merits in view of current archaeological discourse. This type of value relates to the ability of a site to answer current research questions and is also based on a site's condition (integrity), content and representativeness.

The overriding aim of cultural heritage management is to preserve a representative sample of the archaeological resource. This will ensure that future research within the discipline can be based on an extant sample of the past. Establishing whether or not a site can contribute to current research also involves defining 'research potential' and 'representativeness'. Questions regularly asked when determining significance are: can this site contribute information that no other site can? Is this site representative of other sites in the region? This criterion will be assessed in this report. It is noteworthy that this criterion has been further informed by the results of a test excavation program at some locations and hence is not based solely on surface manifestations or previous sub-surface archaeological investigations.

Aesthetic value

This refers to the sensory, scenic, architectural and creative aspects of the place. It is often closely linked with the social values. It may consider form, scale, colour, texture and material of the fabric or landscape, and the smell and sounds associated with the place and its use (ICOMOS 1988). This value will be assessed in the ACHA.

Historic value

Historic value refers to the associations of a place with a historically important person, event, phase or activity in an Aboriginal community. Historic places do not always have physical evidence of their historical importance (such as structures, planted vegetation or landscape modifications). They may have 'shared' historic values with other (non-Aboriginal) communities.

Places of post-contact Aboriginal history have generally been poorly recognised in investigations of Aboriginal heritage. Consequently the Aboriginal involvement and contribution to important regional historical themes is often missing from accepted historical narratives. This means it is often necessary to collect oral histories along with archival or documentary research to gain a sufficient understanding of historic values. This value will be assessed in the ACHA.

9.2 BACKGROUND TO THE ASSESSMENT OF SCIENTIFIC SIGNIFICANCE

This assessment will use the following terms where appropriate:

- High Scientific Significance or high archaeological values;
- Moderate Scientific Significance or moderate archaeological values; and
- Low Scientific Significance or low archaeological values.

This hierarchy is used to categorise the archaeological landscape of the Proposed Disturbance Area based, in this report, on the assessed scientific or archaeological values of a particular location.

This is not to say that the author is unaware of possible social / cultural, aesthetic and historic values at a particular location, but the assessment here is of the scientific values alone while the other values will be examined in the ACHA.

In terms of scientific significance, locations will primarily be assessed on their ability to add reliable archaeological information which can further our understanding of the archaeology at a local and regional level or a site type's rarity within the landscape. This assessment has been informed through surface observations/survey, sub-surface archaeological testing and review of previous site specific reports.

Considerations taken in this scientific assessment include an understanding that a part of the archaeological value of a place is the general community's association to that place. This is

often distinct from the Social, Aesthetic and Historic criteria used to assess heritage significance as it relates to a person's relationship to the archaeology of the place. For the Aboriginal participants on the survey, for example, an archaeological site was appreciated as much for its archaeological values as it was for its cultural values. A site displaying either a large number of artefacts or a number of interesting artefacts would engender fascination and discussion on purely archaeological grounds (Where did people live / eat? How did they live? How did they use the artefact and what does it tell us about the people who made it?).

It is therefore understood that many Aboriginal people, or people generally interested in pre-history, would see the sites recorded in this assessment to have higher archaeological values than may be given in this assessment. However, this assessment has attempted to distinguish between an artefact scatter with potential to yield further information (moderate–high scientific significance) and an artefact scatter in an eroded context that would yield little meaningful further information (low scientific significance).

Incorporating research on the rarity, representativeness and integrity or condition of a site, along with the considerations outlined above, this assessment defines the following categories when assessing scientific significance:

High Scientific Significance

Locations displaying these values would include one or more of the following features:

- The location would contain known areas of undisturbed archaeological deposits that are likely to add significantly to our knowledge concerning Aboriginal archaeology in the region.
- Would contain archaeological information to address complex research questions about the region.
- The site contains outstanding features that can be appreciated by non-specialists / enthusiasts.
- The site type is rare in the region and / or in danger of becoming unrepresented in the region.

Moderate Scientific Significance

Locations displaying these values would include one or more of the following features:

- The location would contain areas of archaeological deposits, sometimes disturbed, that are likely to add to our knowledge about the Aboriginal archaeology of the local area only.
- Would contain archaeological information to address general research questions about the region.
- The site contains features that would be appreciated by a specialist / enthusiast.

- Portions of the site have been lost due to erosion or the landscape context of the site has been impacted.

Low Scientific Significance

Locations displaying these values would include one or more of the following features:

- The location may contain areas of archaeological deposits but they are likely to be disturbed and any information gained would only address limited research questions.
- The site is largely displaced by erosion.
- The landscape context of the site has been heavily modified.
- The site exists in areas where A Horizon soil loss is extensive.
- The site contains features that would be difficult to interpret in a meaningful way.

9.2.1 Assessed significance of the recorded sites

The current assessment has recorded 11 artefact scatters, 25 isolated finds and three extensions to previously recorded sites.

Although the assessment of significance to a particular site is a subjective task, the use of the guidelines outlined in **Section 9.2**, enables a reasonable standard of objectivity, or at least a criterion-based standard of assessment.

The overall scientific significance of sites within the Proposed Disturbance Area has been lowered due to:

- wide-spread soil loss that affects nearly all portions of the Project Area;
- major disturbances from approved mining activity including built infrastructure, soil dumps, tracks, the diversion of water away from creeks and other mine related impacts such as revegetation programs;
- the archaeological landscape within the Proposed Disturbance Area being fragmented by approved mining; and
- the varying degrees of archaeological salvage that has been carried out.

As a result, no areas are assessed to have high or moderate scientific significance.

The majority of sites recorded during this assessment (n=36; including 10 artefact scatters, two extensions to previously recorded sites and 24 isolated finds) have been assessed as having low scientific significance. In most cases this is because the sites are low density artefact scatters or isolated finds located in landforms with thin A Horizon soils where further subsurface archaeological deposits are unlikely. In some cases the artefacts may be more numerous but erosion has affected a large percentage of the site and the visible artefacts are displaced and of limited archaeological value.

The high frequency of low scientific significance is directly related to the extensive and long-running previous disturbances within the Proposed Disturbance Area.

Three sites have been assessed as having low-moderate scientific significance. Two of these sites are artefact scatters (MOCO OS-4 and Extension to site #37-3-0611) and they have this slightly higher value as there is the possibility of further subsurface archaeological deposits at these locations: although these deposits are likely to contain a low density of artefacts. The third site (MOCO IF-16) attains this level of significance due to the rarity of the artefact type, rather than its association to other artefacts or to subsurface contexts.

Table 50 assesses the scientific significance of the artefact scatters and isolated finds recorded during this assessment. Under the column 'Significance Background' a brief explanation is given of those site features that elevate or lower a particular site's scientific significance.

Table 50: Assessment of scientific significance for recorded sites.

Site Number	Site Description	Scientific significance	Significance Background
MOCO OS-1	Artefact scatter covering approximately 157m by 40m along minor ephemeral tributaries to Bettys Creek. Located in the north of the Proposed Disturbance Area. Extends outside the Proposed Disturbance Area.	Low	- Low density scatter - High disturbance - Previous archaeological salvage
MOCO OS-2	Artefact scatter covering approximately 78m by 24m in a flat portion of a lower slope landform. Not associated with any obvious waterways. Located in the north of the Proposed Disturbance Area.	Low	- Low density scatter - Thin A Horizon soils - Low potential landform
MOCO OS-3	Artefact scatter covering approximately 305m by 28m along the Bettys Creek diversion. Highly disturbed site. Located in the northwest of the Proposed Disturbance Area.	Low	- Re-deposited site - No archaeological deposits in adjoining areas as testing confirmed
MOCO OS-4	Artefact scatter extending approximately 525m by up to 263m on both banks of the eastern drainage. Located in the northeast of the Proposed Disturbance Area.	Low-Moderate	- Low density scatter - Some potential for further subsurface artefacts - Low potential for further discrete concentrations of artefacts as seen in the test excavation program - Archaeological integrity present but very limited in its extent.
MOCO OS-5	Artefact scatter extending approximately 208m by up to 30m along a water drain to the east of the Mount Owen rail spur. Located in the centre east of the Proposed Disturbance Area.	Low	- Low density scatter - High localised disturbance - Representative of the background density of artefacts associated with the banks of Bettys Creek
MOCO OS-6	Diffuse artefact scatter on the west bank of Bettys Creek in the Bettys Creek Habitat Management Area. The site spans the Proposed Disturbance Area (rail spur).	Low	- Diffuse artefact scatter - Thin A Horizon soils - Representative of the background density of artefacts associated with the banks of Bettys Creek - Previous archaeological salvage

Site Number	Site Description	Scientific significance	Significance Background
MOCO OS-7	Low density artefact scatter on the east bank of the main channel for Bettys Creek. The site spans the Proposed Disturbance Area (rail spur).	Low	• Very low density scatter • Representative of the background density of artefacts associated with the banks of Bettys Creek
MOCO OS-8	Low density artefact scatter in an area of general high disturbance. Located to the east of the existing Mount Owen rail spur. The site spans the Proposed Disturbance Area (rail spur).	Low	• Low density scatter • High disturbance • Thin A Horizon soils • Low potential landform
MOCO OS-9	Medium density artefact scatter located along a service track immediately north of the main rail line. The site is immediately adjacent to Bettys Creek that is located to the north of the site. The site spans the Proposed Disturbance Area (rail spur).	Low	• Medium density scatter • Moderate disturbance • Previous archaeological salvage • Thin A Horizon soils
MOCO OS-10	Low density artefact scatter located on a rocky rise adjacent to the northern bank of Bowmans Creek. The site spans the Proposed Disturbance Area (Hebden Road realignment).	Low	• Low density scatter • High disturbance • Thin A Horizon soils
MOCO OS-11	Very low density artefact scatter on the east bank of Swamp Creek.	Low	• Low density scatter • Thin A Horizon soils
MOCO Extension to site #37-3-0649	Located on the northern bank of a tributary to Bettys Creek.	Low	• Low density scatter • Thin A Horizon soils • Previous archaeological salvage failed to locate artefacts
MOCO Extension to site #37-3-0611	Located along a minor, ephemeral tributary to Bettys Creek.	Low-Moderate	• Low density scatter • A Horizon soils present • Moderate potential landform with other extant sites in the vicinity • Possibility of further subsurface artefacts at a low density
MOCO Extension to site #37-3-0600	Located 30m from the eastern bank of Bettys Creek.	Low	• Extensively excavated during 2005/2006 • Recorded shallow deposits, low density artefact counts and an absence of archaeological stratigraphy • Remaining artefacts are representative of the background density of artefacts associated with the banks of Bettys Creek
MOCO IF-1	Flaked stone artefact	Low	• No associated artefacts or archaeological deposits
MOCO IF-2	Flaked stone artefact	Low	• No associated artefacts or archaeological deposits
MOCO IF-3	Flaked stone artefact	Low	• No associated artefacts or archaeological deposits
MOCO IF-4	Flaked stone artefact	Low	• No associated artefacts or archaeological deposits
MOCO IF-5	Flaked stone artefact	Low	• No associated artefacts or archaeological deposits
MOCO IF-6	Flaked stone artefact	Low	• No associated artefacts or archaeological deposits

Site Number	Site Description	Scientific significance	Significance Background
MOCO IF-7	Flaked stone artefact	Low	No associated artefacts or archaeological deposits
MOCO IF-8	Flaked stone artefact	Low	No associated artefacts or archaeological deposits
MOCO IF-9	Flaked stone artefact	Low	No associated artefacts or archaeological deposits
MOCO IF-10	Flaked stone artefact	Low	No associated artefacts or archaeological deposits
MOCO IF-11	Flaked stone artefact	Low	No associated artefacts or archaeological deposits
MOCO IF-12	Flaked stone artefact	Low	No associated artefacts or archaeological deposits
MOCO IF-13	Flaked stone artefact	Low	No associated artefacts or archaeological deposits
MOCO IF-14	Flaked stone artefact	Low	No associated artefacts or archaeological deposits
MOCO IF-15	Flaked stone artefact	Low	No associated artefacts or archaeological deposits
MOCO IF-16	Flaked glass	Low-Moderate	- Knapped glass artefact with clear flaking characteristics - Rare artefact type - No associated artefacts or archaeological deposits
MOCO IF-17	Flaked stone artefact	Low	No associated artefacts or archaeological deposits
MOCO IF-18	Flaked stone artefact	Low	No associated artefacts or archaeological deposits
MOCO IF-19	Flaked stone artefact	Low	No associated artefacts or archaeological deposits
MOCO IF-20	Flaked stone artefact	Low	No associated artefacts or archaeological deposits
MOCO IF-21	Flaked stone artefact	Low	No associated artefacts or archaeological deposits
MOCO IF-22	Flaked stone artefact	Low	No associated artefacts or archaeological deposits
MOCO IF-23	Flaked stone artefact	Low	No associated artefacts or archaeological deposits
MOCO IF-24	Flaked stone artefact	Low	No associated artefacts or archaeological deposits
MOCO IF-25	Flaked stone artefact	Low	No associated artefacts or archaeological deposits

9.3 LIKELY IMPACTS TO ABORIGINAL HERITAGE FROM THE PROJECT

Most activity associated with the construction of Project infrastructure or the operations of the extended North Pit involves some degree of surface disturbance and direct impact to the landscape. These footprints are designed to avoid or minimise harm.

Where possible, activities will be undertaken in a manner that limits the amount of physical ground disturbance; however, this is not always possible, nor is the Project able to accurately

identify every area within the disturbance area of the Project Area that will remain intact or will be disturbed.

Consequently, not all of the area identified as being within the disturbance footprint will be disturbed as a result of the Project. The difficulty is in accurately defining the precise location of laydown pads, storage, access tracks, infrastructure and support alignments, water management infrastructure, and impact areas associated with the development of the Project. To overcome this, buffers have been applied around areas that are known to be, or are likely to be disturbed. In this way, the maximum potential footprint of the Project has been identified and assessed, and is known as the Proposed Disturbance Area of the Project.

Of the 39 sites recorded in this assessment (11 artefact scatters, 25 isolated finds and three site extensions), all but eight are within the Proposed Disturbance Area and are liable to be harmed by the Project. Five of the sites located outside of the Proposed Disturbance Area are within 50m of the disturbance boundary while three are located some distance away (sites within Survey Unit 6). Additionally, three previously recorded sites are also likely to be harmed by the Project (**Table 51**).

In total, therefore, the Project is likely to harm 34 Aboriginal sites: 26 sites will be totally impacted by the proposed works and eight sites will be partially impacted. Eight sites recorded as part of this assessment are located outside the Proposed Disturbance Area and will not be impacted by the Project.

Table 51: Impact assessment of all sites included within this assessment.

Site Number	Type of Harm (Direct/Indirect / None)	Degree of Harm (Total/Partial/None)	Type of Harm	Consequence of Harm
MOCO OS-1	Direct	Partial	Proposed North Pit Continuation	Partial loss of value. Site spans the Proposed Disturbance Area Boundary
MOCO OS-2	Direct	Total	Proposed North Pit Continuation	Total loss of value. Within the Proposed Disturbance Area
MOCO OS-3	Direct	Total	Proposed North Pit Continuation	Total loss of value. Within the Proposed Disturbance Area
MOCO OS-4	Direct	Total	Proposed North Pit Continuation	Total loss of value. Within the Proposed Disturbance Area
MOCO OS-5	Direct	Partial	Proposed Rail Spur and Line Duplication	Partial loss of value. Site spans the Proposed Disturbance Area Boundary
MOCO OS-6	Direct	Partial	Proposed Rail Spur and Line Duplication	Partial loss of value. Site spans the Proposed Disturbance Area Boundary
MOCO OS-7	Direct	Partial	Proposed Rail Spur and Line Duplication	Partial loss of value. Site spans the Proposed Disturbance Area Boundary

Site Number	Type of Harm (Direct/Indirect / None)	Degree of Harm (Total/Partial/None)	Type of Harm	Consequence of Harm
MOCO OS-8	Direct	Partial	Proposed Rail Spur and Line Duplication	Partial loss of value. Site spans the Proposed Disturbance Area Boundary
MOCO OS-9	Direct	Partial	Proposed Rail Spur and Line Duplication	Partial loss of value. Site spans the Proposed Disturbance Area Boundary
MOCO OS-10	Direct	Total	Proposed Hebden Road realignment	Total loss of value. Within the Proposed Disturbance Area
MOCO OS-11	Direct	Partial	Proposed non-public construction road	Partial loss of value. Site spans the Proposed Disturbance Area Boundary
MOCO Extension to site #37-3-0649	Direct	Total	Proposed North Pit Continuation	Total loss of value. Within the Proposed Disturbance Area
MOCO Extension to site #37-3-0611	Direct	Partial	Proposed Rail Spur and Line Duplication	Partial loss of value. Site spans the Proposed Disturbance Area Boundary
MOCO Extension to site #37-3-0600	Direct	Total	Proposed Rail Spur and Line Duplication	Total loss of value. Within the Proposed Disturbance Area
MOCO IF-1	Direct	Total	Proposed North Pit Continuation	Total loss of value. Within the Proposed Disturbance Area
MOCO IF-2	Direct	Total	Proposed North Pit Continuation	Total loss of value. Within the Proposed Disturbance Area
MOCO IF-3	None	None	Proximity to Proposed North Pit Continuation	No loss of value. 20m outside the Proposed Disturbance Area
MOCO IF-4	None	None	Proposed Rail Spur and Line Duplication	No loss of value. 10m outside the Proposed Disturbance Area
MOCO IF-5	Direct	Total	Proposed Rail Spur and Line Duplication	Total loss of value. Within the Proposed Disturbance Area
MOCO IF-6	None	None	Proposed Rail Spur and Line Duplication	No loss of value. 20m outside the Proposed Disturbance Area
MOCO IF-7	Direct	Total	Proposed North Pit Continuation	Total loss of value. Within the Proposed Disturbance Area
MOCO IF-8	Direct	Total	Proposed North Pit Continuation	Total loss of value. Within the Proposed Disturbance Area
MOCO IF-9	Direct	Total	Proposed North Pit Continuation	Total loss of value. Within the Proposed Disturbance Area

Site Number	Type of Harm (Direct/Indirect / None)	Degree of Harm (Total/Partial/None)	Type of Harm	Consequence of Harm
MOCO IF-10	Direct	Total	Proposed North Pit Continuation	Total loss of value. Within the Proposed Disturbance Area
MOCO IF-11	Direct	Total	Proposed North Pit Continuation	Total loss of value. Within the Proposed Disturbance Area
MOCO IF-12	Direct	Total	Proposed North Pit Continuation	Total loss of value. Within the Proposed Disturbance Area
MOCO IF-13	Direct	Total	Proposed North Pit Continuation	Total loss of value. Within the Proposed Disturbance Area
MOCO IF-14	Direct	Total	Proposed North Pit Continuation	Total loss of value. Within the Proposed Disturbance Area
MOCO IF-15	Direct	Total	Proposed North Pit Continuation	Total loss of value. Within the Proposed Disturbance Area
MOCO IF-16	None	None	Proposed Rail Spur and Line Duplication	No loss of value. 50m outside the Proposed Disturbance Area
MOCO IF-17	None	None	Proposed Rail Spur and Line Duplication	No loss of value. 15m outside the Proposed Disturbance Area
MOCO IF-18	Direct	Total	Proposed Rail Spur and Line Duplication	Total loss of value. Within the Proposed Disturbance Area
MOCO IF-19	Direct	Total	Proposed Hebden Road realignment	Total loss of value. Within the Proposed Disturbance Area
MOCO IF-20	Direct	Total	Proposed Hebden Road realignment	Total loss of value. Within the Proposed Disturbance Area
MOCO IF-21	Direct	Total	Proposed North Pit Continuation	Total loss of value. Within the Proposed Disturbance Area
MOCO IF-22	Direct	Total	Proposed North Pit Continuation	Total loss of value. Within the Proposed Disturbance Area
MOCO IF-23	None	None	No proposed works in the vicinity	No loss of value. Outside of the Proposed Disturbance Area
MOCO IF-24	None	None	No proposed works in the vicinity	No loss of value. Outside of the Proposed Disturbance Area
MOCO IF-25	None	None	No proposed works in the vicinity	No loss of value. Outside of the Proposed Disturbance Area
#37-3-0985	Direct	Total	Proposed Hebden Road realignment	Total loss of value. Within the Proposed Disturbance Area

Site Number	Type of Harm (Direct/Indirect / None)	Degree of Harm (Total/Partial/None)	Type of Harm	Consequence of Harm
#37-3-0611	Direct	Total	Proposed Rail Spur and Line Duplication	Total loss of value. Within the Proposed Disturbance Area
#37-3-0527	Direct	Total	Proposed Rail Spur and Line Duplication	Total loss of value. Within the Proposed Disturbance Area

10 MANAGEMENT AND MITIGATION: ABORIGINAL HERITAGE

10.1 GENERAL PRINCIPLES FOR THE MANAGEMENT OF ABORIGINAL SITES

This report will concentrate on the management of the archaeological values present within the Proposed Disturbance Area, although given the cultural connection this archaeological landscape has for certain communities, an understanding of the RAP's cultural values in connection to the area is also embedded in the archaeological management recommendations that follow.

For example, from a purely archaeological perspective, much of the Proposed Disturbance Area is so disturbed that further archaeological investigation would only be able to address very basic research questions. As no meaningful archaeological information could be gained from these sites, a purely archaeological recommendation should be that no further investigation is justified.

However, the basis of the following proposed archaeological management will be to understand that, even if a site is diminished in its archaeological values, that its physical manifestation may still have cultural value to certain communities. Therefore, the task of the management recommendations in this report will be to frame research questions that will enable a thorough study of all the Proposed Disturbance Area's remaining archaeological values: not only those locations displaying high archaeological values.

10.2 PREVIOUS MANAGEMENT AT THE MOUNT OWEN COMPLEX

The recent approvals regime at the Mount Owen Complex extends back to 2000. The management recommendations pertaining to Aboriginal cultural heritage from DA 52-3-99 and DA 14-1-2004 are listed in **Table 52**. These conditions fall into two main categories:

- Conditions pertaining to management of sites within impact areas such as archaeological salvage; and
- Conditions pertaining to other mitigation measures such as contributions to a Trust Fund.

Table 52: Existing management requirements for the Mount Owen Complex stemming from approval conditions.

Approval Number	Conditions pertaining to cultural heritage
Ravensworth East Mine Development Application: DA 52-3-99. Applicant: Hunter Valley Coal Corporation Pty Ltd. Consent Authority: Minister for Urban Affairs and Planning. Date 2000	No specific cultural heritage conditions.
Glendell Mine Development Application: DA 14-1-2004. Applicant: Hunter Valley Coal Corporation Pty Ltd. Consent Authority: Minister for Infrastructure and Planning. Date 2004	Section 90 Consents 52. The Applicant shall obtain section 90 consents from DEC, under section 90 of the National Parks and Wildlife Act 1974, prior to disturbing any of the following Aboriginal sites and artefacts (sites shown in Figure 12.2 of the EIS): MC 1; MC 2; MC 3; MC 4; MC 5; MC 6; BC 44 – 67; and SC 13. Archaeological Salvage Program 53. The Applicant shall prepare and implement a salvage program to the satisfaction of DEC that is based on landform context, including open area excavations in three or four locations, to complement and extend the previous investigations and salvages in the local area. The Aboriginal community must have input into the salvage program. Trust Fund Contribution 54. Within 6 months of this consent, or as otherwise agreed by the Director-General, the Applicant shall contribute \$50,000 to the Hunter Aboriginal Cultural Heritage Trust Fund for further investigations into Aboriginal cultural heritage, as defined by the Trust Deed.

In addition to conditions attached to the approval listed in **Table 52**, the AHIP conditions stemming from these approvals also contain specific management conditions pertaining to Aboriginal cultural heritage. These are listed in **Table 53**. These conditions mostly pertain to the ultimate fate of artefacts and, in the case of Consent #2131, conditions regarding the management of the Yorks Creek VCA.

Table 53: Existing management requirements for the Mount Owen Complex stemming from AHIP approvals.

Consent (AHIP) number	Specific conditions pertaining to Aboriginal cultural heritage
Department of Environment and Conservation (NSW) Consent #1762 2003	6. Any Aboriginal objects recovered, being the property of the Crown, shall be deposited at The Australian Museum, in accordance with adopted procedures for the deposition of Aboriginal objects as prescribed by The Australian Museum, at or before a period of two years from the date of expiration of the Permit or any renewal thereof, whichever occurs first. Information about deposition requirements can be obtained from the Aboriginal Collections Manager, Division of Anthropology, The Australian Museum, on (02) 339 8111.
Department of Environment and Conservation (NSW) Consent #2131 2005	4. The Consent Holder shall ensure that the actions and commitments detailed in Section 2.10 (Yorks Creek Aboriginal Cultural Heritage Remediation Project) of the Report are developed in conjunction with the Aboriginal community and the Department of Environment and Conservation.
Department of Environment and Conservation (NSW) Consent #2267 2005	4. The Consent Holder shall ensure that protocols for the long-term management of Aboriginal objects/sites that are not proposed to be impacted by open cut mining or associated infrastructure are incorporated within the broader Environmental Management Strategy documents for the respective mining operations within the Glendell and Mt Owen Mining Lease areas. 16 (iv) deposit any Aboriginal objects removed during work associated with the Permit, together with a copy of all field

Consent (AHIP) number	Specific conditions pertaining to Aboriginal cultural heritage
	records, at The Australian Museum or at another place designated by the Museum, after these Aboriginal objects have been fully examined, or within six months from the date of revocation of that Permit whichever occurs sooner.

The current ACHMP for the Mt Owen Complex (GSS 2008) includes several controls for the management of Aboriginal cultural material within the Mount Owen Complex. The two most relevant controls in the framing of management recommendations are 'existing controls' and 'general controls' (**Table 54**).

Table 54: Management controls from the Mount Owen ACHMP (2008).

Control	Action
6.1.1 Existing Controls	- A significant area of the Mt Owen Complex has been previously surveyed for Aboriginal Heritage sites by archaeologists and Aboriginal community groups; - A database of Aboriginal sites has already been established for the Mt Owen Complex; - Mt Owen Complex maintains an up to date mine plan which minimises mining in areas of high Aboriginal significance; - There is an Aboriginal Heritage section within the Mt Owen Complex Induction; and - Pre – clearance surveys are undertaken prior to any ground disturbance.
6.1.2 General Controls	- Consultation with Aboriginal community (undertaking field study and reviewing reports); - Xstrata to make an application for a s90 Permit (including salvage details) for heritage sites which could potentially be affected by disturbance; - Salvage of Aboriginal Heritage items which could be affected within the Mt Owen Complex in accordance with requirements of the s90 approval. Under consultation with the Aboriginal groups, Items are kept in safe place until the disturbance is completed. Replacement of artefacts following completion of mining; - Contractors working in the general Mt Owen Complex Area to be made aware of responsibilities under NPW Act 1974 and location of known sites; and - Location of known sites to be added to Mt Owen Complex Aboriginal Heritage Sites Database used for disturbance permit assessment system.

10.3 MANAGEMENT OPTIONS

The management of any archaeological landscape must include the consideration of all available options and an evaluation of the viability of these options to achieve the best archaeological outcome.

In brief there are three main options available and the archaeological merits of each option will be discussed below.

Option A: Do Nothing

This option is a real possibility because if the Project is not approved then a 'do nothing' option will be followed probably with little more management of the archaeological landscape than is happening at present within the auspices of the current Mount Owen Complex ACHMP. A 'do

nothing' option, in its purist sense, will mean no 'extra' management of the archaeological landscape.

Whilst no sites would be deliberately destroyed, this option will not stop the on-going natural deterioration of sites in the Project Area, and as a result, this option would contribute to the cumulative loss of sites in the region.

Option A makes a small contribution to intergenerational equity as, in theory, the landscape is preserved (albeit with on-going erosion) and would be available for future generations to visit.

However, all of the Proposed Disturbance Area is on Mount Owen Complex owned land. This does not allow, in the short term at least, for free access and use of any areas. Additionally, as discussed above, without management there will be a landscape surviving but one continuing to be denuded of A Horizon soils and a landscape without, in all likelihood, many archaeological sites in good condition.

Option B: Modify Project design to avoid harm

Another option that can be considered is that certain areas, now within the Proposed Disturbance Area, could be excluded from the Project design and the areas conserved as archaeological / cultural zones.

However, no other individual artefact scatter, or group of artefact scatters, was assessed as of high enough archaeological significance that would justify major design changes in order to avoid particular areas.

While it is possible in theory to avoid mining activity in certain areas, the following questions need to be borne in mind:

- What is being saved?
- Does the item have high enough social or archaeological values to justify saving?
- What is the long-term advantage of saving such an item?
- How will the item ultimately be managed and used?
- Would the benefit of doing these works from an archaeological perspective be outweighed by other archaeological mitigation strategies?

Given the nature of the current recordings (low density artefact scatters), the past loss of archaeological landscape context, the impact of on-going erosion and the danger of continuing in-direct disturbances from nearby mining, it is difficult to justify major Project design changes on archaeological grounds alone.

It should also be noted harm avoidance has been incorporated into the Project design from inception. For example, where the Proposed Disturbance Area intersects with the two largest

creek systems in the impact footprint (Bowmans and Bettys Creek) impacts to immediate bank areas within the Proposed Disturbance Area will be minimised.

Adjacent to Bettys Creek the rail line has been designed to avoid harm, with the alignment located adjacent to existing emplacement areas and to the north over existing and disturbed landform. The rail line's location was also placed well to the north of extant sites #37-3-0294 and #37-3-0612. The design has also provided a 100m to 200m buffer to the southern portion of the existing Bettys Creek and requires one creek bridge crossing. The bridge will not affect the water flow in the creek during run off episodes, as it is designed as a span bridge similar to the bridge on the existing Complex's rail spur. Although piers will be located on the creek's banks, this bridge design minimises impact to the more-archaeologically sensitive areas immediately adjacent to the drainage line.

The bridge at Bowman's Creek has been designed to remain outside of the normal stream flow area, and bridge pylons will be located on the banks outside the waterway. While this will cause localised impact to the immediate bank areas, impacts will be less than with other bridge designs that permanently impact larger bank areas.

Should Option B be followed, the Project would contribute less to the cumulative loss of sites in the region by permanently preserving a number of sites. The Project could also add to intergenerational equity by following Option B as the preserved areas would potentially be available, at some time when mining concludes, for future generations to use and enjoy.

Elsewhere in this EIS, the rationale behind the need to mine or modify areas within the Proposed Disturbance Area are given. Given the condition and context of the sites, the history of past impacts in their vicinity and their location in areas vital for the successful operation of the Project, the current assessment does not see an Option B approach for archaeological management as practical and therefore this option is not recommended.

Option C: No design change and mitigate archaeological impacts

If the Project is granted development consent in its current form, then there is potential impact to 34 Aboriginal sites within the Proposed Disturbance Area.

Under the scenario of Project approval, Option C should be followed. This option would be carried out with the advice and involvement of the RAPs under the terms of a revised ACHMP. It would also follow all appropriate guidelines pertaining to the NPW Act. This option is also supported in Article 28 of *The Burra Charter* (2013) that reads:

Article 28. Disturbance of fabric

28.1 Disturbance of significant fabric for study, or to obtain evidence, should be minimised. Study of a place by any disturbance of the fabric, including archaeological excavation, should only be undertaken to provide data essential for

decisions on the conservation of the place, or to obtain important evidence about to be lost or made inaccessible.

28.2 Investigation of a place which requires disturbance of the fabric, apart from that necessary to make decisions, may be appropriate provided that it is consistent with the policy for the place. Such investigation should be based on important research questions which have potential to substantially add knowledge, which cannot be answered in other ways and which minimises disturbance to the fabric.

The Burra Charter (2013) is the primary guideline policy document for the conservation and protection of Australian cultural heritage. According to the Burra Charter, the destruction of fabric is to be avoided although it is recognised that destruction of fabric is sometimes unavoidable. *The Burra Charter* recommends that mitigation studies be undertaken in an effort to offset the loss of fabric.

In the face of widespread disturbance, Option C is justified: “*to obtain important evidence about to be lost or made inaccessible*”. This loss of fabric (i.e. archaeological sites) will be minimised in the sense that only areas within the Proposed Disturbance Area will be investigated and all archaeological investigations will be framed within research questions that will allow as much information to be captured before the sites are further impacted by erosion and “lost” forever. The “policy” to oversee and control this “destruction of fabric” would be an ACHMP that would be developed in consultation with the RAPs following Project approval.

Option C contributes to the cumulative loss of sites from the region because the relatively large Proposed Disturbance Area (485ha) would be subject to archaeological salvage works. Option C also does not add substantially to intergenerational equity: apart from the fact that the salvage program, if conducted as described below, will capture further information about the archaeological landscape within the Proposed Disturbance Area that will be available to future generations and scholars seeking information about the area.

Should the Project be approved in its present form, Option C will form the basis of the management recommendations that follow.

10.4 MANAGEMENT AND MITIGATION OF RECORDED ABORIGINAL SITES

As a result of the current assessment, 39 sites have been newly recorded within or adjacent to the Proposed Disturbance Area. In addition, there are three previously recorded sites within the Proposed Disturbance Area. Of these 42 sites:

- 26 sites will be totally impacted by the Project;
- Eight sites will be partially impacted by the Project; and
- Eight sites will be avoided by the Project as they are located outside of the Proposed Disturbance Area.

In total, therefore, 34 sites will be directly or partially impacted by the Project and eight sites will be avoided by the Project.

As seen in **Table 55** the most common management strategy recommended on archaeological grounds alone is for the salvage of a site through the recording and collection of surface artefacts. This recommendation is made due to:

- the nature of the recorded sites (95% of sites are isolated finds or low density artefact scatters with no associated subsurface deposits);
- generally thin A Horizon soils that preclude subsurface archaeological deposits;
- being generally located in landforms of lower archaeological potential (i.e. in areas distant to reliable water);
- generally high previous disturbance from a range of factors including erosion and land use practices;
- intensive archaeological salvage programs that have already taken place in the Proposed Disturbance Area including manual excavation, artefact collection and grader scrapes;
- the results of the current test excavation program that has adequately sampled MOCO OS-4; and
- the low archaeological values assigned to the sites.

The typical site within the Proposed Disturbance Area is a low density artefact scatter or an isolated find located in a landform distant to water that has been modified by soil loss, vegetation clearing and other farm and mine related impacts. Sites such as these have a very limited ability to further inform the community about the history and culture of the area. While any potential research questions are limited, some information can nevertheless be gained (see **Section 10.5**).

Table 55 sets out the recommended archaeological management of all sites within or adjacent to the Proposed Disturbance Area.

Table 55: Management recommendations for sites within or adjacent to the Proposed Disturbance Area.

Site Number	Assessed scientific significance	Degree of Harm	Comments	Management strategy
MOCO OS-1	Low	Partial	Salvage programs have already been carried out within the site	Mapping, description and collection of surface artefacts within the portion of the site within the Proposed Disturbance Area
MOCO OS-2	Low	Total	Low density artefact scatter	Mapping, description and collection of surface artefacts
MOCO OS-3	Low	Total	Redeposited site. Tested during the current assessment	Mapping, description and collection of surface artefacts

Site Number	Assessed scientific significance	Degree of Harm	Comments	Management strategy
MOCO OS-4	Low-Moderate	Total	Low density artefact scatter already extensively tested during the current assessment	It is assessed that there is a probability that this site contains a low density of subsurface artefacts. Mapping, description and collection of surface artefacts should take place in the first instance. Up to a total of 2m² in total of manual excavation should be undertaken adjacent to the recorded artefact concentration to ensure that it is an isolated feature. Any expansion beyond this limit would require the agreement of the Proponent, archaeologist and RAPs as to whether further excavation is justified (see Section 10.5.2). This assessment notes that the site has been extensively tested during the current assessment and that further excavation would not greatly change the characterisation of the site.
MOCO OS-5	Low	Partial	Low density artefact scatter	Mapping, description and collection of surface artefacts within the portion of the site within the Proposed Disturbance Area
MOCO OS-6	Low	Partial	Low density artefact scatter	Mapping, description and collection of surface artefacts within the portion of the site within the Proposed Disturbance Area
MOCO OS-7	Low	Partial	Low density artefact scatter	Mapping, description and collection of surface artefacts within the portion of the site within the Proposed Disturbance Area
MOCO OS-8	Low	Partial	Low density artefact scatter	Mapping, description and collection of surface artefacts within the portion of the site within the Proposed Disturbance Area
MOCO OS-9	Low	Partial	Low density artefact scatter	Mapping, description and collection of surface artefacts within the portion of the site within the Proposed Disturbance Area
MOCO OS-10	Low	Total	Low density artefact scatter	Mapping, description and collection of surface artefacts
MOCO OS-11	Low	Partial	Low density artefact scatter	Mapping, description and collection of surface artefacts within the portion of the site within the Proposed Disturbance Area
MOCO Extension to site #37-3-0649	Low	Total	Low density artefact scatter	Mapping, description and collection of surface artefacts
MOCO Extension to site #37-3-0611	Low-Moderate	Partial	Low density artefact scatter	It is assessed that there is a probability that this site contains a low density of subsurface artefacts. Mapping, description and collection of surface artefacts should take place in the first instance. Up to a total of 2m² in total of manual excavation should be undertaken adjacent to the recorded artefact concentration to ensure that it is an isolated feature. Any expansion beyond this limit would require the agreement of the Proponent, archaeologist and RAPs as to whether further excavation is justified (see Section 10.5.2).
MOCO Extension to site #37-3-0600	Low	Total	Extensive salvage programs have already been carried out within the site	Mapping, description and collection of surface artefacts within the portion of the site within the Proposed Disturbance Area
MOCO IF-1	Low	Total	Isolated artefact	Description and collection of surface artefact
MOCO IF-2	Low	Total	Isolated artefact	Description and collection of surface artefact
MOCO IF-3	Low	None	Isolated artefact	Locate and fence site to avoid inadvertent impact during construction
MOCO IF-4	Low	None	Isolated artefact	Locate and fence site to avoid inadvertent impact during construction
MOCO IF-5	Low	Total	Isolated artefact	Description and collection of surface artefact

Site Number	Assessed scientific significance	Degree of Harm	Comments	Management strategy
MOCO IF-6	Low	None	Isolated artefact	Locate and fence site to avoid inadvertent impact during construction
MOCO IF-7	Low	Total	Isolated artefact	Description and collection of surface artefact
MOCO IF-8	Low	Total	Isolated artefact	Description and collection of surface artefact
MOCO IF-9	Low	Total	Isolated artefact	Description and collection of surface artefact
MOCO IF-10	Low	Total	Isolated artefact	Description and collection of surface artefact
MOCO IF-11	Low	Total	Isolated artefact	Description and collection of surface artefact
MOCO IF-12	Low	Total	Isolated artefact	Description and collection of surface artefact
MOCO IF-13	Low	Total	Isolated artefact	Description and collection of surface artefact
MOCO IF-14	Low	Total	Isolated artefact	Description and collection of surface artefact
MOCO IF-15	Low	Total	Isolated artefact	Description and collection of surface artefact
MOCO IF-16	Low-Moderate	None	Isolated artefact	Locate and fence site to avoid inadvertent impact during construction
MOCO IF-17	Low	None	Isolated artefact	Locate and fence site to avoid inadvertent impact during construction
MOCO IF-18	Low	Total	Isolated artefact	Description and collection of surface artefact
MOCO IF-19	Low	Total	Isolated artefact	Description and collection of surface artefact
MOCO IF-20	Low	Total	Isolated artefact	Description and collection of surface artefact
MOCO IF-21	Low	Total	Isolated artefact	Description and collection of surface artefact
MOCO IF-22	Low	Total	Isolated artefact	Description and collection of surface artefact
MOCO IF-23	Low	None	Isolated artefact	Located well away from proposed works. Site location should be entered onto the Mount Owen GIS database
MOCO IF-24	Low	None	Isolated artefact	Located well away from proposed works. Site location should be entered onto the Mount Owen GIS database
MOCO IF-25	Low	None	Isolated artefact	Located well away from proposed works. Site location should be entered onto the Mount Owen GIS database
#37-3-0985	Low	Total	Low density artefact scatter	Mapping, description and collection of surface artefacts
#37-3-0611	Low	Total	Low density artefact scatter	Mapping, description and collection of surface artefacts Note: MOCO Extension to Site #37-3-0611 was recorded adjacent to the location for #37-3-0611. MOCO Extension to Site #37-3-0611 has a higher scientific significance as it covers a larger area of potential archaeological deposit rather than the small area of #37-3-0611.
#37-3-0527	Low	Total	Isolated artefact	Description and collection of surface artefact

In addition to the management options outlined in **Table 55** some specific management recommendations are made here in relation to the bridges that are proposed to span Bettys Creek and Bowmans Creek. While it is noted above that the bridge design minimises impact to the archaeologically sensitive bank areas (**Section 10.3**), there will still be localised impacts from the construction and placement of the bridge piers that will be located on the bank areas.

It is therefore recommended here that the locations of the bridge piers within 20m of the current bank edge be manually excavated to culturally sterile levels such as basal clay. This will ensure that the bank area being impacted is completely salvaged prior to the commencement of works.

At Bowmans Creek only the eastern bank of Bowmans Creek presents any heritage constraints and excavations should be confined to piers on this bank only. The western bank of Bowmans Creek is a broad floodplain that has previously been investigated by grader scrapes (Umwelt 2013b) with no artefacts being recorded. The eastern bank is in proximity to MOCO OS-10 and the previously salvaged site #37-3-0614 and has a greater archaeological sensitivity.

At Bettys Creek there is no bank bias and piers on both banks (within 20m) should be investigated. However, there have already been extensive manual excavations at the approximate location where the bridge will be located (Umwelt 2013b). Care should therefore be taken to locate the old archaeological excavations to ensure that the location of any bridge pier has not already been salvaged.

10.4.1 Further Archaeological Management Options

This assessment has recorded 39 Aboriginal sites¹²: although 62% of sites are isolated finds and a further 33% of sites are low density artefact scatters with a low probability of associated subsurface deposits (95% of all sites). As a consequence, all such sites were assessed as having low archaeological value.

Only two sites (5% of all sites; MOCO OS-4 and MOCO Extension to site #37-3-0611), were assessed as locations with the potential for subsurface artefacts; although it is assessed that these would be at a low density. These two sites, along with MOCO IF-16 (due to the rarity of the artefact type, not its context), were assessed as having low-moderate archaeological values (7% of all sites).

As the archaeological value of the Proposed Disturbance Area is not high enough to warrant major Project design changes, the Project, if approved, will contribute to the cumulative loss of Aboriginal sites in the immediate area.

The archaeological management recommendations (**Table 55**) should also be added to a history of previous archaeological salvage in the immediate district. Within the Proposed Disturbance Area, for example, 18 Aboriginal sites have already been salvaged (see **Table 6**).

In this way, the current recommendations are adding to the loss of Aboriginal sites, not only in the Proposed Disturbance Area, but also from the Ravensworth East / Mount Owen / Glendell Mining lease areas.

It should be stressed that the salvage measures set out in **Table 55** are assessed as sufficient to adequately mitigate impacts to the archaeological values of sites in the Proposed Disturbance Area. However, in order to address the cumulative loss of sites in the immediate

¹² There are 42 sites within or adjacent to the Proposed Disturbance Area discussed in this report: 39 newly recorded and three previously recorded.

vicinity of the Proposed Disturbance Area, the following strategies should be investigated by the Proponent in order to achieve further archaeological benefits arising from the Project:

- The Proponent should investigate further measures to ensure the maintenance for archaeological values in the existing Yorks Creek Voluntary Conservation Area (VCA). The Plan of Management devised for the VCA (GSS 2006) should be reviewed and updated to determine if previous measures have been successful and if there are areas now needing conservation measures. To further enhance the archaeological outcome of this process the Proponent should investigate ways in which the Yorks Creek VCA can be made more accessible for teaching and training purposes by the local Aboriginal community. Ideally this would include the building of a storage facility at the Yorks Creek VCA which could house all of the artefacts that have been excavated from the Mount Owen Complex over the years. To have a lasting archaeological outcome, the artefacts at the keeping place should be curated. While sufficient analysis has taken place on these artefacts, permanent storage in a manner where they are available to future scholars and teachers will ensure that the artefacts continue to be available for research and appreciation; and/or
- The Proponent could investigate funding a project to study the archaeological values in unmodified areas that are outside of the current Proposed Disturbance Area, but are still located on lease areas owned by the Proponent (the Project Area).

This study should focus on the AHIMS registered sites in the Project Area and should involve resurvey of these sites in order to ground-truth the location and condition of all previously recorded sites. The aim of this survey would be to recommend management procedures for all sites outside of the Proposed Disturbance Area. The GSS 2006 Plan of Management for the Yorks Creek VCA would be a good template to follow in order to assess, at some detail, how future management of these sites will be conducted. In most cases, this preservation would involve fencing and signage (if not already in place), although if erosion threatens a site, broader erosion controls/sandbagging of banks etc may be needed to ensure the site's preservation. Recommended management procedures should be reflective of a site's scientific/cultural values in that sites with low values would not require the same level of management as sites with higher scientific/cultural values. Procedures for this study could be incorporated in a revised ACHMP that would be agreed to between the Proponent, RAPs and OEH.

There are 49 known Aboriginal sites within the Project Area but outside of the Proposed Disturbance Area: not including #37-3-0670, #37-3-0018, sites #37-3-0274 to #37-3-0281 (eight sites) and #37-3-0727¹³ (marked in blue in **Table 56**, see **Section 5.3.1**). **Table 56** lists all known extant sites outside of the Proposed Disturbance Area but inside the Project Area. **Figure 117** shows the location of these sites. Many of these sites are located in the Yorks Creek VCA and would already have management recommendations attached to them flowing from the GSS 2006 Plan of Management.

This recommendation is in line with conditions stemming from previous project and AHIP approvals that stress that the Proponent should undertake measures to ensure

¹³ This tally does not include newly recorded sites arising from this assessment that are located outside of the Proposed Disturbance Area. Specific management recommendations for the newly recorded sites are given in **Table 55**. As there are eight sites in this category, there are a total of 57 known Aboriginal sites outside of the Proposed Disturbance Area but within the Project Area.

the preservation of sites outside of impact (see **Section 10.2**). As was noted, this management condition is set out in the Mount Owen ACHMP. The controls in the current ACHMP are essentially passive in that the management is geared towards avoidance of harm (**Section 10.2**).

In this recommendation, however, a more active approach is envisioned whereby sites are re-investigated and practical measures undertaken to ensure that the archaeological values of sites are maintained or improved.

Table 56: Recorded Aboriginal sites inside the Project Area but outside the Proposed Disturbance Area.

	GDA Zone 56	AHIMS Number	Site Name	Site Type	Landform	Number of artefacts at site
	323955 /6413189	37-3-0018 ¹⁴	Falbrook; Arizona	Stone Arrangement	Lower slope	0
1	317454 /6415518	37-3-0039	Stringybark Creek	Artefact Scatter	Creek bank	
2	321094 /6416501	37-3-0045	Swamp Ck A	Artefact Scatter	Creek bank	28
3	322008 /6416518	37-3-0046	Swamp Creek; Swamp Creek B	Artefact Scatter	Creek bank	>25
4	319283 /6415552	37-3-0050	Yorks Creek; Yorks Creek A	Artefact Scatter	Creek bank	>50
	322025 /6415089	37-3-0274* ¹⁵	HVCC 100	Artefact Scatter	Terrace	<20
	322035 /6415089	37-3-0275*	HVCC 99	Artefact Scatter	Bedrock foot slope	>20
	322035 /6414389	37-3-0276*	HVCC 95	Artefact Scatter and Knapping Floor	Lower alluvium	>50
	322055 /6415489	37-3-0277*	HVCC 90	Artefact Scatter	Terrace	>50
	322045 /6415389	37-3-0278*	HVCC 94	Artefact Scatter	Terrace	>100
	322055 /6415589	37-3-0279*	HVCC 89	Artefact Scatter	Terrace	>50
	322055 /6415789	37-3-0280*	HVCC 88	Artefact Scatter	Terrace	>50
	322045 /6415889	37-3-0281*	HVCC 86	Artefact Scatter	Terrace	>100
5	318555 /6414519	37-3-0343	Mt Owen (1996) 1; MtO1	Artefact Scatter	Creek bank	11
6	320245 /6415789	37-3-0346	Mt Owen (1996) 6	Isolated Find	Hill slope	1
7	319482 /6414609	37-3-0349	Mt Owen (1996) 10	Isolated Find	Creek bank	1
8	319705 /6414609	37-3-0350	Mt Owen (1996) 9	Artefact Scatter	Foot slope	4
9	319385 /6415989	37-3-0354	Mt Owen (1996) 14	Artefact Scatter	Creek line	12
10	319895 /6415989	37-3-0355	Mt Owen (1996) 20	Artefact Scatter	Creek	5
11	320215 /6416059	37-3-0356	Mt Owen (1996) 18	Artefact Scatter	Slope to creek	8
12	320425 /6416269	37-3-0357	Mt Owen (1996) 17	Artefact Scatter	Creek bank	20
13	319865 /6415049	37-3-0359	Mt Owen (1996) 3	Artefact Scatter	Ridge	36
14	319085 /6414419	37-3-0360	Mt Owen (1996) 2	Isolated Find	Slope/creek flat	1
15	319735 /6415599	37-3-0362	Mt Owen (1996) 24	Isolated Find	Foot slope to gully	1

¹⁴ Site #37-3-0018 does not exist and is the same site as site #37-3-0637 at the location given here for #37-3-0637. The existence of only one stone arrangement was ascertained during a targeted assessment by OzArk (archaeologist: Ben Churcher) on 15 May 2013. This site is not shown in **Figure 117**.

¹⁵ Sites #37-3-0274 to #37-3-0281 (eight sites) plot to highly modified areas within the mining lease and are likely to have been previously salvaged under appropriate approvals or have the wrong coordinates entered into AHIMS. These sites are not shown in **Figure 117**.

	GDA Zone 56	AHIMS Number	Site Name	Site Type	Landform	Number of artefacts at site
16	323618 /6413117	37-3-0637	Bettys Creek Stone Arrangement	Stone Arrangement	Creek terrace	0
17	316646 /6414633	37-3-0642	Liddell Pipeline 1	Artefact Scatter		
18	316669 /6414898	37-3-0643	Bowmans Creek 1 PAD	PAD		
	316646 /6414633	37-3-0670 ¹⁶	Liddell Pipeline	Artefact Scatter	Mid slope/lower slope/high bench	
19	320145 /6415879	37-3-0691	Mt Owen(1996) 7	Artefact Scatter	Valley margin/hill slope	33
20	320265 /6416129	37-3-0692	Mt Owen(1996) 16	Artefact Scatter	Creek bank/hill slope	42
21	319965 /6415939	37-3-0693	Mt Owen(1996) 19	Artefact Scatter	Creek	18
22	319675 /6415559	37-3-0694	Mt Owen(1996) 23	Artefact Scatter	Gully	9
23	320045 /6415779	37-3-0695	Mt Owen(1996) 25	Artefact Scatter	Foot slope	19
24	323984/6414421	37-3-0702	Forest East Offset 1 (FEO 1)	PAD/Artefact Scatter	Creek terrace	9
25	323991 /6414828	37-3-0703	Forest East Offset 2 (FEO 2)	Artefact Scatter	Flat on spur	3
26	323943 /6413945	37-3-0704	Forest East Offset 3 (FEO 3)	Artefact Scatter	Spur	2
27	323316 /6416779	37-3-0705	Northeast Offset 1 (NEO 1)	PAD/Artefact Scatter	Lower slope	30
28	323393 /6416884	37-3-0706	Northeast Offset 2 (NEO 2)	Artefact Scatter	Lower spur slope	3
29	323417 /6416986	37-3-0707	Northeast Offset 3 (NEO 3)	Artefact Scatter	Lower spur slope	2
30	321618 /6416359	37-3-0708	Northwest Offset 1 (NWO 1)	PAD/Artefact Scatter	Lower slope	81
31	320271 /6416119	37-3-0726	Yorks Creek (Mt Owen Mine) 1	Artefact Scatter	Hill	4
	319085 /6414389	37-3-0727 ¹⁷	Yorks Creek (Mt Owen Mine) 2	Artefact Scatter	Creek bank	12
32	320137 /6415919	37-3-0728	Yorks Creek (Mt Owen Mine) 3	Artefact Scatter	Creek bank	13
33	319265 /6414649	37-3-0729	Yorks Creek (Mt Owen Mine) 4	Artefact Scatter	Creek flat	90
34	319964 /6415923	37-3-0730	Yorks Creek (Mt Owen Mine) 5	Artefact Scatter	Slope	12
35	319403 /6415765	37-3-0731	Yorks Creek (Mt Owen Mine) 6	Artefact Scatter	Creek bank	43
36	319135 /6416134	37-3-0732	Yorks Creek (Mt Owen Mine) 7	Artefact Scatter	Hill	22
37	319329 /6416187	37-3-0733	Yorks Creek (Mt Owen Mine) 8	Artefact Scatter	Flat on spur	1
38	319451 /6416082	37-3-0734	Yorks Creek (Mt Owen Mine) 9	Artefact Scatter	Gentle slope	
39	319707 /6415600	37-3-0735	Yorks Creek (Mt Owen Mine) 10	Artefact Scatter	Flat on spur	1
40	324255 /6410311	37-3-0922	MCISO2	Isolated Find	Creek terrace/crest landform	1

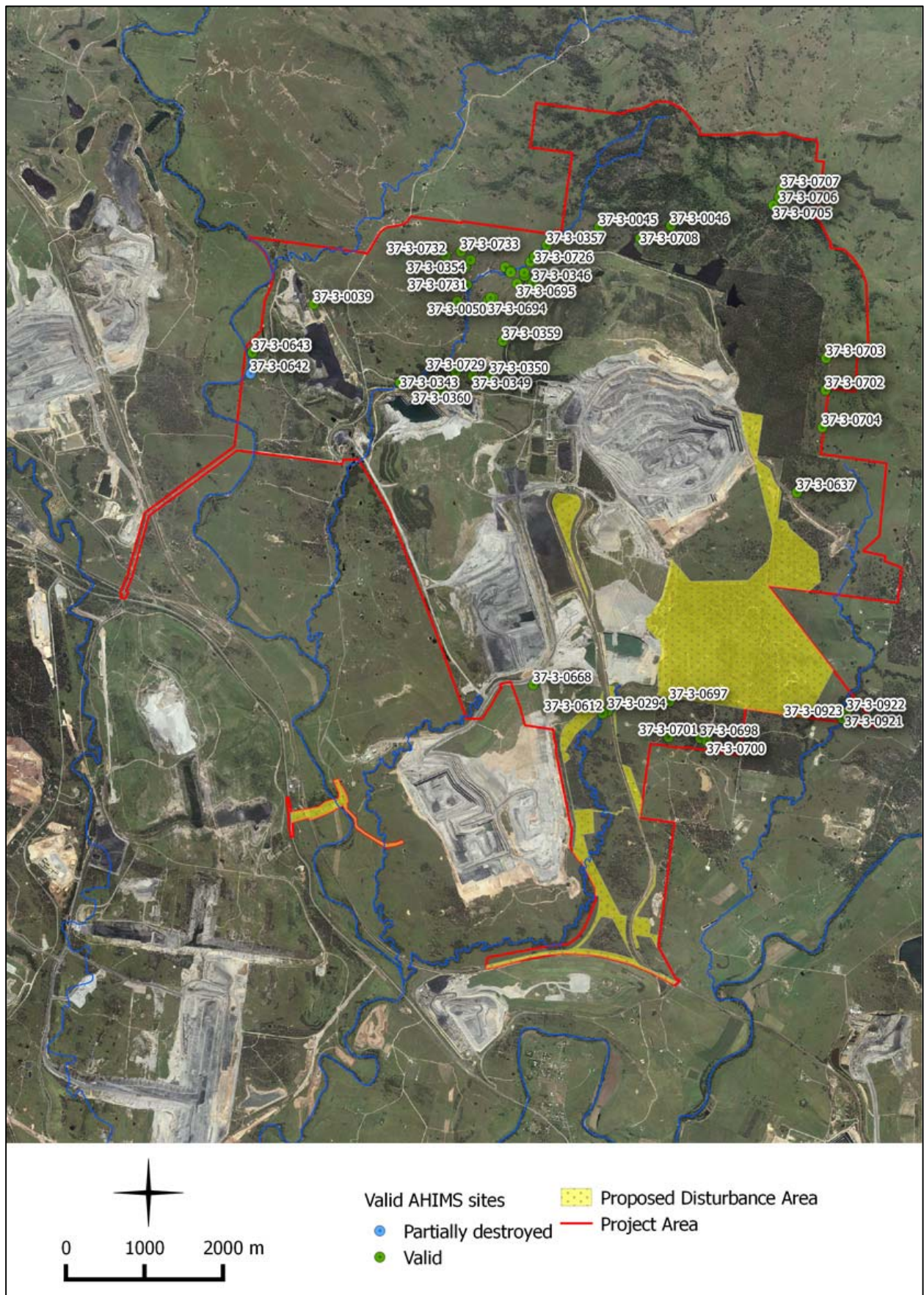
¹⁶ Site #37-3-0670 plots to the same location as #37-3-0642. #37-3-0670 is removed from **Figure 117**.

¹⁷ Site #37-3-0727 plots to a highly modified area and has likely been previously salvaged. This site is not shown in **Figure 117**.

	GDA Zone 56	AHIMS Number	Site Name	Site Type	Landform	Number of artefacts at site
41	324200 /6410232	37-3-0923	MCISO3	Isolated Find	Creek terrace/crest landform	1
42	320255 /6410664	37-3-0668	Swamp Creek PAD	Artefact Scatter		
43	321992 /6410450	37-3-0697	GCS9	Artefact Scatter	Crest	1
44	322383 /6409981	37-3-0698	GCS8	Artefact Scatter	Drainage depression	1
45	322469 /6409945	37-3-0700	GCS-9	Artefact Scatter	Crest	1
46	321205 /6410329	37-3-0294	Site 2;	Artefact Scatter	Creek bank	-20
47	321979 /6409995	37-3-0701	GCS-10	Artefact Scatter	Upper to lower slopes	11
48	321138 /6410296	37-3-0612	Bettys Creek 22	Artefact Scatter	Floodplain	1
49	324228 /6410295	37-3-0921	MCISO1	Isolated Find	Crest of creek terrace	1

It is felt, from an archaeological perspective that if both, or either, of these strategies is followed that the Project would contribute to intergenerational equity in the district by ensuring the on-going maintenance of extant archaeological sites and it would ensure an enhanced mitigation for the loss of archaeological values from within the Proposed Disturbance Area.

Figure 117: Location of extant sites inside the Project Area but outside the Proposed Disturbance Area.



10.5 MANAGEMENT PROCESS

10.5.1 Archaeological salvage: artefact collection

Research aim: Is there any variation, on a macro level, in the distribution of certain artefact attributes such as raw material type and artefact type across the Proposed Disturbance Area?

Action: To conduct an analysis of the raw materials and basic artefact features to determine whether there is site to site variation across the Proposed Disturbance Area, particularly in sites located away from water.

Aim: Archaeological data obtained will allow a local level analysis of distribution patterns within the Proposed Disturbance Area.

Research Design: All visible artefacts would be flagged in the field. On hand-held GIS units, the location, artefact class and artefact type will be catalogued in the field. A representative sample of artefacts and views of site and *in situ* artefacts will be photographed. When recorded, all artefacts from the surface of the site will be collected according to an established grid system that will cover the whole site.

Stone artefact sites managed under this archaeological salvage will contribute to the research aim in that the sites will have surface artefacts mapped, catalogued, selectively photographed, collected and moved to safe-keeping.

It is envisioned that these investigations would include the following methodology although the final form of any investigation would be done in consultation with the RAPs:

Archaeological salvage: surface collection of artefacts

In order to fulfil the research aim, the following program is suggested:

- All visible artefacts at a site should be flagged in the field;
- The site should be photographed after flagging and before recording;
- All artefacts should have the following artefact information entered directly into a GPS unit, albeit one set up with all variable fields already entered to make the field recording job more efficient:
 - Location;
 - Artefact Class;
 - Artefact Type;
 - Size;
 - Reduction level;
 - Raw Material; and

- Notes.
 - A selection of indicative and / or unusual artefacts from each site will be photographed;
 - A sketch plan of the site will be completed indicating zones for the surface collection of artefacts; and
 - Once all recording is complete, the artefacts will be collected according to site zones with artefacts from each zone being kept separate.
- Should the collection team encounter a human burial, all work should cease in the area and advice from authorities and RAPs (should the remains be Aboriginal) sought;
- The recording of the artefacts recovered will largely be completed in the field and this data would be incorporated into a report; and
- Analysis will attempt to answer the research aim which is to record a statistically valid artefact assemblage from across the Proposed Disturbance Area in order to better understand inter-site variations.

The sites recommended for archaeological salvage by means of surface collection are shown in **Table 55**.

10.5.2 Archaeological salvage: limited manual excavation

At two locations: MOCO OS-4 and MOCO Extension to site #37-3-0611 it is assessed that there is a low likelihood that further subsurface artefacts may be present at a low density.

At these sites it is recommended that the surface collection of artefacts occur first and that limited manual excavation in the area of the known concentration of artefacts (TR3 SQ 4) should take place up to a maximum of 2m² in order to confirm that no further artefact concentrations are located in the vicinity of TR 3 SQ4.

It is stressed that MOCO OS-4 has already been extensively tested during the current assessment and that it is felt that further excavation, beyond that recommended here, will not substantially add to our knowledge concerning the site.

At MOCO Extension to site #37-3-0611 it is assessed that further subsurface artefacts are likely to be at a low density, and following the surface collection, limited manual excavation along the northern bank of the gully that dissects the site should take place up to a maximum of 2m² in order to confirm that further artefacts are likely to be at a low density.

The manual excavation at these locations should follow the following framework.

Archaeological Salvage: Limited Subsurface Investigations

Research Aim: Are there either subsurface artefacts or intact archaeological deposits at the location?

Action: To conduct targeted, limited archaeological excavations at the site.

Aim: To use the results of the limited manual excavation to confirm the assessment in this report.

Research Design: At locations indicated above up to eight 0.5m by 0.5m excavation squares should be excavated. The excavation squares could be grouped to maximise information in one area, or spaced out to maximise cover. If spread out, it is recommended that pairs of 0.5m by 0.5m squares are excavated together to gain a meaningful sample from any area. These squares, in 0.5m by 0.5m increments, could be expanded if finds or deposits indicate that it would be advantageous.

The methodology for the possible salvage by manual excavation at these sites is as follows:

- It would be possible to conduct up to five shovel pits (approximately 0.15m x 0.15m) at any location to help determine the placement of excavation squares;
- A maximum of eight 0.5m by 0.5m excavation squares (two square metres) would be excavated to culturally sterile soil levels such as the basal clays within one investigation area;
- The eight excavation squares could be grouped together or spaced at no more than 5m apart. Thus a 35m transect could be investigated, or a two square metre contiguous area excavated.
- Spits at each area would start in 5cm increments although 10cm increments could be used once it is established it is archaeologically prudent to do so;
- All deposits would be dry sieved at location;
- All recording will be done in the field in standard context sheets and the archaeologist will ensure that all necessary photographs, section drawings and soil analysis shall take place;
- A maximum area of two square metres shall be excavated at any one area unless deposits and finds warranted a further expansion (see below);
- The decision to expand from the mandated two square metres shall be determined by the results of the eight 0.5m by 0.5m squares and would be done in consultation between the archaeologists and RAPs present;
- Should deposits or finds indicate that it would be desirable to expand beyond the two square metres; this will be possible if agreement is reached between the archaeologist and RAPs present. The grounds for expansion would include:
 - The complete excavation of a feature (such as a hearth) that may have been intersected by an excavation square; and
 - The complete excavation of a concentration of artefacts such as a knapping floor that may have been intersected by an excavation square.

- Any expansion beyond the two square metres would include areas totalling no more than 50% of the original area (i.e. an additional four 0.5m by 0.5m squares [one square metre] would be permissible);
- In what is assessed as an unlikely event, should the excavations encounter high value archaeological deposits, it should be possible to commence larger scale manual excavation at that location. Deposits or features that would characterise high value deposits include:
 - Undisturbed deposits showing discernible archaeological stratigraphy;
 - Any exceptional finds (unusual materials, rare preservation, rare artefact type) believed to have archaeological context; and
 - A high density of artefacts (in excess of 100 per square metre) in largely undisturbed contexts.
- Should the excavations encounter a human burial, all work should cease in the area and advice from authorities and RAPs (should the remains be Aboriginal) sought; and
- All excavated material (stone tools, bone, shell etc) will be fully analysed and a report of the findings prepared.

The sites recommended for archaeological salvage by means of limited manual excavation are shown in **Table 55**.

11 RECOMMENDATIONS

The following recommendations are made on the basis of:

- There are 42 extant Aboriginal sites located within or adjacent to the Proposed Disturbance Area that forms the basis of this study.
- 36 newly recorded sites and three previously recorded sites have low scientific significance. Three sites (MOCO OS-4, MOCO IF-16 and Extension to site #37-3-0611) have low-moderate scientific significance.
- 34 sites would be directly or partially impacted by the Project.
- 57 sites located within the Project Area (eight sites recorded during this assessment and 49 AHIMS registered sites) will be avoided as they are located beyond the Proposed Disturbance Area.

Table 55 lists all sites that are likely to be impacted by the Project and tabulates the associated scientific values assessment and recommended archaeological management strategies.

As a consequence of the proposed impacts to Aboriginal cultural heritage sites within the Proposed Disturbance Area, the following archaeological recommendations are made in an effort to responsibly mitigate the loss of cultural heritage in the impact footprint.

1. Should development consent for Project be granted, archaeological management strategies to mitigate the impact of the proposed works are set out in **Section 10.4**. All sites will be salvaged by a surface collection of all visible artefacts (see **Section 10.5.1**).

Two sites have some further management recommendations:

- a. MOCO OS-4: It is assessed that there is a probability that this site contains a low density of subsurface artefacts. Mapping, description and collection of surface artefacts should take place in the first instance. Up to a total of 2m² in total of manual excavation should be undertaken adjacent to the recorded artefact concentration to ensure that it is an isolated feature. Any expansion beyond this limit would require the agreement of the Proponent, archaeologist and RAPs as to whether further excavation is justified (see **Section 10.5.2**); and
- b. MOCO Extension to site #37-3-0611: It is assessed that there is a probability that this site contains a low density of subsurface artefacts. Mapping, description and collection of surface artefacts should take place in the first instance. Up to a total of 2m² in total of manual excavation should be undertaken adjacent to the erosion gully that bisects the site to confirm that any subsurface artefacts are at a low density. Any expansion beyond this limit would require the agreement of the Proponent, archaeologist and RAPs as to whether further excavation is justified (see **Section 10.5.2**).

2. The locations of proposed bridge piers within 20m of the current bank edge on the eastern bank of Bowmans Creek and on both banks of Bettys Creek should be salvaged by manual excavation to culturally sterile soil levels such as basal clays.
3. The salvage works will include artefact mapping, artefact analysis and results reporting to preserve the data in a useable form.
4. In order to address the issue of cumulative loss of sites in the district, the Project should investigate an enhanced management protocol for the Yorks Creek VCA including the building of a storage facility where all artefacts from the Mount Owen Complex can be secured and available for future research.
5. In order to address the issue of cumulative loss of sites in the district, the Project should investigate undertaking a management program to ensure that the integrity of remaining AHIMS registered archaeological sites (n=57) within the Mount Owen Complex are maintained¹⁸.
6. Following development consent of the Project, an AHIP will not be required for impacts to cultural heritage, so long as the impact accords with the terms and conditions of the consent. Instead, impacts on Aboriginal heritage would be managed through an ACHMP which is to be agreed to by the Proponent, RAPs and OEH. The archaeological management recommendations within this report would normally be incorporated into the ACHMP that is usually formulated following Project development consent.

¹⁸ Eight sites recorded during this assessment and 49 AHIMS registered sites. See footnote 13.

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APPENDICES

ABORIGINAL ARCHAEOLOGICAL VALUES ASSESSMENT

Mount Owen Continued Operations Near Ravensworth, Upper Hunter Valley, NSW Singleton LGA

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Appendices 1 to 4 have been produced over the past year and a half (2012-2014). In this time, these internal documents have used varying names to describe sites within the Project Area. These appendices have not been altered to take this into account and any site name used in these documents is superseded by the site names and descriptions in the main report.



Environmental and
Heritage Management P/L

OzArk EHM

145 Wingewarra St
(PO Box 2069)
Dubbo NSW 2830

Phone: (02) 6882 0118

Fax: (02) 6882 0630

jodie@ozarkehm.com.au

phil@ozarkehm.com.au

www.ozarkehm.com.au

APPENDIX 1: MOUNT OWEN CONTINUED OPERATIONS SURVEY METHODOLOGY



Environmental and
Heritage Management P/L

ABORIGINAL HERITAGE SURVEY METHODOLOGY

**Mt Owen Continued Operations
October 2012**

OzArk EHM

145 Wingewarra St
(PO Box 2069)
Dubbo NSW 2830

Phone: (02) 6882 0118

Fax: (02) 6882 0630

jodie@ozarkehm.com.au

phil@ozarkehm.com.au

www.ozarkehm.com.au

**Prepared by
OzArk Environmental & Heritage Management Pty Ltd**

BACKGROUND TO MT OWEN CONTINUED OPERATIONS PROJECT

The Mt Owen Complex is located within the Hunter Coalfields in the Upper Hunter Valley of New South Wales (NSW), approximately 20 kilometres north-west of Singleton, 24 kilometres south-east of Muswellbrook and to the north of Camberwell village (refer to **Figure 1**). The Mt Owen Complex consists of the Ravensworth East, Glendell and Mt Owen open cut mining operations.

The Mt Owen Mine (the North Pit) is owned by Xstrata Coal Australia Pty Limited (Xstrata), managed by Xstrata Mt Owen (XMO) Pty Ltd, and operated by Thiess Pty Limited (Thiess). The Mt Owen open cut mine has an approved production rate of 10 million tonnes per annum (Mtpa) of run of mine (ROM) coal and the Mt Owen Complex has an approved total processing capacity of 15 Mtpa of ROM coal. Based on the current production schedule, it is expected that XMO will complete mining within the currently approved area of North Pit by 2018.

XMO has undertaken an exploration program within its mining tenements to the south-east of North Pit and has identified significant additional coal resources in this area. As part of the Mt Owen Continued Operations Project (MOCO, the Project), XMO is seeking approval to continue mining of the North Pit to the south-east of the current approved pit limit (refer to **Figure 2**) to enable extraction of approximately 80 million tonnes of additional coal resource.

Additionally, XMO is seeking to increase the currently approved processing and load-out capacity at the Mt Owen Coal Handling and Preparation Plant (CHPP) from 15 Mtpa to 17 Mtpa to allow for capacity to wash ROM coal up to the currently approved mining production limit for the Mt Owen Complex. To facilitate the increased processing capacity, the Project is proposing to extend the existing product coal stockpile, located within the currently disturbed area of the Mine Infrastructure Area (MIA). The Project also seeks approval for upgrade to the MIA including increased capacity at the existing workshop and fuel farm and replacement of some other site services to meet current best practice standards.

To allow for increased efficiencies of the Hunter Valley Coal Chain and the provision of parking areas for the Xstrata Rail (X-Rail) fleet, the Project also includes the potential augmentation of the existing rail spur through the construction of an additional rail line and northern turn-out west of the existing Mt Owen rail spur.

The existing employee and services access to the Mt Owen Complex is via Hebden Road from the New England Highway. To minimise delays on Hebden Road associated with the existing level rail crossing, the Project also seeks approval to construct a road traffic (Hebden Road) rail overpass over the Main Northern Rail Line. Further, to improve road safety and capacity, a new bridge over Bowmans Creek on Hebden road is also proposed. These Hebden Road upgrade works are a significant investment in improved public road infrastructure that will result in reduced traffic congestion and improved safety.

No changes are proposed to the existing Glendell or Ravensworth East mining operations as part of the Project.

As the Project is development for the purposes of coal mining, the Project is State Significant Development (SSD) as defined under Schedule 1 of the State Environmental Planning Policy (State and Regional Development) 2011. Initial consultation with the Department of Planning and Infrastructure (DP&I) confirmed the appropriate approval path for this Project is a new project approval under Part 4 of the *Environmental Planning and Assessment Act 1979*.

An Environmental Impact Statement (EIS) will be prepared for the Project to accompany a Project Application, planned to be submitted in the third quarter of 2013.

Figure 1. Location of Mt Owen Mine.



Figure 2. Proposed impact footprint of MOCO¹.

¹ Figure as sent to RAPs in October 2012. Current Project Area and Proposed Disturbance Area differ from that shown here.

INTRODUCTION TO THE ABORIGINAL HERITAGE SURVEY

Survey for the Environmental Assessment will be undertaken in compliance with the NSW Office of the Environment and Heritage (OEH) *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW 2010). This Code has been developed to support the process of investigating and assessing Aboriginal cultural heritage. It specifies the minimum standards for archaeological investigation undertaken in NSW under the National Parks and Wildlife Act 1974. The Aboriginal cultural heritage assessment and archaeological investigation are to be undertaken in accordance with the requirements of this Code.

This survey methodology is informed by previous archaeological research that was carried out during 2011 by Umwelt Australia Pty Limited (Umwelt) as part of a constraints analysis for Mt Owen Continuing Operations. The main findings of this research, as they pertain to the current Project Area, are presented below.

The objectives of the study undertaken by Umwelt in 2011 were to (in part):

- identify Aboriginal archaeological sites previously recorded within the Project Area and its environs on the NSW Office of Environment and Heritage (OEH) Aboriginal Heritage Information Management System (AHIMS) register; and
- identify any Aboriginal archaeological sites and landforms of high Aboriginal cultural value and/or archaeological significance.

ENVIRONMENTAL SETTING

The Project Area lies within a topography that is comprised of a number of low, generally north-south trending ridges (elevation from around 10 to 140 metres) with east-west trending spurs and long slope lengths with slopes of low to moderate gradient. Numerous drainage depressions flow between each spur, forming first, second and third order ephemeral tributaries of Bowmans Creek, Yorks Creek, Swamp Creek, Bettys Creek, Main Creek, Chain of Ponds Creek and Bayswater Creek.

The main channels of Chain of Ponds Creek, Swamp Creek, Bettys Creek, Yorks Creek and Main Creek and any associated swamps and billabongs would have provided a semi-permanent water source. The tributary systems of these lower order streams (e.g. first and second order streams) would have only provided an ephemeral water source.

Bettys Creek, Swamp Creek, Yorks Creek, Main Creek, Bowmans Creek, Chain of Ponds Creek and Bayswater Creek have deeply incised channels. The present deeply incised nature of the channels is most likely the result of European land-use practices (especially vegetation clearance and overstocking) in the area and studies of the soil profiles exposed in the banks of

Bettys Creek, Swamp Creek, Yorks Creek, Main Creek and Chain of Ponds Creek indicate that these creeks formerly had shallow channels with a chain of ponds morphology.

Both within the Project Area and within adjacent landforms, the drainage systems have often been impacted to varying degrees by gully erosion.

Surveys of adjacent landforms to the Project Area record that gully erosion has formed gullies up to two metres deep and extensive areas have also been affected by sheet erosion. Consequently, in the region of the Project Area, there has been extensive downslope and downstream movement of topsoil (and any Aboriginal artefacts it may have contained). Disturbances of this sort are also expected to be found within the Project Area.

ARCHAEOLOGICAL BACKGROUND

Regional Archaeological Context

Extensive archaeological investigations for the Glendell, Mt Owen and Ravensworth East Mines, with archaeological surveys conducted by Brayshaw (1981² and 1982), Croft and Associates (1983), Dean-Jones (1991a, 1991b, 1991c and 1992), ERM (1995, 1999 and 2002), Barber (1993), Baker (1997), AMBS (1995 and 1998), Ruig (1996), Hughes and Sullivan (1997), HLA (2001) and Umwelt (2001, 2003a, 2003b, 2004a, 2004b, 2005, 2006).

Searches were undertaken by Umwelt in 2011 of the OEH AHIMS database to obtain details of any previously registered sites. A total of five searches were undertaken on 5 November 2010, and a further six searches throughout February 2011 to cover an area incorporating the Project Area and its locale. The AHIMS search showed that there are 977 registered sites within the region of the Project Area. 190 of these 977 sites are listed in the AHIMS database as having been 'destroyed'³ (**Figure 3**).

Of the 977 sites within the broader search area, site types included artefact scatters, isolated finds, an art (engraving) site, potential archaeological deposits (PADs), scarred trees, stone arrangements, a quarry site, a massacre site and sites combining more than one site type within their bounds. **Table 1** displays this information.

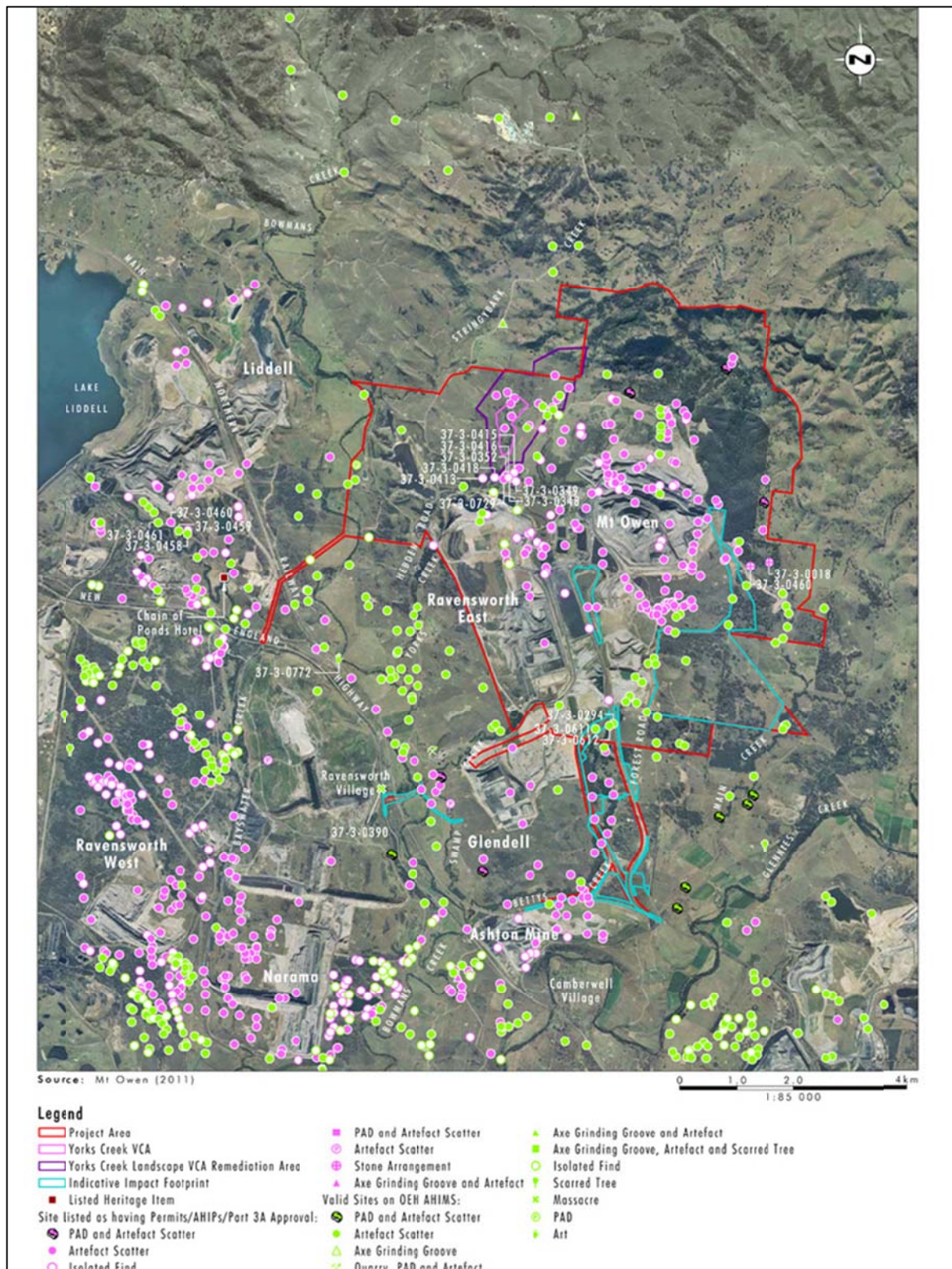
In addition, Umwelt have examined archaeological reports, site cards and AHIP applications to accurately determine the present status of Aboriginal sites in the Glendell, Mt Owen and

² References are given here to give an indication of the year of investigation only.

³ Examination of the available data suggests that the current AHIMS listings of 'valid' and 'destroyed' are not an accurate indication of the actual number of extant sites in the search area. Of the 787 sites still listed as 'valid' in the AHIMS database it has been noted that more than 230 of these sites have recently had permits/consents issued in association with works for Ravensworth East, Glendell, Mt Owen and surrounding mining operations. Therefore the actual number of destroyed sites in the vicinity of the Project Area is likely to be greater than AHIMS would indicate.

Ravensworth East Lease Areas (Mining Lease Area). The results of this research will be presented below.

Figure 3. Location of previously recorded sites in the vicinity of the Project Area⁴.



⁴ Figure as sent to RAPs in October 2012. Current Project Area and Proposed Disturbance Area differ from that shown here.

Table 1. Site Types within the Broader Search Area.
Covering Zone 56 AGD 311800E to 326000E, 6404400N to 6424000N.

Site Type	Number of sites
Art (Engraving Site)	1
Artefact Scatter	686
Isolated Find	263
PAD	3
PAD/Artefact Scatter	11
Quarry/PAD/Artefact Scatter	1
Stone Arrangement	2
Scarred Tree/Artefact Scatter	1
Scarred Tree	4
Massacre	1
Grinding Groove	1
Grinding Groove/Artefact Scatter	2
Grinding Groove/Artefact Scatter/Scarred Tree	1
TOTAL	977

The archaeological surveys for the Mining Lease Area have identified 302 Aboriginal archaeological sites (of varying significance) which are currently registered on the OEHS AHIMS database. Of the 302 registered sites, 48 have been salvaged (destroyed), five remain in place (valid) but are in areas that have active AHIPs in force, and 249 sites remain valid.

The vast majority of the registered sites within the Mining Lease Area were located in areas of low gradient (<2 degrees) within 50 metres of the creek lines. The largest sites in terms of artefact numbers and spatial extent were associated with creek confluences or with swamps and billabongs associated with the creek lines.

Many more sites were located along the main channels of Swamp Creek, Bettys Creek, Yorks Creek, Main Creek, Chain of Ponds Creek and Bayswater Creek than were located along Bowmans Creek. This result has been found to be biased by ground surface visibility and the depth and type of erosion present in association with the creek lines. Erosion related to Swamp Creek, Bettys Creek, Yorks Creek, Main Creek, Chain of Ponds Creek and Bayswater Creek is mainly scouring of the topsoil from the foot slopes of the spurs and banks of the creeks. This form of erosion exposes wide areas of the subsurface soil profile and allows for the identification of previously buried artefacts.

In contrast, the majority of the landforms beside Bowmans Creek consist of heavily grassed, deep, alluvial, floodplain and terrace deposits. The major erosional agent of the floodplains is creek line migration which results in bank collapse and vertical channel walls which are not

conducive to the exposure of artefacts. Any artefacts exposed by bank collapse are usually carried away by creek flow.

However, works such as the major trench (creek diversion known registered as the Bowmans/Swamp Creek trench: 37-3-0469) excavated between Bowmans Creek and Swamp Creek (constructed for Glendell mine) have exposed several hundred artefacts indicating that site location associated with Bowmans Creek alluvial deposits has been biased by ground surface visibility.

Those artefact scatter and isolated find sites that have been recorded in association with Bowmans Creek are generally located in areas where the creek channel is bedrock confined and the foot slopes of the spurs continue to the bank of the creek line. These areas are subject to scouring and thus have much greater potential for artefact visibility.

As only a small portion of Bowmans Creek is contained in the Project Area (for a potential bridge crossing) it is expected that the survey will be unlikely to locate Aboriginal sites due to the constraints outlined above.

Small numbers of sites have also been located within the Mining Lease Area on the ridge and spur crests that would have provided good vantage points. Very few sites have been located on mid and upper slopes.

There have been no Aboriginal scarred trees recorded in the vicinity of the Project Area.

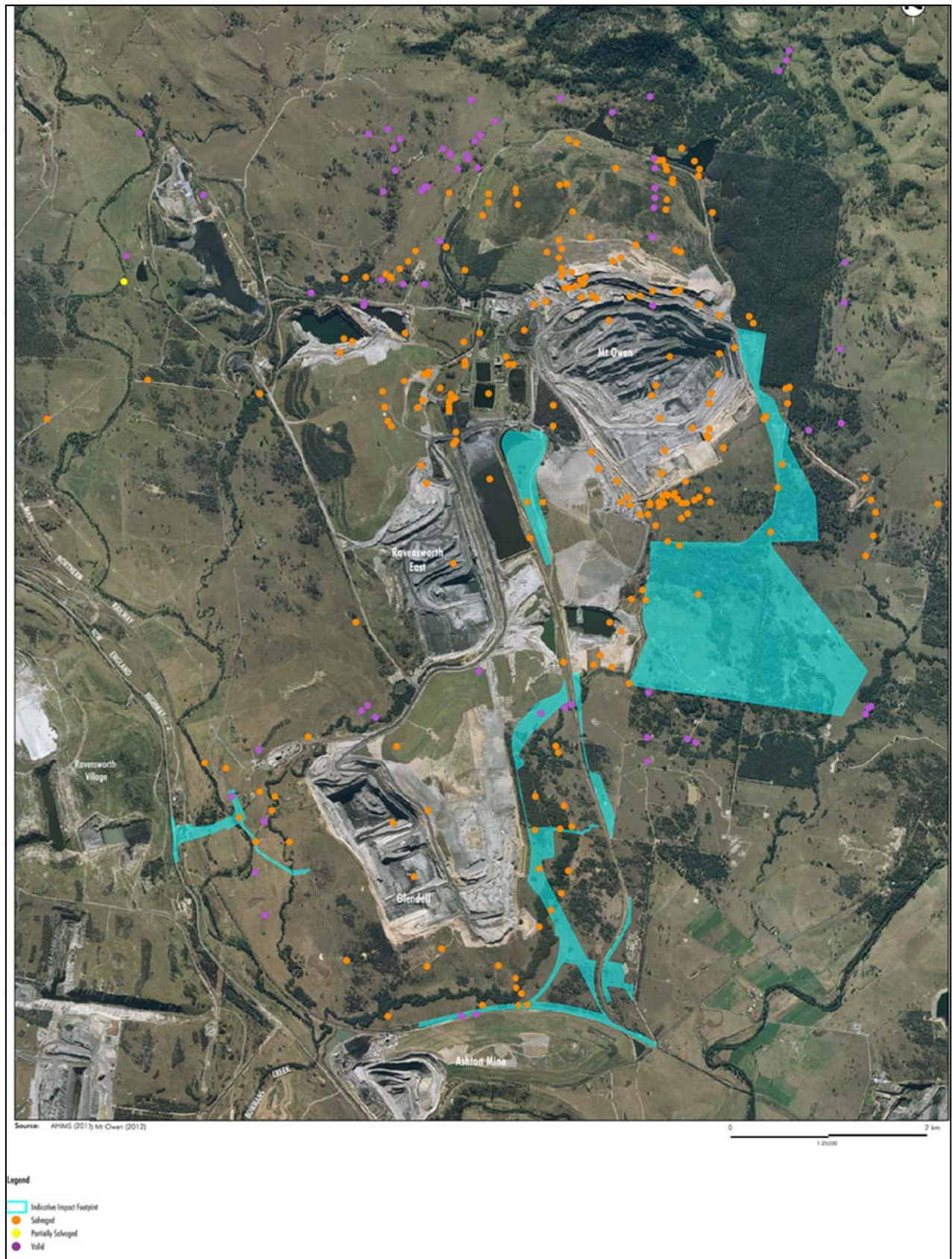
An Aboriginal Voluntary Conservation Area (VCA) currently exists at Mt Owen over an area of approximately 29 hectares around Yorks Creek to the west of the Mt Owen main overburden dump for protection of archaeological sites. This area is known as the Yorks Creek VCA and is not included in the Project Area.

Local Archaeological Context

Of the 303 sites recorded during the archaeological investigations for the Mining Lease Area, 21 are mapped within the surface disturbance footprint of the Project Area. Of these 21 registered sites within the impact footprint for the proposed Project, 17 have been previously salvaged and four remain valid (**Figure 4**).

In the vicinity of the Bettys Creek Habitat Management Area (BCHMA), one valid site is located within the Project impact footprint and one valid site exists in the Bowmans Creek portion of the Project Area.

Figure 4: Registered Aboriginal sites within and adjacent to the MOCO impact footprint⁵.



⁵ Figure as sent to RAPs in October 2012. Current Project Area and Proposed Disturbance Area differ from that shown here.

BETTYS CREEK HABITAT MANAGEMENT AREA: KNOWN CULTURAL AND ARCHAEOLOGICAL VALUES

The proposed Project is adjacent to two registered Aboriginal sites; MORL-2 (37-3-0294) and Bettys Creek 22 (37-3-0612), previously identified for conservation within a Heritage Management Area (now known as the BCHMA) associated with Bettys Creek (Umwelt 2008). During the preparation of the Glendell Mine ACHMP (Umwelt 2008), this area was identified by the Registered Aboriginal Parties (RAPs) as suitable for setting aside for the management of Aboriginal cultural values. The Aboriginal cultural values noted include (Umwelt 2008:18–19):

- a ridge that affords expansive views of the Bettys Creek valley;
- areas along Bettys Creek and on the lower slopes where five or more useful/edible plants were recorded during the Glendell survey;
- semi-permanent water from Bettys Creek and associated billabongs (old meander cutoffs) and a permanent waterhole in the vicinity of Bettys Creek 21, Bettys Creek 22 and MORL_2; and
- numerous creek confluences with associated areas of low gradient suitable for camping.

From an archaeological perspective, the BCHMA was set up primarily in response to the conservation of ecological values as part of Glendell's 2007 Modification to DA 80/9525. As impact from infrastructure/topsoil dumps was initially proposed for the BCHMA area, the majority of the sites along Bettys Creek were salvaged under Section 90 Consent (#2267). Salvage excluded MORL-2 (37-3-0294) and Bettys Creek 22 (37-3-0612) which were outside the area to be impacted and thus were set aside for conservation along with a third site in the same area: Bettys Creek 21 (37-3-0611; located within the proposed Project disturbance footprint).

MORL-2 (37-3-0294) had earlier been identified as being of high enough archaeological significance to be fenced and conserved when the site was located as part of the Mt Owen Rail Loop assessment (ERM 1995). The site was subsequently fenced and then further protected through inclusion in the BCHMA (Umwelt 2008). This site will be avoided by the proposed Project. This will be confirmed following re-inspection of the sites during the current assessment to determine the site's current extent and archaeological values.

BOWMANS CREEK: KNOWN CULTURAL AND ARCHAEOLOGICAL VALUES

The proposed Project area currently includes works associated with the Hebden Road deviation. Associated works will impact the bank areas of Bowmans Creek

All creek lines have been previously assessed as having high Aboriginal cultural significance. Major creeks like Bowmans Creek are seen as particularly important. This importance has been described as being related to the creek's:

- high resource value (aquatic plants and aquatic prey species, reliable water);
- likelihood to have been associated with large camp sites which would have been sustained by the resources of the area and which may remain buried in deep alluvial deposits;
- likelihood of burials in deep alluvial deposits; and
- known sites of high cultural significance and rarity (e.g. the Bowmans Creek 16 Engraving Site: the proposed infrastructure works is situated to the north and upstream of this site).

From an archaeological perspective the Bowmans Creek terraces have recently been assessed as having moderate archaeological significance (Umwelt 2010). However, the exact location of the proposed works is in an area of generally high prior disturbance that may lower the archaeological values of the portion of Bowmans Creek within the infrastructure impact footprint.

PREDICTIVE MODEL FOR SITE LOCATION WITHIN THE PROPOSED PROJECT AREA

Despite the fact that a large portion of the Project Area has been surveyed for many earlier assessments there are still some portions of the proposed Project surface disturbance area that have not been surveyed previously, or have only been subject to limited survey.

Thus there is the likelihood that a number of additional Aboriginal archaeological sites will be located during further survey associated with the Environmental Assessment. OEH will also require resurvey of areas previously investigated (that have not been impacted by works) due to the length of time passed since the last survey (the current OEH perspective is that if the survey was undertaken prior to the June 2007 flood that the area will require resurvey as erosion instigated by the flood has been shown to have exposed many more sites). It is also probable that ongoing erosion may have exposed many sites previously not recorded in these areas.

Utilising the known locations of sites within the Project Area and its locale, its environmental context and impacts of historic land-use it can be predicted that:

- artefact scatters and isolated find sites will be located within landforms of gentle gradient associated with the main channels of the creeks as these are likely to have been attractive camping areas. Smaller sites containing low density and low

complexity assemblages are predicted near semi-permanent watercourses (Bettys Creek), while the more permanent nature of Bowmans Creek suggests that this creek may have been the focus of more intensive (longer duration) camping which would have produced larger sites with higher density and more complex assemblages;

- moderate to steeply sloping areas are unlikely to have been utilised by Aboriginal people for camping and that their use would have been generally transient in nature and therefore, would not result in the discard of large amounts of cultural heritage material making their use harder to discern archaeologically and sites less likely;
- low gradient ridge crests and spur crests would have been attractive as an area for camping when an extensive outlook was required. The lack of water in these elevated areas would suggest, however, that camping would only have been short term and that sites would be smaller and contain low density and low complexity assemblages;
- location of scarred trees is unlikely due to high levels of tree clearance;
- possibility of locating grinding grooves or further engravings is limited due to the general lack of outcropping sandstone in the creek lines in the proposed Project surface disturbance area;
- land-use practices during the modern period in the proposed Project surface disturbance area will have resulted in the loss of much of the topsoil on the crests and slopes and thus acted to expose sites/destroy sites/redistribute artefacts from sites downslope. Creek bank erosion may also have acted to expose/destroy sites while migration of the creeks across their floodplains may also have acted in this manner; and
- alluvial deposition on floodplains and terraces may have acted to bury and preserve sites. Older terraces may have the potential to contain sites of antiquity.

PROPOSED ABORIGINAL HERITAGE SURVEY METHODOLOGY

Umwelt has been engaged to prepare the required Environmental Impact Statement (EIS) for the proposed Project, OzArk Environmental and Heritage Management (OzArk) has been engaged to undertake the archaeological assessment and Connect for Effect has been engaged to undertake the Aboriginal community consultation and cultural values assessment.

Please note the following methods relate specifically to the archaeological investigation of the Project Area. More general cultural values of the area will be the subject of the consultation being undertaken by Connect for Effect.

THE PROJECT AREA

The proposed Project's impact footprint is shown in **Figure 2**. Some of this area has already undergone archaeological assessment in the past, and many of the previously recorded sites have already had Section 90 impact permits enacted over them (see **Section 2.2.2**). Conversely, a portion of the Project Area (Mt Owen SE Continuation area) has never been the

subject of any archaeological assessment in the past. The methods for surveying previously assessed areas versus those never assessed, will differ slightly.

ARCHAEOLOGICAL ASSESSMENT

The following archaeological methodology is based on the understanding that portions of the Project Area have been previously surveyed and, in some areas, salvaged as a result of past archaeological assessments and works related to mining approvals. There is, therefore, significant knowledge about the location and likelihood of further unidentified Aboriginal objects or sites in many of these previously surveyed areas. As such, from an archaeological perspective, the appropriate survey level is lower in these assessed areas than may be the case in less studied areas.

In general, this archaeological assessment will evaluate the archaeological potential of landforms within the proposed Project footprint, attempt to reassess any previously recorded sites that are thought to remain intact within the proposed Project footprint and record any previously unrecorded Aboriginal sites that may be recorded as a result of the survey.

The results of the archaeological assessment will enable a determination of the archaeological significance of various areas and/or sites within the proposed Project footprint.

The archaeological assessment report will also include recommendations for future archaeological management of areas and/or sites within the proposed Project footprint. These recommendations will be based on both the assessed archaeological significance of an area, as well as from information and suggestions gained through discussions that will be held in the field on an on-going basis with all RAP representatives present on the survey.

CULTURAL VALUES ASSESSMENT

The separate cultural values assessment will assess the cultural/social and historic values of various areas and/or sites within the proposed Project footprint.

The cultural values assessment, in conjunction with the archaeological assessment, will allow the full assessment of the cultural/social, archaeological, aesthetic and historic values of various areas and/or sites within the proposed Project footprint.

METHODOLOGY FOR THE ARCHAEOLOGICAL ASSESSMENT

The archaeological methods employed for the proposed Project survey and reporting will follow the DECCW 2010 *Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW* and the OEH 2011 *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW*.

Field Assessment

The field assessment will be undertaken over the entire disturbance footprint as shown in **Figure 2**. This assessment will include a buffer of at least 50m around the outside of the proposed Project disturbance footprint (where possible and warranted) and will include the re-visiting and re-recording of any previously recorded sites within 100m of the Project boundary to ensure that the site does not extend into areas where proposed impacts are to occur.

It is envisioned that fieldwork for the survey would commence in November 2012. It is estimated that there will be approximately two weeks of field survey.

The survey will take the form of pedestrian transects and will cover the entire disturbance footprint. This includes areas that are previously unassessed (such as the Mt Owen SE Continuation area) and areas with potentially high potential archaeological values (such as the in the vicinity of the BCHMA and Bowmans Creek). This intensive survey coverage will include:

- Pedestrian field survey to identify and record any Aboriginal archaeological sites within the landscape, and to record any areas that may have potential to have subsurface Aboriginal artefacts present.
- In the Mt Owen SE Continuation area field survey will, wherever possible, be conducted in transects of 50 metre intervals (with up to ten recorders spaced five metres apart). If field conditions do not allow straight transects some areas may be investigated more opportunistically where exposures and/or vegetation allow. This will be to assess this previously unassessed area in detail.
- In the vicinity of the BCHMA, the study area is relatively narrow and the entire width of the disturbance footprint will be subject to pedestrian survey. Areas of disturbance would be assessed in less detail.
- As the survey area at Bowman's Creek is relatively small, the whole area will be able to be fully surveyed.
- If areas have significant levels of ground cover and pedestrian survey is considered by the archaeologist and RAP representatives to yield no results, then assessment will be made, based in part on knowledge gained from past archaeological research in the area, of the potential of the area to have Aboriginal artefacts present.

General

The archaeological assessment will form part of Stage 3 (*Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010*; DECCW 2010) of the consultation process. Prior to field work commencing, all RAPs will have been informed about the Project and will have had the opportunity to comment on a draft of this survey methodology. Any preliminary cultural values that may be provided by RAPs that may affect the running of this methodology will be incorporated into the final draft of this document.

All field assessment will include archaeologists from OzArk and RAP representatives. As the number of RAP groups is quite high, participation in the field survey is likely to be managed by a roster. It is understood that Mt Owen will manage the survey attendance roster directly.

Mt Owen and Xstrata in general have many OH&S conditions relevant to contractors undertaking work on their site. All representatives of registered stakeholder groups taking part in the field surveys will be subject to the same site requirements as other contractors on site and a precondition of survey participation is meeting any site specific Mt Owen requirements.

Survey team numbers and logistics will to be determined through discussion with RAPs but total team size is not expected to exceed 15 persons.

Preliminary discussions will be held during each field survey day regarding the day's findings, including any specific identified cultural values. Discussions will also canvas the possible significance and management of Aboriginal heritage sites recorded and culturally acceptable mitigation measures that might be considered.

Records of sites identified and the outcomes of cultural heritage discussions in the field will be recorded in writing and circulated to all registered stakeholder groups within 5 working days following the completion of each week's survey work.

Post- field assessment

After survey all registered Aboriginal parties will be invited to an Aboriginal Focus Group Meeting (AFGM) at which the results of the survey will be presented. A site visit to some of the recorded sites may be necessary as not all sites will have been seen by all stakeholders.

Discussion will then follow regarding the significance of the recorded archaeological sites and the implications of impact and possible management measures / solutions.

Draft report and its finalisation

OzArk will prepare a draft report based on the results of the field survey and the meeting regarding sites and management.

Each RAP will be invited to review this draft report and provide comment within a given time frame and feedback will be included in report finalisation and provided as an appendix to the final report.

As a component of the consultation process, there will be a final AFGM held to allow all stakeholders an opportunity to discuss the draft report and any associated cultural heritage issues. It is noted, however, that by the stage the draft report is prepared, it is likely to contain a lot of material generated by the RAPs in regards to cultural values and the significance of sites as a result of the prior meetings and consultation undertaken by Connect for Effect.

A copy of the final report, or advice of its availability, will be provided to each RAP prior to the Proponent submitting it to the relevant authorities.

Conclusion

We look forward to working together with you in undertaking this Aboriginal archaeological investigation. Please note that information regarding cultural values / significance is welcome and indeed invited from representatives at any stage of the Project.

It is our intention to identify any protocols that the RAPs wish to be adopted into the information gathering process and assessment methodology and any matters such as issues/areas of cultural significance that might affect, inform or refine the assessment methodology. Comments can be provided in writing, or may be sought verbally by the Project (through Connect for Effect) and accurately recorded.

The OzArk Project Manager for this Project is Senior Archaeologist, Ben Churcher. If you have any specific issues regarding development throughout the archaeological assessment period feel free to contact Ben or any other member of the Project team directly. Ben can be contacted at ben@ozarkehm.com.au.

REFERENCES

- | | |
|-------------|--|
| ERM 1995 | ERM Mitchell McCotter Pty Limited. <i>Mount Owen Rail Project, Statement of Environmental Effects (SEE)</i> . Report prepared for BHP Australia Coal. |
| Umwelt 2008 | Umwelt (Australia) Pty Limited. <i>Research Design and Methodology to Accompany a Section 87 and Section 90 Consent Application for Aboriginal Sites within the Liddell Colliery Development Consent Area</i> . A report prepared for Liddell Coal Operations Pty Limited. |
| Umwelt 2010 | Umwelt (Australia) Pty Limited. <i>Aboriginal Heritage and Archaeological Assessment Report, Ravensworth Project</i> . A report prepared for Ravensworth Operations Pty Limited. |

APPENDIX 2: MOUNT OWEN CONTINUED OPERATIONS SURVEY SUMMARIES

The following summary was sent to all RAPs in 2012 following the initial 10 days of survey.

MT OWEN CONTINUED OPERATIONS (MOCO)

Archaeological Survey

This document is to inform all Registered Aboriginal Parties (RAPs) of the progress of the archaeological fieldwork component of the MOCO Project. This document presents preliminary results although full information and discussion will be contained in the forthcoming *Aboriginal Archaeological Values Report* that will be produced in conjunction with the *Aboriginal Cultural Heritage Assessment*.

Introduction

At this stage, all archaeological survey of the Project Area is completed. The survey occurred over two weeks (10 days: 26 November to 30 November and 3 December to 7 December 2012).

Each day's survey crew comprised of up to 12 RAP representatives, two archaeologists from OzArk (Ben Churcher and Joshua Noyer) and Gary Bernasconi (XCN) who was an invaluable guide and provider of shelter, toilets and water. The perimeter of the Disturbance Area had been pegged out and the survey usually consisted of the group conducting a linear transect of a landform across an area of up to 150m across.

Landscape Context

The majority of the Disturbance Area is located on sloping or elevated landforms that are at a distance from reliable water (**Plates 1 and 2**). Such landforms have historically contained low site numbers with sites either consisting of low density artefact scatters or isolated finds.

At one instance, the Disturbance Area crosses Bowman's Creek which has the most reliable water in the Disturbance Area (**Figure 1**). The area of impact to the creek's banks is limited and in an area where there is generally high disturbance from roads, tracks, electricity and Telstra easements and past agricultural land use.

The Disturbance Area also crosses Bettys Creek and includes a longer linear area running parallel, although away from, the creek's banks. Parts of this area have been subject to archaeological salvage in the past and today the area is characterised as flat land with thin A Horizon soils now extensively overgrown, for the most part, by recent *Casuarina* regrowth. Some areas in the north in the vicinity of Betty Creek are open paddocks. Bettys Creek, at the time of the survey, was dry and without ponds. The morphology of the creek suggests that it would rarely contain reliable water (**Plates 3 and 4**).

The only other drainage line of note is located in the very east of the Disturbance Area and consists of an ephemeral creek with sizeable areas of gully erosion (the eastern drainage). No water was in the eastern drainage at the time of the survey and although eroded, the morphology of the system, as well as its limited catchment, suggest that it now would only carry run-off water.

However, there are several benches in this drainage system that have since been utilised by farmers who have excavated farm dams at these locations. It is possible that these bench areas once contained ponds/swamps that have since been drained by gully erosion and subsequent dam construction. This creek is a tributary to Main Creek that lies to the east of the Disturbance Area.

In general, across the surveyed areas, ground surface visibility was extremely low. In areas away from water the visibility was obstructed by thick grass cover as most of the survey area was open paddocks. In areas away from water where there was tree cover, thick mats of dead leaves covered the ground. In areas closer to drainage lines the ground surface was either obscured by grass (as the areas were paddocks) or thick layers of *Casuarina* needles (in regenerating areas). Exposure incidence was also very low across the Disturbance Area and extensive erosion scalds were confined to the eastern drainage system (associated with Main Creek noted above).

While current erosion is rare within the Disturbance Area, the historic effects of erosion, principally, sheet wash, were noticeable in the very thin A Horizon soils noted across the Disturbance Area. Soils ranged from skeletal on the slopes and elevated landforms to thin along Betty Creek (old archaeological excavations adjacent to the creek that are still extant showed less than 10cm of A Horizon soils remaining). The exceptions are the floodplains at Bowmans Creek and Main Creek that are included in the Disturbance Area. A linear, approximately 100m wide, disturbance corridor is proposed for the Bowmans Creek floodplain and only a small portion (1 to 2ha?) of the Main Creek floodplain is included in the Disturbance Area. Floodplains such as these are likely to have deeper soils and a series of test excavation trenches by Umwelt have been excavated across the Bowmans Creek floodplain and yielded deep soils, although no artefacts (Allen Paget, Ungooroo Aboriginal Corporation, *pers. comm.*).

The Disturbance Area has also been disturbed by past agricultural land use and current approved mining activities. The entire Disturbance Area would have once been largely cleared and very few mature trees were noted during the assessment. In addition dwellings, tracks, dams and fences have been constructed and in the east relatively extensive contour dykes were noted (constructed by Soil Conservation?). These have had the effect of disturbing localised areas while the general use of the land for grazing has promoted sheet wash erosion and soil loss. Disturbances from approved mining activities mostly have to do with the workings of the underground Integra mine that underlies much of the eastern portion of the Disturbance Area and exploratory drilling for the current Project. These approved disturbances include track grading, pad clearance and sump digging. At several places permanent, smaller pieces of infrastructure (gas testing stations?) are located, often protected by two telegraph poles containing lightening conductors.

Survey Results

As a consequence of the types of landforms within the Disturbance Area and the degree of past disturbance, very few sites were recorded during the survey.

Eastern Areas

In the sloping and elevated landforms to the east, a number of isolated finds were recorded in landforms with thin A Horizon soils and a high likelihood that there are no associated archaeological deposits. Only two low density artefact scatters were recorded in association to drainage features in the east of the Disturbance Area. The first was up to 20 artefacts recorded in an eroded section of the eastern drainage (tributary to Main Creek; **Plates 5 and 6**) and the second was along the spoil heap created during the construction of the Bettys Creek diversion channel (obviously the artefacts in this modified landform are not in direct association to Betty Creek but appear to represent artefacts originating in the flat landform surrounding Bettys Creek; **Plates 7 and 8**). A third artefact scatter consisting of around six artefacts was recorded at the location of a former archaeological salvage programme (grader scrapes at sites #37-3-0636 and #37-3-0649) that is located on a low rise above an area that would have once supported swamp vegetation **Plates 9 and 10**.

In the eastern portion of the Disturbance Area, two possible resource trees dating to post-1788 were recorded **Plates 11 and 12**. These 'honey trees' used steel axes to extract honey (?) from the tree possibly indicating a post-contact Aboriginal origin.

The low site recording in the eastern portion of the Disturbance Area could be attributable to the generally low ground surface visibility noted above, however, it is the assessment here that it is a true reflection of the generally lower density sites in this area. The majority of the landforms in the Eastern Area are slope or elevated landforms distant from reliable water: landforms that are usually associated in the upper Hunter Valley with sites displaying low artefact densities, small site size and low site complexity. The few drainage features in this area did record a low density of artefacts associated with them but as all drainage systems in this area have unreliable water they have not encouraged more intense occupation.

Bettys Creek Area

Only isolated finds were recorded in this area although two low density artefact scatters have been previously recorded in association to Bettys Creek in this area.

There are several reasons for the lack of sites in this area: the major one being that the Disturbance Area only includes small portions of the actual banks of Bettys Creek but instead includes areas of the flat landscape adjacent to the creek. As noted above, this area is characterised by thin A Horizon soils and recent *Casuarina* regrowth. This indicates that the

whole area, until recently, has been cleared and erosion over the years has removed a lot of the A Horizon soils levels. A relatively recent by Umwelt was conducted on the eastern bank of Bettys Creek directly in the middle of the Disturbance Area footprint in this area (salvage at site #37-3-0600). The sides of the trenches remain defined and it was clear that less than 10cm of A Horizon soil exists above the basal clays in this area. Following assessment, this same amount of soil depth is expected across Disturbance Area in the Bettys Creek area.

The previously recorded sites (located on the bank of Bettys Creek) indicate that sites exist in the area but a combination of past erosion and the location of the Disturbance Area away from the creeks banks mean that the probability of recording sites in this area is diminished. In addition, as noted above, Bettys Creek is not a reliable water source (certainly not now and from the creek's morphology, probably not pre-mining either) and low site densities could be expected (**Plates 13 and 14**).

Bowmans Creek

Only a small portion of bank, floodplain and associated lower slopes was assessed as the Disturbance Area is limited in this area. No artefacts were recorded on the floodplain but a number of isolated finds were recorded on the lower slopes on both the eastern and western sides of the drainage (**Plates 15 and 16**).

This would accord with the general site distribution recorded in this area namely that the drainage itself and its floodplain have poor conditions for the preservation of archaeological sites while evidence of occupation is mostly located on the lower slopes where sites may be preserved beyond the range of most flood events.

Conclusion

The assessment successfully completed its major aim which was to intensively assess all portions of the Disturbance Area.

The results obtained by the assessment accord with predictions based on previous archaeological work in the area and an assessment of the landforms within the Disturbance Area and their proximity to reliable water.

The low number of sites recorded is directly associated to the type of landforms within the assessment area, the lack of reliable water within the assessment area and the level of prior disturbance to those landforms both from past agricultural use as well as the current mining use.

OzArk would like to thank all participants in the archaeological assessment. The survey coincided with some very hot weather and for much of the assessment area there was little shade. Even though the conditions were trying, the survey progressed efficiently and professionally due to the efforts of all involved.

Ben Churcher. Senior Archaeologist. December 2012

PLATES AND FIGURES



PLATE 1. VIEW OF A RIDGE LINE IN THE EASTERN PORTION OF THE PROPOSED DISTURBANCE AREA LOOKING BACK TOWARDS THE CURRENT MOUNT OWEN PIT.



PLATE 2. TYPICAL LANDFORMS IN OTHER AREAS IN THE EASTERN PORTION OF THE PROPOSED DISTURBANCE AREA. ALL VISIBLE TREES ARE REGENERATION OR REGROWTH.



PLATE 3. VIEW OF BETTYS CREEK WITHIN THE DISTURBANCE AREA AT THE TIME OF SURVEY.



PLATE 4. TYPICAL LANDFORM SURROUNDING BETTYS CREEK WITHIN THE PROPOSED DISTURBANCE AREA.



PLATE 5. VIEW OF EROSION SCALD ALONG THE EASTERN DRAINAGE THAT FLOWS INTO MAIN CREEK.



PLATE 6. RANGE OF ARTEFACTS RECORDED ALONG THE EASTERN DRAINAGE.



PLATE 7. VIEW OF THE SPOIL HEAP CREATED DURING THE CONSTRUCTION OF THE BETTYS CREEK DIVERSION CHANNEL WHERE ARTEFACTS WERE RECORDED (PINK FLAGS).



PLATE 8. BACKED MUDSTONE BLADE LOCATED ON THE SPOIL HEAP FROM THE BETTYS CREEK DIVERSION CHANNEL.



PLATE 9. VIEW OF THE PREVIOUSLY SALVAGED SITES #37-3-0636 AND #37-3-0649 IN THE EASTERN PORTION OF THE PROPOSED DISTURBANCE AREA.



PLATE 10. RETOUCHE FLAKE FROM SITES #37-3-0636 AND #37-3-0649.



PLATE 11. VIEW OF A POSSIBLE ABORIGINAL RESOURCE TREE (POST-CONTACT).



PLATE 12. VIEW OF A POSSIBLE ABORIGINAL RESOURCE TREE (POST-CONTACT).



PLATE 13. VIEW OF AN ARTEFACT RECORDED IN THE BETTYS CREEK AREA.



PLATE 14. VIEW OF POSSIBLE KNAPPED GLASS FROM THE BETTYS CREEK AREA.



PLATE 15. LOCATION OF AN ISOLATED FIND ON THE LOWER SLOPES ABOVE BOWMANS CREEK (IN BACKGROUND).



PLATE 16. VIEW OF A BANDED MUDSTONE FLAKE FROM THE BOWMANS CREEK AREA.

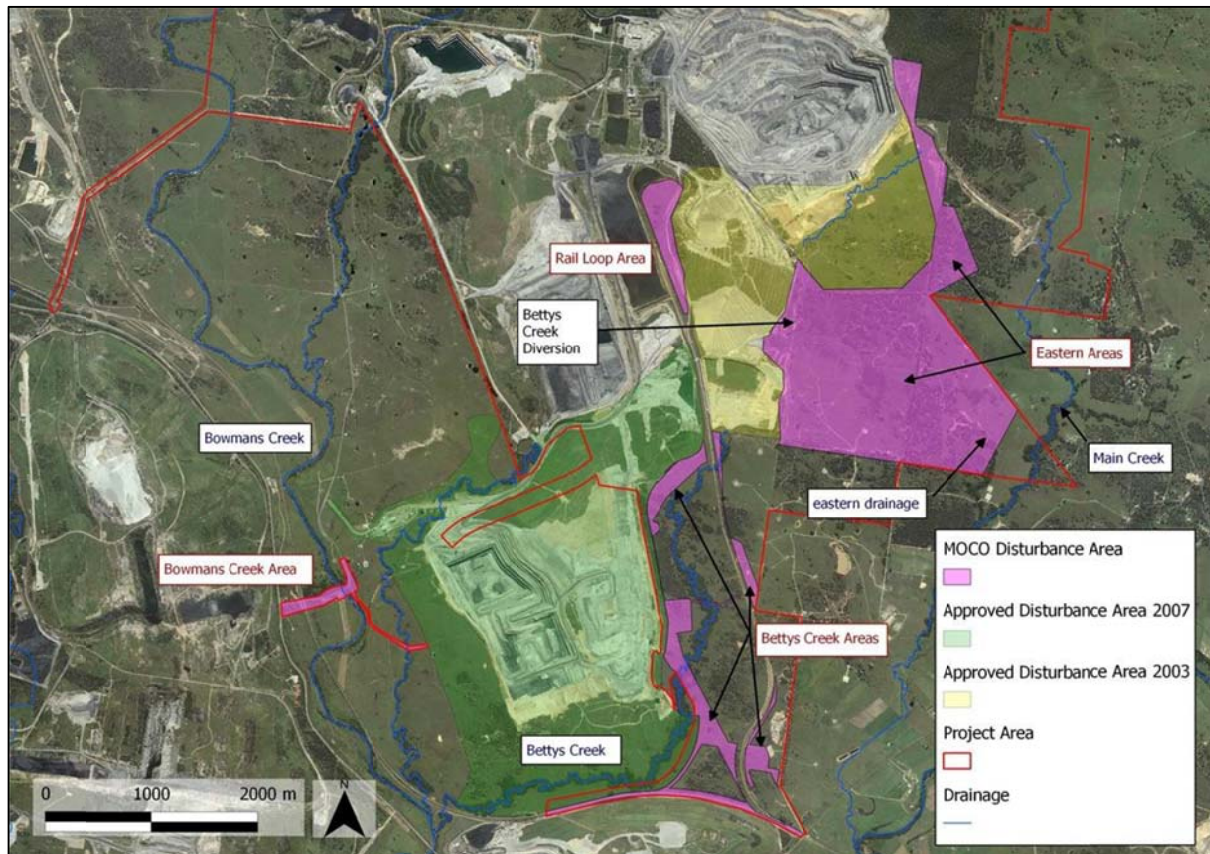


Figure 1: Proposed Disturbance Area (subject to archaeological survey)⁶.

⁶ Figure as sent to RAPs in December 2012. Current Project Area and Proposed Disturbance Area differ from that shown here.

The following summary was sent to all RAPs in 2014 following a further 1 day of survey in April 2014.



A VIEW OF THE NORTH PIT EXTENDED STUDY AREA.

ABORIGINAL ARCHAEOLOGICAL ASSESSMENT

MOUNT OWEN CONTINUED OPERATIONS PROJECT PROPOSED NORTH PIT EXTENDED AND DETENTION BASIN STUDY AREAS

SUMMARY OF FINDINGS

AUTHOR: BEN CHURCHER

MAY 2014



**Environmental and
Heritage Management P/L**

OzArk EHM

145 Wingewarra St
(PO Box 2069)
Dubbo NSW 2830

Phone: (02) 6882 0118

Fax: (02) 6882 0630

jodie@ozarkehm.com.au

phil@ozarkehm.com.au

www.ozarkehm.com.au

Background

This summary report has been prepared to inform the Registered Aboriginal Parties (RAPs) of the findings arising from an additional survey that was completed for the Mount Owen Continued Operations Project (the Project).

During 2013, an Aboriginal Cultural Heritage Assessment (ACHA) was undertaken by Mount Owen Pty Ltd (Mount Owen) and Australian Cultural Heritage Management Pty Ltd (ACHM) in collaboration with the Project's RAPs to assess the Aboriginal cultural heritage values of the proposed Project.

OzArk Environmental also prepared an Aboriginal Archaeological Values Assessment (November 2013) to assess the scientific (archaeological) value, and provide management recommendations for, identified and potential Aboriginal sites within the Project Disturbance Area.

These reports were provided to the RAPs as a Draft Report for 28 days of review and comment prior to the finalisation of the ACHA in November 2013 and subsequently incorporated into the Project's EIS. The EIS was submitted to the Department of Planning and Environment (DP&E), (formerly the Department of Planning and Infrastructure (DP&I)) for adequacy review in December 2013.

Mount Owen Pty Limited (Mount Owen) plans to revise the current Project EIS to include mining of the Bayswater North Pit (BNP), at the Ravensworth East mine, and other minor amendments including additional disturbance for a minor extension of the North Pit shell and an allowance for a detention basin (if required) (**Figure 1**).

The data within this summary will be incorporated into the Archaeological Values Assessment (November 2013) which will accompany the revised EIS when it is re-submitted.

This summary of the additional assessment will be sent to all RAPs to inform them of the findings and to provide RAPs the opportunity, if they wish, to comment on the findings or recommendations contained in this document that pertain to the most recent assessment. The revised Archaeological Values Assessment report will contain no new additions other than what is presented in this document.

To avoid unnecessary duplication, the full version of the revised Archaeological Values Assessment will not be re-sent to RAPs as it will be, in the majority, identical to the report RAPs have already received. Notwithstanding, Mount Owen will provide the relevant sections/pages of the Archaeological Values Assessment that have changed for the RAPs to review.

Proposed new Disturbance Areas

The works associated with BNP will impact areas that are located in areas previously approved for mining and further archaeological investigation is unwarranted within this area.

The project Disturbance Area will increase by approximately 21ha in the south east of the Disturbance Area associated with the North Pit that was subject to the Archaeological Values Assessment (November 2013). This area was previously unassessed for archaeological values in the 2012/2013 surveys and so is included in the current assessment (North Pit Extended Study Area; **Figure 1**).

A small area of additional disturbance may be required to the north of the existing Disturbance Area associated with the North Pit, in the vicinity of the Orica explosives facility. This area is being considered for a potential detention basin (dam) and this area was also assessed to identify any Aboriginal heritage constraints (Detention Basin Study Area; **Figure 1**).

Figure 1: Location of the North Pit Extended Study Area and the Detention Basin Study Area



The Study Areas

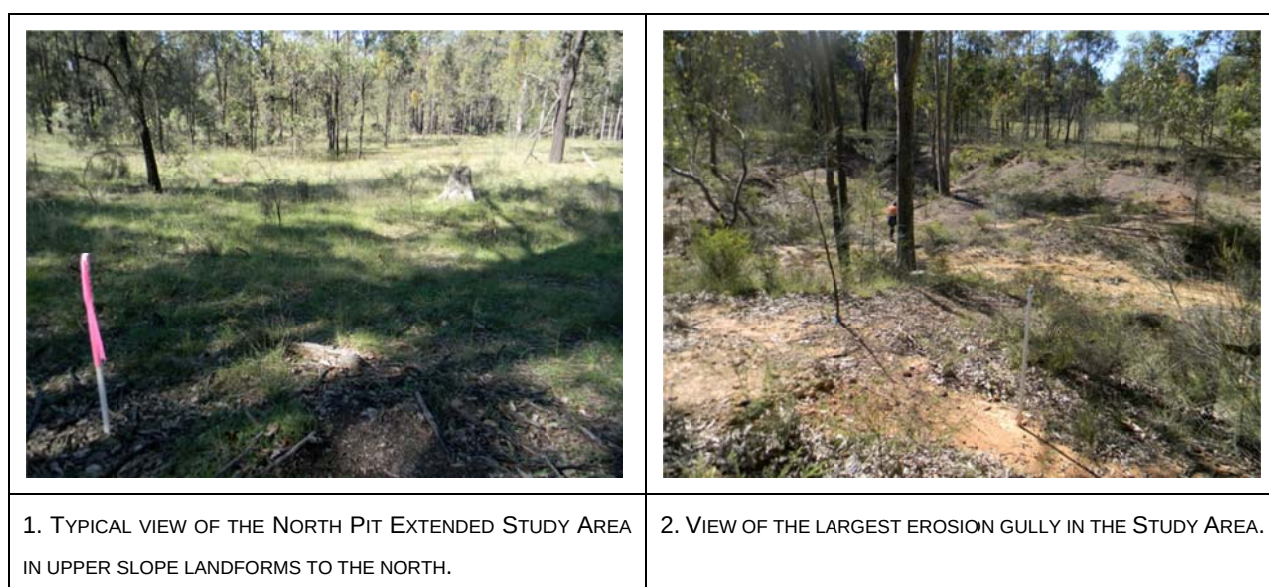
The areas subject to Aboriginal heritage assessment were limited to a 21ha area to the east (North Pit Extended Study Area) and a 10.7ha area in the north (Detention Basin Study Area). All other areas affected by the revised Disturbance Area are either in heavily modified landforms or in areas where archaeological salvage has already taken place in the past.

North Pit Extended Study Area

The Study Area consists of upper, mid and lower slopes on the eastern side of a ridge that divides the Bettys Creek catchment to the west from that of Main Creek to the east. The Study Area contains moderate to gentle slopes in landforms that have been completely cleared of tree cover in the past. Currently, approximately 25% of the area consists of cleared paddocks, while the remainder is regenerating Ironbark or Spotted Gum woodland (**Figure 2. 1**).

There are no permanent water sources within the Study Area, and while there are some sizeable erosion gullies, these would only carry water following rain (**Figure 2. 2**).

Figure 2: Environment of the North Pit Extended Study Area.



Detention Basin Study Area

The Study Area occupies lower slopes in an area that has largely been cleared of trees, although a few isolated trees remain particularly in the east and north of the Study Area (**Figure 3. 1**).

The Study Area consists of a shallow valley that currently has water running through it at times of rain. However there is no evidence that the area contained permanent water in the form of a waterway, or even a swamp, prior to changes in local hydrology brought about by the nearby mine dump area. An 80m long and 30m wide erosion scald is located in the centre of the Study Area (**Figure 3.2**). The erosion has removed the A Horizon soils from within this area.

Figure 3: Environment of the Detention Basin Study Area.

Archaeological background

North Pit Extended Study Area

The 2012/2013 archaeological investigation for the Mount Owen Continued Operations Disturbance Area included contiguous landforms on the western slope of the ridge on which, the current Study Area is located, albeit on the eastern slopes. During the earlier assessment, one very low density artefact scatter was recorded at the base of the western slope (MOCO OS-2) and three isolated finds (MOCO IF-1 to 3) were recorded further north along the same ridge occupied by the current Study Area (**Figure 4**). Two further sites, 37-3-0655 and 37-3-0656, have also been recorded on the lower western slopes of the ridge, although both these sites have been salvaged in the past.

No sites were recorded during the earlier assessment on the slopes or crest of the ridge in the immediate vicinity of the Study Area and no sites have been previously recorded within the Study Area.

Detention Basin Study Area

Landforms contiguous with this Study Area did not form part of the earlier Mount Owen Continued Operations archaeological assessment.

One previously recorded site, 37-3-0350, is located within the Study Area (see **Figure 11**). Site 37-3-0350 is an artefact scatter consisting of four artefacts in a 30m by 30m area.

Figure 4: The North Pit Extended Study Area and previously recorded sites.



Survey Method and Constraints

The survey of both Study Areas was undertaken by Ben Churcher (Senior Archaeologist) and Jennifer Bertolani (Archaeologist) (OzArk Environmental & Heritage Management Pty Limited), eight Registered Aboriginal Parties (RAPs), or their representatives, and Gary Bernasconi (Mount Owen). The survey took place on Tuesday 29 April 2014.

Both Study Areas were surveyed by full pedestrian survey and this was aided by their relatively small size. There were no constraints to the survey in terms of access, terrain or vegetation.

Ground surface visibility (GSV) was variable across both Study Areas.

In the North Pit Extended Study Area the grass cover was light and exposures were relatively frequent. Around the ephemeral drainage lines, the exposures were more extensive. In 25% of the Study Area which consisted of cleared paddocks, the GSV was lower as thick grass often obscured the ground surface.

In the Detention Basin Study Area, GSV was extremely low within cleared paddocks as thick grass cover obscured the ground surface. The only exception to this was in a series of erosion scalds in the centre of the Study Area where there was 100% visibility, albeit of basal clays rather than A Horizon soils. Areas within the open woodland portions of the Study Area generally also had low GSV although exposures were more frequent when compared to the lack of exposures in the open paddock portions.

Although low GSV was a hindrance to the archaeological survey, particularly in the Detention Basin Study Area, this was compensated for by the number of surveyors (ten), a more-intensive investigation of the available exposures and an assessment of the landforms based on past findings in the area.

In conclusion, it is considered that the Study Areas were able to be adequately assessed during the survey to enable the archaeological characteristics of each area to be determined.

Survey Results

Five isolated artefacts were recorded during the assessment: two in the North Pit Extended Study Area and three in the Detention Basin Study Area. Details concerning these sites are provided in **Table 1**.

Table 1. Sites recorded during the current assessment.

Site name	Site type	Site description	GDA Zone 56 Easting	GDA Zone 56 Northing	Study Area
MOCO IF21	Isolated artefact	Broken mudstone flake	323845	6412318	North Pit Extended
MOCO IF22	Isolated artefact	Mudstone flake with possible edge wear	323861	6411957	North Pit Extended
MOCO IF23	Isolated artefact	Mudstone flake	319809	6414557	Detention Basin

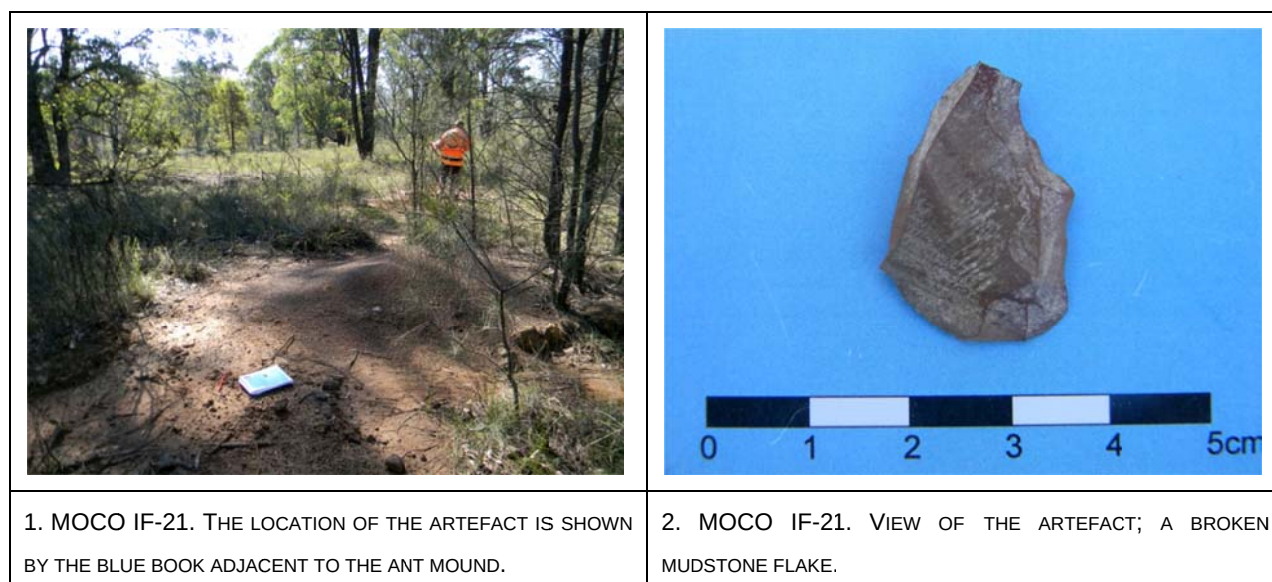
Site name	Site type	Site description	GDA Zone 56 Easting	GDA Zone 56 Northing	Study Area
MOCO IF24	Isolated artefact	Broken retouched mudstone blade	319791	6414618	Detention Basin
MOCO IF25	Isolated artefact	Broken silcrete flake	319780	6414604	Detention Basin

North Pit Extended Study Area

MOCO IF-21

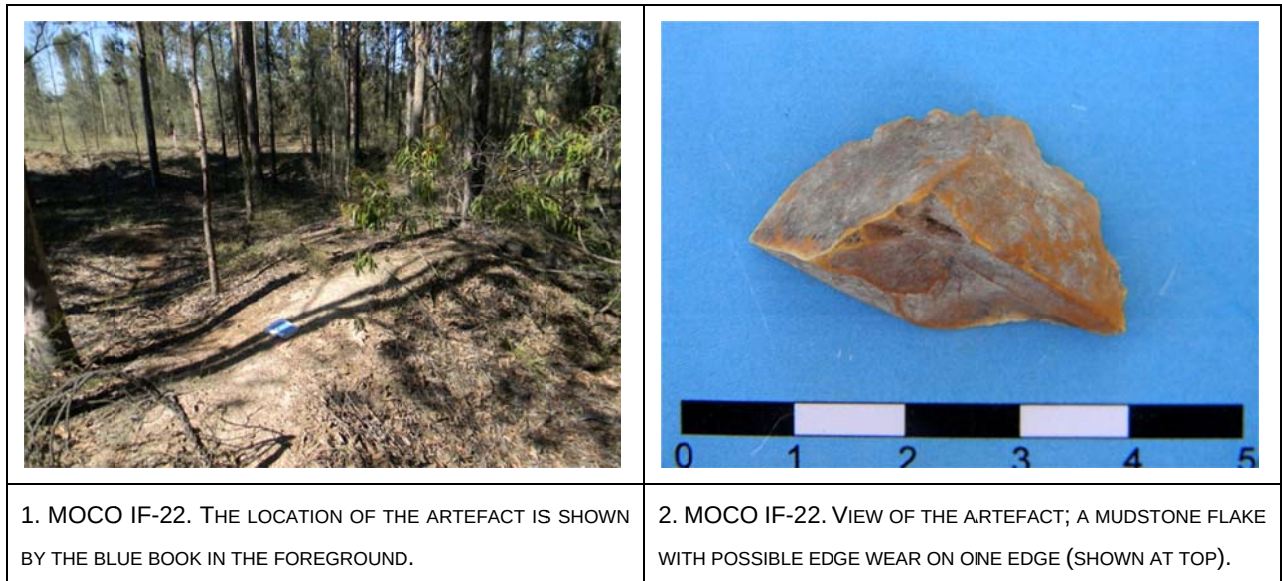
MOCO IF-21 is a broken mudstone flake that was located on an ant mound in a sloping landform that is generally overlooking an ephemeral gully (**Figure 5**). It is likely the artefact has been displaced from its original location due to bioturbation. The site is within an Ironbark woodland (**Figure 7**).

Figure 5: MOCO IF-21.



MOCO IF-22

MOCO IF-22 is a mudstone flake located on the banks of an ephemeral drainage line where there has been sheet wash erosion and soil loss (**Figure 6**). It is likely the artefact has been displaced from its original location due to erosion. The site is within a Spotted Gum woodland (**Figure 7**). The artefact displayed evidence old non-recent edge wear at the distal end.

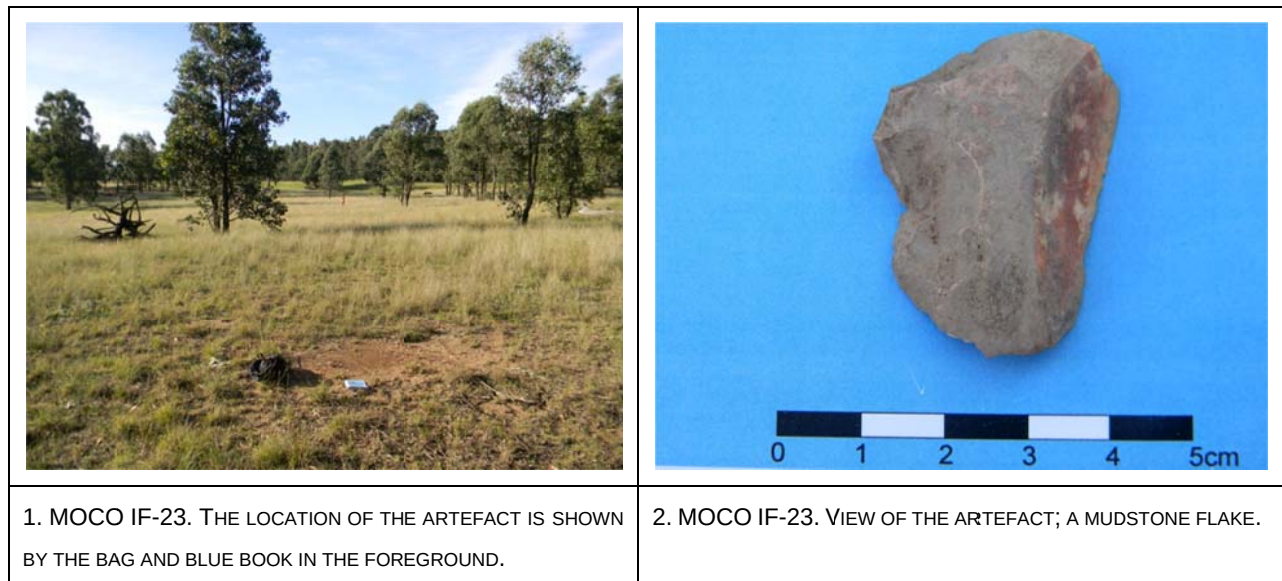
Figure 6: MOCO IF-22.**Figure 7: Location of MOCO IF-21 and MOCO IF-22.**

Detention Basin Study Area

MOCO IF-23

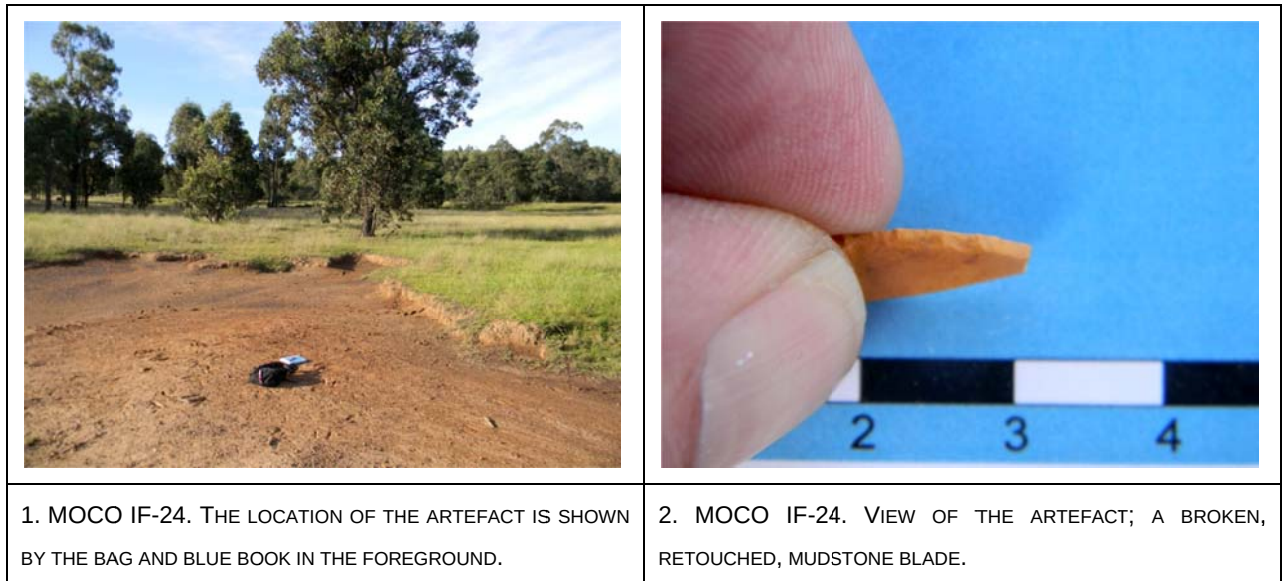
MOCO IF-23 is a mudstone flake located on the edge of open woodland in a small area of exposure (**Figure 8**). The immediate vicinity of the site has been cleared and is currently grassed (**Figure 11**). It is likely the artefact has been displaced from its original location due to vegetation removal and erosion.

Figure 8: MOCO IF-23.

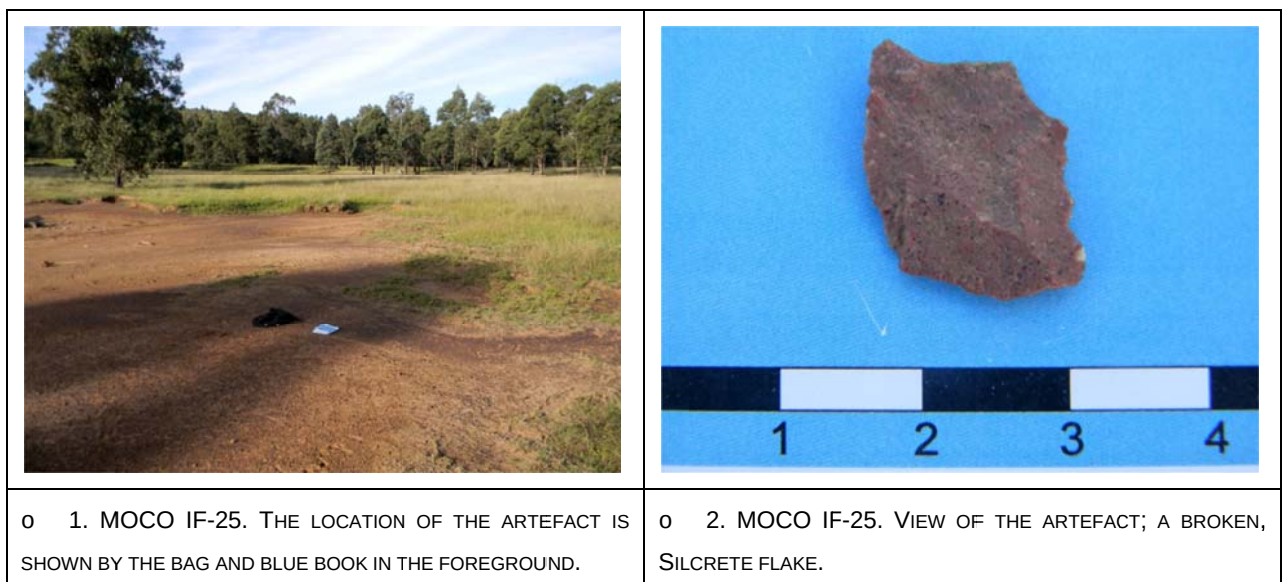


MOCO IF-24

MOCO IF-24 is a broken, retouched mudstone blade located within a large erosion scald (**Figure 9**). The artefact, of which only 1.5cm remains, displayed fine, uni-facial retouch along one lateral edge. The site is located in an area of total modification by erosion and the artefact has been definitely displaced from its original position by erosion (**Figure 11**). No evidence of further artefacts were observed eroding from the nearby bank of the erosion scald suggesting that the artefact has not come from the immediate vicinity.

Figure 9: MOCO IF-24.**MOCO IF-25**

MOCO IF-25 is a broken Silcrete flake located within a large erosion scald (**Figure 10**). The site is located in an area of total modification by erosion and the artefact has been definitely displaced from its original position by erosion (**Figure 11**). No evidence of further artefacts was observed in the area suggesting that the artefact has not come from the immediate vicinity.

Figure 10: MOCO IF-25.**37-3-0350**

The site card for 37-3-0350 records that the site consisted of four artefacts when recorded by Jill Ruig in 1996. These were two mudstone flakes (maximum dimensions: 12mm and 21mm), a flaked piece (mudstone; maximum dimension 22mm) and a volcanic axe (Maximum dimension 129mm).

The site is described as being in a cleared paddock in the footslopes above an erosion scald.

Although an effort was made to locate the site during the assessment, no artefacts were observed at the location given in the site card. It is still considered likely that this site exists however, as the area at the time of the assessment was covered in thick grass that obscured a good view of the ground surface meaning that the artefacts may have been missed. It is also entirely likely, however, that during the intervening 18 years that have passed since the original recording that these artefacts have been displaced from their recorded location by water movement on the sloping landform.

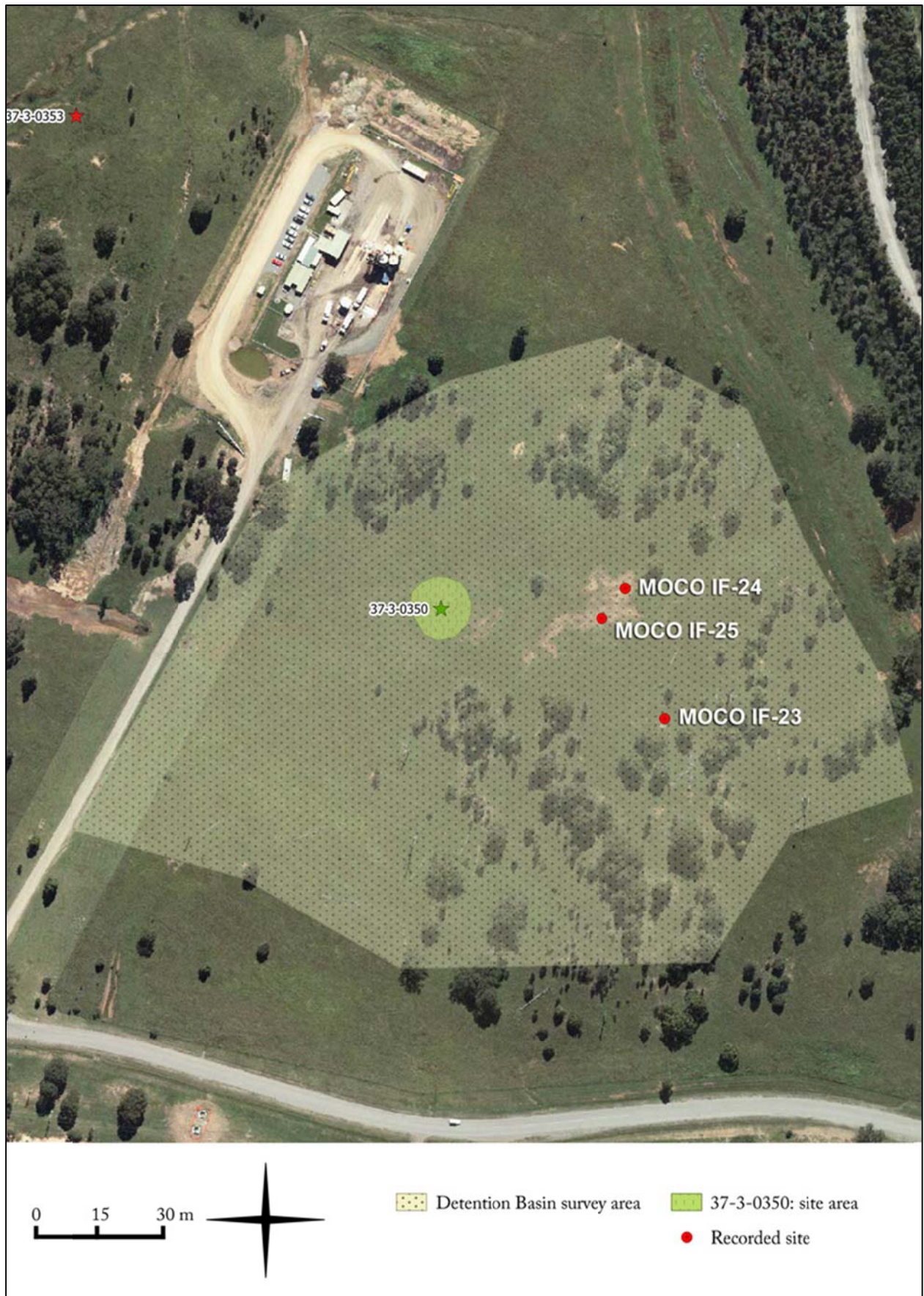
Discussion

Based on the findings from the 2012/2013 assessment for the Project and previous archaeological work that has been carried out in the area, the results of the current assessment are in accord with other findings. As neither Study Area contained areas of permanent water, and in the case of the North Pit Extended Study Area, gentle to moderate slopes, the landforms are not those where one would expect to record large and/or complex sites.

It is likely that all recorded artefacts have been displaced by erosion from their original locations, and this is definitely the case with regards to MOCO IF-24 and IF-25.

Therefore it is assessed that the recorded artefacts are not associated with further sub-surface archaeological deposits at their find location. As such, displaced artefacts such as these have a very limited capacity to contribute to the archaeological context of the area and are better described as 'background' artefacts whose original depositional location is unknown.

Figure 11: Location of MOCO IF-23, IF-24 and IF-25 and previously recorded site 37-3-0350.



Assessment of Scientific Significance

As all newly recorded sites are isolated finds without associated archaeological deposits, all sites have a limited ability to further inform about the past Aboriginal occupation of the Study Areas. As such, sites MOCO IF-21 to MOCO IF-25 are assessed as having **low scientific significance**.

This assessment of scientific significance is consistent with the level of significance afforded similar sites that were recorded as part of the 2012/2013 Mount Owen Continued Operations archaeological assessment.

In the Detention Basin Study Area, a low density artefact scatter (37-3-0350) was recorded in 1996. The site card states that the site has a '**low significance**' (V. Perry [Wonnarua Tribal Council] and T. Griffiths [Wanaruah Local Aboriginal Land Council]). Given what is now known of the Study Area, the current assessment has no reason to revise this assessment.

Management of Aboriginal cultural heritage values

North Pit Extended Study Area

Within the North Pit Extended Study Area, two isolated finds were recorded. As recommended in **Table 2**, a prudent management measure is to collect the artefacts prior to the works commencing so that they are removed from harm and the basic artefact attributes are recorded. A report of the salvage program should be produced to record these details for future research.

Table 2: Management recommendations for sites within the North Pit Extended Study Area.

Site Number	Assessed scientific significance	Degree of Harm	Comments	Management strategy
MOCO IF-21	Low	Total	Isolated find without associated deposits	Mapping, description and collection of surface artefact
MOCO IF-22	Low	Total	Isolated find without associated deposits	Mapping, description and collection of surface artefact

Detention Basin Study Area

Within the Detention Basin Study Area, three isolated finds were recorded. In addition, there is one extant, previously recorded, low density artefact scatter (37-3-0350) located within the Study Area. The precise design of the Detention Basin is, at present, not known. However, when the design plans are finalised, if any of the sites are to be impacted the management measures as recommended in **Table 3** should be undertaken and include collection of the artefacts prior to the works commencing so that they are removed from harm and the basic artefact attributes are recorded. A report of the salvage program should be produced to record these details for future research.

Table 3: Management recommendations for sites within the Detention Basin Study Area.

Site Number	Assessed scientific significance	Degree of Harm	Comments	Management strategy
MOCO IF-23	Low	Not finalised	Isolated find without associated deposits	Mapping, description and collection of surface artefact
MOCO IF-24	Low	Not finalised	Isolated find without associated deposits	Mapping, description and collection of surface artefact
MOCO IF-24	Low	Not finalised	Isolated find without associated deposits	Mapping, description and collection of surface artefact
37-3-0350	Low	Not finalised	Low density artefact scatter consisting of four artefacts	Mapping, description and collection of surface artefacts

Recommendations

The following recommendations shall be added to the already existing recommendations contained in the November 2013 Archaeological Values Assessment.

1. The information contained within the summary document will be incorporated into the November 2013 Aboriginal Archaeological Values Assessment;
2. The five newly recorded sites should be registered with the Office of the Environment and Heritage's Aboriginal Heritage Information Management System;
3. Sites MOCO IF-21 to IF-22 should be included within the salvage program for the Project;
4. Should MOCO IF-23 to IF-25 and 37-3-0350 be impacted by the final design of the Detention Basin, they should be included in the salvage program for the Project; and
5. All sites are assessed as having a low scientific significance and therefore a surface collection of artefacts is an appropriate management measure.

APPENDIX 3: MOUNT OWEN CONTINUED OPERATIONS TEST EXCAVATION METHODOLOGY



VIEW WEST TOWARDS THE EASTERN DRAINAGE IN TEST EXCAVATION AREA 2.

ARCHAEOLOGICAL TEST EXCAVATION METHODOLOGY

Mount Owen Continued Operations

Xstrata Mount Owen

February 2013

**Prepared by
OzArk Environmental and Heritage Management Pty Ltd
for Xstrata Mount Owen**



**Environmental and
Heritage Management P/L**

OzArk EHM

145 Wingewarra St
(PO Box 2069)
Dubbo NSW 2830

Phone: (02) 6882 0118

Fax: (02) 6882 0630

jodie@ozarkehm.com.au

phil@ozarkehm.com.au

www.ozarkehm.com.au

INTRODUCTION

The Mount Owen mine is in the Upper Hunter Valley of New South Wales, approximately 20km northwest of Singleton and 24km southeast of Muswellbrook. Xstrata Mount Owen (the Proponent) is currently in the process of preparing an Environmental Impact Assessment (EIS) for proposed continued operations at the Mount Owen mine (MOCO; the Project) which involves planning for ongoing open cut coal mining at the existing Mount Owen operations.

OzArk Environmental and Heritage Management (OzArk) has been engaged to undertake the archaeological assessment for the Project.

As a result of the archaeological assessment over areas that will be potentially impacted by the Project, a number of locations have been identified that require subsurface test excavations in order to determine the integrity and/or extent of sites recorded during the field assessment.

This document sets out the proposed methodology for these test excavations and follows the *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* under Part 6 *National Parks and Wildlife Act 1974* (NPW Act; the Code).

The Code lists a number of requirements pertaining to test excavation. These requirements are enumerated below and further information pertaining to these requirements follow in subsequent sections of this document.

Requirement 14 (Test excavation which is not excluded from the definition of harm):

Sub-surface investigation will not be excluded from harm where they are carried out in the following areas:

- in or within 50m of an area where burial sites are known or are likely to exist
- in or within 50m of a declared Aboriginal place
- in or within 50m of a rock shelter, shell midden or earth mound
- in areas known or suspected to be Aboriginal missions or previous Aboriginal reserves or institutes
- in areas known or suspected to be conflict or contact sites.
 - o None of the test excavation locations are known to be located within the vicinity of the items listed under Requirement 14 of the Code.

Requirement 15a (Consultation): As the proposed archaeological test excavation programme is part of the Project, consultation has been ongoing with the Registered Aboriginal Parties (RAPs) and has been completed to the stage described in subclause 80C (6) of the *National Parks and Wildlife Regulation 2009* (NPW Regulation).

Requirement 15b (Test excavation sampling strategy): This document sets out the proposed sampling strategy for the test excavation programme.

Requirement 15c (Notification):

- the location of the proposed test excavation and the subject *area*.
 - o This document sets out the proposed location of the test excavation programme.
- the name and contact details of the legal entity with overall responsibility for the project.
 - o Xstrata Mount Owen, Singleton NSW, 2330
- the name and contact details of the person who will be carrying out the test excavations where this is different to the legal entity with overall responsibility for the project.
 - o OzArk Environmental and Heritage Management, 145 Wingewarra St, DUBBO, NSW, 2830
- the proposed date of commencement, and estimated date of completion, of the test excavations.
 - o Anticipated Commencement: early March 2013

Anticipated Completion: early March 2013

Weather permitting, the projected date for the excavations are for one week: 11 March to 15 March 2013.
- the location of the temporary storage location for any Aboriginal objects uncovered during the test excavations.
 - o Aboriginal objects recovered during the excavations will be temporarily housed in a locked container at 21 Agnes Ave, CRESTWOOD, NSW, 2620 (OzArk branch office) as the objects undergo analysis. Following analysis they will be stored in a locked container at Xstrata Mount Owen until such times as a Care and Control agreement is reached by all RAPs.

Requirement 16a (Test Excavation): The test excavation programme will adhere to Requirement of 16a as set out in this document (see **Section 4.3**).

Requirement 16b (Objects recovered during test excavations): Aboriginal objects recovered during the excavations will be temporarily housed in a locked container at 21 Agnes Ave, CRESTWOOD, NSW, 2620 (OzArk branch office) as the objects undergo analysis. Following analysis they will be stored in a locked container at Xstrata Mount Owen until such times as a Care and Control agreement is reached by all RAPs.

Requirement 17 (When to stop test excavations): the test excavation programme will adhere to the requirements set out in the Code: Any test excavation carried out under this requirement will cease when suspected human remains area encountered; or when enough information has been recovered to adequately characterise the objects present with regard to their nature and significance.

The test excavation methodology for the Project was written by Ben Churcher (Senior Archaeologist, OzArk EHM)

THE IMPACT FOOTPRINT

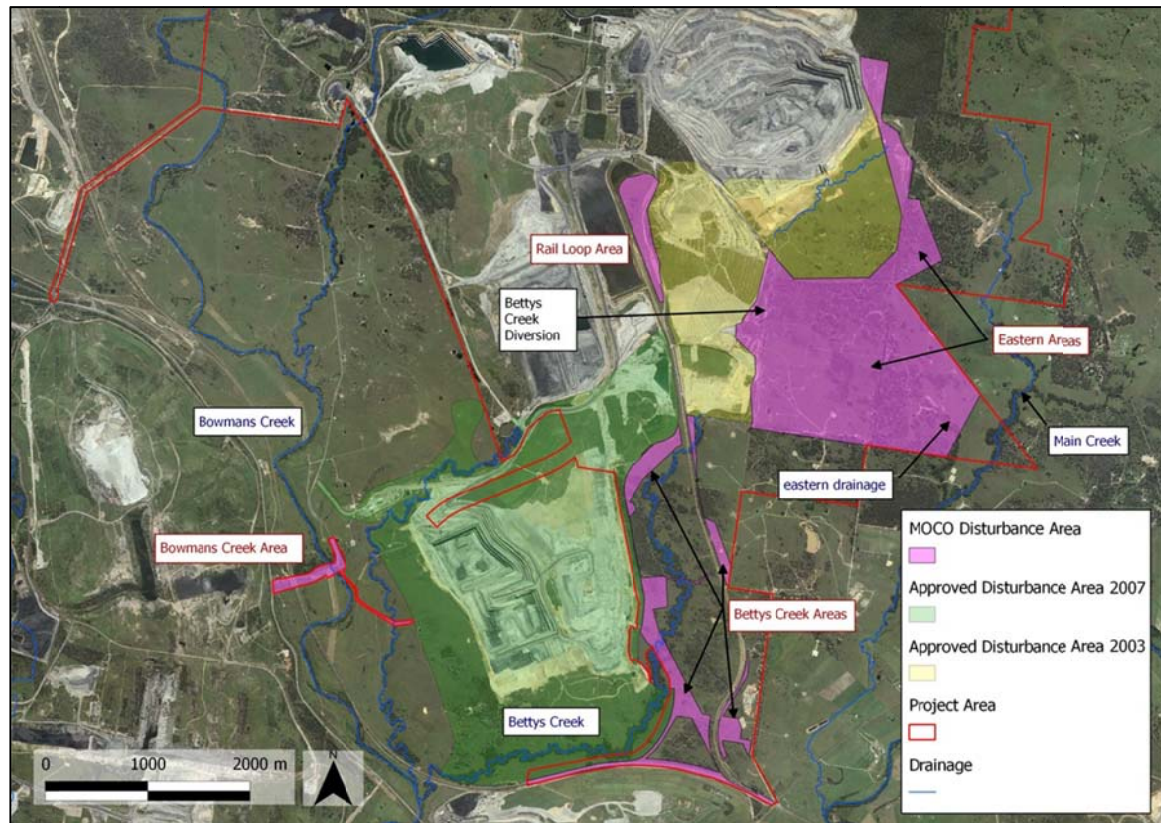
Figure 1 shows the proposed Project Disturbance Area and some of the main topographical features of the vicinity. For convenience the Project Disturbance Area can be divided into four main areas: the eastern areas, the Rail Loop area, the Bettys Creek areas and the Bowmans Creek area. These non-contiguous areas can be briefly characterised as follows:

Eastern Areas: consists mostly of elevated landforms between Bettys Creek and Main Creek. Small portions of the floodplain for Main Creek are included in this area, as are small portions of the flat landforms that were once adjacent to Bettys Creek. Included in this area is the already constructed Bettys Creek diversion channel that cuts through these flat landforms. In the majority, however, this area is comprised of slopes and ridges with the 'eastern drainage' (a name applied here to the unnamed ephemeral watercourse; see **Figure 1**) being the only drainage line of note.

Rail Loop Area: consists of gentle slopes without drainage features in an area displaying generally high modification from past land use and nearby approved mining activities including rail and dam construction.

Bettys Creek Area: consists of flat landforms adjacent to Bettys Creek although only limited areas of the banks of Bettys Creek are included in the Disturbance Area.

Bowmans Creek Area: consists of a small area of the banks of Bowmans Creek along with associated floodplain and lower slope landforms.

Figure 1: Proposed locations of the Project Disturbance Area⁷.

The approximate locations of the two areas of proposed test excavation are shown in **Figure 2**.

Figure 2: Proposed locations of the MOCO test excavation programme⁸.

⁷ Figure as sent to RAPs in February 2013. Current Project Area and Proposed Disturbance Area differ from that shown here.

⁸ Figure as sent to RAPs in February 2013. Current Project Area and Proposed Disturbance Area differ from that shown here.

BACKGROUND TO THE TEST EXCAVATION PROGRAMME

The test excavation programme follows an extensive programme of surface survey across areas that will be impacted by the proposed Project. The Aboriginal heritage surface survey commenced on 26 November 2012 and included 10 days of assessment. The assessment consisted of full pedestrian assessment of potentially impacted areas.

The results of the Aboriginal heritage assessment will be contained in the forthcoming MOCO Aboriginal Cultural Heritage Assessment (ACHA) that will provide full details of all sites recorded.

The results of the current proposed test excavation will also form part of the MOCO ACHA and will help inform the mitigation and management options that will be contained in the MOCO ACHA.

In brief, the Project Disturbance Area (see **Figure 1**) is relatively large and contains areas of varying archaeological potential. It is the aim of the test excavation programme to only target those areas displaying higher archaeological potential that have a good probability of containing not only further Aboriginal objects, but intact subsurface archaeological deposits. In addition, ground surface visibility was variable in some areas of higher archaeological potential and so the test excavation programme has been designed to determine the extent of recorded sites that may well extend into areas where thick ground vegetation prevented an accurate assessment of site extent to be made.

Two locations were assessed as holding higher archaeological potential. They are areas either side of the Bettys Creek diversion channel (**Figure 2**; Test Excavation Area 1) and areas surrounding the eastern drainage in the very east of the Disturbance Area (**Figure 2**; Test Excavation Area 2).

It should be stressed that these areas do not represent the only locations where Aboriginal objects were recorded but they do represent the only areas where contiguous artefact scatters were recorded within the Project's Disturbance Area. In both cases the artefact scatters were recorded in areas of high disturbance where the artefacts have been moved from their original locations. In the case of Test Excavation Area 1 the artefacts were recorded along the artificial bank of the Bettys Creek Diversion channel while the surrounding undisturbed landform had very low ground surface visibility. In the case of the Test Excavation Area 2, artefacts were recorded in the eroded stream bed of the eastern drainage. While ground surface visibility adjacent to the drainage was greater in this area when compared to Test Excavation Area 1, no surface artefacts were recorded beyond the stream banks. Therefore, in both cases, further information on the archaeological values in adjacent undisturbed landforms would be useful in order to inform possible mitigation and/or management options at these locations.

PROPOSED METHODS

PURPOSE OF THE TEST EXCAVATION PROGRAMME

Although the archaeologically sensitive areas that would be impacted by the Project are within a landscape that has undergone varying degrees of disturbance, there is still a high potential for partially intact features and/or archaeological deposits to exist within the Project's proposed impact footprint.

The purpose of the test excavation programme is to understand more completely the nature of the sub-surface material within the proposed impact footprint to better inform mitigation strategies in terms of the proposed Project impacts. Data obtained from the test excavation programme will inform the mitigation and management options in the forthcoming MOCO ACHA.

The aims are therefore to:

1. Establish the extent and nature the of sub-surface archaeological deposits within the Project's proposed impact footprint;
2. Use the data gained from the test excavation programme to better evaluate the archaeological significance and potential of the area; and
3. Develop, in consultation with the RAPs, an informed management strategy for the Project Disturbance Area to assist in mitigating the proposed impacts.

Excavations undertaken as per the Code do not require an Aboriginal Heritage Impact permit (AHIP) under the NPW Act.

SAMPLING STRATEGY

The sampling strategy in these areas will take the form of first excavating 0.5m x 0.5m excavation squares at 10m intervals to create a linear transect of 50m (called here the 'initial transect'). These transects will be placed directly adjacent to known concentrations of artefacts (i.e. out of erosion areas) that have been identified in both Test Excavation Areas 1 and 2. In the case of Test Excavation Area 1, the transects have been positioned to sample the landforms adjacent to the already existing Bettys Creek diversion channel. While this is an artificial feature, the recording of artefacts on the banks of the diversion channel suggests that their original location may have been close-by. Transects in this area will determine the nature and integrity of archaeological deposits in areas adjacent to the diversion channel. In Test Excavation Area 2, the transects will be laid out, in the most part, so as to run roughly parallel to the eastern drainage. A series of transects in Test Excavation Area 2 will also sample the lower slope landforms to the east of the eastern drainage. If the final pit of a particular transect records reasonable numbers of artefacts (i.e. more than 5 – equivalent to 20 artefacts per m²) the initial transect should be expanded linearly, in 10m intervals, until such time as it is clear

that the site boundary has been passed (i.e. test excavation pits are recording no artefacts or very low artefact densities of less than five artefacts per pit), the extent of potential impact has been reached or the transect has been expanded to a maximum linear distance of 100m.

If, along the initial transect, reasonable numbers of artefacts (i.e. more than 5 – equivalent to 20 artefacts per m²) or archaeological features are encountered, then a further transect (also at 10m intervals) will be placed at right angles to the pit containing the artefacts/features so that it runs away from the watercourse. An archaeological feature could be such things as a hearth or an unusually high concentration of artefacts. This transect would continue until it is clear the site boundary has been passed. Along any one initial transect these perpendicular transects would be limited to a maximum of two.

Thus, at any one location a minimum of six pits shall be excavated and it is envisioned that at most locations, allowing for perpendicular expansion, that up to 11 pits would be excavated to give a testing area of 50m x 50m (i.e. 6 pits along the initial transect = 50m plus five pits perpendicular to the transect = 50m).

Should notable concentrations of artefacts (i.e. in excess of 20 artefacts per square metre) and/or archaeological features such as hearths be encountered in any pit along any transect, the methodology allows for additional 0.5m x 0.5m pits to be placed immediately adjacent to the pit containing the artefacts/feature to allow a full examination of the feature (up to the maximum of 3m² allowed under the Code).

In this way transects, particularly in Test Excavation Area 2, will not only investigate the distribution of artefacts along a watercourse, but also the distribution away from the watercourse to determine site boundaries.

The following sections examine each test excavation area in turn.

It should be noted that no test excavation is proposed in areas adjacent to the actual course of Bettys Creek in the Bettys Creek Area, nor adjacent to Bowmans Creek where there is potential impact from the Project (see **Figure 1**). This is due to the fact that a number of previously recorded sites have already been excavated and/or salvaged in these areas allowing the archaeological character of these areas to be understood without the need for further test excavation.

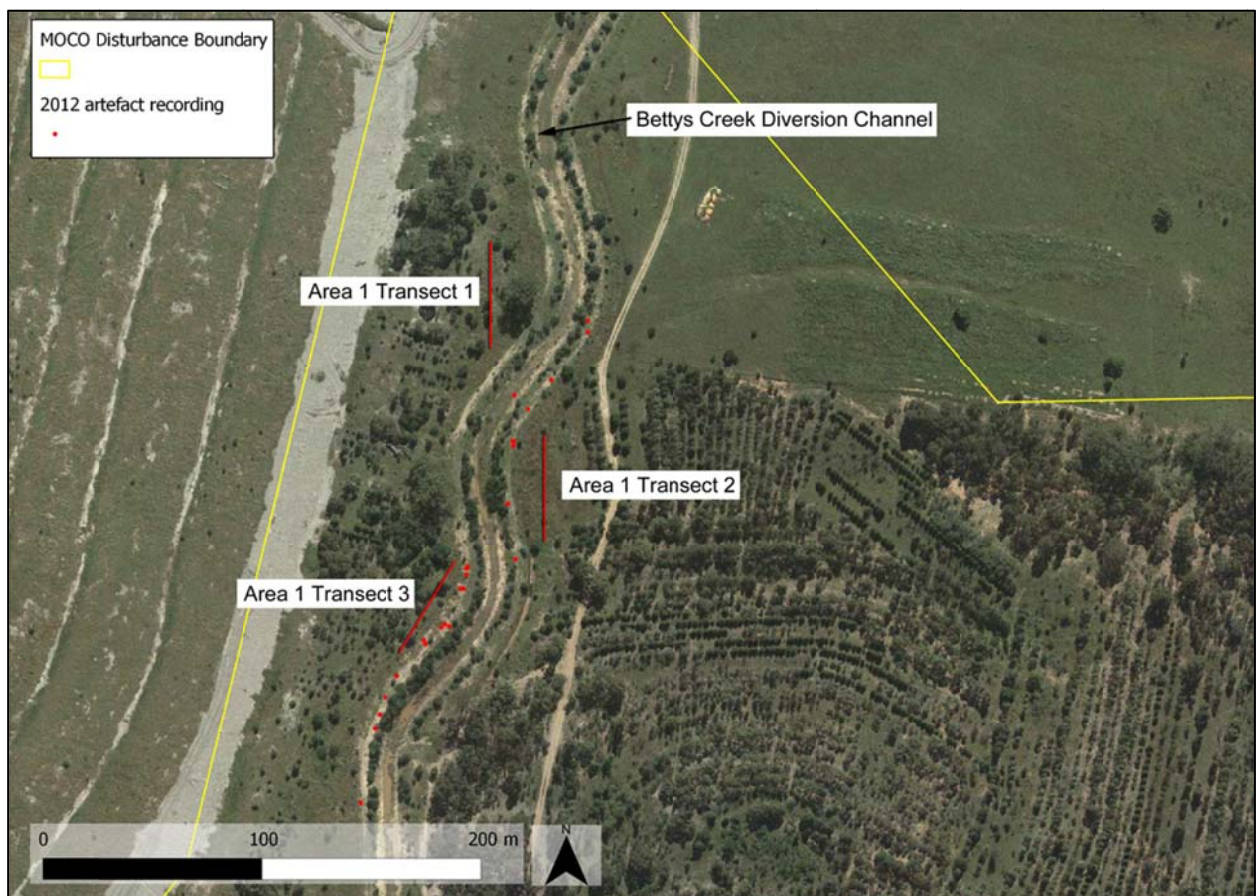
Test Excavation Area 1

The 2012 survey identified a low density scatter of artefacts along the banks of the Bettys Creek diversion channel. Although this is an artificial feature, the recorded artefacts are assumed to have originated in the general vicinity of the channel that has been created in the flat landform that would have once been adjacent to the original location of Bettys Creek (which would have once flowed further to the west in areas now heavily modified by approved mining activity). It

should be noted that previous artefact scatters (BC51, BC52 and BC67 approximately 500m south; BC54 and BC55 between 130m and 250m east and BC58 approximately 160m north) have been recorded in identical landforms. All these sites have been previously salvaged. No previously recorded sites are recorded within 130m of Test Excavation Area 1. The test excavation in this area is therefore designed to assess the archaeological nature of the flat landform on either side of the diversion channel. During the assessment there was low ground surface visibility in these areas and the test excavation programme is to determine if the landform continues to contain intact archaeological deposits.

Figure 3 shows the proposed location of the 50m transects in this area. It is proposed that three 50m initial transects be excavated to determine if the recorded artefacts along the Bettys Creek diversion channel are representative of deposits that may still exist on either side of the artificial channel. Should these transects display concentrations of artefacts then the additional perpendicular transects (as proposed above) should determine the east-west extent of these deposits.

Figure 3: Proposed locations of transects in Test Excavation Area 1.

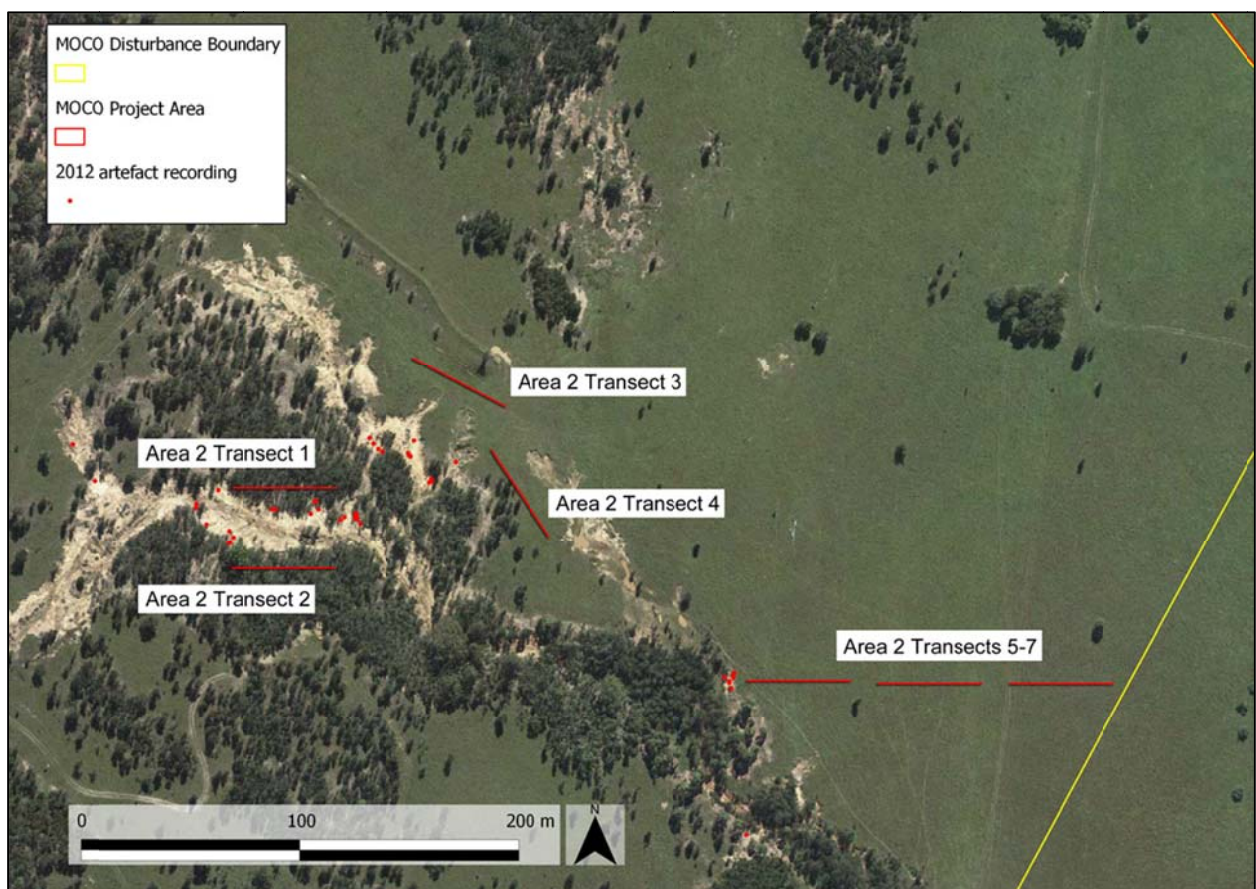


Test Excavation Area 2

The excavation strategy is designed to test two aspects of this area. Transects 1 to 4 are placed to test the nature and extent of archaeological deposits adjacent to the known location of

artefacts along the eastern drainage (**Figure 4**). These transects are proposed to be located just beyond the erosion edge to determine if the observed artefacts are associated with further archaeological deposits that may exist further away from the current erosion edge in areas where there was relatively low ground surface visibility. Transects 5 to 7, together, form a longer linear transect that is designed to test the nature and integrity of deposits in the landform that extends to the east of the eastern drainage towards the floodplain of Main Creek (see cover photo). This photo shows the sloping landform to be investigated by transects 5 to 7. This landform consists of a gentle rise that, beyond the proposed Disturbance Area, terminates in a relatively steep (but short) drop to the floodplain of Main Creek. Main Creek has several previously recorded sites along its length. MCIS01, MCIS02 and MCIS03, all isolated finds, are recorded approximately 600m southeast from Test Excavation Area 2, while further north along Main Creek, MC1, MC2, MC4, MC5 and MC6, all artefact scatters, have been recorded. Given the archaeological potential of landforms adjacent to the floodplain of Main Creek and the observed artefact scatters along the eastern drainage, transects 5 to 7 are placed to investigate the nature of deposits between these two nodal points.

Figure 4: Proposed locations of transects in Test Excavation Area 2.



SAMPLING STRATEGY COMPLIANCE WITH THE CODE: REQUIREMENT 16

1 Test excavation units must be placed on a systematic grid appropriate to the scale of the area—either PAD or site—being investigated e.g. 10m intervals, 20m intervals, or other justifiable and regular spacing.

The sampling strategy outlined above complies with this requirement.

2 Any test excavation point must be separated by at least 5m.

The sampling strategy outlined above complies with this requirement. It should be noted that while the initial transects will have 10m intervals that the Code allows expansion around pits displaying notable concentrations of artefacts (i.e. more than 20 artefacts per square metre) or archaeological features. These 'expansions' are limited to a maximum area of 3m².

3 Test excavations units must be excavated using hand tools only.

The sampling strategy outlined above complies with this requirement.

4 Test excavations must be excavated in 0.5m x 0.5m units.

The sampling strategy outlined above complies with this requirement.

5 Test excavations units may be combined and excavated as necessary to understand the site characteristics, however:

i) the maximum continuous surface area of a combination of test excavation units at any single excavation point conducted in accordance with point 1 (above) must be no greater than 3m²;

The sampling strategy outlined above complies with this requirement.

ii) the maximum surface area of all test excavation units must be no greater than 0.5% of the area—either PAD or site—being investigated.

- The number and size of test excavations undertaken as part of this programme will be managed to ensure that this requirements is satisfied.

6 Where the 0.5m x 0.5m excavation unit is greater than 0.5% of the area then point 5 (ii) (above) does not apply.

Not applicable. The potential archaeological deposit identified at Test Excavation Area 1 is approximately 2.5ha in area while the potential archaeological deposit at Test Excavation Area 2 is approximately 8ha. As all potential archaeological deposits are large, less than 0.5% of the known potential archaeological deposits dimensions will be investigated.

7 The first excavation unit must be excavated and documented in 5cm spits at each area—either PAD or site—being investigated. Based on the evidence of the first excavation unit, 10cm spits or sediment profile/stratigraphic excavation (whichever is smaller) may then be implemented.

Complies. See **Section 5** point 5.

- 8 All material excavated from the test excavation units must be sieved using a 5mm aperture wire-mesh sieve.

Complies. See **Section 5** point 6.

- 9 Test excavation units must be excavated to at least the base of the identified Aboriginal object-bearing units, and must continue to confirm the soils below are culturally sterile.

This requirement will be fulfilled in the field and all excavation squares will be excavated to the basal clays. To ensure that, as suspected, these basal clays are culturally sterile, several deeper probes within both Test Excavation Areas will be excavated into these clays to ensure that they are, in fact, culturally sterile.

- 11 Photographic and scale-drawn records of the stratigraphy/soil profile, features and informative Aboriginal objects must be made for each single excavation point.

Complies. See **Section 5** points 8, 9, 12, 13, 14 and 15.

- 12 Test excavations units must be backfilled as soon as practicable.

Complies. See **Section 5** point 7.

- 13 Following test excavation, an Aboriginal Site Impact Recording form must be completed and submitted to the AHIMS Registrar as soon as practicable, for each AHIMS site that has been the subject of test excavation in accordance with the requirements of the Code.

It will be the responsibility of OzArk EHM to ensure that this requirement is met.

PERSONNEL AND METHODS

The excavation programme will be undertaken by archaeologists and members of registered Aboriginal parties and will include the following aspects:

1. Two areas will be investigated by the test excavation programme: Test Excavation Area 1 – the Bettys Creek diversion channel and Test Excavation Area 2 – the eastern drainage.
2. Locations for the proposed initial transects are provided in **Section 4.2**.
3. Prior to any excavation, the site will be recorded via digital photography.
4. A minimum of 60 0.5m x 0.5m excavation units will be excavated across the two impact areas: 18 in Test Excavation Area 1 and 42 in Test Excavation Area 2. These will be positioned so as a valid sample of the impact areas is obtained so that the archaeological values of each area can be characterised.
5. Initial excavation squares will be excavated in 5cm spits to determine whether archaeological stratigraphy is present. If not, spit size will be increased to 10cm. If archaeological stratigraphy is present, this will be used rather than spits.

6. The excavated material from all pits will be sieved on site using dry sieving through nested sieves of 6–8mm and 2.5–3.5mm mesh (which is considered to satisfy the 5mm aperture wire-mesh sieve requirement).
7. Each excavator (by hand) will be responsible for sieving the deposit from their pit, retrieving the artefacts and, in conjunction with the supervising archaeologist, correctly recording their provenance. There could be some room for assistance with the sieving but a self-contained approach is preferable. Deposits will be sieved on to tarpaulins and the spoil used to backfill the pit.
8. A standard excavation recording form will be used for each excavated pit. Details will include; date, site recorder, spit number and depth, description of finds, description of soil, sketch plan of excavation (if relevant to show structure), end of spit levels, soil pH (when necessary or appropriate) and a bucket tally.
9. It is envisioned that the excavation crew will consist of two archaeologists; one assistant archaeologist, one operations manager and around twelve RAP representatives. The operations manager would operate with a 4WD vehicle and move between excavation teams, attending to problems, fixing equipment, backfilling positions if needed etc. The excavator of each pit, in conjunction with the supervising archaeologist, will be responsible for ensuring any forms are correctly completed. It will be the site archaeologist's responsibility to perform all photographic tasks, undertake any planning and section drawing if required and to ensure that a correct location of each pit is maintained.
10. Given that the work will be reasonably physical, all persons participating on the test excavation programme should be aware of this and be 'fit for work'.
11. If intact archaeological deposits or archaeological features are encountered, then additional archaeological pits may be excavated to ensure documentation of any features and/or retrieval of artefacts and other relevant archaeological material. A feature would include a high density of artefacts within a square, or a pit containing rare or unusual artefacts (such as artefacts constructed from a stone type rarely represented in the area or less-common tool forms such as ground edge axes, hammerstones etc), or other signs of human occupation i.e. ground ovens/hearths or charcoal concentrations.
12. If appropriate (i.e. intact archaeological stratigraphy is recorded) section drawings will be completed for appropriate pits. If no archaeological stratigraphy is recorded then digital photographs shall be taken of a representative section of each pit and a suitably representative drawing made of the pit section to show the soil profile.
13. Analysis of all excavated lithics will be made in order to determine the site's characteristics and to enable the site to be compared with other sites in the region.

Analysis will also assist in determining what type of activities the Aboriginal people carried out at the site and their relationship with local resources (fauna, flora, water and stone). All artefacts will be analysed and selectively photographed and the more diagnostic artefacts will be drawn by a lithic specialist. If charcoal from a secure context is obtained, it may be sent to a laboratory for C14 dating (subject to proponent's agreement).

14. If deposits dictate, further dating attempts may be warranted (e.g. thermoluminescence: subject to proponent's agreement).
15. All faunal remains will be analysed by a fauna specialist. Remnant shell and bone fragments may assist in determining what foods Aboriginal people may have eaten at the specific site and may elucidate possible foraging strategies. In conjunction with *in situ* stone tools, bone/shell fragments may also provide evidence of specific usage of stone tools for food processing.
16. Artefacts will remain in the care of OzArk EHM until such time as the analysis is complete. Once complete, the artefacts will be returned to Xstrata Mount Owen offices where they will be kept in a locked location until point 18 below is enacted.
17. The results of the test excavation programme will inform the forthcoming MOCO ACHA report. Excavation results will be used to advise further courses of action in relation to the management and mitigation options for the Project.
18. Once all salvage activities for this Project are complete, artefacts will be amalgamated and their ultimate fate will be a negotiated agreement between the RAPs and OEH.

APPENDIX 4: MOUNT OWEN CONTINUED OPERATIONS TEST EXCAVATION SUMMARY⁹

⁹ Summary as sent to RAPs in April 2013. Current Project Area and Proposed Disturbance Area differ from that shown here.

Mount Owen Continued Operations Project



FACT SHEET: ARCHAEOLOGICAL TEST EXCAVATION SUMMARY

APRIL, 2013

This document is to inform all Registered Aboriginal Parties (RAPs) of the progress of the archaeological fieldwork component of the Mount Owen Continued Operations Project. This document presents preliminary results of the test excavation program and full information and discussion will be contained in the forthcoming Aboriginal Archaeological Report that will be produced in conjunction with the Aboriginal Cultural Heritage Assessment.

Introduction

The test excavation for the Project Area is completed. The excavation occurred over one week, from 11 to 15 March 2013.

Each day's excavation crew comprised of up to 12 RAP representatives, three archaeologists from OzArk (Ben Churcher, Nick Harrop and Joshua Noyer) and Gary Bernasconi (XCN) who was an invaluable guide and provider of shelter, toilets and water. Rowan Murphy acted as OzArk's Operations Manager during the week.

The agreed test excavation methodology outlined two discrete areas of investigation: Area 1 surrounding the Bettys Creek diversion and Area 2 surrounding the eastern drainage (Figure 1).

Area 1

Area 1 was proposed for investigation due to the fact that a number of artefacts were recorded during the survey along the artificial banks of the diversion channel for Bettys Creek. As surrounding areas had very low ground surface visibility, test excavation was proposed in this area to determine if the landform through which the diversion channel has been cut contains further archaeological deposits.

In all, five transects, each containing six 0.5m x 0.5m excavation pits, were excavated, giving a total of 30 pits in Area 1. Three transects (Transects 1-3) were located to the west of the diversion channel on flat land, while two transects (Transects 4-5) were located to the east of the diversion channel on flat to gently rising landforms (Figure 2). The western transects tested a narrow area of land between heavily modified landforms to the west and the



Figure 1: Location of test excavation areas

FACT SHEET: ARCHAEOLOGICAL TEST EXCAVATION SUMMARY

APRIL, 2013

diversion channel itself (Figure 3). The eastern transects were located 50m to 70m from the diversion channel as wet areas (see Figure 2) made excavation of closer test pits impossible. These eastern transects were within areas of revegetation that occupy the lower slopes that would have been to the east of the flat landforms surrounding the original course of Bettys Creek (Figure 4).

The excavation of the 30 pits at Area 1 did not record any artefacts. Further, A1 Horizon soils were largely absent and most pits revealed a shallow A2 soil level (a leached loam/clay) before the basal clays of the B Horizon were reached. This suggests that, over much of this area, the A1 soils have been removed, potentially by machinery during the construction of the diversion channel.



Figure 2: Location of excavation pits at Area 1



Figure 3: View of excavation underway at Transect 3 on the flat landform to the west of the Bettys Creek diversion channel



Figure 4: The location of Transect 5 on the gently rising lower slopes to the east of the Bettys Creek diversion channel



Figure 5: View of excavation underway at Transect 1 on the flat landform to the west of the Bettys Creek diversion channel. Note the soil mound in the background (arrow)



Figure 6: Area 1 Transect 1 showing semi-mature trees with what appears to be natural soil levels at their bases

While it was initially thought that the diversion had been created by cutting into the original landform and piling the spoil as a bank, it became clear during the investigation that while some cutting occurred, surrounding soils also were pushed up to form the bank. This disturbance was variable as, in some places, piles of soil remained visible (see **Figure 5**), although adjacent areas had several semi-mature trees where there had been minimal soil removal at their bases (**Figure 6**).

The results of the test excavation at Area 1 demonstrated that there is a low probability of there being further undetected, intact, archaeological deposits in this area.

Area 2

Area 2 was proposed for test excavation because during the survey a number of artefacts were recorded within the in-stream erosion area of the eastern drainage. All of the recorded artefacts have been displaced from their original locations and the test excavation program was designed to test the nature and integrity of the non-eroded areas on either side of the drainage to determine if intact archaeological deposits remain in these areas.

In all, eight transects were excavated at Area 2. Like the Area 1 transects, each Area 2 transect contained six 0.5m x 0.5m excavation squares apart

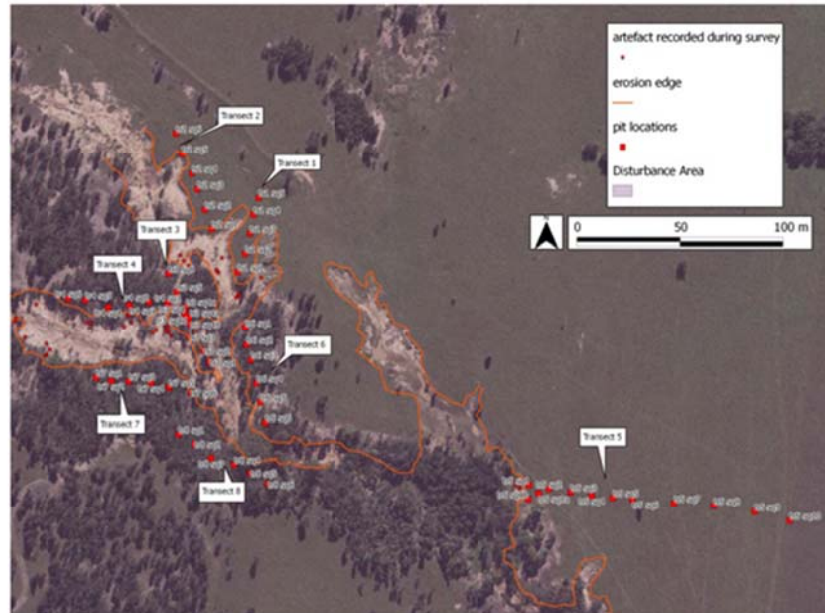


Figure 7: Location of excavations pits at Area 2a

from Transect 1 that contained five squares and Transect 5 that contained 10 squares. In addition, two extension squares were excavated at Transect 5 and five extension squares were excavated at Transect 3, making a total of 58 excavation squares at Area 2.

These transects were located on either side of the eastern drainage and on an area of residual ground surface between the two arms of the creek in order to fully investigate the nature and

integrity of deposits in non-eroded areas surrounding the creek. A further transect (Transect 5) was placed across the flat to gently rising landform to the east of the eastern drainage to examine the archaeological potential of this area (**Figure 7**).

Area 2 recorded artefacts; however, there was a very low artefact density at Area 2. Even when transects were placed adjacent to known artefact scatters, the pits recorded very

few artefacts indicating that the visible artefacts in the erosion areas are not part of a more-extensive site that extends into the non-eroded areas (**Figures 8 and 9**). In particular, Transect 5 was placed so that it began within two metres of a cluster of artefacts that were visible within the eroded in-stream area (see **Figure 9**). Even though two extra pits were excavated here (squares 1a and 1b), no pit recorded more than a low artefact density.



Figure 8: View from the eastern drainage towards Transect 2



Figure 9: View from the erosion edge towards Transect 5

FACT SHEET: ARCHAEOLOGICAL TEST EXCAVATION SUMMARY

APRIL, 2013



Figure 10: View of Transect 3, Square 4 along with extensions Sq 4 a, b and e. Extension SQ 4d in background

The only exception to this was on Transect 3 that is located on an area of original ground surface between the two arms of the drainage. At one location only (square 4) a cluster of 10+ artefacts was recorded. An additional five pits were excavated around this point to determine the extent of this cluster. While immediately adjacent pits recorded diminishing numbers of artefacts, pits placed five metres away failed to register further artefacts. It appears, therefore, that this artefact cluster is a localised occurrence and not part of a more extensive site (Figure 10).

As a result, Area 2 has a greater chance to contain further subsurface archaeological deposits than Area 1, although the deposits at Area 2 are likely to contain only a low density of artefacts.

Conclusion

OzArk and Xstrata Mount Owen would like to thank all participants in the test excavation program. The excavation progressed efficiently and professionally due to the efforts of all involved and the aims of the test excavation methodology were able to be achieved.

Ben Churcher,
OzArk Senior Archaeologist
8 April 2013

The Mount Owen Complex would like to acknowledge the Traditional Owners of the Mount Owen area – the Wonnarua People – and pay respect to their cultural heritage, beliefs and continuing relationship with the land. We pay respect to the Elders, both past and present, for they hold the memories, traditions, culture and hope of Aboriginal people in the area.

For further information contact:

Gary Bernasconi
T: 0417 067 591
E: gbernasconi@xstratacoal.com.au

Appendix 5: Tabulation of revised AHIMS data set listing sites within or adjacent to the Project Area¹⁰

¹⁰ The following table displays data that was checked by Umwelt during the feasibility phase of the Project rather than rely on the incomplete and out of date AHIMS data (see **Section 5.3**).

AHIMS number	Site name	MGA Easting	MGA northing	status	Site type	Landform	# of artefacts
37-3-0018	Falbrook; Arizona;	323955	6413189	Extant	Stone Arrangement	Lower slope	0
37-3-0025	Bettys Creek 2/Glennies Creek Site A / Brayshaw Site GC- A	320877	6408060	Not extant	Artefact Scatter	Lower slope	>100
37-3-0026	Glennies Creek Site B / Bettys Creek - B	320635	6407541	Not extant	Artefact Scatter	Creek bank	11
37-3-0027	Glennies Creek Site C/Bettys Creek - C	321045	6409909	Not extant	Artefact Scatter	Gully bank	2
37-3-0039	Stringybark Creek;	317454	6415518	Extant	Artefact Scatter	Creek bank	
37-3-0045	Swamp Ck A;	321094	6416501	Extant	Artefact Scatter	Creek bank	28
37-3-0046	Swamp Creek; Swamp Creek B;	322008	6416518	Extant	Artefact Scatter	Creek bank	>25
37-3-0050	Yorks Creek; Yorks Creek A;	319283	6415552	Extant	Artefact Scatter	Creek bank	>50
37-3-0051	Yorks Creek Yorks Creek B	320180	6416483	Extant	Artefact Scatter	Creek bank	10
37-3-0056	Stringybark Creek; Hebden;	316802	6416146	Extant	Artefact Scatter	Creek bank/gully bank	8
37-3-0194	HVCC 1;	320355	6413489	Not extant	Artefact Scatter	Creek terrace	7
37-3-0195	HVCC_2;	320555	6413789	Not extant	Isolated Find	Creek terrace	1
37-3-0196	HVCC 3;	320605	6413789	Not extant	Artefact Scatter	Creek terrace	3
37-3-0197	HVCC 4;	320535	6413869	Not extant	Artefact Scatter	Creek terrace	3
37-3-0198	HVCC 5;	320725	6414139	Not extant	Artefact Scatter	Creek bank	16
37-3-0199	HVCC 6;	320945	6414429	Not extant	Isolated Find	Terrace	1
37-3-0200	HVCC 8;	321305	6414469	Not extant	Isolated Find	Footslope	1
37-3-0201	HVCC 9;	321455	6414459	Not extant	Artefact Scatter	Footslope	8
37-3-0202	HVCC 10;	321415	6414489	Not extant	Artefact Scatter	Footslope	14
37-3-0203	HVCC 11;	321135	6414569	Not extant	Artefact Scatter	Bench below terrace	6
37-3-0204	HVCC 12;	321185	6414569	Not extant	Isolated Find	Terrace	1
37-3-0205	HVCC 13;	321325	6414609	Not extant	Artefact Scatter	Footslope	4
37-3-0206	HVCC 15;	321585	6414239	Not extant	Artefact Scatter	Bench below terrace	4
37-3-0207	HVCC 16;	321295	6414649	Not extant	Artefact Scatter	Terrace	14
37-3-0208	HVCC 17;	321245	6414589	Not extant	Artefact Scatter	Terrace	3
37-3-0209	HVCC 18;	321345	6414679	Not extant	Artefact Scatter	Bench below terrace	9
37-3-0210	HVCC 19;	322165	6415369	Not extant	Artefact Scatter	Terrace	2
37-3-0211	HVCC 20;	321705	6414879	Not extant	Artefact Scatter	Bench below terrace	2
37-3-0212	HVCC 21;	321625	6414839	Not extant	Artefact Scatter	Bench below terrace	6
37-3-0213	HVCC 22;	321655	6415789	Not extant	Artefact Scatter	Terrace	2
37-3-0214	HVCC 23;	321395	6415089	Not extant	Artefact Scatter	Bedrock footslope	10
37-3-0215	HVCC 24;	321105	6414689	Not extant	Artefact Scatter	Terrace	2
37-3-0216	HVCC 25;	321105	6414769	Not extant	Isolated Find	Terrace	1
37-3-0217	HVCC 26;	321205	6414729	Not extant	Artefact Scatter	Terrace	13

AHIMS number	Site name	MGA Easting	MGA northing	status	Site type	Landform	# of artefacts
37-3-0218	HVCC 27;	321115	6414739	Not extant	Artefact Scatter	Terrace	13
37-3-0219	HVCC 28;	321075	6414879	Not extant	Artefact Scatter	Terrace	3
37-3-0220	HVCC 29;	321105	6414969	Not extant	Artefact Scatter	Bedrock footslope	8
37-3-0221	HVCC 30;	321075	6415059	Not extant	Artefact Scatter	Bedrock footslope	2
37-3-0222	HVCC 31;	321085	6415619	Not extant	Artefact Scatter	Footslope	2
37-3-0223	HVCC 32;	321155	6415629	Not extant	Artefact Scatter	Lower alluvium	11
37-3-0224	HVCC 33;	321865	6415009	Not extant	Isolated Find	Lower alluvium	1
37-3-0225	HVCC 34;	322455	6415859	Not extant	Artefact Scatter	Terrace	46
37-3-0226	HVCC 35;	322235	6415679	Not extant	Artefact Scatter	Bedrock footslope	24
37-3-0227	HVCC 36;	322235	6415639	Not extant	Artefact Scatter	Bedrock footslope	34
37-3-0228	HVCC 37;	319965	6413419	Not extant	Artefact Scatter	Lower alluvium	6
37-3-0229	HVCC 38;	319955	6413399	Not extant	Artefact Scatter	Lower alluvium	3
37-3-0230	HVCC 39;	319955	6413349	Not extant	Isolated Find	Lower alluvium	1
37-3-0231	HVCC 40;	319955	6413309	Not extant	Artefact Scatter	Bedrock footslope	3
37-3-0232	HVCC 41;	320025	6413099	Not extant	Artefact Scatter	Terrace	7
37-3-0233	HVCC 42;	320025	6413009	Not extant	Isolated Find	Terrace	1
37-3-0234	HVCC 43;	320115	6413779	Not extant	Artefact Scatter	Lower alluvium	2
37-3-0235	HVCC 44;	320115	6413789	Not extant	Isolated Find	Lower alluvium	1
37-3-0236	HVCC 45;	320115	6413819	Not extant	Artefact Scatter	Bedrock footslope	2
37-3-0237	HVCC 46;	320265	6414109	Not extant	Artefact Scatter	Bedrock footslope	4
37-3-0238	HVCC 47;	320105	6414019	Not extant	Isolated Find	Bedrock footslope	1
37-3-0239	HVCC 48;	320825	6414399	Not extant	Artefact Scatter	Terrace	4
37-3-0240	HVCC 49;	320955	6414939	Not extant	Isolated Find	Bedrock hillslope/ridge	1
37-3-0241	HVCC 50;	322495	6415709	Not extant	Isolated Find	Hillslope/ridge	1
37-3-0242	HVCC 51;	322505	6415779	Not extant	Artefact Scatter		
37-3-0243	HVCC 52;	322325	6415989	Not extant	Isolated Find	Ridge crest	1
37-3-0244	HVCC 53;	322135	6415869	Not extant	Artefact Scatter	Terrace	9
37-3-0245	HVCC 54;	322165	6415809	Not extant	Artefact Scatter	Hillslope/ridge	3
37-3-0246	HVCC 55;	322175	6415769	Not extant	Artefact Scatter	Bedrock footslope	2
37-3-0247	HVCC 56;	322085	6415869	Not extant	Artefact Scatter	Terrace	9
37-3-0248	HVCC 57;	322175	6415469	Not extant	Artefact Scatter	Terrace	43
37-3-0249	HVCC 58;	321215	6415349	Not extant	Artefact Scatter	Bench below terrace	14
37-3-0250	HVCC 59;	322265	6414959	Not extant	Artefact Scatter	Bedrock hillslope/ridge	8
37-3-0251	HVCC 60;	322315	6414939	Not extant	Artefact Scatter	Bedrock footslope	6
37-3-0252	HVCC 61;	322305	6414549	Not extant	Isolated Find	Lower alluvium	1
37-3-0253	HVCC 62;	322265	6414529	Not extant	Isolated Find	Lower alluvium	2
37-3-0254	HVCC 63;	322035	6414539	Not extant	Isolated Find	Lower alluvium	1
37-3-0255	HVCC 64;	321805	6414479	Not extant	Artefact Scatter	Terrace	18
37-3-0256	HVCC 65;	321905	6414489	Not extant	Artefact Scatter	Terrace	13
37-3-0257	HVCC 66;	320655	6415419	Not extant	Isolated Find	Bedrock hillslope/ridge	1
37-3-0258	HVCC 67;	320635	6415539	Not extant	Isolated Find	Footslope	1

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37-3-0259	HVCC 68;	320635	6415579	Not extant	Isolated Find	Footslope	1
37-3-0261	HVCC 70;	321175	6416079	Not extant	Isolated Find	Footslope	2
37-3-0262	HVCC 71;	321255	6416039	Not extant	Artefact Scatter	Footslope	18
37-3-0263	HVCC 72;	321255	6416039	Not extant	Artefact Scatter	Footslope	39
37-3-0264	HVCC 73;	322505	6414399	Not extant	Artefact Scatter	Footslope	5
37-3-0265	HVCC 74;	322635	6415339	Not extant	Artefact Scatter	Bedrock footslope	8
37-3-0266	HVCC 75;	322705	6414289	Not extant	Artefact Scatter	Bedrock footslope	2
37-3-0267	HVCC 76;	322205	6413869	Not extant	Artefact Scatter	Bedrock hillslope/ridge	2
37-3-0268	HVCC 77;	322065	6413569	Not extant	Isolated Find	Bedrock hillslope/ridge	2
37-3-0269	HVCC 78;	322025	6413469	Not extant	Isolated Find	Bedrock hillslope/ridge	1
37-3-0274	HVCC 100;	322025	6415089	Extant	Artefact Scatter	Terrace	<20
37-3-0275	HVCC 99;	322035	6415089	Extant	Artefact Scatter	Bedrock footslope	>20
37-3-0276	HVCC 95;	322035	6414389	Extant	Artefact Scatter and Knapping Floor	Lower alluvium	>50
37-3-0277	HVCC 90;	322055	6415489	Extant	Artefact Scatter	Terrace	>50
37-3-0278	HVCC 94;	322045	6415389	Extant	Artefact Scatter	Terrace	>100
37-3-0279	HVCC 89;	322055	6415589	Extant	Artefact Scatter	Terrace	>50
37-3-0280	HVCC 88;	322055	6415789	Extant	Artefact Scatter	Terrace	>50
37-3-0281	HVCC 86;	322045	6415889	Extant	Artefact Scatter	Terrace	>100
37-3-0294	Site 2;	321205	6410329	Extant	Artefact Scatter	Creek bank	-20
37-3-0295	Site 1;	320755	6412389	Not extant	Artefact Scatter	Flats	4
37-3-0297	BC 1;	322575	6413059	Not extant	Isolated find	Creek terrace	1
37-3-0298	BC 2;	322595	6413039	Not extant	Artefact Scatter	Alluvial terrace	2
37-3-0299	BC 3;	322375	6412379	Not extant	Artefact Scatter	Footslope	8
37-3-0300	BC 4;	322505	6412439	Not extant	Artefact Scatter	Stream channel	18
37-3-0301	BC 5;	323055	6414209	Not extant	Artefact Scatter	Footslope	5
37-3-0302	BC 6;	323015	6414279	Not extant	Artefact Scatter	Midslope	11
37-3-0303	BC 7;	322695	6413689	Not extant	Artefact Scatter	Base of bedrock footslope/drainage line	3
37-3-0304	BC 8;	323405	6413389	Not extant	Artefact Scatter	Midslope	2
37-3-0305	BC 9;	323385	6413539	Not extant	Artefact Scatter	Midslope/Footslope	3
37-3-0306	BC 10;	322865	6413959	Not extant	Artefact Scatter	Creek bank/alluvial flat	5
37-3-0307	BC 11;	322705	6413899	Not extant	Artefact Scatter	Creek flat/bank	2
37-3-0308	BC 12;	322625	6413489	Not extant	Artefact Scatter	Creek bank	2
37-3-0309	BC 13;	322605	6413389	Not extant	Artefact Scatter	Creek bank/terrace to footslope	79
37-3-0310	BC 14;	323165	6413229	Not extant	Artefact Scatter	Creek bank/footslope	1
37-3-0311	BC 15;	323185	6413259	Not extant	Artefact Scatter	Creek bank/footslope	1
37-3-0312	BC 16;	322155	6412909	Not extant	Artefact Scatter	Midslope	3
37-3-0313	BC 17;	322125	6412679	Not extant	Artefact Scatter	Gully	1
37-3-0314	BC 18;	322165	6412469	Not extant	Artefact Scatter	Creek flats	9

AHIMS number	Site name	MGA Easting	MGA northing	status	Site type	Landform	# of artefacts
37-3-0315	BC 19	322135	6412449	Not extant	Artefact Scatter	Flats	16
37-3-0316	BC 20;	322185	6412459	Not extant	Artefact Scatter	Creek bank	26
37-3-0317	BC 21;	322255	6412479	Not extant	Artefact Scatter	Creek bank	11
37-3-0318	BC 22;	322245	6412459	Not extant	Artefact Scatter		5
37-3-0319	BC 23;	322095	6412389	Not extant	Artefact Scatter	Creek bank/flats	42
37-3-0320	BC 24;	322105	6413239	Not extant	Artefact Scatter	Ridgeline	1
37-3-0321	BC 25;	322435	6413139	Not extant	Artefact Scatter	Footslope	1
37-3-0322	BC 26;	322605	6413129	Not extant	Artefact Scatter	Creek bank	1
37-3-0323	BC 27;	322745	6412939	Not extant	Artefact Scatter	Midslope	1
37-3-0324	BC 28;	322585	6412509	Not extant	Artefact Scatter	Gully	1
37-3-0325	BC 29;	322455	6412409	Not extant	Artefact Scatter	Creek bank/footslope	8
37-3-0326	BC 30;	322325	6412379	Not extant	Artefact Scatter	Gully edge	7
37-3-0327	BC 31;	322285	6412419	Not extant	Artefact Scatter	Creek flat/footslope	22
37-3-0328	BC 32;	322145	6412379	Not extant	Artefact Scatter		
37-3-0329	BC 33;	322105	6412339	Not extant	Artefact Scatter	Creek bank	15
37-3-0330	BC 34;	322365	6412599	Not extant	Artefact Scatter		>2
37-3-0331	BC 35;	322005	6412359	Not extant	Artefact Scatter	Creekline	>2
37-3-0332	BC 36;	321985	6412259	Not extant	Artefact Scatter	Creekline	>2
37-3-0333	BC 37;	321905	6412259	Not extant	Artefact Scatter	Creekline	>2
37-3-0334	BC 38;	321805	6412359	Not extant	Artefact Scatter	Creekline	>2
37-3-0335	BC 39;	321775	6412439	Not extant	Artefact Scatter	Creekline	>2
37-3-0343	Mt Owen (1996) 1;MtO1;	318555	6414519	Extant	Artefact Scatter	Creek bank	11
37-3-0344	Mt Owen (1996) 1;	320355.035	6415439.447	Not extant	Isolated Find	Hillslope	1
37-3-0345	Mt Owen (1996) 4;	320295	6415309	Not extant	Artefact Scatter	Hillslope	2
37-3-0346	Mt Owen (1996) 6;	320245	6415789	Extant	Isolated Find	Hillslope	1
37-3-0347	Mt Owen (1996) 8;	319955	6415539	Not extant	Isolated Find	Hillslope	1
37-3-0348	Mt Owen (1996) 11;	319365	6414669	Not extant	Artefact Scatter	Footslope	10
37-3-0349	Mt Owen (1996) 10;	319482	6414609	Extant	Isolated Find	Creek bank	1
37-3-0350	Mt Owen (1996) 9;	319705	6414609	Extant	Artefact Scatter	Footslope	4
37-3-0351	Mt Owen (1996) 12;	319265	6414649	Not extant	Artefact Scatter	Creek bank	4
37-3-0352	Mt Owen (1996) 13;	319305	6414709	Not extant	Artefact Scatter	Footslope	2
37-3-0353	Mt Owen (1996) 15;	319535	6414839	Not extant	Artefact Scatter	Creek bank	3
37-3-0354	Mt Owen (1996) 14;	319385	6415989	Extant	Artefact Scatter	Creekline	12
37-3-0355	Mt Owen (1996)_20;	319895	6415989	Extant	Artefact Scatter	Creek	5
37-3-0356	Mt Owen (1996)_18;	320215	6416059	Extant	Artefact Scatter	Slope to creek	8
37-3-0357	Mt Owen (1996)_17;	320425	6416269	Extant	Artefact Scatter	Creek bank	20

AHIMS number	Site name	MGA Easting	MGA northing	status	Site type	Landform	# of artefacts
37-3-0358	Mt Owen (1996)_21;	320355	6415529	Not extant	Artefact Scatter	Hillslope	2
37-3-0359	Mt Owen (1996)_3;	319865	6415049	Extant	Artefact Scatter	Ridge	36
37-3-0360	Mt Owen (1996)_2;	319085	6414419	Extant	Isolated Find	Slope/creek flat	1
37-3-0361	Mt Owen (1996)_22;	320115.032	6414749.45	Not extant	Artefact Scatter	Creek bed	10
37-3-0362	Mt Owen (1996)_24;	319735	6415599	Extant	Isolated Find	Footslope to gully	1
37-3-0363	Mt Owen (1996)_26;	319925	6414989	Not extant	Isolated Find	Hillslope	1
37-3-0393	Ravensworth East 1	319502	6414109	Not extant	Isolated Find	Slope	1
37-3-0394	Ravensworth East 4	318844	6413910	Not extant	Artefact Scatter	Hillslope	8
37-3-0395	Ravensworth East 5	319275	6413510	Not extant	Isolated Find	Slope/alluvial plain	1
37-3-0396	Ravensworth East 16	319363	6413158	Not extant	Isolated Find	Gentle slope	1
37-3-0398	Ravensworth 09	319743	6413684	Not extant	Isolated Find	Gentle slope	1
37-3-0399	Ravensworth 10	319865	6413543	Not extant	Isolated Find	Low flat aluvial land	1
37-3-0400	Ravensworth East 11	319972	6413482.22	Not extant	Isolated Find	Eroded channel	2
37-3-0401	Ravensworth East 12	319685	6413419	Not extant	Artefact Scatter	Drainage terrace/gully	2
37-3-0402	Ravensworth East 13	320014	6413444	Not extant	Open Artefact Scatter	Drainage slope	23
37-3-0403	Ravensworth East 14	319636	6413346	Not extant	Open Artefact Scatter	Gully	4
37-3-0404	Ravensworth east 2	318969	6414024	Not extant	Isolated Find	Creekline	1
37-3-0405	Ravensworth east 3	318885	6414052	Not extant	Artefact Scatter	Creekline	2
37-3-0406	Rav east 6	319494	6413617	Not extant	Isolated Find	Floodplain	1
37-3-0407	Rav east 7	319697	6413691	Not extant	Isolated Find	Undulating floodplain	1
37-3-0408	Rav east 8	319747	6413714	Not extant	Isolated Find	Gentle slopes/flatland	1
37-3-0409	Rav east 15	319669	6412759	Not extant	Artefact Scatter	low lying swamp/plan	9
37-3-0410	ravensworth east 17	320000	6412975	Not extant	Isolated Find	Anthill	1
37-3-0411	rave east 18	320783	6412019	Not extant	Isolated Find	Upper slope of crest	1
37-3-0412	rav east 19	319996	6411762	Not extant	Open Artefact Scatter	Low undulating hills/ridges	150
37-3-0413	rav east 30	318895	6414664	Not extant	Open Artefact Scatter	Creekline	5
37-3-0414	rav east 29	319613.032	6414949.449	Not extant	Isolated Find	Drainage/dams	1
37-3-0415	rav east 28	319447	6414764	Not extant	Isolated Find	Eroded bank	3
37-3-0416	rav east 27	319348	6414679	Not extant	Isolated Find	Dam wall	11
37-3-0417	rav east 25	318028	6413487	Not extant	Isolated Find	Dam edge	13

AHIMS number	Site name	MGA Easting	MGA northing	status	Site type	Landform	# of artefacts
37-3-0418	ravensworth east 26	319105	6414679	Not extant	Isolated Find	Dam edge	3
37-3-0420	rav east 23	316885	6413629	Not extant	Artefact Scatter	Crest/hillslope	28
37-3-0421	rav east 22	321124	6410757	Not extant	Artefact Scatter	Creek flats	3
37-3-0422	rav east 20	320368.028	6412622.456	Not extant	Artefact Scatter	Creek bed/slope	5
37-3-0423	rav east 21	319725	6412579	Not extant	Artefact Scatter	Alluvial plain	5
37-3-0424	RE34	319294	6413351	Not extant	Artefact Scatter		
37-3-0425	RE35	319328	6413209	Not extant	Artefact Scatter		
37-3-0469	Bowmans/Swamp Creek Trench 1	318072	6409137	Extant	Artefact Scatter	Floodplain between 2 creeks	479
37-3-0494	MO-IF2	319060	6410265	Extant	Stone artefact (isolated find)	Alluvial terrace	1
37-3-0521	MO-IF1	319123	6410319	Extant	Isolated Find	Alluvial terrace	1
37-3-0526	Ashton EWA 16	320229	6407170	Extant	Isolated Find	Valley bottom	3
37-3-0527	Ashton EWA 17	320079	6407152	Extant	Artefact Scatter	Flat spur slope	1
37-3-0584	BC40	321705	6412389	Not extant	Artefact Scatter		
37-3-0585	BC41	322615	6412389	Not extant	Artefact Scatter		
37-3-0586	BC42	322005	6412379	Not extant	Artefact Scatter		
37-3-0587	BC43	321705	6412389	Not extant	Artefact Scatter		
37-3-0592	Bettys Creek 1	319329	6407149	Not extant	Artefact Scatter	Floodplain	3
37-3-0593	Bettys Creek 3	321088	6409060	Not extant	Artefact Scatter	Floodplain	3
37-3-0594	Bettys Creek 4	320837	6409391	Not extant	Artefact Scatter	Lower slope of spur	2
37-3-0595	Bettys Creek 5	321070	6409844	Not extant	Artefact Scatter	Tributary banks	3
37-3-0596	Bettys Creek 6	321128	6409296	Not extant	Artefact Scatter		17
37-3-0597	Bettys Creek 7	321207	6409084	Not extant	Artefact Scatter	Floodplain on creek bank	4
37-3-0598	Bettys Creek 8	321172	6408634	Not extant	Artefact Scatter	Floodplain on creek bank	37
37-3-0599	Bettys Creek 9	321100	6408400	Not extant	Artefact Scatter	Creek terrace between creek & tributary	10
37-3-0600	Bettys Creek 10	320994	6408230	Not extant	Artefact Scatter	Creek terrace/ridge between creek & tributary	26
37-3-0601	Bettys Creek 11	320695	6407384	Not extant	Artefact Scatter	Tributary bank	5
37-3-0602	Bettys Creek 12	320293	6407266	Not extant	Artefact Scatter	Footslope on both sides of tributary	10
37-3-0603	Bettys Creek 13	320662	6407265	Not extant	Artefact Scatter	Footslope	>100
37-3-0604	Bettys Creek 14	320759	6407271	Not extant	Artefact Scatter	Lower slope	20
37-3-0605	Bettys Creek 15	320638	6407443	Not extant	Artefact Scatter	Creek bank	1
37-3-0606	Bettys Creek 16	320877	6408654	Not extant	Artefact Scatter	Lower slope	10
37-3-0607	Bettys Creek 17	320833	6409048	Not extant	Artefact Scatter	Lower slope	1
37-3-0608	Bettys Creek 18	320455	6407668	Not extant	Artefact Scatter	Lower slope	22
37-3-0609	Bettys Creek 19	319879	6407839	Not extant	Artefact Scatter	addle/upper slope	2
37-3-0610	Bettys Creek 20	319730	6407658	Not extant	Artefact Scatter	Spur crest	10
37-3-0611	Bettys Creek 21	320893	6410239	Extant	Artefact Scatter	Gentle slope	1
37-3-0612	Bettys Creek 22	321138	6410296	Extant	Artefact Scatter	Floodplain	1

AHIMS number	Site name	MGA Easting	MGA northing	status	Site type	Landform	# of artefacts
37-3-0613	Bowmans Creek 1	317468	6409734	Not extant	Artefact Scatter	Floodplain	5
37-3-0614	Bowmans Creek 2	317816	6409176	Not extant	Artefact Scatter	Floodplain/lower slope	4
37-3-0615	Bowmans Creek 3	317989	6408929	Not extant	Artefact Scatter	Floodplain	2
37-3-0616	Bowmans Creek 4	317685	6409678	Not extant	Artefact Scatter	First terrace/base of footslope	8
37-3-0617	Bowmans Creek 5	318014	6409872	Extant	Quarry/PAD/Artefact Scatter	Ridge crest	15
37-3-0618	Swamp Creek 1	318147	6409247	Not extant	Isolated Find	Modified floodplain (now slope)	1
37-3-0619	Swamp Creek 2	318327	6408928	Not extant	PAD	Modified floodplain (now slope)	6
37-3-0620	Swamp Creek 3	318178	6409390	Not extant	PAD/Artefact Scatter	Floodplain/creek bank	2
37-3-0621	Swamp Creek 4	318026	6409439	Not extant	Artefact Scatter	Footslope	5
37-3-0622	Swamp Creek 5	318912	6407719	Not extant	PAD/Artefact Scatter	Lower slope	8
37-3-0623	Swamp Creek 6	319739	6409247	Not extant	Isolated Find	Ridge line/upper slope	1
37-3-0624	SwampCreek 7	319597	6408574	Not extant	Artefact Scatter	Lower slope of tributary valley	1
37-3-0625	Swamp Creek 8	318524.02	6410001.455	Not extant	Artefact Scatter	Lower slope	2
37-3-0626	Swamp Creek 12	319378	6409124	Not extant	Artefact Scatter	Lower slope	4
37-3-0627	Swamp Creek 13	319417	6409904	Not extant	Artefact Scatter	Midslope on dam on tributary	3
37-3-0628	BC58	322064	6412146	Not extant	Artefact Scatter	Floodplain	8
37-3-0629	BC55	322185	6411985	Not extant	Artefact Scatter	Lower slope	
37-3-0630	BC50	321407	6412896	Not extant	Artefact Scatter	Spur crest	1
37-3-0631	BC49	321479	6412727	Not extant	Artefact Scatter	Midslope	3
37-3-0632	BC48	321664	6412602	Not extant	Artefact Scatter	Footslope	2
37-3-0633	BC47	320913	6412387	Not extant	Artefact Scatter	Midslope	
37-3-0634	BC46	321018	6413159	Not extant	Artefact Scatter	Upper slope	1
37-3-0635	BC45	321020	6413369	Not extant	Artefact Scatter	Ridge crest	1
37-3-0637	Bettys Creek Stone Arrangement	323618	6413117	Extant	Stone Arrangement	Creek terrace	0
37-3-0642	Liddell Pipeline 1	316646	6414633	Partially extant	Artefact Scatter		
37-3-0643	Bowmans Creek 1 PAD	316669	6414898	Extant	PAD		
37-3-0645	BC44a	321494	6410827	Not extant	Artefact Scatter	Floodplain/drainage line	1
37-3-0646	BC44b	321427	6410732	Not extant	Artefact Scatter	Floodplain/drainage line	2
37-3-0647	BC51	321820	6411403	Not extant	Artefact Scatter	Tributary bank	3
37-3-0648	BC52	321932	6411494	Not extant	Artefact Scatter	Creek bank	11
37-3-0649	BC53	322493	6411450	Not extant	Artefact Scatter	Tributary bank	3
37-3-0650	BC54	322302	6411943	Not extant	Artefact Scatter	Lower slope	1
37-3-0651	BC56	322386	6412267	Not extant	Artefact Scatter	Spur crest	2
37-3-0652	BC57	322322	6412220	Not extant	Artefact Scatter	Spur crest	1

AHIMS number	Site name	MGA Easting	MGA northing	status	Site type	Landform	# of artefacts
37-3-0653	BC59	323423	6413553	Not extant	Artefact Scatter	Crest of spur line	11
37-3-0654	BC60	323349.041	6412769.454	Not extant	Artefact Scatter	Upper slope	2
37-3-0655	BC61	323306	6412535	Not extant	Artefact Scatter	Midslope	3
37-3-0656	BC62	323232	6412080	Not extant	Artefact Scatter	Midslope	1
37-3-0657	BC63	321592	6411166	Not extant	Artefact Scatter	Floodplain/drainage line	10
37-3-0658	BC64	321712	6411072	Not extant	Artefact Scatter	Floodplain/drainage line	1
37-3-0659	BC65	321796	6410542	Not extant	Artefact Scatter	Floodplain/drainage line	2
37-3-0660	BC66	321615	6410709	Not extant	Artefact Scatter	Floodplain/drainage line	2
37-3-0661	BC67	321964	6411392	Not extant	Artefact Scatter	Slope	2
37-3-0662	MC-1	324195	6412633	Not extant	Artefact Scatter	Floodplain	5
37-3-0663	MC-2	324256	6412409	Not extant	Artefact Scatter	Floodplain	35
37-3-0664	MC-3	324928	6412370	Not extant	Artefact Scatter	Floodplain	15
37-3-0665	MC-4	324302	6412279	Not extant	Artefact Scatter	Floodplain	11
37-3-0666	MC-5	324280	6412043	Not extant	Artefact Scatter	Floodplain	<16
37-3-0667	MC-6	324202	6411840	Not extant	Artefact Scatter	Floodplain	>600
37-3-0668	Swamp Creek PAD	320255	6410664	Extant	Artefact Scatter		
37-3-0670	Liddell Pipeline	316646	6414633	Partially Not extant	Artefact Scatter	Midslope/lower slope/high bench	
37-3-0691	Mt Owen(1996) 7	320145	6415879	Extant	Artefact Scatter	Valley margin/hillslope	33
37-3-0692	Mt Owen(1996) 16	320265	6416129	Extant	Artefact Scatter	Creek bank/hillslope	42
37-3-0693	Mt Owen(1996) 19	319965	6415939	Extant	Artefact Scatter	Creek	18
37-3-0694	Mt Owen(1996) 23	319675	6415559	Extant	Artefact Scatter	Gully	9
37-3-0695	Mt Owen(1996) 25	320045	6415779	Extant	Artefact Scatter	Footslope	19
37-3-0696	GCS10	321978	6409747	Extant	Artefact Scatter	Lower slope	1
37-3-0697	GCS9	321992	6410450	Extant	Artefact Scatter	Crest	1
37-3-0698	GCS8	322383	6409981	Extant	Artefact Scatter	Drainage depression	1
37-3-0700	GCS-9	322469	6409945	Extant	Artefact Scatter	Crest	1
37-3-0701	GCS-10	321979	6409995	Extant	Artefact Scatter	Upper to lower slopes	11
37-3-0702	Forest East Offset 1 (FEO 1)	323984.048	6414421.447	Extant	PAD/Artefact Scatter	Creek terrace	9
37-3-0703	Forest East Offset 2 (FEO 2)	323991.048	6414828.446	Extant	Artefact Scatter	Flat on spur	3
37-3-0704	Forest East Offset 3 (FEO 3)	323943.048	6413945.449	Extant	Artefact Scatter	Spur	2
37-3-0705	Northeast Offset 1 (NEO 1)	323316.046	6416779.441	Extant	PAD/Artefact Scatter	Lower slope	30
37-3-0706	Northeast Offset 2 (NEO 2)	323393.046	6416884.441	Extant	Artefact Scatter	Lower spur slope	3
37-3-0707	Northeast Offset 3 (NEO 3)	323417.046	6416986.44	Extant	Artefact Scatter	Lower spur slope	2

AHIMS number	Site name	MGA Easting	MGA northing	status	Site type	Landform	# of artefacts
37-3-0708	Northwest Offset 1 (NWO 1)	321618.041	6416359.443	Extant	PAD/Artefact Scatter	Lower slope	81
37-3-0726	Yorks Creek (Mt Owen Mine) 1	320271	6416119	Extant	Artefact Scatter	Hill	4
37-3-0727	Yorks Creek (Mt Owen Mine) 2	319085	6414389	Extant	Artefact Scatter	Creek bank	12
37-3-0728	Yorks Creek (Mt Owen Mine) 3	320137	6415919	Extant	Artefact Scatter	Creek bank	13
37-3-0729	Yorks Creek (Mt Owen Mine) 4	319265	6414649	Extant	Artefact Scatter	Creek flat	90
37-3-0730	Yorks Creek (Mt Owen Mine) 5	319964	6415923	Extant	Artefact Scatter	Slope	12
37-3-0731	Yorks Creek (Mt Owen Mine) 6	319403	6415765	Extant	Artefact Scatter	Creek bank	43
37-3-0732	Yorks Creek (Mt Owen Mine) 7	319135	6416134	Extant	Artefact Scatter	Hill	22
37-3-0733	Yorks Creek (Mt Owen Mine) 8	319329	6416187	Extant	Artefact Scatter	Flat on spur	1
37-3-0734	Yorks Creek (Mt Owen Mine) 9	319451	6416082	Extant	Artefact Scatter	Gentle slope	
37-3-0735	Yorks Creek (Mt Owen Mine) 10	319707	6415600	Extant	Artefact Scatter	Flat on spur	1
37-3-0773	Swamp Ck 10	319005.022	6411167.455	Not extant	Artefact Scatter	Lower slope	1
37-3-0921	MCISO1	324228	6410295	Extant	Isolated Find	Crest of creek terrace	1
37-3-0922	MCISO2	324255	6410311	Extant	Isolated Find	Creek terrace/crest landform	1
37-3-0923	MCISO3	324200	6410232	Extant	Isolated Find	Creek terrace/crest landform	1
37-3-0985	REA89	317742	6409391	Extant	Artefact Scatter	Gently inclined slope	1
37-3-1005	REA124	317982	6408615	Extant	Artefact Scatter	Stream bank	1
37-3-1009	REA131	318080	6408179	Extant	Artefact Scatter	Flat	1