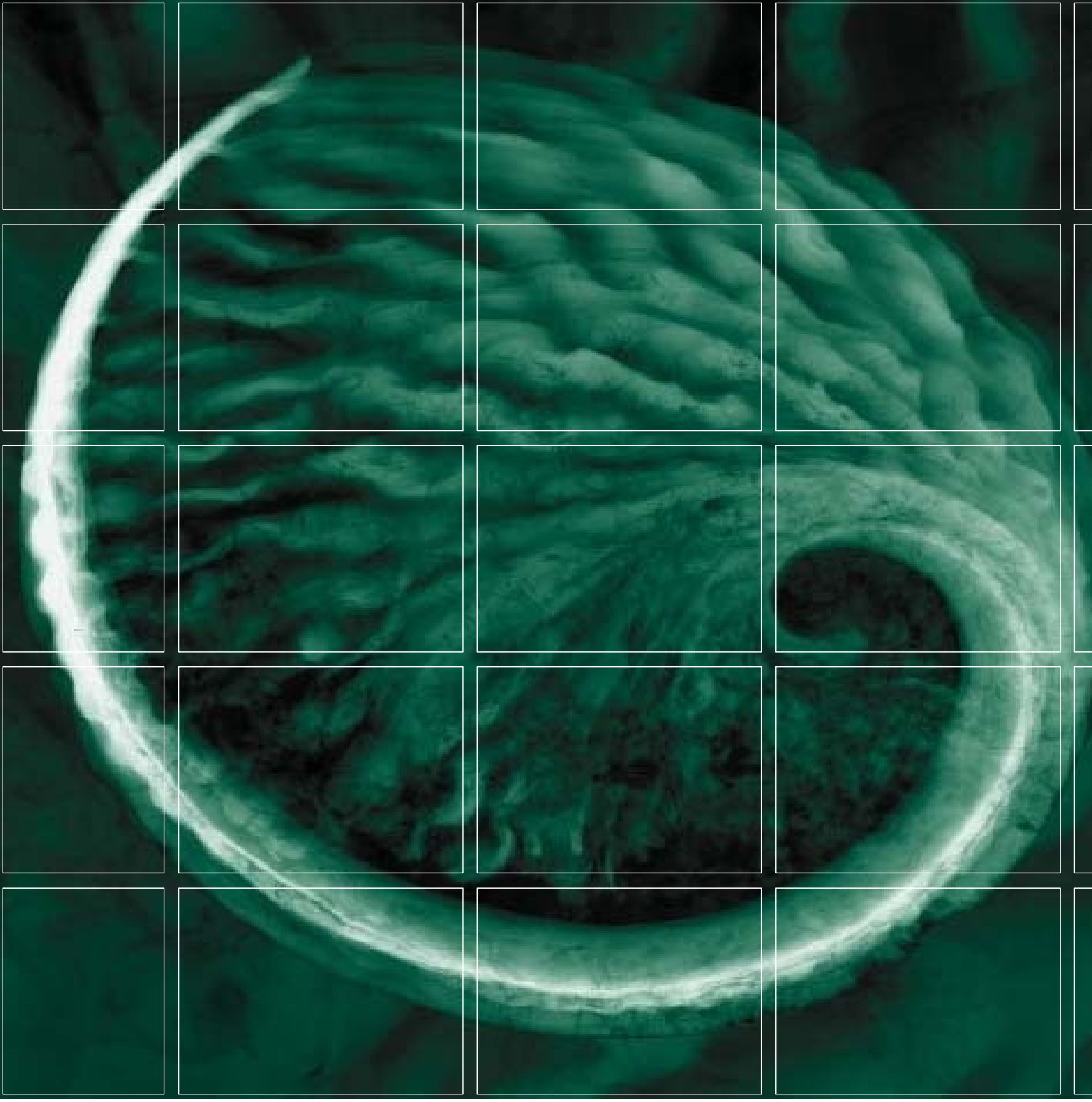
ANNEX F

Cultural Heritage Assessment (ERM 2006b)



Glennies Creek Colliery Longwall Panels Ten to Seventeen

Cultural Heritage Assessment

Integra Coal Operations Pty Ltd

April 2007

0047481 Final

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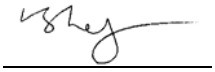
Approved by:	*Joanne Woodhouse*
Position:	Project Manager
Signed:	
Date:	*18 April, 2007*
Approved by:	*Mike Shelly*
Position:	Project Director
Signed:	
Date:	*18 April, 2007*

Environmental Resources Management Australia Pty Ltd Quality System

Glennies Creek Colliery Longwall Panels Ten to Seventeen

Cultural Heritage Assessment

Integra Coal Operations Pty Ltd

April 2007

0047481 Final

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1 INTRODUCTION

1.1 INTRODUCTION

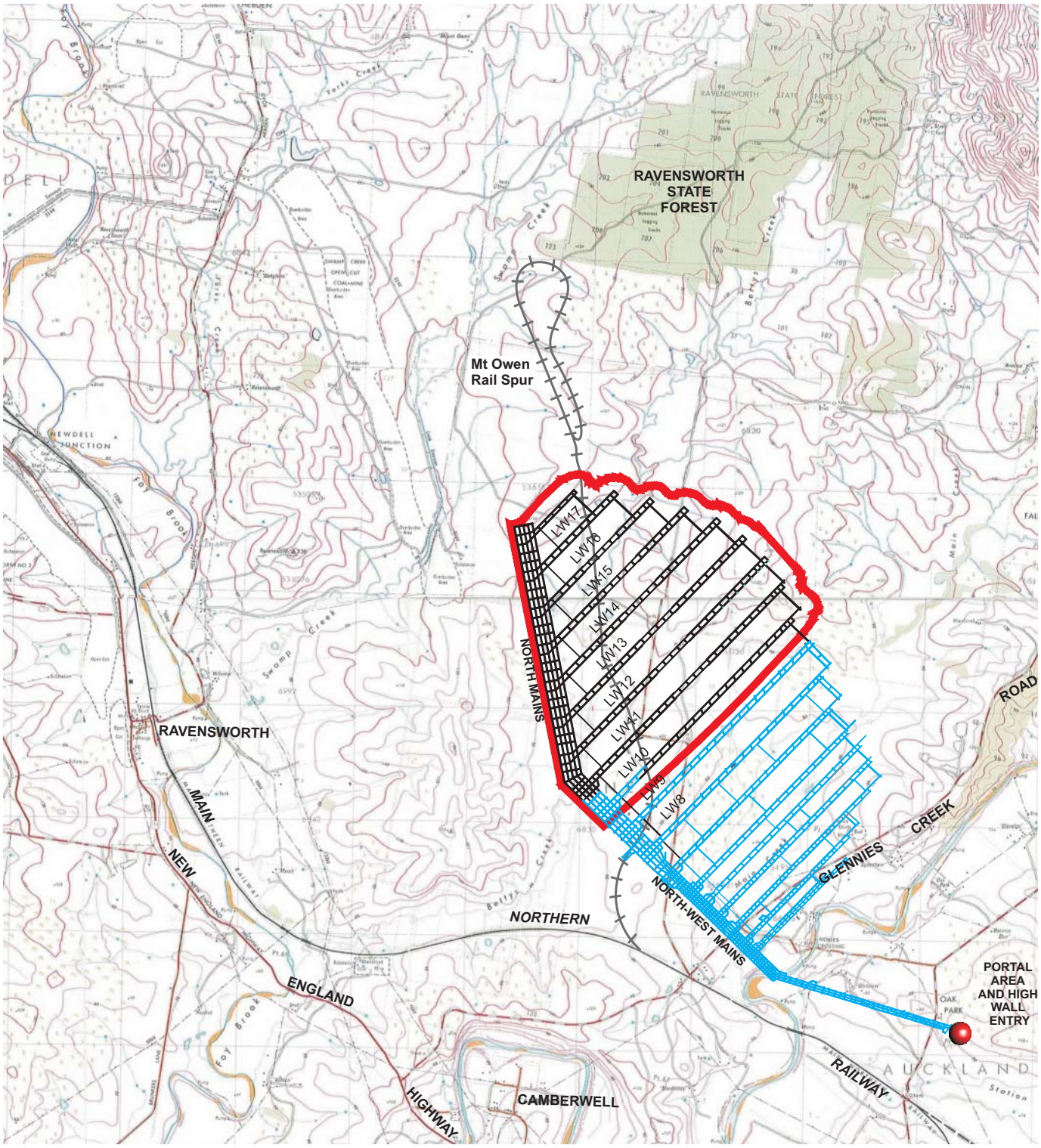
Glennies Creek Coal Management Pty Ltd (GCCM) proposes to conduct underground mining in Longwall Panels 10 to 17 within the Glennies Creek Coal Lease, Hunter Valley, New South Wales. As mining-induced subsidence has the potential to impact upon cultural heritage, GCCM commissioned Environmental Resources Management Australia Pty Ltd (ERM) to conduct a cultural heritage assessment of the Application Area (defined by a 26.5° angle of draw from the extremities of the longwall panels to be extracted). This report provides the finding of the cultural heritage assessment and presents cultural heritage impact management and mitigation recommendations. This report will support a Part 3A application for the proposed development.

All survey work was undertaken for this assessment was originally commissioned to support the Subsidence Management Plan (SMP) for Longwalls 10 to 17 that was submitted to the Department Primary Industries (Minerals) in January 2007.

1.2 THE STUDY AREA

The study area comprises approximately 600 ha situated above and adjacent to Longwall Panels 10 to 17 within the Glennies Creek Coal Lease (CL 382), approximately three kilometres north-east of Camberwell in the Upper Hunter Valley (refer to *Figure 1.1*). The study area incorporates all areas of potential subsidence associated with the mining of these panels, together with all areas of surface disturbance associated with the installation of boreholes to drain mine gas from those panels. The Glennies Creek Colliery is located adjacent to or in the vicinity of a number of other existing and proposed coal mining operations including the Mt Owen Mine, the Ravensworth Mine and the Glendell operation, all of which have been the subject of archaeological investigations (refer to *Figure 1.2*).

Archaeological investigations (ERM 1998, 2002; Umwelt 2003a, 2004b, 2004c, 2005, in prep) have recently been conducted within portions of the study area. Following consultation with the Department of Environment and Conservation (DEC), the portions of the study area that had been previously assessed were not included in the field survey. The area assessed during the field survey, hereafter referred to as the survey area, is shown in *Figure 1.2* and covered approximately 140 ha.



Legend

- Study Area
- Existing Mine Workings
- Proposed Mine Workings (Mains and Gateroads)

Figure 1.1

Locality Plan

Client:	Integra Coal Operations Pty Ltd		
Project:	Env. Assessment Glennies Creek Part 3A		
Drawing No:	0047481hv_arch_rev_01		
Date:	13/04/07	Drawing size:	A4
Drawn by:	JD	Reviewed by:	JW
Source:	1:25000 Topo Series, Camberwell Sheet		
Scale:	Refer to Scale Bar		

0 500m 1 1.5km

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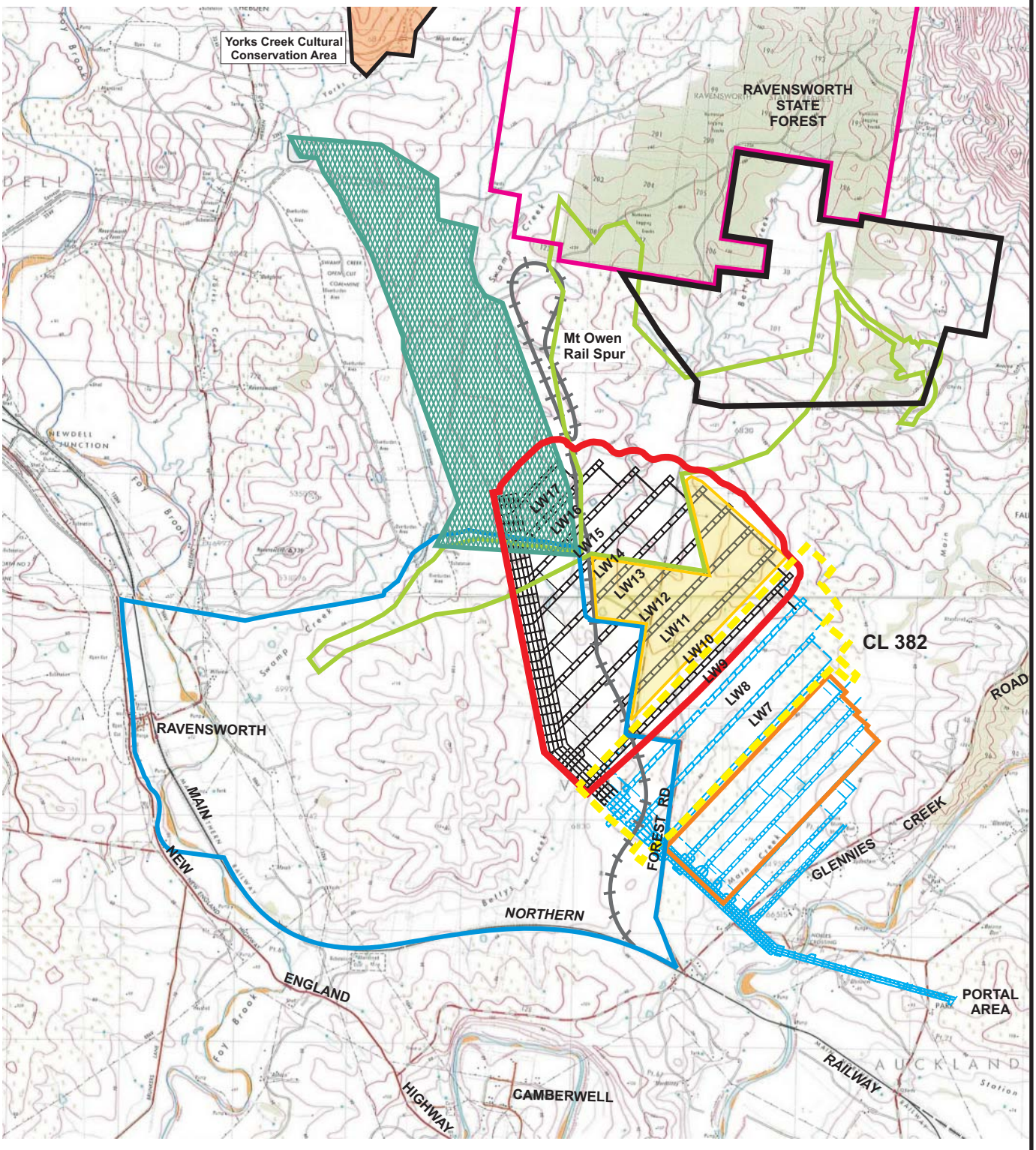

Legend

- Glendell Project Area
- Resource Planning 1993
- Study Area
- Mt Owen Survey Area
- ERM 1998
- ERM 2005
- Main Creek (Umwelt 2004b) Project Area
- Resource Planning 1991
- Existing Mine Workings
- Proposed Mine Workings (Mains and Gateroads)
- 2006 Survey Area

Figure 1.2

Location of Archaeology Survey Area

Client:	Integra Coal Operations Pty Ltd		
Project:	Env. Assessment Glennies Creek Part 3A		
Drawing No:	0047481hv_Arch_rev_02		
Date:	10/04/07	Drawing size:	A4
Drawn by:	JD	Reviewed by:	JW
Source:	LPI 1:25 000 Topo Camberwell Sheet		
Scale:	Refer to Scale Bar		

0 500m 1 1.5km

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1.3 THE PROPOSED DEVELOPMENT

GCCM propose to undertake underground mining of Longwall Panels 10 to 17. Underground mining of this type generally results in subsidence of the ground surface, with the severity of subsidence determined by a number of factors. It is predicted that the subsidence over Longwall Panels 10 to 17 will be a maximum of 1.6 m and will result in a trough centred on each longwall panel. As will be discussed in *Section 9,* subsidence may also result in ponding (pooling) of water or surface cracking, with remediation measures potentially necessary to counteract these effects. Each of these impacts have the potential to disturb surface and subsurface artefacts within the study area.

The proposal includes the installation of approximately four gas drainage boreholes per longwall panel to manage gas levels in the mine. The exact location of these gas boreholes is flexible. Each borehole will disturb an area of approximately eight metres by eight metres. Each area will be fenced and include infrastructure such as a venting stack and a fire suppression unit. Under normal circumstances only three to four boreholes will be active at any given time. Once each borehole is no longer required, the infrastructure will be removed, and the area rehabilitated.

1.4 OBJECTIVES

The objectives of the Cultural Heritage assessment were to:

- review the environmental, historical and archaeological context of the study area;
- consult with the Aboriginal community in regard to the social significance of the study area and any Aboriginal sites/objects incorporated within its boundaries;
- undertake a field investigation of the survey area in conjunction with members of the Aboriginal community in order to identify and record any Aboriginal sites/objects and historic heritage items present; and
- review the potential impacts of subsidence and gas drainage borehole installation on the cultural heritage of the study area and, where applicable, provide a discussion and recommendations as to relevant mitigation and management strategies.

1.5 STATUTORY CONTROLS

Aboriginal cultural heritage in New South Wales is primarily protected and managed under the *National Parks and Wildlife Act 1974* (NPW Act). The NPW Act defines an Aboriginal object as any deposit, object or material evidence (not being a handicraft made for sale) relating to Aboriginal habitation of the area that comprises New South Wales. Under Section 90 of the Act, it is an offence to knowingly destroy, deface or damage Aboriginal objects or Aboriginal places (defined under Section 86 of the NPW Act) without the prior written consent of the Director-General of National Parks and Wildlife.

The *Environmental Planning and Assessment Act* 1979 (EP & A Act) also provides protection for cultural heritage. Part 3A of the Act covers the assessment and approvals process for projects that are considered (by the Minister for Planning) to be of State Significance. The Director General, Department of Planning, has deemed an Aboriginal cultural heritage assessment necessary for the project. Approved projects under Part 3A of the Act do not require Section 87 permits or Section 90 consents under the *National Parks and Wildlife Act 1974*.

Other legislation and planning instruments relating to Aboriginal cultural heritage which are of relevance include *The Aboriginal and Torres Strait Islander Heritage Protection Act 1984* (Commonwealth) and the *Singleton Local Environmental Plan 1996*.

1.6 PROJECT TEAM

The field survey was conducted by Nicola Roche (ERM), Joanne Woodhouse (ERM), Samantha Ward (Ungooroo Aboriginal Corporation), Barry French (Wanaruah Local Aboriginal Land Council), Gordon Griffiths (Wonnarua Culture Heritage), Trevor Archbold (Hunter Valley Cultural Consultants), John and Margaret Matthews (Aboriginal Native Title Elder Consultants), Michele Stair (Giwiirr Consultants Pty Ltd) and Thomas Franks (Yarrawalk). This report was prepared by Nicola Roche and reviewed by Neville Baker (ERM).

2 *ABORIGINAL COMMUNITY CONSULTATION*

The involvement and input of the Aboriginal community is an essential component of any Aboriginal cultural heritage assessment. Consultation with the local Aboriginal community was on-going throughout this project as required in the Department of Environment and Conservation (DEC) publication entitled "Interim Community Consultation Requirements for Applicants (2004).

In accordance with the above requirements, the DEC, Singleton Council, the Registrar of Aboriginal Owners, Native Title Services and the Wanaruah Local Aboriginal Land Council (WLALC) were notified of the project and were asked to provide information regarding any parties that may be interested in the assessment. A public notice was also placed in the Newcastle Herald (19 October 2005) requesting that interested parties register in writing.

Table 2.1 lists the groups who provided written notification of their interest in the project. Each was involved from the outset.

Table 2.1 Aboriginal Groups Consulted

Group name	Fieldwork participant
Wonnarua Culture Heritage	Gordon Griffiths
Yarrawalk	Thomas Franks
Giwiirr Consultants	Michele Stair
Aboriginal Native Title Elders Consultants	John and Margaret Matthews
Hunter Valley Cultural Consultants	Trevor Archbold
Wanaruah Local Aboriginal Land Council	Barry French
Ungooroo Aboriginal Corporation	Samantha Ward

A copy of the draft report was provided to all of the registered groups for comment. Written responses from the groups is included in *Annex A* of this final document.

3 ENVIRONMENTAL CONTEXT

3.1 INTRODUCTION

Environmental factors affect the way in which people go about their daily life and may also impact on the preservation of the archaeological record. This is particularly relevant to Aboriginal people in the past because, as hunter-gatherers, their choices were influenced by the availability of local resources. Alterations to the natural environment also impact upon the preservation and integrity of any cultural materials that may have been deposited, whilst current vegetation and erosional regimes affect the visibility and detectability of sites and relics. Environmental factors are therefore very important when interpreting the archaeological record. Five aspects of the environment are discussed below: geology and soils, topography, water availability, flora and fauna and past land uses and disturbances.

3.2 GEOLOGY AND SOILS

The study area is situated on the Jerrys Plains and Vane Subgroups of the Permian period Wittingham Coal Measures, with Quaternary alluvium present in association with Bettys Creek (refer to 1:100 000 Hunter Coalfield Sheet 90033). Material types in these Sub-groups include tuffaceous claystone, siltstone, sandstone, conglomerate, shale, silt, sands and gravels. Materials of these types may outcrop within the study area and may be exposed within watercourses. Raw materials suitable for the manufacture of stone artefacts include cobbles of mudstone, silcrete and other, less frequently occurring rock types that are available along the Hunter River (Umwelt 2004a).

The soils within the study area belong to the Bayswater and Hunter soil landscapes. The Bayswater soil landscape is formed on undulating low hills from in-situ weathered sandstone, shale, mudstone, conglomerate and coal. Slopes within this landscape are susceptible to moderate sheet and gully erosion and the soils are moderately alkaline to moderately acidic (Kovac and Lawrie 1991:84-85). Soils of the Hunter soil landscape are alluvial and deposited in association with the floodplains along Glennies and Bettys Creeks. The alluvium and clays associated with this soil landscape are weakly to moderately alkaline (Kovac and Lawrie 1991:212-213).

3.3 TOPOGRAPHY

The study area can be divided into landform elements based on the ten morphological units described by Speight (1998). For archaeological investigations, they divide the landscape into standardised elements that can be used for comparative purposes.

Six landform units were identified within the study area (refer to *Figure 3.1*): crests, slopes, flats (subdivided to distinguish between alluvial and non-alluvial flats) and open depressions (divided into minor unnamed drainage lines and Bettys Creek).

3.4 WATER AVAILABILITY

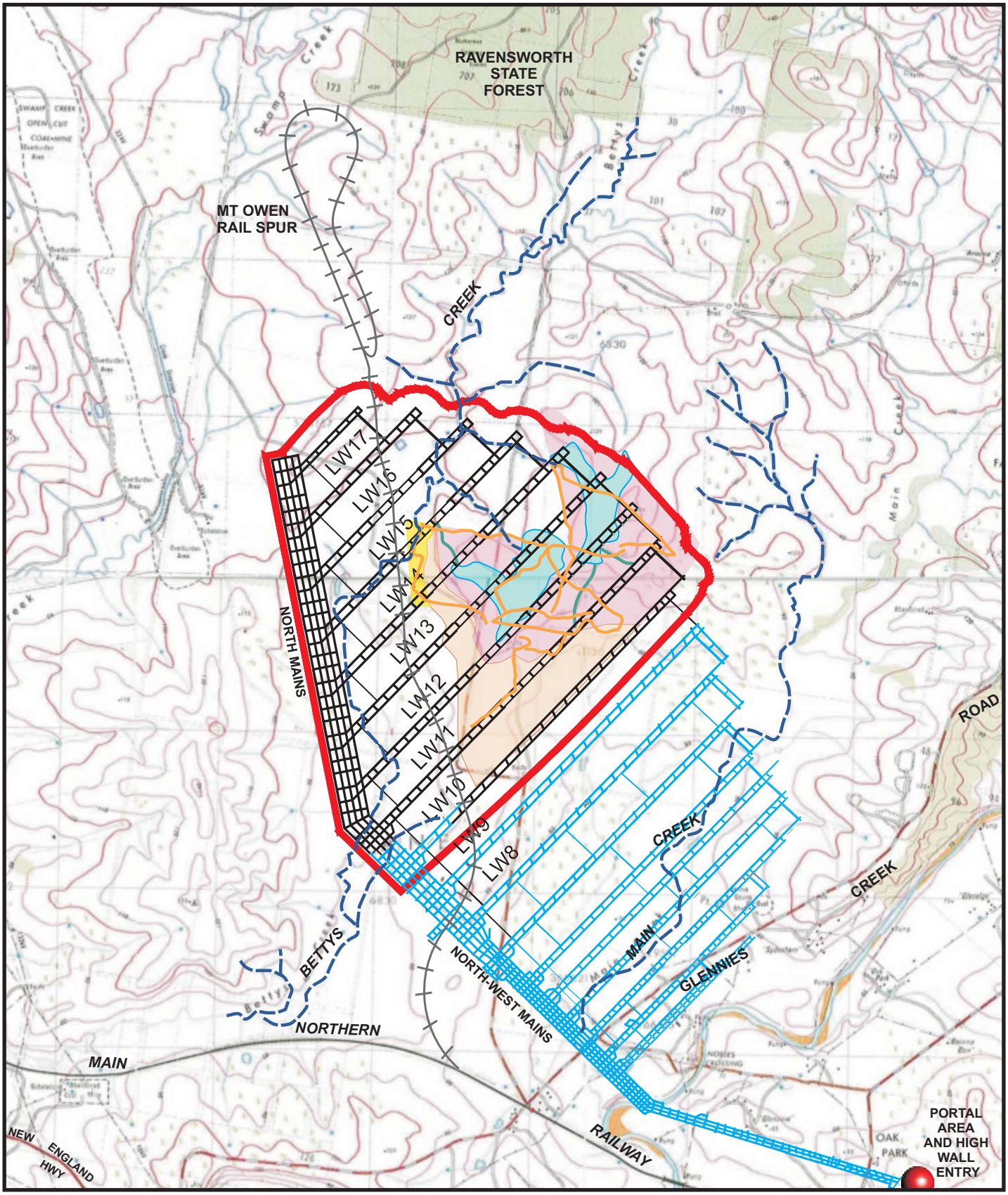
The study area is situated within the well-watered environs to the north of the Hunter River. The study area includes a very small portion of Bettys Creek, an associated ephemeral drainage line and two ephemeral drainage lines in the north-east of the study area. Main Creek is less than 700 m to the south-east of the study area and the lower portion of Glennies Creek (formally known as Fal Brook) is less than three kilometres to the south-east.

Bettys Creek is a third order watercourse which flows freely during periods of rainfall but, during drier periods, retains water only in large waterholes (Umwelt 2003a). Mitchell (Umwelt 2004a: Appendix 2) suggests that Bettys Creek would originally have had a 'chain of ponds' form in which the watercourse consisted of a series of ponds linked by drainage channels. Water flow would only have occurred during periods of high rainfall, with the ponds acting as a permanent water source outside these times. The subsequent changes to creek morphology represent the impacts of increased runoff, erosion and sedimentation due to land clearance and agricultural practices.

The Hunter River is approximately seven kilometres south of the study area. During the pre-contact period, it is likely that the Hunter River also had a narrower and deeper structure and was a reliable source of water except in periods of severe drought (ERM 2004:27).

3.5 FLORA AND FAUNA

Although the majority of the study area has now been cleared for farming purposes, vegetation outside the creekline areas would previously have consisted of savannah woodland (Kovac Lawrie 1991:24). Prior to European settlement, riparian vegetation would have dominated the main creeks and rivers within the area and would have provided important floral resources for the Aboriginal people (ERM 2004:29). Within the study area, the Bettys Creek 'chain of ponds' would have consisted of waterholes and grassy meadows supporting a variety of plants and animals that would have provided food for people living in the area. The animals may have included various macropod



Legend

- Study Area
- Existing Mine Workings
- Proposed Mine Workings (Mains and Gateroads)
- Survey Transect
- Crests
- Slopes
- Flats
- Alluvial Flats
- Drainage Lines
- Creek

Figure 3.1

Landform Elements within the Study Area

Client:	Integra Coal Operations Pty Ltd		
Project:	Env. Assessment Glennies Creek Part 3A		
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Date:	10/04/07	Drawing size:	A4
Drawn by:	JD	Reviewed by:	JW
Source:	LPI 1:25 000 Topo Camberwell Sheet		
Scale:	Refer to Scale Bar		

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species and a range of other small mammals, reptiles and birds. Currently, remnant bull oak, casuarina and white box communities are clustered along Bettys Creek and its tributaries.

3.6 PAST LAND USES AND DISTURBANCES

The majority of the study area has been cleared for agricultural purposes, which has affected the archaeological record both directly and indirectly. The removal of large trees results in the destruction of scarred or carved trees that may have been present and may also cause the disturbance of subsurface deposits. Ploughing and construction of drainage contours and other features may also cause the destruction or movement of artefacts. Land clearance also enhances erosion, which in turn exposes and potentially disturbs archaeological deposits.

As discussed in *Section 3.4*, increased water run-off and erosion associated with land clearance and farming has also affected the structure of creeks within the area. Consequently, the banks of Bettys Creek are likely to have altered through time, with the subsequent removal of archaeological material.

The north-western portion of the study area falls within the current workings of the Ravensworth East/Swamp Creek open cut mine and has been subjected to wholesale disturbance. The Glendell open cut mine lease extends into the western portion of the study area and, although archaeological investigations have been carried out in this area, the mine is not yet operational. The north-eastern portion of the study area is within the Mt Owen colliery holding and has been subject to disturbance associated with mine operations. As part of ongoing operations at Mt Owen mine, Bettys Creek will be diverted within the study area. This will take place as a staged process to be concluded by the end of 2007 and will involve significant surface and subsurface impacts including the construction of alternative channels for water flow.

4 ARCHAEOLOGICAL AND HISTORICAL CONTEXT

4.1 ABORIGINAL ARCHAEOLOGICAL CONTEXT

4.1.1 Regional Archaeological Context

Storey *et al.* (1963) divided the Hunter Valley into a number of sub-regions, with the study area included within the Central Lowlands. By far the bulk of the archaeological investigations in this region have been carried out in the Upper Hunter area of the Central Lowlands in relation to development projects, primarily those associated with the mining industry. A number of reports incorporate a review of previous archaeological work undertaken throughout the region (refer to Hughes 1984; Kuskie 2000; Australian Museum Business Services (AMBS) 2002; MCH 2004; ERM 2004).

In regard to the antiquity of Aboriginal occupation, evidence of late Pleistocene use of the region by Aboriginal people has been reported at a number of sites, namely Glennies Creek (which is situated in very close proximity to the study area), Lemington and Warkworth West (Koettig 1987; Kuskie 2000; AMBS 2002; ERM 2004:15). Whilst the representation of Pleistocene sites in the region appears to be low, it should not be assumed that this apparent paucity of dated sites reflects a lack of human activity. Based on the current models for the peopling of Australia and the evidence from surrounding regions, it seems likely that the Hunter Valley was initially occupied at some time between 20,000 and 40,000 years ago (ERM 2004:68). A number of artefact scatters within the Central Lowlands have been absolutely dated (via radiocarbon or thermoluminesence determinations) to the late Holocene period (Attenbrow 2004:352). The proposed geomorphological age of the upper soil units in texture contrast soils and the presence of backed artefacts have also been considered as grounds to date the bulk of sites within the area to the mid-late Holocene (Umwelt 2003a:3.2).

Sites within the region include a range of types, namely scarred trees, rock shelters, grinding grooves, engravings, artefact scatters, isolated artefacts, quarries, shell middens, stone arrangements, bora grounds, burials and natural/mythological sites. Of these, artefact scatters and isolated artefacts are by far the most common site types. The vast majority of these sites are situated in close proximity to creeks and major drainage lines, with artefact densities typically greatest along creeklines and watercourses (ERM 2004:52).

Mudstone/indurated tuff (refer to ERM 2004:30) is the most common lithic raw material, followed by silcrete. Chert, quartz, quartzite, petrified wood, porcellanite, hornfels, porphyry and basalt also occur in smaller quantities. The gravel bed of the Hunter River is likely to have been the source of most of these raw materials, although other possible raw material sources have been identified along smaller watercourses.

In general terms, the most common artefact types are flakes, flake fragments and flaked pieces, which are generally considered to be debitage or waste produced during tool production and curation. Cores, edge-ground axes, millstones, grindstones, hammerstones and retouched and backed artefacts (including symmetrical and assymetrical backed artefacts), eloueras and scrapers also occur, though in lower frequencies.

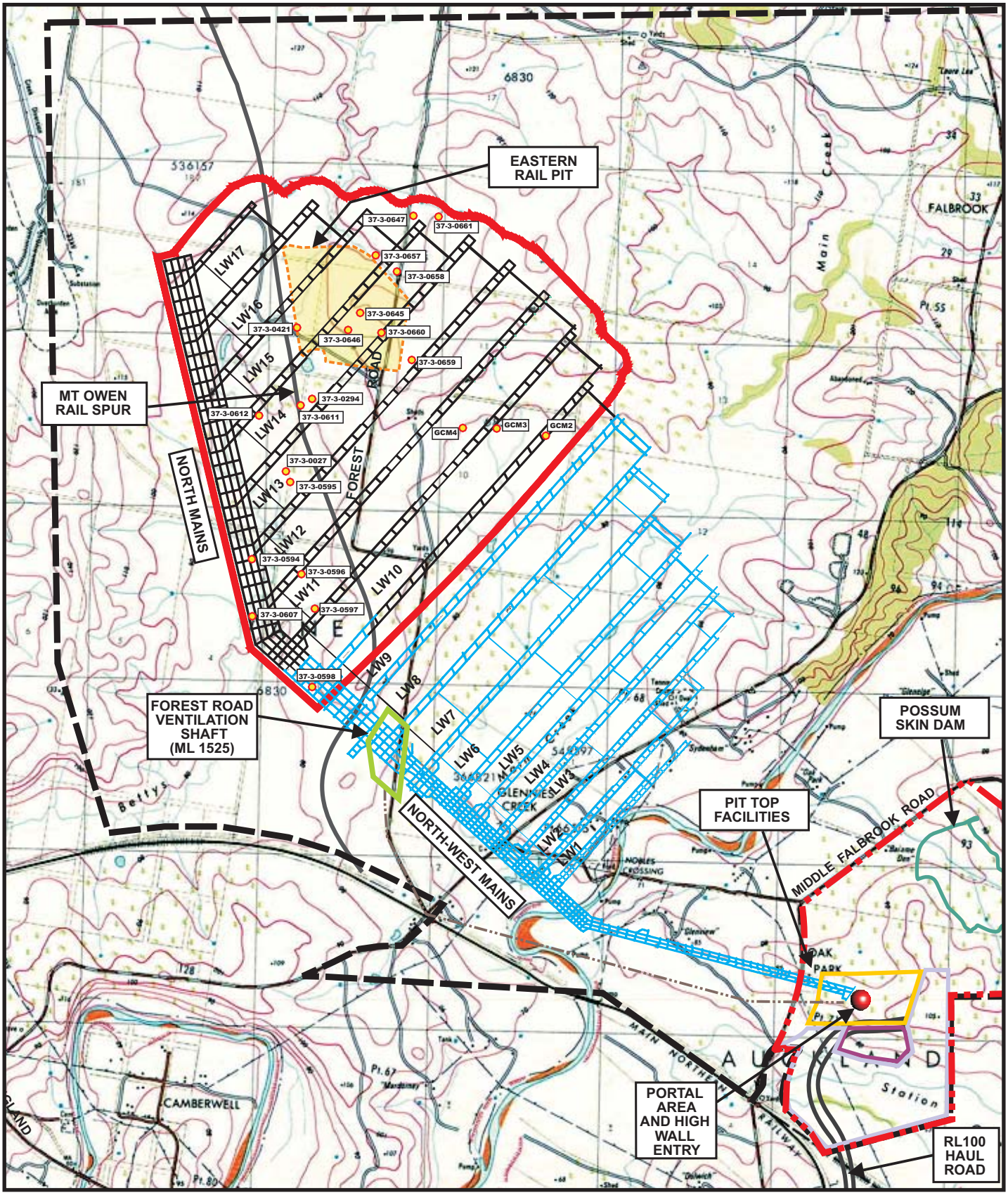
Within the Sydney Basin (of which the Central Lowlands is a part), backed artefacts have been found in securely dated contexts from the early Holocene period and become considerably more common during the mid Holocene (Hiscock and Attenbrow 1998:58). The presence of backed artefacts in Hunter Valley open sites has commonly been used by archaeologists to date artefact scatters or isolated finds to the mid Holocene (refer to Kuskie and Kamminga 2000).

Based on the results of the range of studies conducted within the Central Lowlands, the following general statements can be made regarding archaeological patterning within the region.

- A wide variety of site types are represented, with the vast majority being artefact scatters and isolated artefacts.
- A range of stone artefacts were primarily manufactured from mudstone/tuff and silcrete with a variety of other raw materials also utilised to a lesser extent.
- A greater proportion of stone artefact scatters are situated in close proximity to permanent water.
- The probability of finding artefact scatters with higher artefact densities (and therefore greater research potential) increases significantly in close proximity to permanent water.

4.1.2 Results of DEC AHIMS Search

A search of the DEC Aboriginal Heritage Information Management System (AHIMS) revealed that 342 sites have been recorded in the area between the AMG coordinates 318000E-327000E and 6404000N-6416000N (refer to *Figure 4.1*). The AHIMS database describes sites according to site feature rather than site type and sites may include several different features. Site features present within the study area are shown in *Table 4.1*. The feature 'artefact' refers to the presence of stone, bone, shell, ceramic or metal. Stone artefact scatters or isolated artefacts are by far the most common site within the study area.



Legend

- Study Area
- Existing Mine Workings
- Proposed Mine Workings (Mains and Gateroads)
- CL 382 Boundary
- ML 1525 Boundary
- ML 1518 Boundary
- ML 1551 Boundary
- ML 1437 Boundary
- Powerline to Ventilation Shaft

Aboriginal Site (artefact scatter/isolated artefact)

- GCM — ERM 2006 Survey
- 37-3-0612 — AHIMS Database Results

Figure 4.1

Identified Sites within the Study Area

Client:	Integra Coal Operations Pty Ltd		
Project:	Env. Assessment Glennies Creek Part 3A		
Drawing No:	0047481hv_Arch_rev_04		
Date:	16/04/07	Drawing size:	A4
Drawn by:	JD	Reviewed by:	JW
Source:	1:25,000 Topographic Series- Camberwell		
Scale:	Refer to Scale Bar		

0 250 500 750m

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Table 4.1 AHIMS Registered Sites

Site Feature(s)	Number of sites
AFT (artefact)	329
TRE (carved or scarred tree)	1
STA (stone arrangement)	2
ART (Art)	1
AFT/PAD (artefact/potential archaeological deposit)	9
Total	342

1. Based on DEC AHIMS searches on 8/12/04 and 16/05/06.

Twenty-two previously identified sites are located within the study area (refer to *Table 4.2)*. These include AHIMS registered sites and sites recorded during a previous survey (ERM 2005) but not yet listed on the AHIMS database (refer to *Figure 4.1*).

Table 4.2 Sites Recorded within the Study Area

Site number	Site name	Site feature(s)	Permits issued for site
37-3-0027[1]	Glennies Creek Site C/Bettys Creek – C	AFT	None
37-3-0294[1]	Site 2/MORL2	AFT	None
37-3-0421[1]	Rav East 22	AFT	None
37-3-0594[1]	Bettys Creek 4	AFT	2267
37-3-0595[1]	Bettys Creek 5	AFT	2267
37-3-0596[1]	Bettys Creek 6	AFT	2267
37-3-0597[1]	Bettys Creek 7	AFT	2267
37-3-0598[1]	Bettys Creek 8	AFT	2267
37-3-0607[1]	Bettys Creek 17	AFT	2267
37-3-0611[1]	Bettys Creek 21	AFT	None
37-3-0612[1]	Bettys Creek 22	AFT	None
37-3-0645[1]	BC44a	AFT	2123
37-3-0646[1]	BC44b	AFT	2123
37-3-0647[1]	BC51	AFT	2267
37-3-0657[1]	BC63	AFT	2267
37-3-0658[1]	BC64	AFT	2267
37-3-0659[1]	BC65	AFT	2267
37-3-0660[1]	BC66	AFT	2267
37-3-0661[1]	BC67	AFT	2267
[2]	GCS8	AFT	None
[2]	GCS9	AFT	None
[2]	GCS10	AFT	None

1. From AHIMS search 16/05/06.
2. From ERM 2005. Not yet registered.
3. AFT = Artefact

Of these sites, 37-3-0594, 37-3-0595, 37-3-0596, 37-3-0596, 37-3-0597, 37-3-0598, 37-3-0607, 37-3-0645, 37-3-0646, 37-3-0647, 37-3-0657, 37-3-0658, 37-3-0659, 37-3-0660 and 37-3-0661 have all been the subject of Section 90 consents. Salvage excavations were conducted at locations within the Mt Owen lease whilst additional locations along Bettys Creek within the Glendell lease have also been the subject of excavations (refer to *Section 4.1.3* below).

Site 37-3-0027 could not be relocated by Umwelt (2004b) and it was recommended that the site should be managed under an Aboriginal Heritage Management Plan for the Glendell mine. Site 37-3-0421 was assessed by ERM (1999) as being of low to medium significance and it was recommended that the proposed test excavations within the Ravensworth East mine lease (as conducted by ERM 2002) would mitigate against any impacts at this site. Sites 37-3-0294, 37-3-0611 and 37-3-0612 were assessed by Umwelt (2004b) as being of low significance. These sites were not within the area to be impacted by the proposed Glendell mining activities and it was recommended that they should be managed under an Aboriginal Heritage Management Plan for the Glendell mine. It is understood that this plan is currently in preparation.

4.1.3 Local Archaeological Context

The area between Ravensworth and Glennies Creek has been the subject of numerous archaeological investigations (AMBS 1997; Koettig 1987; Dean-Jones 1991, 1992; Resource Planning 1991, 1993; ERM 1995). Most of the study area (refer to *Figure 1.2*) has been included within previous archaeological assessments for the surrounding coal mines at Glendell (Umwelt 2004b, 2004c, 2005, in prep), Mt Owen (Umwelt 2003a, 2004a, 2004b), Ravensworth East (ERM 1999) and Longwall Panels 7 to 9 of the Glennies Creek Coal Mine (ERM 2005). The most relevant of these studies are summarised below.

AMBS (1997)

Following the recommendations of a Resource Planning (1993) assessment of the proposed extension to the Mt Owen coal mine, excavations were conducted at sites located along Bettys Creek, to the north-east of the present study area. As a component of the study, geomorphological investigations were carried out and determined that topsoils along Bettys Creek were derived from the fluvial deposition of weathered sandstone from outcrops on the nearby slopes and spurs. That study concluded that sites located on the lower gentle slopes and creek flats were likely to be preferentially preserved in comparison to those on the slopes and spurs (AMBS 1997:17-18).

A test excavation program across a variety of landforms at varying distances from Bettys Creek was undertaken to examine the hypothesis that sites would be concentrated within 30 metres of creeklines (AMBS 1997:21-22). Of the excavated artefacts, 64 percent were within 10 metres of Bettys Creek and 97 percent were within 30 metres of Bettys Creek (AMBS 1997:29). There was no detectable patterning in artefact distribution, with clusters of increased

artefact density occurring at various locations along Bettys Creek (AMBS 1997:29).

The excavated artefacts were compared with artefacts from sites along Yorks Creek, Bayswater Creek and Swamp Creek and showed that heavily reduced cores were markedly more common along Bettys Creek. AMBS (1997:46-47) suggested that the excavated sites may have been used as activity specific locales as opposed to residential base camps and that the occupation of sites along Bettys Creek represented short-term site use.

ERM (1999)

This assessment was conducted in relation to the proposed extension of the Ravensworth East Mine (formerly Swamp Creek Coal Mine) at Ravensworth (refer to *Figure 1.2*) and included a portion of the present study area.

Thirty sites were recorded, five of which may have been previously recorded by Dean-Jones (ERM 1999:51). All sites were isolated artefacts or artefact scatters, with the bulk of sites (80%) containing 10 or fewer artefacts (ERM 1999:73). The majority of sites were located on drainage lines and slopes, with a general tendency for isolated artefacts to be more common on slopes and areas over 200 m from water. Sites with the greater numbers of artefacts were located within 30 m of drainage lines (ERM 1999:75,83) and the bulk of sites were in close proximity to third order drainage lines in comparison to higher order watercourses (ERM 1999:84).

Mudstone was the dominant raw material recorded during the survey, with silcrete also relatively common. Mudstone was again the most common raw material for artefacts with retouch or usewear. However, the majority of the rarer raw materials (such as chert and basalt) had been retouched or demonstrated signs of use (ERM 1999:80).

At site RE04, ERM (1999:53) reported that two artefacts had been manufactured from a ceramic electrical insulator (ERM 1999:53). Definite post-contact Aboriginal flaked artefacts (that is, made from European materials) are extremely rare within the Hunter Valley (ERM 2004:77). The identification of post-European settlement artefacts is often problematic (refer to Allen and Jones 1999:230) for example, artefacts manufactured from glass or ceramic materials readily fracture conchoidally, thus giving them the appearance of artefacts. As limited information is provided regarding the context in which these artefacts were found and the criteria by which they were identified as artefacts, this evidence requires further confirmation.

In assessing the significance of the Ravensworth East sites, particular emphasis was placed on the contrast between the densities and distributions of sites at Ravensworth East in relation to sites along Yorks Creek, which are more strongly clustered around watercourses (ERM 1999:124-125). This is of particular relevance as Yorks Creek is the subject of a conservation zone and yet does not appear to be entirely representative of archaeological patterning

within the locality. This is viewed as enhancing the representativeness and significance of sites in the Ravensworth East mine lease (ERM 1999:125).

ERM (2002)

This assessment was conducted based on the recommendations provided by ERM (1999) and involved test and salvage excavations of sites along Swamp Creek. Eighty-seven artefacts were retrieved from the manual test pits in the vicinity of sites RE 12-14, with only one test pit containing more than 11 artefacts and less than five artefacts found in the majority of test pits (ERM 2002:43-44). The test pit excavations showed a low density of artefacts across a low rise, with a discrete concentration of material surrounding Test Pit 4 (ERM 2002:45).

Over 1000 artefacts were recovered from the 96 square metre area surrounding Test Pit 4 and comprised a consistent low density scatter with three distinct artefact concentrations surrounding the peak of the rise. ERM (2002:53-54) subsequently interpreted these as three knapping floors associated with the production of geometric microliths and artefact curation/rejuvenation. In comparison to surrounding catchments, there appeared to be a lower artefact density within the Swamp Creek catchment (ERM 2002:6.18).

Umwelt (2003a)

As part of an Environmental Impact Statement for the extension of facilities and operations within the Mt Owen Mine lease, Umwelt (2003a) conducted an archaeological survey of sections of Bettys Creek, Main Creek and the proposed haul road within the Glendell lease.

The survey identified 33 sites comprising a scarred tree and 32 isolated artefacts or artefact scatters. The bulk of sites were concentrated on Bettys Creek, with only one site containing more than 20 artefacts located away from this watercourse. Most sites contained less than 10 artefacts (Umwelt 2003a:7.1). Ninety-five percent of sites in the Bettys Creek catchment were situated within 30 metres of the creekline and artefact density declined in inverse proportion to distance from the creek. There was also an increase in artefact density within the northern portion of Bettys Creek, a pattern which did not correlate with visibility (Umwelt 2003a:7.12).

Cores and retouched flakes were largely found only along the floodplain and therefore, Umwelt (2003a:7.4-7.5) suggested that artefact manufacturing processes were limited to this area. Analysis of the artefact assemblage (including attributes such as platform width and overhang removal) further supported the suggestion that specialised artefact manufacturing locations (including backed artefact 'workshops') were present along Bettys Creek (Umwelt 2003a:7.7.8-7.10). The distribution and nature of archaeological material within the Main Creek catchment was similar to that along Bettys

Creek (Umwelt 2003a:8.2). Site use within the Umwelt study area seems to have been of short duration, with artefact manufacturing activities concentrated along Bettys Creek.

Umwelt (2004a)

This study area was centred on Main Creek and its tributaries, with the survey strategy involving the pedestrian inspection of the watercourses and any additional exposures that were visible. Seven sites (five artefact scatters and two isolated finds) were identified in the study area. All sites were recorded in areas of exposure within 20 metres of a watercourse and contained less than 30 artefacts. Mudstone was the most common raw artefact material, with slightly lesser amounts of silcrete and considerably lesser quantities of volcanic material, petrified wood and quartz. It was suggested that the low number of artefacts may be a factor of visibility (Umwelt 2004a:6.6). However, in light of previously recorded sites within the local area, it may be a true reflection of the low density of artefacts. An additional seven potential archaeological deposits (PADs) were identified in areas within 50 metres of water and broadly associated with the recorded archaeological sites (Umwelt 2004a:7.3).

Umwelt (2004b)

This assessment of the Glendell Mine Lease involved a comprehensive survey of the portions of Bowmans Creek, Bettys Creek and Swamp Creek that were included within the study area. A total of 37 sites were identified, with 30 sites being artefact scatters (one with an associated quarry) and the remainder, isolated artefacts. Twenty two of the sites were located in the Bettys Creek catchment and this area was identified as a potential archaeological deposit. The low number of sites along Bowmans Creek and Swamp Creek was seen as a reflection of the lower visibility along these creeks and the comparatively small area of Bowmans Creek included in the study area (Umwelt 2004b:7.7).

Sites were primarily located within 30 metres of water on the banks of minor watercourses, with major watercourses and alluvial flats/floodplains containing slightly a slightly smaller number of sites. The smaller number of sites along major watercourses (as also identified by ERM 1999:84) seems anomalous given the proposed link between reliable water sources and site location. However, this pattern is conceivably influenced by enhanced visibility along the minor watercourses in comparison to the flats and major creeklines (Umwelt 2004b:7.8).

Over half the sites recorded by Umwelt (2004b) comprised less than 10 artefacts, with less than seven percent of sites containing over 100 artefacts (Umwelt 2004b:7.9). The range of artefacts and raw materials were similar to the standard types for the region, with mudstone and silcrete the dominant raw materials. Although quartz, quartzite and crystalline tuff are available

locally (in conglomerates and the gravel bed of Bowmans Creek), these materials were not heavily used in artefact manufacture (Umwelt 2004b:7.12).

ERM (2005)

This assessment was undertaken as part of the development of a Subsidence Management Plan for Longwall Panels 7 to 9 at the Glennies Creek Colliery. Previous studies (Umwelt 2004b, 2004c, 2005) had already been conducted within the 280 hectare subsidence area above Longwalls 7 to 9 and therefore only 225 hectares were subjected to field survey (ERM 2005:1).

Eight sites (five isolated finds and three artefact scatters) were identified and contained a total of 59 artefacts. Mudstone was the dominant raw material, followed by silcrete, with limited quantities of igneous material, quartz, porcellanite and tuff also recorded. The largest site contained 33 artefacts within an area of 150 m^2, demonstrating that artefact density was relatively low throughout the surveyed area. Three sites were located on slopes, two were in a drainage depression, one was on a crest and two were on a creek bank near the confluence of Main Creek and an unnamed tributary (ERM 2005:24). Two additional sites were recorded but were not included within the report as they were outside the survey area.

Artefact densities were low across the range of landforms within the survey area and several of the major exposures contained no archaeological material. ERM (2005) argued that the sites within the survey area represented a continuous low density background scatter related to transitional movement through the area rather than focussed occupation. Consequently, ERM (2005:32) suggested that subsurface deposits that may remain within the surveyed area would have limited potential to supplement existing knowledge of the area. Conversely, the floodplain and footslopes along Bettys Creek are located along what was a reliable watercourse and may have provided a more suitable location for camping activities. The portion of the study area along Bettys Creek was therefore identified as a potential archaeological deposit.

Umwelt (in prep)

Umwelt (in prep. (a) and (b)) has undertaken mitigation and salvage works at sites within the Mt Owen and Glendell leases. These involved surface collection and subsurface salvage (in the form of grader scrapes and test excavations) at various sites along Bettys Creek, Bowmans Creek and Swamp Creek. With the exception of sites MORL2 (37-3-0294), Bettys Creek 22 (37-3-0612) and Bettys Creek 23 (37-3-0611), all sites and associated areas of potential archaeological deposit along Bettys Creek and its tributaries within the Glendell lease have been salvaged under a Section 90 consent. Within the Mt Owen lease, Sites BC44a and BC44b have been the subject of surface collections and subsurface investigations under a Section 90 consent (consent

#2123), and surface collections have been conducted at Sites BC51, BC52, BC63 to BC67 under a Section 90 consent (consent #2267).

Preliminary findings of these investigations support the suggestion that the floodplain either side of Bettys Creek contains a continuous low density scatter with concentrations of artefacts on slightly elevated areas associated with former swamps, billabongs and at the confluences of tributaries and the main channel. Artefacts were most concentrated in the upper reaches of Bettys Creek on a gentle lower slope associated with a swamp that formed approximately 4000 years ago and was drained during the early years of European settlement (Jan Wilson pers.comm).

4.1.4 Settlement Models Emerging from Previous Archaeological Research

Umwelt (2005) identified two major models for Aboriginal activity along Bettys Creek, namely those proposed by AMBS (1997) and Umwelt (2005). The first of these was formulated by AMBS (1997: Appendix A) on the basis of excavations at Bettys Creek within the Mt Owen lease (as discussed above). Based on the results of the excavations, AMBS (1997: Appendix A:108) argued that sites along the creekline 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.

The main signatures of the two models are summarised in *Table 4.3*.

Table 4.3 Hypothesised Archaeological Signatures for Bettys Creek Occupation Models

Risk Prone Winter Occupation (based on AMBS 1997Appendix 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.	Flake attributes will include platform faceting, overhang removal and multiple dorsal scars.
Cores will show evidence of rotation.	Cores will show evidence of rotation.
Sites will be concentrated on swamp locations, with limited evidence elsewhere.	Sites will be located 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.

1. Based on Umwelt (2005:3.7-3.9)

The primary consideration with both of these models is the availability of lithic resources for the manufacture of stone artefacts. The Hunter River, the primary source of stone for the manufacture of artefacts, is within 5 km of Bettys Creek in the lower portion of the Glendell lease and 7 km of the lower section of the Mt Owen lease. Thus, the acquisition of stone resources would have involved not more than two to three hours' walk from the majority of sites along Bettys Creek. Within the present study area, the acquisition of raw materials would not have been as significant an effort as it would have been in relation to sites on the upper reaches of Bettys Creek.

It is possible to test the AMBS (1997) model in that the presence of large quantities of primary or secondary artefacts in sites along upper Bettys Creek would contradict this model. However, it is not possible, based on the criteria provided by Umwelt (2005), to distinguish between a site of the type described by AMBS (1997) and a site that represents the later stages of a cycle of the Umwelt (2005) model. That is, 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. Seasonality, which is a major component of both models, is very

difficult to detect within an open site context and therefore would not be a consideration in most instances.

4.1.5 Discussion of Aboriginal Archaeological Context and Issues for Further Consideration

The large number of archaeological studies undertaken within the vicinity of the current study area provides information to obtain a sound understanding of the nature and distribution of archaeological sites within the area. Although there is some conjecture about the relationship between stream order and site numbers and densities, the general pattern is that the majority of sites are present within 30 metres of watercourses (Dean-Jones 1992:26-27; AMBS 1997:29). Although sites are present in locations at a greater distance from water, these sites are limited in terms of both number and size, constituting a lower density scatter than is found along the creeklines (Resource Planning 1992:24; ERM 1999:22-23). The majority of sites are small, with larger sites typically found in association with permanent watercourses. Reduced visibility has been proffered as an explanation for the higher number of sites and artefacts present along the more heavily eroded and less vegetated minor watercourses as compared to major creeks (Umwelt 2004b:7.7; ERM 1999:84).

In relation to models of occupation, two models have been put forward for the Bettys Creek area (AMBS 1997, Umwelt 2005). Both models propose short-term use of sites, although the Umwelt (2005) theory argues that the use of the area involved multiple short-term occupations at a number of locations. Unfortunately, it is very difficult to prove or disprove either of these theories archaeologically. It may consequently be of greater value to consider the relationship between the archaeological evidence present at sites along Bettys Creek and their distance to the major resource base of the Hunter River. In this instance it will be possible to consider issues such as:

- do the number of sites and/or densities of artefacts present along Bettys Creek differ with distance from the Hunter River;
- is there a detectable change in artefact assemblages (artefact types, raw materials, reduction strategies) at sites along Bettys Creek with increasing distance from the Hunter River;
- how does the evidence from Bettys Creek compare with that from other permanent water sources such as Bowmans Creek and Glennies Creek; and
- is the lower representation of sites along major creeks as opposed to lower order watercourses a reflection of reduced visibility and exposure along larger watercourses or is this a true representation of site distribution?

4.2 HISTORIC ARCHAEOLOGICAL CONTEXT

4.2.1 Historic Background

Following the discovery of the Hunter River in 1797, the lower Hunter Valley region was initially settled from about 1813 and was farmed for crops such as potatoes, wheat and corn (Perry 1963:61). In 1818, John Howe undertook the initial investigation of a transport route from the Hunter Valley to the Hawkesbury region and in 1820 established a stock route between Richmond and the Hunter Valley (Perry 1963:63). This provided the means to open the Hunter Valley for grazing activities on a broad scale. By 1821 Benjamin Singleton was advertising a private agistment service at St Patrick's Plains (now Singleton) and by 1822 graziers were reported to have settled in the Singleton area (Perry 1963:63-65). The issuing of land grants between 1820 and 1825 resulted in rapid settlement of the area and the expansion of grazing and farming properties (Heritage Office 1996:47). During this period, grazing remained the primary activity of major landholders including James Bowman, whose Ravensworth station was situated to the west of the current study area (Umwelt 2003b:2.1). The Vane parish map for 1912 shows that the major landowners within the boundaries of the study area were William and Eliza Russell and Martha Lye. In 1847, the Russells purchased Ravensworth from James Bowman and continued to expand their landholdings (Umwelt 2003b:2.2).

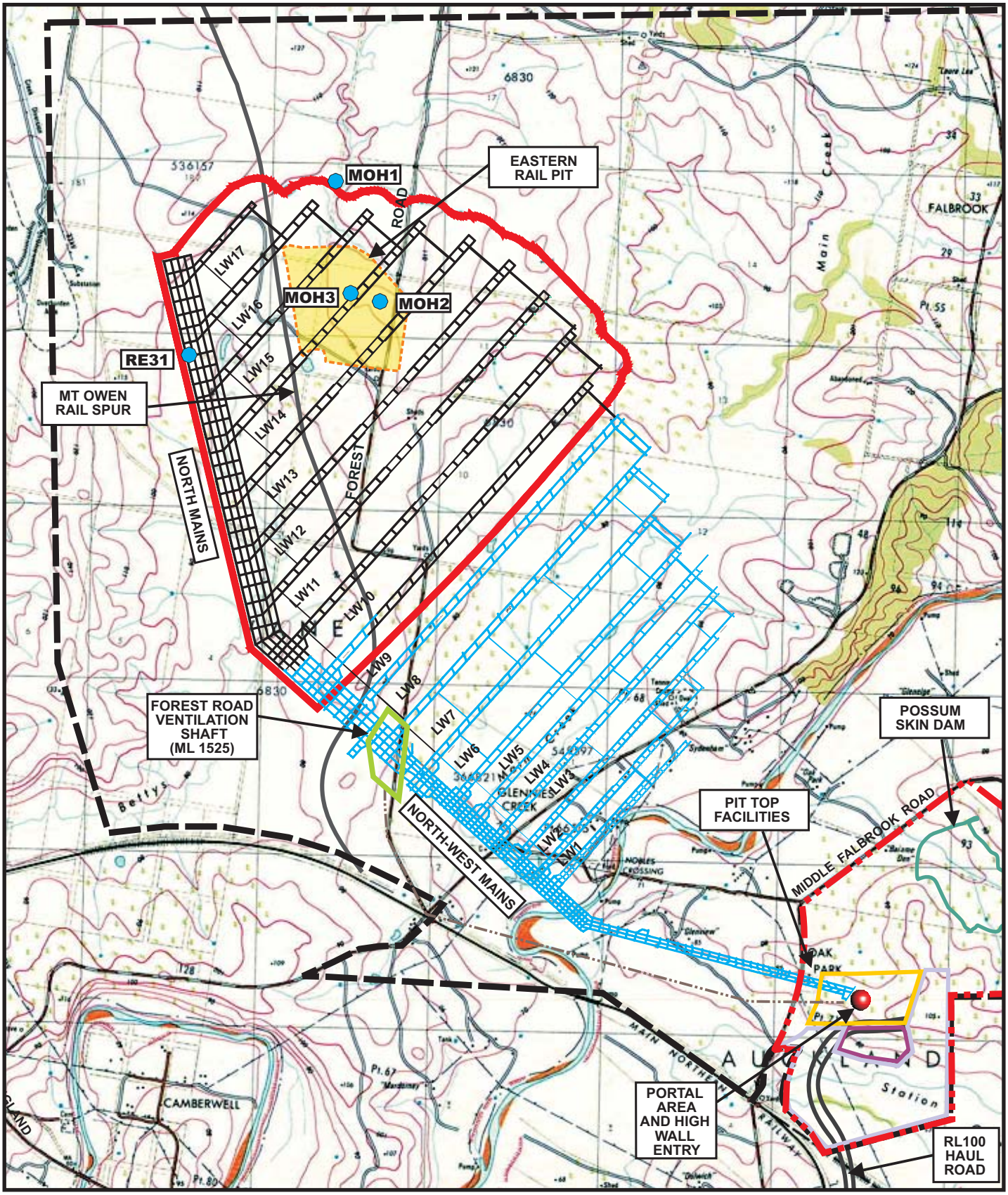
Agriculture has remained an important activity in the Upper Hunter. However, with the discovery of coal deposits in the 1820s, a gradual shift towards industrial activities began. The first coal mine in the area opened at Rixs Creek (south of the study area) in 1860 and, by the late 19th century, 16 mines were present in the area (http://www.uhrw.hl.com.au/singleton.htm). The coal mining industry did not develop on a large scale in the Upper Hunter until the late 1960s and since this time, has become the economic base of the area.

4.2.2 Previous Studies

A number of historic heritage studies have been conducted in relation to the expansion of mining activities in the area and the most relevant of these are summarised below.

ERM (1999)

One historic site was identified within the current study area and is shown on *Figure 4.2*. RE31 consists of a number of timber fence posts, building stumps and gate posts that were interpreted as relating to shearing facilities. This site (in conjunction with other farm buildings) was assessed as being of moderate significance. As the proposed Ravensworth East mining operations would result in the destruction of this site, it was recommended that additional survey and recording of the site be conducted prior to any disturbance.



Legend

- Study Area
- Existing Mine Workings
- Proposed Mine Workings (Mains and Gateroads)
- CL 382 Boundary
- ML 1525 Boundary
- ML 1518 Boundary
- ML 1551 Boundary
- ML 1437 Boundary
- Powerline to Ventilation Shaft
- Historical Heritage Site

0 250 500 750m

Approximate Only

Figure 4.2

Recorded Historical Sites in the Mount Owen Lease

Client:	Integra Coal Operations Pty Ltd		
Project:	Env. Assessment Glennies Creek Part 3A		
Drawing No:	0047481hv_Arch_rev_05		
Date:	16/04/07	Drawing size:	A4
Drawn by:	JD	Reviewed by:	JW
Source:	1:25,000 Topographic Series- Camberwell		
Scale:	Refer to Scale Bar		

Environmental Resources Management Australia Pty Ltd
53 Bonville Avenue, Thornton, NSW 2322
Telephone +61 2 4964 2150

ERM

Umwelt (2003b)

During the course of the survey of the Mt Owen Extension Area, five historic heritage sites were recorded (refer to *Figure 4.2*). These comprised a former dwelling (MOH1), a former occupation site (MOH2), a post and rail fence line (MOH3), a former dairy floor and associated cattleyards and dwelling (MOH4) and a former homestead and dairy (MOH5). These sites are suggested to date to the early 1920s and were described as '…representative examples of early homesteads demonstrating a cross-section of early farming practices in the locality.' (Umwelt 2003b:4.3).

Sites MOH2 and MOH3 are within the current study area. Both sites were assessed as being of local significance. As the proposed Mt Owen mining activity would result in the destruction of both of these sites, it was recommended by Umwelt (2003) that mitigation activities would be necessary prior to any impacts. Site MOH3 was subject to an exemption under Section 139(4)(v) of the *Heritage Act 1977* (NSW) whilst it was recommended that a permit be sought under Section 140 of *Heritage Act 1977* (NSW) prior to any disturbance at Site MOH2.

Umwelt (2004a)

A timber bridge, interpreted as dating to the late 19th or early 20th century, was identified within the Glendell Mine Lease. The log girder and split timber decking bridge remained relatively intact and was unlikely to be affected and no further recommendations were made as to its management (Umwelt 2004a:6.7, 8.4).

ERM (2005)

Research undertaken as part of the Subsidence Management Plan for Longwall Panels 7 to 9 at Glennies Creek Colliery found that the original line of road from Singletons Ford to Muscle Creek (now Muswellbrook) crossed the proposed subsidence area. This portion of road was in use by 1825 and originally recorded by Robert Dixon in 1833 (ERM 2005:13). No sites of historic significance were identified during the field survey (ERM 2005:30).

4.3 PREDICTIVE MODEL

Based on the review of the regional and local context, the results of the AHIMS search and the environmental information discussed in *Chapter 2*, it is possible to establish a predictive model for the study area.

4.3.1 Aboriginal Heritage

Scarred or carved trees

Scarred trees are defined as trees that have been deliberately altered by Aboriginal people through the deliberate removal of bark or wood for the manufacture of implements such as water carriers or weapons (Long 2005: 6). Carved trees are those in which bark has been removed and designs have been incised. Although a scarred tree has been recorded in the local area, the preservation of sites of this type is a factor of the extent of clearing undertaken and the range of mature trees present within the study area. Small areas of remnant vegetation are present along Bettys Creek and, therefore, it is possible that trees of sufficient age to bear scars of Aboriginal origin may be located within the survey area. Carved trees are extremely rare and are not expected to occur within the study area.

Stone arrangements

Stone arrangements consist of intentional placements of stone and can range from simple rock piles to more complex stone circles (Hughes 1984:46). Although two stone arrangements have been reported in the Glennies Creek/Ravensworth area, stone arrangements are vulnerable to disturbance and/or destruction. Due to the level of agricultural activity in the area, sites of this type are unlikely to remain within the survey area.

Grinding grooves

Grinding grooves are typically found in association with watercourses and are formed in exposed sandstone outcrops as a result of the use of the sandstone to sharpen or create an edge on ground artefacts. Sandstone outcrops may occur within the survey area and there is a possibility that grinding grooves may be present in that portion of Bettys Creek included within the survey area.

Stone artefact scatters/isolated artefacts

Surface scatters of stone artefacts are ubiquitous within the Australian archaeological record and are the most durable form of open site. The review of previous studies in the region and locality indicates that the identification of sites of this type is closely related to resource availability, landform and the level of exposure and visibility. Previous studies indicate that, along Bettys Creek, there is a consistent low density scatter of artefacts with areas of discrete concentration centred unpredictably. The distribution of artefacts away from the creekline is far more dispersed and non-level sloping landforms, in particular, seem to be contain only very sporadic and sparse evidence of human activity.

Due to the fact that the majority of the survey area is situated some distance from Bettys Creek and consists predominantly of sloping landforms, it is considered that sites within the area will be neither extensive nor concentrated. The small portions of creek included within the survey area are likely to contain greater concentrations of artefacts. However, the identification of sites may be impacted by factors of erosion and visibility.

4.3.2 Historic Heritage

Based on a review of parish maps and the historical context of the area, it is considered unlikely that relics or additional sites of historical significance will be located within the study area.

5 METHODOLOGY

5.1 INTRODUCTION

In order to determine the validity of a field survey, it is necessary to describe the fieldwork methodology. This section describes the survey strategy, the criteria used to identify artefacts and the means by which survey coverage was calculated. All survey work undertaken for this assessment was originally commissioned to support the Subsidence Management Plan (SMP) for Longwalls 10 to 17 that was submitted to the Department Primary Industries (Minerals) in January 2007.

5.2 SURVEY STRATEGY

The survey area was traversed in a number of transects by up to nine people spaced approximately five metres apart. Due to the level of vegetation coverage, the survey focussed on areas of exposure and did not involve 100 percent coverage of the survey area. All landforms within the study area were sampled. The minor drainage lines were not subject to detailed survey due to the lack of visibility. However, the course of Bettys Creek within the survey area and the associated alluvial flats were surveyed in their entirety

5.3 SURVEY COVERAGE

In accordance with NSW NPWS (1997:18), the description of survey coverage includes the landform, survey unit area and a quantification of the level of exposure and visibility. The survey units were mapped using a combination of hand-held GPS and visible landmarks.

Visibility refers to the amount of ground upon which artefacts could be sighted and is expressed as a percentage of the survey unit (NSW NPWS 1997:18). The presence of vegetation, leaf litter and other variables can obscure visibility. Exposure is defined as areas in which erosional processes result in the removal of soils and permit the detection of archaeological material that was formerly subsurface. Exposure is also expressed as a percentage of the survey unit (NSW NPWS 1997:18).

5.4 ABORIGINAL SITE IDENTIFICATION

The criteria applied to the identification of Aboriginal sites are outlined below.

Stone Artefacts

There are a number of grounds for distinguishing between artefacts that have been flaked through human activity and those that result from natural processes, including features such as negative and positive bulbs of percussion, ring cracks, ripple marks, flake terminations and errailure scars (Holdaway and Stern 2004:6-9). For the purposes of this assessment, flaked stone artefacts were identified on the basis of the presence of one or more of these attributes. Other stone artefacts such as grindstones or hammerstones are identified by the presence of distinctive pitted, crushed or abraded surfaces.

The location of each artefact was recorded using a hand-held GPS unit and the attributes listed in *Table 5.1* were recorded for each artefact (where applicable).

Table 5.1 Recorded Artefact Attributes

Variable	Attribute
Raw material	Mudstone, silcrete, quartz and igneous (GI).
Artefact type	Flake (recorded as complete, proximal fragment or other fragment), core (unidirectional, multidirectional, bipolar); retouched flake; broken flake (proximal or other); flaked piece[1].
Implement	Following McCarthy (1976)
Size	Maximum dimension (mm)
Platform type	Cortex – surface is outer weathered surface of a stone cobble or fragment Single scar – platform is a single flaked surface or freshly broken surface Several scars - platform comprises several flaked scars Faceted – platform surface comprises a series of small scars typically overlying larger scars
Cortex	Proportion of cortex remaining on the artefact (%)
Notes	Includes notes on macroscopic signs of use

1. Artefact types defined by Hiscock 2001 (see McCarthy 1976 for implement types).

The following variables were recorded for stone artefact scatters: site coordinates (AMG84); landform element; site size (visible distribution of artefacts within a continuous exposure or landform); exposure type; visibility within and outside the exposure, and the likelihood of subsurface deposits.

Scarred Trees

The removal of bark and wood from trees results in the presence of scarring on the tree trunk. However, it is often difficult to distinguish between scars of natural and cultural origin and it is important to identify where scarring relates to Aboriginal rather than European activities. Two broad criteria were used to define Aboriginal scarred trees during this survey (refer to Long 2005:20-22) and are detailed below.

- The scar must be of a size and shape and location on the tree that suggests it was caused by removal of bark by an Aboriginal person or Aboriginal people. Typically scars are symmetrical in form and of a size that suggests the removal of bark for containers, carrying implements, shields or canoes. There may also be small scars resulting from the cutting of footholds used to climb trees.

- Tool/axe marks that may be present should be of a size and demonstrate a degree of weathering that indicates that they are not of recent origin.

- The tree (and the scar) must be sufficiently old to indicate that the removal of bark took place at a time when Aboriginal people were employing traditional methods in the production of their material culture.

6 SURVEY RESULTS

The survey was conducted on the 14 February, 2006 and resulted in the identification of four sites, including three previously identified sites. The sites were concentrated on a vehicle track running from Forest Road to the south-eastern boundary of the study area. This section provides a description of the survey coverage, the identified sites and potential archaeological deposits.

6.1 SURVEY COVERAGE

The calculation of effective coverage provides a means to describe the proportion of the study area in which it was possible to assess the presence or absence of artefacts. Due to the limited archaeological visibility and exposure, effective coverage was very low at 0.24 percent (refer to *Table 6.1*).

6.2 PREVIOUSLY IDENTIFIED SITES

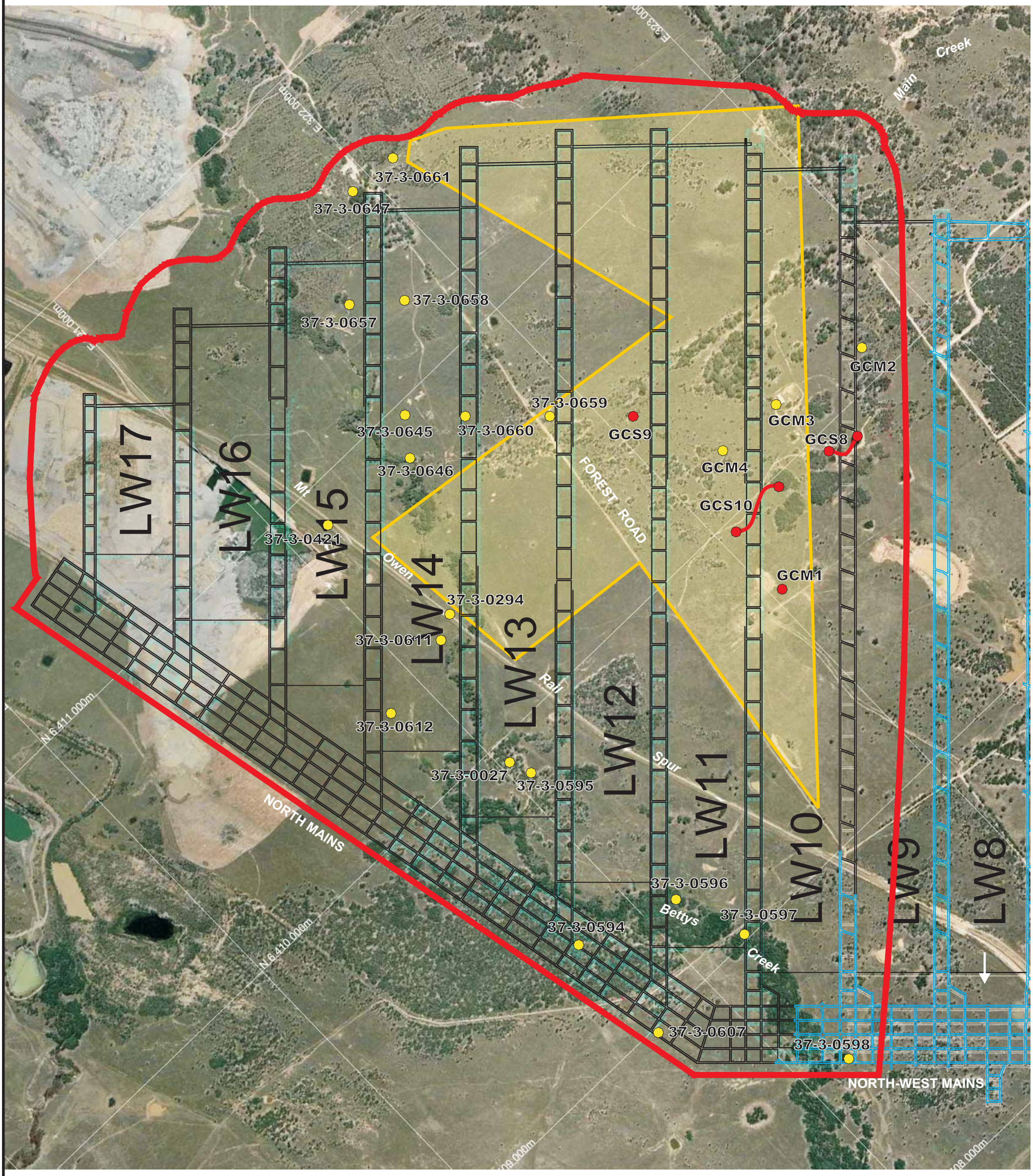
Three sites (GCS8, GCS9 and GCS10) had been previously recorded within the survey area (refer to *Figure 6.1*).

6.2.1 GCS 8 (322278E 6409792N) Isolated Artefact

GSC8 was recorded by ERM in 2005 as containing a single mudstone flake on a drainage depression through a slope. The mudstone artefact was not relocated during the present survey. However, a single piece of mudstone heat shatter was present in an erosion exposure associated with a dam fed by a drainage depression. The heat shattered piece is outside the survey area although likely to be part of the same site. Visibility and exposure in the area surrounding the site were relatively high due to high levels of erosion.

6.2.2 GCS 9 (321887E 6410261N) Isolated Artefact

GCS 9 was relocated and consisted of a yellow mudstone flake within an area of exposure on a track above a minor drainage line that extends outside the survey area. GCS 9 is located on a crest with gently undulating surrounding slopes and has been disturbed by the use of the track and the construction of a fence nearby. Visibility within the track was high at 70%, although visibility within the surrounding area was constrained by vegetation coverage. The potential for additional artefacts was considered to be low as no other artefacts were visible in the track or area of exposure at a nearby fenceline.



Legend

- Study Area
- Existing Mine Workings
- Proposed Mine Workings (Mains and Gateroads)
- Survey Area (ERM 2006)

Aboriginal Heritage Sites

- GCS — ERM 2005 Survey
- GCM — ERM 2006 Survey
- 37-3-0612 — AHIMS Database Results

Figure 6.1

Recorded Sites within the Study Area

Client:	Integra Coal Operations Pty Ltd		
Project:	Env. Assessment Glennies Creek Part 3A		
Drawing No:	0047481hv_Arch_rev_06		
Date:	17/04/07	Drawing size:	A3
Drawn by:	JD	Reviewed by:	JW
Source:	Glennies Creek Coal Management Pty Ltd		
Scale:	Refer to Scale Bar		

0 25 50 75m

Environmental Resources Management Australia Pty Ltd
53 Bonville Avenue, Thornton, NSW 2322
Telephone +61 2 4964 2150

ERM

Table 6.1 Effective Coverage

Landform	Total Area (m^2)	Area surveyed (m^2)	Exposure	Visibility	Effective coverage (m^2)	Description	Sites
Flats	180765	87,200	5%	5%	872	Visibility within the flats was low at approximately 5% (due to heavy pasture grass coverage) and exposure was less than 5%. Areas of exposure included a small area adjacent to Forest Road and an area of exposure surrounding a vacated residence and dam in the south east of the study area.	None
Slopes	1061415	187,400	10%	15%	2811	Gently inclined slopes comprise the majority of the survey area. Several areas of exposure were present, namely a vehicle track that passes across a south east facing slope to a disused building and dams.	GCM1, GCS8 and GCS10
Crests	300509	70,640	5%	5%	177	The crests within the survey area are relatively level and visibility and exposure was limited due to pasture grass and native vegetation cover.	GCS9
Alluvial flats	60849	20,360	0%	5%	0	Visibility along the alluvial flats was low due to pasture grass coverage and no areas of exposure were recorded. The alluvial flats consist of level flats overlooking Bettys Creek.	None
Creek	4640	4,640	5%	5%	12	Vegetation along Bettys Creek consisted predominantly of casuarinas. Visibility was limited due to leaf litter and vegetation ground cover. Portions of the creek bank were exposed and were examined but no artefacts were visible.	None
Drainage lines	28170	7,200	1%	5%	4	None of the drainage lines contained water at the time of the survey. The drainage line in the north west of the survey area (associated with Bettys Creek) was covered by pasture grass growth and was lightly incised. The drainage line in the central portion of the study area that leads to a small dam was more heavily incised however no major areas of bank were exposed and vegetation coverage was very heavy.	None
Totals	1636348	377,440			3875		
Effective coverage %					0.24%		

6.2.3 *GCS 10 (321874E 6409806N) Artefact Scatter*

GCS10 was originally recorded by ERM in 2005 as containing 11 mudstone artefacts (of which seven were recorded as heat shatter). The site is located on a vehicle track that runs from upper to lower slopes to vacant farm buildings on the south eastern boundary of the study area.

During the present study, an additional four mudstone artefacts were recorded at three locations on the track moving downslope from the original site location towards the farm buildings. Although the vehicle track is not in frequent use, sheetwash erosion is active, resulting in the removal of topsoil and the exposure of the B horizon in areas.

6.3 *ADDITIONAL SITE*

One additional site (GCM1) was recorded during the present survey (refer to *Figure 6.1*).

6.3.1 *GCM 1 (321873E 6409558N) Isolated Artefact*

This mudstone flaked piece was present on an erosion exposure to the south west of a dam near an abandoned dwelling in the eastern portion of the survey area. The site was heavily disturbed due to earth movement associated with the construction of the dam. Although the area of visibility surrounding the artefact approximated 40 m by 10 m, no other artefacts were present.

6.4 *ARTEFACTS*

A total of seven artefacts were recorded during the survey and are described in detail in *Annex B*. All artefacts were mudstone and consisted of three complete flakes, two flaked pieces, one broken flake and a piece of heat shatter.

6.5 *HISTORICAL HERITAGE*

No heritage items or heritage places were recorded in the survey area.

7 DISCUSSION

The following discussion focuses on two aspects of the assessment of cultural heritage within the study area, namely:

(i) the information provided by the sites recorded within the survey area; and

(ii) the potential for further unidentified sites to be present within the survey area.

7.1 INTERPRETATION OF SITES AND ARCHAEOLOGICAL POTENTIAL WITHIN THE SURVEY AREA

The small number of sites and artefacts recorded during the current survey is consistent with the results of previous surveys in the locality. Artefacts were visible only in areas of exposure and were present at low density on the slope and crest landforms which constitute the bulk of survey area. A number of the exposures within the study area were relatively large, including the vehicle tracks and associated dams. However, only limited numbers of artefacts were identified within these large exposures. These results are comparable with the results of previous investigations in the locality which found that, although artefacts may be present across all landforms, artefact densities are considerably lower in areas away from Bettys Creek and its tributaries. The identified sites within the survey area consist of a very low density scatter of artefacts across several landforms with no identifiable areas of concentration. It is therefore suggested that Aboriginal use of the majority of the survey area was probably transient rather than involving lengthy or frequent occupation.

7.2 POTENTIAL ARCHAEOLOGICAL DEPOSIT

It is essential to consider the potential for archaeological material to be present in areas of poor visibility and/or in a subsurface context. In relation to the management of the archaeological resource and legislative requirements, the likelihood that subsurface archaeological deposits may be present within an area has implications for any proposed development activity.

In terms of archaeological assessment, not all potential deposits necessarily contribute to our understanding of past human activities. The primary scientific importance of subsurface deposits lies in their potential to provide information that will assist in interpretation of the archaeological record through time and space. For this reason, areas described as potential archaeological deposits should satisfy one or more of the following criteria.

- Be likely to contain sufficiently high numbers of artefacts to allow for statistically viable detailed analysis and intra- and inter-site comparison of artefact assemblages.

- Exhibit minimal disturbance and a high level of integrity.

- Have the potential to contain dateable materials, either in chronological or absolute terms.

As discussed previously, artefacts were identified only in areas of exposure and, therefore, additional undetected artefacts may be present within the survey area. However, based on the results of the survey and the local archaeological context, these deposits would be few in number, widely dispersed and unlikely to retain archaeological integrity, and thus not satisfy the criteria listed above.

In contrast, previous studies have demonstrated that a consistent low-density scatter of artefacts is present along Bettys Creek, with areas of discrete artefact concentrations in association with permanent waterholes or confluences. The area along Bettys Creek for approximately 30 metres either side of the creekline should be considered as a potential archaeological deposit. However, in terms of the research value of this potential archaeological deposit, the area along Bettys Creek has been the subject of numerous subsurface investigations which provide a large amount of information about the use of this area by Aboriginal people (refer to *Section 4.1.3*). It is therefore argued that additional excavation of sites along Bettys Creek would not serve any further scientific purpose.

8 SIGNIFICANCE ASSESSMENT

The assessment of significance is an integral component in the formulation of management and mitigation plans in relation to cultural heritage resources (Pearson and Sullivan 1994:21). Without an understanding of the relative significance of a site or item, it is not possible to determine the appropriate level and detail of management strategies. The Burra Charter (Australia ICOMOS Burra Charter 1999) defines cultural significance in terms of the aesthetic, historic, scientific and social value of a heritage item or place. In relation to Aboriginal cultural material, considerations of social and scientific significance are generally weighted most heavily, although other factors may also be of relevance.

For management purposes, the levels of site significance can be described as follows.

- Sites that are assessed to be of high significance should be conserved and warrant protection against development.
- Sites that are assessed to be of moderate significance should be conserved if possible. However, in the event that these may be affected by development, management strategies should be implemented to mitigate against the impact.
- Sites that are assessed to be of low significance should be conserved if possible, but should not represent an obstacle to development.

8.1 ABORIGINAL (SOCIAL) SIGNIFICANCE

The assessment of social significance is the prerogative of the Aboriginal community and typically involves the consideration of a site(s) as part of the broader landscape, including surrounding sites, natural heritage and non-tangible cultural heritage.

During the field survey, no specific comments were made by the Aboriginal representatives regarding areas or sites as being of particular cultural value. The Aboriginal significance of the area appears to be related to the presence of stone artefacts (both visible and as potential deposits) which provide a tangible link to the use of the area by Aboriginal people in the past.

8.2 *ARCHAEOLOGICAL (SCIENTIFIC) SIGNIFICANCE*

The scientific significance of an Aboriginal site, object or place essentially refers to its potential to address research questions and provide additional information of value to interpretations of past human activities (Australia ICOMOS Incorporated 2000:12). The determination of scientific significance should assess the rarity and representativeness of the site, its integrity and connectedness in relation to research potential. *Table 8.1* provides an assessment of the significance of the sites identified within the survey area.

Table 8.1 Assessment of Significance

Site	Rarity and representativeness	Integrity	Research potential	Significance
GCS8	GCS8 is an isolated artefact located on a drainage line. Sites of this type are common within the locality and are well represented.	GCS8 is within an area of moderate to severe erosion and lacks integrity.	It is unlikely that further substantial archaeological deposits are present in association with GCS8 and it has low research potential.	GCS8 has low archaeological significance.
GCS9	GCS9 is a small artefact scatter situated on a crest formation and is a typical site well represented within the locality.	GCS9 is in a disturbed context on an eroded vehicle track and has little integrity.	GCS9 is situated within a comparatively large area of exposure. However, no other artefacts were identified. The site has low research potential.	GCS9 is of low archaeological significance.
GCS10	GCS10 is a dispersed scatter of artefacts along a slope formation. Sites of this type are common within the locality and GCS10 does not have high representative value.	The site is located in a heavily eroded vehicle track and is heavily disturbed.	Additional archaeological deposits are likely to be present in the undisturbed areas adjoining the vehicle track. However, it is unlikely that these deposits will be of a sufficient size to facilitate further research.	GCS10 is of low to moderate archaeological significance.
GCM1	GCM1 is a single artefact situated on a slope associated with a dam. It has low rarity and representative value.	The site has been disturbed by the construction of a dam, resulting in the movement and exposures of sub-soils. The site has no integrity.	It is unlikely that further information could be obtained from this site given its level of disturbance and the lack of additional artefacts.	GCM1 is of low archaeological significance.

9 IMPACTS

In order to provide appropriate recommendations for the management of cultural heritage, it is essential to understand the impacts that the proposed underground mining may have on the study area. This will involve the direct impact of the installation of gas drainage boreholes, indirect impacts associated with the subsidence of the ground surface and the cumulative impacts of additional mining activity within the locality.

9.1 DIRECT IMPACTS

The proposal includes the installation of four gas drainage boreholes along each longwall panel, ie a total of 32 boreholes over the life of the Longwalls 10 to 17. The exact location of the boreholes will be determined in the field in to avoid clearance of recorded sites and stands of native vegetation. Disturbance associated with each gas drainage borehole will be minimal (8m by 8m) and at any one time there will only be three or four boreholes operational. The installation and fencing of the boreholes will clear approximately 0.2 hectares of grassland over the life of the operation.

Provided that the gas drainage boreholes are not located within the vicinity of the recorded sites or within 30m of Bettys Creek, they are unlikely to directly impact on the archaeological record of the region.

9.2 INDIRECT IMPACTS

Longwall mining techniques generally result in the occurrence of subsidence which is evidenced by changes in the level of the ground surface. The predicted subsidence over Longwall Panels 10-17 is shown in *Table 9.1*.

Table 9.1 Subsidence Predictions

Longwall	Predicted Subsidence (m)	Predicted Tensile Strain (mm/m)	Predicted Compressive Strain (mm/m)	Predicted Tilt (mm)
10	1.6	6	9	12
11	1.6	6	9	12
12	1.6	6	9	12
13	1.6	6	9	12
14	1.6	6	9	12
15	1.6	6	9	12
16	1.6	6	9	12
17	0.8	6	9	12

Subsidence will cause a trough centred above each longwall panel. Subsidence troughs are formed through the vertical settlement of rock into the void created as the coal is removed between the chain pillars. As a trough is formed, the ground surface is subjected to varying tilts and strains depending

on the geology, depth of cover, panel dimensions and position above the panel. Strains pull on structures commonly damaging inflexible material by stretching and rupturing. Predicted subsidence will cause maximum tensile strains of 6.0 mm per metre and maximum compressive strains of 9.0 mm per metre.

Subsidence may also result in changes to gradients or locations of watercourses within the affected area, ranging from the occurrence of ponding to increased erosion. Subsidence-related ponding within the channel of Bettys Creek is anticipated over Longwalls 10, 11, 13, 14 and 15. Obvious post-subsidence ponding is not anticipated in the elevated central and north-eastern sections of the Application Area.

Subsidence may also result in the development of cracks within the Application Area. Mills (2005) predicts that surface cracking over Longwalls 10 to 17 is unlikely to be notable on agricultural land and no rectification works are expected to be required. Surface cracking does, however, have the potential to cause damage to dam walls, resulting in significant water run-off and possible enhanced erosion.

Remediation measures may be deemed necessary in relation to increased erosion and the effects of surface cracking or ponding on groundwater availability, dams and watercourses. Subsidence remediation measures may involve ground surface disturbance and vegetation clearance or replanting, that is, activities which have the potential to disturb surface and subsurface artefacts.

9.3 CUMULATIVE IMPACTS

The direct impacts of the proposed underground mining activity on cultural heritage should also be considered in relation to previous and ongoing impacts within the area. The study area is situated in an area of intensive coal mining activity. The Mt Owen and Ravensworth Mines are operational open cut coal mines where current and future mining activities will significantly impact upon both Aboriginal and historical cultural heritage. Glendell Mine is a proposed open cut mine and has the potential to impact cultural heritage. As discussed in *Section 3.6*, the extension of operations at the Mt Owen mine will involve the diversion of a section of Bettys Creek within the study area, resulting in significant disturbance. Vegetation clearance for farming and grazing has also impacted upon the landscape within the study area. Thus, although the direct impacts of underground mining are relatively minor, they have the potential to constitute an additional impact in a locality where mining and, to a lesser extent, farming and grazing, have already had a significant impact on the landscape.

9.4 IMPACTS TO ABORIGINAL HERITAGE

The sites within the study area are all stone artefact scatters. Although subsidence may result in the lowering of ground surface level and alterations in the morphology of landforms, they will not cause significant disturbance to sites that may be present.

Within the survey area Sites GCS9, GCS10 and GCM1 are unlikely to be impacted by the subsidence or any associated ponding, surface cracking and erosion. However, Site GCM8 is situated in close proximity to a dam and therefore may be affected indirectly by cracking that may occur in the dam wall. Sites Glennies Creek C (37-3-0027), MORL2 (37-3-0294), Bettys Creek 22 (37-3-0612) and Bettys Creek 21 (37-3-0611) are situated in close proximity to Bettys Creek or its tributaries and are likely to be impacted by any change in creek morphology or remediation work that may occur in this portion of Bettys Creek. All other sites within the study area have been the subject of mitigation measures involving surface collection or archaeological salvage (refer to *Table 9.2*) and therefore there is no further potential for impacts.

Table 9.2 Previous Mitigation Measures Taken for Sites within the Study Area

Site number	Site name	Mitigation measures
37-3-0421	Rav East 22	Included within area subject to test excavation by ERM (2002)
37-3-0594	Bettys Creek 4	Section 90 permit #2267
37-3-0595	Bettys Creek 5	Section 90 permit #2267
37-3-0596	Bettys Creek 6	Section 90 permit #2267
37-3-0597	Bettys Creek 7	Section 90 permit #2267
37-3-0598	Bettys Creek 8	Section 90 permit #2267
37-3-0607	Bettys Creek 17	Section 90 permit #2267
37-3-0645	BC44a	Section 90 permit #2123
37-3-0646	BC44b	Section 90 permit #2123
37-3-0647	BC51	Section 90 permit #2267
37-3-0657	BC63	Section 90 permit #2267
37-3-0658	BC64	Section 90 permit #2267
37-3-0659	BC65	Section 90 permit #2267
37-3-0660	BC66	Section 90 permit #2267
37-3-0661	BC67	Section 90 permit #2267

The impacts of subsidence on potential archaeological deposits should also be considered. Archaeological deposits may be present in any landform within the study area. However, with the exception of the area along Bettys Creek, these deposits are likely to be of a very low density. Possible subsidence remediation (such as the draining of areas of ponding) is unlikely to affect the archaeological significance of sites of this type. However, changes in creek morphology or the need for subsidence remediation works along Bettys Creek will impact upon the notable potential archaeological deposits identified in this area. As discussed in *Section 4.1*, archaeological deposits along Bettys Creek have been examined at a number of locations, resulting in a relatively large sample of excavated sites and artefacts. Consequently, although the disturbance of potential archaeological deposits along Bettys Creek within the

study area will diminish their research potential, the research value of sites along Bettys Creek has already been recognised by previous mitigation measures.

9.5 IMPACTS TO HISTORICAL HERITAGE

The historical heritage sites within the study area are likely to be impacted by the proposed underground mining. The structures that compose these sites could be damaged by subsidence and the associated tilts and strains. However, due to the length of time that has elapsed since these sites were recorded and the ongoing mining activities within the Mt Owen and Ravensworth leases, it is probable that these sites have already been disturbed by ongoing mining activities.

10 MITIGATION AND MANAGEMENT MEASURES

The following mitigation and management recommendations have been formulated in light of the local and regional context of the study area; the results of the survey; the potential direct and indirect impacts of the proposed underground mining, and the requirements of cultural heritage legislation.

10.1 ABORIGINAL CULTURAL HERITAGE

The recommendations regarding Aboriginal cultural heritage take into account both the scientific and Aboriginal significance of the identified sites and potential archaeological deposits within the study area.

10.1.1 Sites within the Survey Area

No further archaeological investigation is required at Sites GCS 8, GCS9, GCS10 and GCM1. These sites should be protected from impacts during the installation of the gas drainage boreholes and any subsidence remediation works that may occur. Should these impacts be unavoidable, the Department of Environment and Conservation and the Aboriginal community should be consulted in regard to any required management measures or salvage activities.

10.1.2 Sites within the Study Area

No further archaeological investigation is required at sites 37-3-0027, 37-3-0294, 37-3-0611 and 37-3-0612. These sites should be protected from impacts during the installation of the gas drainage boreholes and any subsidence remediation works that may occur. Should these impacts be unavoidable, the Department of Environment and Conservation and the Aboriginal community should be consulted in regards to any required management measures or salvage activities.

10.1.3 Potential Archaeological Deposits

It is recommended that no further archaeological investigation is required in relation to the potential archaeological deposits located 30 metres either side of the banks of Bettys Creek. The Aboriginal community should be consulted regarding any proposed subsidence remediation works or borehole installation along Bettys Creek and may wish to take the opportunity to conduct salvage activities. Should these impacts be unavoidable, the Department of Environment and Conservation and the Aboriginal community should be consulted in regards to any required management measures or salvage activities.

10.2 HISTORICAL HERITAGE

Prior to the commencement of mining of Longwall Panel 14, an additional inspection of Sites RE31, MOH2 and MOH3 should be carried out by an archaeologist to determine whether these sites remain extant. The results of the inspection and refined subsidence predictions for Longwall Panels 14 to 17 (based on measured subsidence over previously mined longwalls) will be used to determine whether further archival recording will be necessary at these sites and whether it is necessary to obtain an excavation permit under Section 140 of the *Heritage Act 1977* (NSW) for Site MOH2.

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Umwelt (in prep. (b)) **Salvage of Aboriginal Sites within the West Dump, Mt Owen Mine Operations, Singleton, NSW.** Report in preparation for Hunter Valley Coal Corporation.

Annex A

Aboriginal Community Correspondence

UNGOOROO
ABORIGINAL CORPORATION

PO Box 3095
Singleton N S W 2330
Ph 02 65 715111
Fax 02 65 715777

Mobile 0418 696 821
ABN: 64 020 872 467

Environmental Resources Management Australia		
Referred to:		
Date Received	10 OCT 2006	
Checked By:	Date	

For The Attention Of:
Joann Woodhouse
ERM Pty Ltd

October 9, 2006

GLENNIES CREEK SUBSIDENCE MANAGEMENT PLAN

Dear Joe
I apologise for the late response on the above project, having reviewed the report we at Ungooroo Aboriginal Corporation concur with ERM's recommendations.

Ungooroo Aboriginal Corporation insists that should at anytime, impact on the banks of Betty's creek is required, Ungooroo Aboriginal Corporation should be involved in any decisions prior to any changes to the recommendations listed.

Yours truly,

Graham Ward CEO

Annex B

Artefact Catalogue

Table B1 Artefacts recorded during the survey

Site	Artefact no.	Easting	Northing	Raw material	Artefact type	Implement	Size (mm)	Platform	Cortex (%)	Comments
GCM1	1	321873	6409558	Mudstone	Flaked piece		18		0	Heat shattering has resulted in the removal of other diagnostic features
GCS8	2	322364	6409756	Mudstone	Heat shatter		20			No diagnostic features
GCS9	3	321887	6410261	Mudstone	Flake		55	Indeterminate	20	
GCS10	4	322077	6409802	Mudstone	Flake		13	Single scar		
	5	As above	As above	Mudstone	BF (left)		8	Single scar		
	6	322312	6409788	Mudstone	Flake		10	Multiple scar (2)		
	7	321875	6409805	Mudstone	Flaked piece		29			

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53 Bonville Ave
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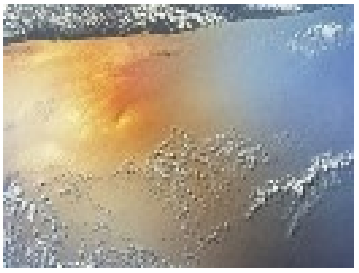
Telephone (02) 4964 2150
Facsimile (02) 4964 2152



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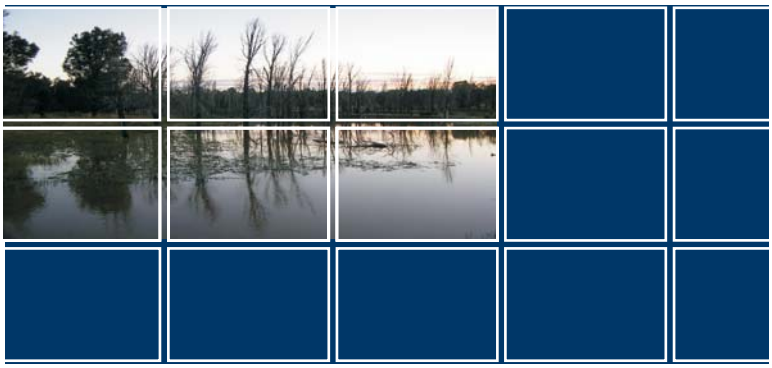

Environmental Resources Management

53 Bonville Ave
Thornton NSW 2322
PO Box 71,
Thornton NSW 2322

T: 61 2 4964 2150
F: 61 2 4964 2152
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