APPENDIX 5

Ecological Assessment

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Oceanic Coal Australia Pty Limited

ECOLOGICAL ASSESSMENT

Proposed Longwalls 51 & 52

West Wallsend Colliery

2013

Oceanic Coal Australia Pty Limited

ECOLOGICAL ASSESSMENT

Proposed Longwalls 51 & 52
West Wallsend Colliery

December 2013

Prepared by
Umwelt (Australia) Pty Limited

on behalf of
Oceanic Coal Australia Limited

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A Threatened Species Assessment

B Flora and Fauna Species Lists

C Seven Part Tests under the *Environmental Planning and Assessment Act 1979*

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1.0 Introduction

West Wallsend Colliery (WWC) is an underground coal mine located in Western Lake Macquarie (refer to **Figure 1.1**), within the Newcastle Coalfield of New South Wales (NSW). WWC is located approximately 1 kilometre east of Killingworth and approximately 1.25 kilometres south-west of Barnsley (refer to **Figure 1.2**). Mining has occurred at the colliery since 1969 and is approved to continue until 2027.

WWC is seeking to modify its 2012 Project Approval (09_0203) (Project Approval) to allow for the longwall mining of two additional longwall panels, longwalls 51 and 52 (hereafter referred to as the 'Project'), within the Southern Domain. The Project Areas has been defined on **Figure 1.2**. The proposed modification will consist of the development and mining of the two longwall panels with no changes proposed to the surface infrastructure which supports the mining operations. The proposed modification to the Project Approval is being sought under Section 75W of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

In accordance with existing approvals and with the implementation of management measures incorporated in the WWC Subsidence Management Plan and Extraction Plan, mining has, and continues to be, undertaken beneath the Sugarloaf State Conservation Area (SSCA) which is managed by the Office of Environment and Heritage (OEH). The proposed modification also includes mining under part of the SSCA.

WWC is operated by Oceanic Coal Australia Pty Limited (OCAL) on behalf of the Macquarie Coal Joint Venture (MCJV). OCAL is the major joint venture participant of MCJV with 70 per cent ownership. Other participants include Marubeni Coal Pty Ltd (17 per cent), OCAL Macquarie Pty Ltd (10 per cent) and JFE Minerals (Australia) Pty Ltd (3 per cent). OCAL, which also owns OCAL Macquarie Pty Ltd, is wholly owned by Glencore Coal Pty Limited (Glencore Coal).

1.1 Objectives of Ecological Assessment

This Ecological Assessment has been prepared to assess the potential impact of the Project on native flora and fauna species, threatened and migratory species, Endangered Populations (EPs), Threatened Ecological Communities (TECs) and their habitats occurring in the Project Area and on adjoining lands. The objectives of the Ecological Assessment were to:

- identify the flora and fauna species recorded within the Project Area from previous studies in the Project Area, local studies and/or ecological databases;
- undertake targeted surveys to further identify any threatened flora or fauna species, migratory fauna species, EPs, TECs, or their habitats within the Project Area, particularly those listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act), NSW *Fisheries Management Act 1994* (FM Act), and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act);
- assess the potential impact of the Project on any threatened flora and fauna species, migratory fauna species, EPs, TECs, or their habitats recorded (or with potential to occur) in the Project Area;

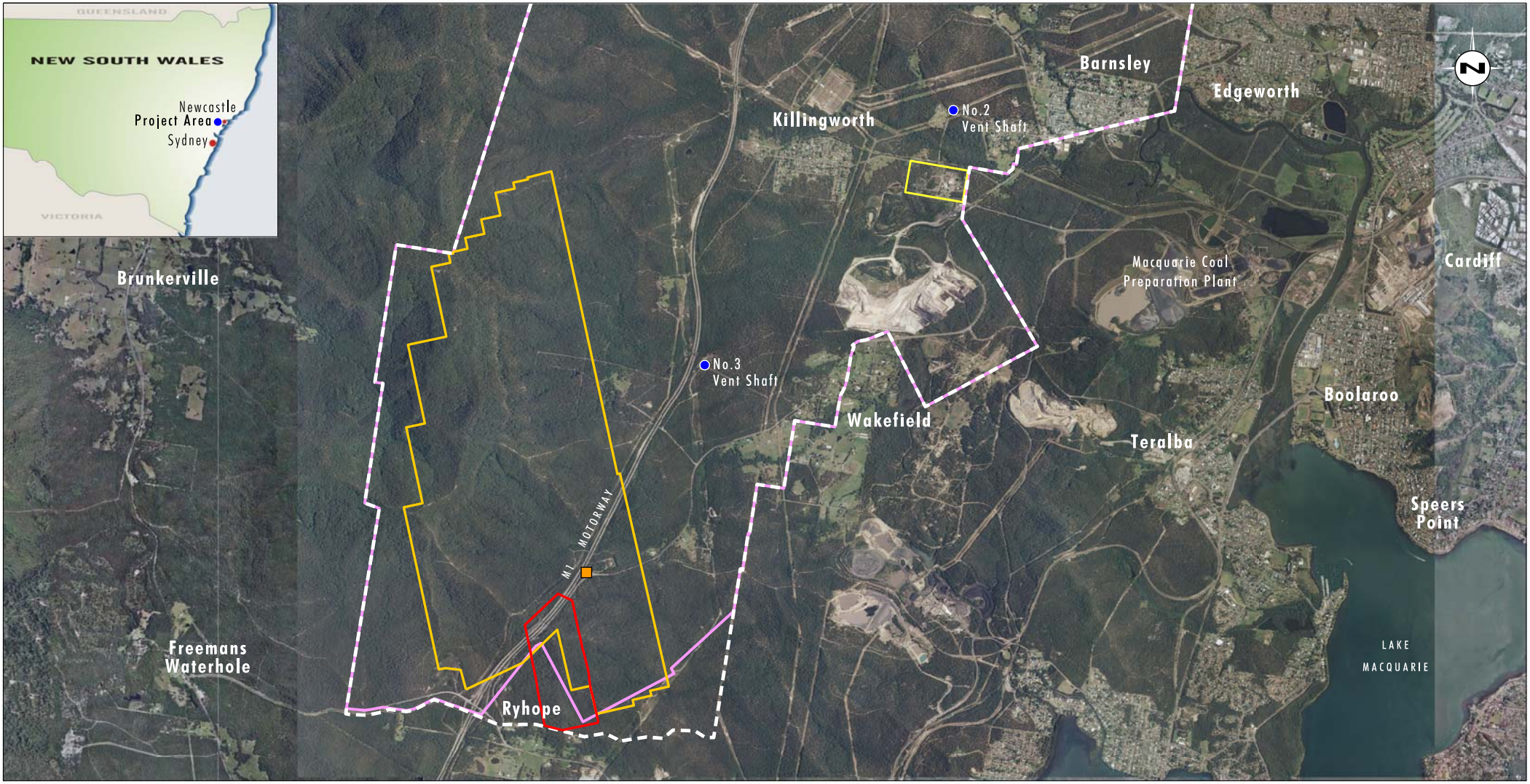

Image Source: OCAL (2008), Google Earth (2009)
Data Source: OCAL (2013)

0 1.0 2.0 3km
1:60 000

Legend

- Project Area
- Approved Continued Underground Mining Area
- West Wallsend Colliery Holding
- West Wallsend Colliery Pit Top Facility
- Project Application Boundary
- Proposed Mining Services Facility

FIGURE 1.1

Locality Plan

File Name (A4): R03/3149_003.dgn
20130807 13.54

- assess the potential impact of the Project on any threatened flora and fauna species, migratory fauna species, EPs, TECs, or their habitats recorded (or with potential to occur) on lands adjoining the Project Area or with potential to be affected by the Project; and
- develop appropriate impact mitigation and management options to minimise ecological impacts associated with the Project.

1.2 Report Structure

This report provides an assessment of the potential ecological impacts of the Project. It begins with an introduction to the Project, including an overview of the Project and the assessment approach undertaken.

Section 2.0 explains the regional context of the Project, discussing regional connectivity of habitats within the Project Area.

Section 3.0 provides a detailed methodology of the surveys undertaken for the Project including detailed literature review and flora and fauna survey methods.

Section 4.0 provides the results of the surveys described in **Section 3.0** and lists the threatened species, TECs, EPs and migratory species identified during surveys or during the literature review.

Section 5.0 details the assessment of the level of impact the Project may have on the threatened species, TECs, EPs and migratory species that were identified in **Section 4.0**.

Section 6.0 discusses the impact mitigation measures to reduce the likely level of impact on threatened species, TECs, EPs and migratory species.

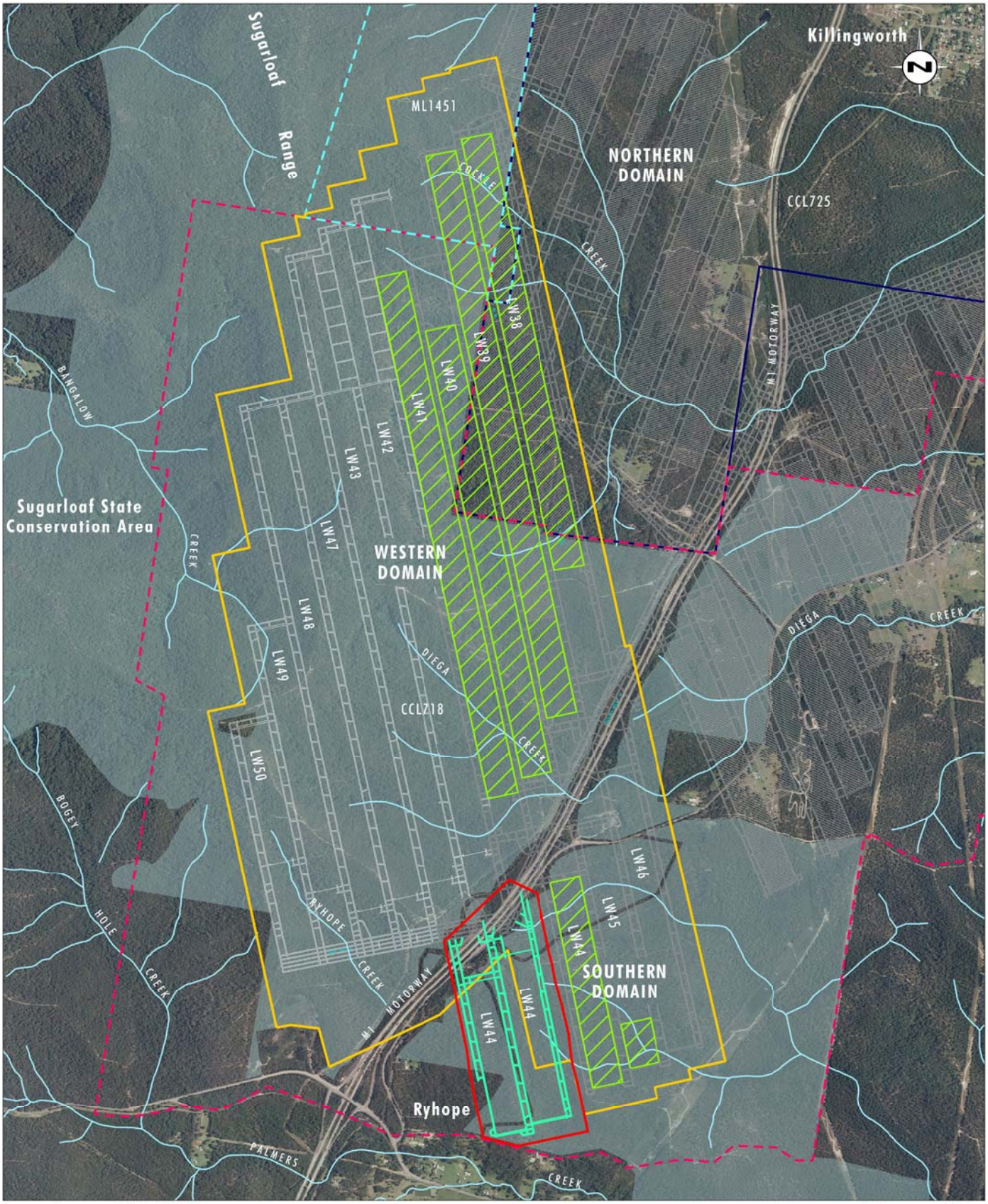

Image Source: OCAL (2008)
Data Source: OCAL (2013)

0 0.5 1.0 1.5km
1:30 000

Legend

- Project Area
- Approved Continued Underground Mining Area
- Approved Underground Workings in the West Borehole Seam
- Proposed Longwall Panels 51 and 52
- Longwall Progression as of October 2013
- Former Underground Workings
- Sugarloaf State Conservation Area
- CCL725
- CCL718
- ML1451

FIGURE 1.2

Conceptual Layout for Proposed Longwall Panels 51 and 52

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20131219 16.28

2.0 Regional Context

The Project Area is situated in the upper reaches of the western extent of the 640 km^2 Lake Macquarie catchment, and is situated about 18 kilometres west of the coast. The Project Area is located between the townships of Wakefield and Awaba, bordered to the west by the M1 Motorway.

The Project Area is situated almost entirely within the bounds of the Sugarloaf State Conservation Area (SSCA) (refer to **Figure 2.1**). The SSCA, formerly Awaba and Heaton State Forests, was gazetted in 2007 as part of the implementation of the Lower Hunter Regional Strategy (Regional Strategy) (DoP 2006) and Lower Hunter Regional Conservation Plan (Conservation Plan) (DECCW 2009c). On a regional scale, this large remnant ultimately links with larger bushland areas to the south including Olney State Forest, Jilliby State Conservation Area and Watagans National Park.

The vegetation communities mapped in the Project Area are consistent with the vegetation community descriptions of Bell and Driscoll (2009), who mapped the vegetation of the SSCA on behalf of the Department of Environment, Climate Change and Water (now OEH). That study area covered approximately 5000 hectares of forested vegetation along the Sugarloaf Range in north-western Lake Macquarie, and included the sampling and analysis of 1469 Rapid Data Points and 68 systematic flora plots.

Twenty-three vegetation communities were delineated by Bell and Driscoll (2009) in the SSCA, comprising one rainforest community, 20 forest communities and two paperbark thickets. Five are listed as threatened ecological communities (TECs) under the TSC Act.

The broad fauna habitat types of forest and riparian habitat found within the Project Area are representative of these same broad habitat types elsewhere in the region. The SSCA and other connected conservation lands are known to contain a high diversity of fauna species with a study of SSCA undertaken by the NSW Department of Environment and Climate Change (now OEH) in 2008 recording 16 threatened fauna species.

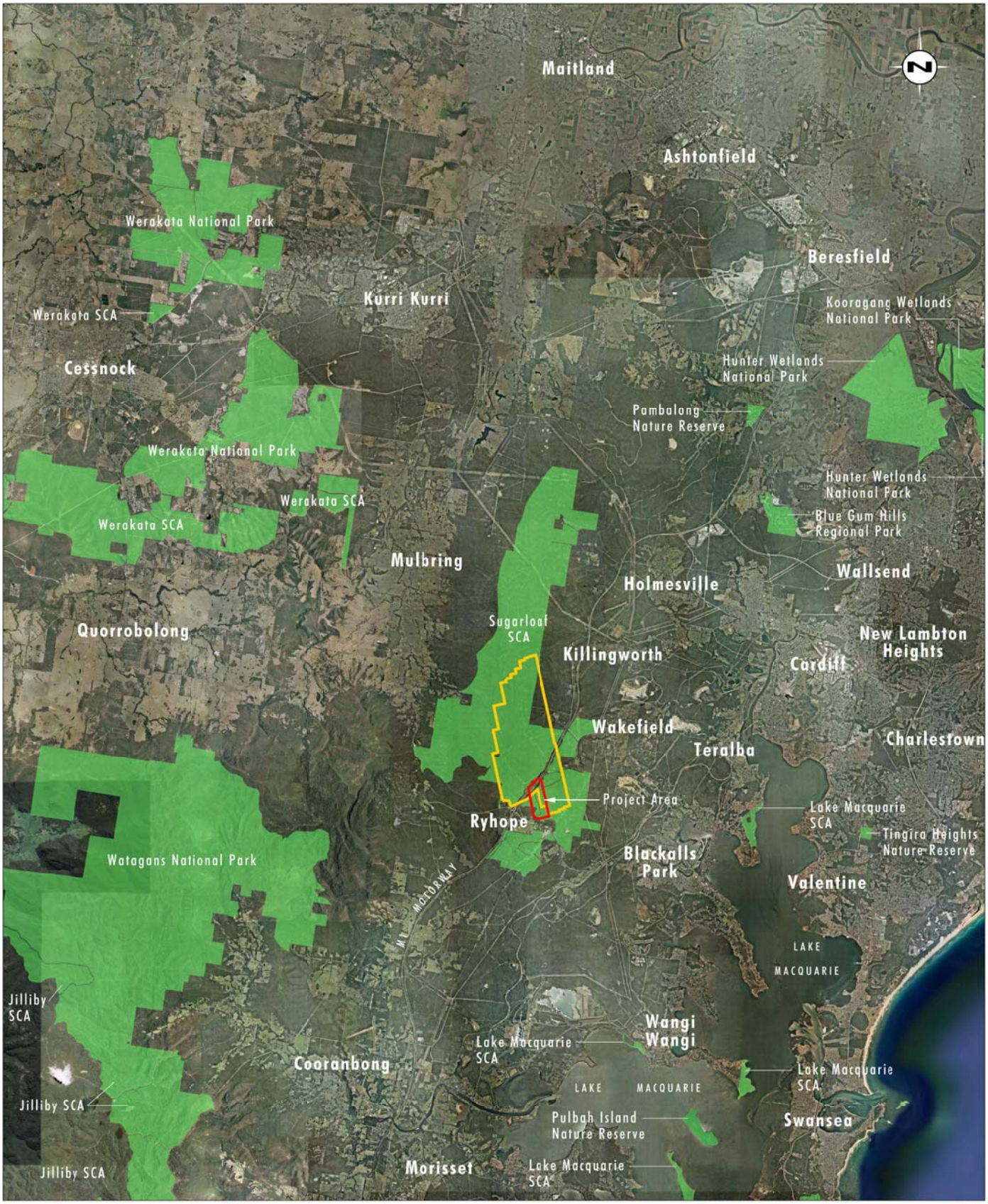

Image Source: Google Earth (2009)
Data Source: Office of Environment and Heritage (OEH 2013)

0 2.5 5.0 10km
1:200 000

Legend

- Project Area
- Approved Continued Underground Mining Area
- Regional Conservation Area

FIGURE 2.1

Regional Conservation Areas

3.0 Survey Methodology

A detailed survey methodology was designed and completed in order to gain a thorough understanding of the ecological features of the Project Area. The methods include a detailed literature review of relevant reports and vegetation mapping, as well as searches of relevant ecological databases. Information gathered from the literature reviews and database searches was then used to design a field survey program to survey and map vegetation communities, and to target threatened and migratory species, EPs, TECs and their habitats.

3.1 Literature Review

A review of all relevant and available literature was undertaken in order to gain a greater understanding of the ecological values of the Project Area and the locality. Documents reviewed included previous ecological studies relating to sites in proximity to the Project Area, regional vegetation mapping, relevant papers in scientific journals and threatened species information resources such as the OEH internet resources.

The literature review also included a search of relevant ecological databases to identify threatened species, EPs and TECs that have been previously recorded or have potential to occur in, or in proximity to the Project Area.

A summary of the ecological findings of the key literature is provided in the following sections.

3.1.1 Ecological Database Searches

A search of the OEH Atlas of NSW Wildlife database was undertaken to identify threatened species, EPs and TECs that have been previously recorded within a 10 kilometre radius of the Project Area. Similarly, the Department of the Environment Protected Matters database was searched to identify Commonwealth listed flora and fauna species and ecological communities whose range falls within the Project Area, and/or have been previously recorded within a 10 kilometre radius. The data obtained from these two database searches was used to compile a list of threatened species, EPs and TECs with potential to occur within the Project Area (refer to **Appendix A** for the full list of species, populations and ecological communities identified).

3.1.2 Ecological Assessment West Wallsend Colliery Continued Operations Project (Umwelt 2010a)

This report was prepared as part of the West Wallsend Colliery Continued Operations Project environmental assessment that was prepared to obtain a Project Approval for the continued operations into two small portions of the continued mining area of WWC which were approved for mining under the Savings Provisions of the Lake Macquarie Local Environmental Plan (LEP, 2004).

Whilst the approval issue related to two small areas within WWC continued underground mining area, the overall objective of the report was to provide WWC with one updated approval for the remaining operations of WWC. Therefore the report not only assessed the two small areas but also covered the entire Life of Mine coal reserves for WWC, the existing pit top and other related ancillary surface facilities. No significant changes to the existing underground mining or associated surface operations were proposed as part of the project application, the existing operations were to continue as per the current operations at the time of report being prepared.

This Ecological Assessment identified the following key ecological values within the Continued Operations Project Study Area:

- A total of 264 species were recorded within the continued underground mining area from 82 families. Fabaceae (Faboideae) (pea plants) were the most speciose plant family (24 species recorded), followed by Myrtaceae (myrtaceous plants) with 23 species recorded and Poaceae (grasses) with 22 species recorded. Of the 264 species recorded, 250 (95 per cent) were native and 14 (5 per cent) were introduced.

- Fifteen vegetation communities were delineated within the continued underground mining area. Community delineation was undertaken using a combination of semi-quantitative plot data collected as part of the project and recent vegetation mapping of the SCA (*Vegetation mapping of Lake Macquarie LGA: Stages 1-3, 5,* 2013). Areas outside the SSCA were mapped and described based on plot and rapid assessment data collected for the project. Based on plot based data and assessment points completed as part of this project, small areas of the SSCA vegetation map compiled by Bell and Driscoll (2013) were modified.

- Two threatened flora species were recorded in the continued underground mining area: black-eyed Susan (*Tetratheca juncea*) and small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*). One species from the 'Rare or Threatened Australian Plant' (ROTAP) list identified by Briggs and Leigh (1996) was recorded in the continued underground mining area: *Eucalyptus fergusonii* subsp. *fergusonii* which was a dominant canopy species in Hunter Valley Moist Spotted Gum Ironbark Forest.

- In addition to those threatened flora species recorded, a number of species were assessed for their potential to occur in the continued underground mining area, based on their known distribution and habitat requirements. Of the 14 threatened flora species assessed, seven (in addition to the two recorded) were found to have reasonable potential, on the basis of suitable habitat, to occur in the continued underground mining area.

- Three vegetation communities recorded in the continued underground mining area conform to an Endangered Ecological Community (EEC) under the TSC Act and/or the EPBC Act: River-flat Eucalypt Forest on Coastal Floodplains, Swamp Sclerophyll Forest on Coastal Floodplains, and Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregion.

- A total of 112 vertebrate fauna species were recorded within the continued underground mining area, comprising 33 mammal species, 68 bird species, five reptile species and six amphibian species.

- Three broad fauna habitat types were identified within the continued underground mining area comprising Dry Forest, Riparian and Mesic habitats and Aquatic habitats.

- Seventeen threatened fauna species have been recorded within the continued underground mining area. Recorded threatened species include 12 species of mammal (including seven species of micro-bat and one mega-bat) and five bird species.

The following impacts to ecological attributes were recorded within the Ecological Assessment:

- A total of 1085 hectares of native vegetation occur in the continued underground mining area, providing habitat for 19 threatened species, and 15 hectares of EEC.

- No direct clearing of native vegetation was required for the project, and predicted subsidence was not expected to impact the structure and floristic composition of vegetation communities, although some subsidence cracking is likely to occur in areas of vegetation. Some minor vegetation disturbance was likely as a result of subsidence management works (e.g. subsidence remediation works and survey lines), however works were considered to be likely to be limited to public access areas (e.g. vehicle tracks). Minor disturbance works may also be undertaken for the completion of drilling within the Continued Underground Mining Area and to confirm the presence of geological features. Any drill sites will be located as far as practical, to have minimal environmental impact and be undertaken in accordance with licence requirements from OEH. Drill sites will typically require the clearing of a pad in the order of 30 metres by 30 metres and be established using small earth moving equipment. Surface water ponding resulting from subsidence was expected to be confined to channels, and therefore not predicted to substantially affect the floristic or structural characteristics of adjacent riparian vegetation communities.

- A total of 0.5 hectares of disturbed land adjacent to the M1 Motorway and Wakefield Road will be removed for the construction of proposed mining services facility.

- The project was not considered likely to result in the removal of a substantial area of threatened species habitat, with impacts on vegetation communities and fauna habitats expected to be limited to approximately 2.25 hectares of increased surface water ponding within drainage lines and the limited clearing for the construction of surface facilities. As a result, the project generally avoided direct impacts and retained habitat for all threatened species recorded in the continued underground mining area.

- An Assessment of Significance was conducted on threatened species and TECs known to occur in the continued underground mining area and concluded that the project would not have a significant impact on any of these values.

3.1.3 Vegetation and Floristics of Sugarloaf State Conservation Area, Lake Macquarie, New South Wales (Bell and Driscoll 2009)

This draft report presents the findings of a vegetation survey that was undertaken within the SSCA of New South Wales. Statistical analysis of plot-based data was utilised to classify the vegetation into 23 native communities, which were then compared to a larger regional dataset to consolidate their regional affiliations.

Five EECs were identified within the SSCA, namely Hunter Lowlands Redgum Forest, Lower Hunter Spotted Gum – Ironbark Forest, Lowland Rainforest, River Flat Eucalypt Forest on Coastal Floodplains and Swamp Sclerophyll Forest on Coastal Floodplains.

The surveys recorded 376 native plant species within the reserve, of which 12 were introduced species. Three vulnerable and three rare species were recorded, namely leafless tongue-orchid (*Cryptostylis hunteriana*), small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*), *Tetratheca juncea*, *Callistemon shiressii*, *Eucalyptus fergusonii* subsp. *fergusonii*, and *Grevillea montana*.

3.1.4 Vegetation Mapping of Lake Macquarie LGA: Stages 1 – 3, 5 (Bell and Driscoll 2013)

This report provides an updated summary of the detailed vegetation mapping of the Lake Macquarie local government area conducted between 2008 and November 2012. The project split the local government area into six distinct stages (Stages 1-6) to allow for funding as it became available. This report summarises the detailed vegetation mapping within Stages 1-3 and 5, covering approximately 46,270 hectares. Stages 4 and 6 have not yet commenced. The vegetation mapping of the SSCA prepared by Bell and Driscoll (2009) was also updated within this latest vegetation mapping project.

The detailed vegetation mapping was achieved through use of the Manifold© GIS mapping program and an extensive field survey effort. Field surveys recorded dominant floristic species within the canopy, shrub and ground layers at as many locations as possible using Rapid Data Points (RDPs). Dominant trends in the vegetation were identified through an averaging process of progressive points which was achieved by conducting sufficient RDPs. Initially, each RDP is assigned a broad vegetation unit but were split into sub-communities or variants as the process progressed and floristic differences and/or trends were identified.

In total, more than 10,000 RDPs were used to inform the delineation of vegetation communities of Stages 1-3 and 5 within the Lake Macquarie local government area. The collected field data and draft vegetation mapping was cross referenced to a number of existing vegetation mapping projects within the local area, wider region, as well as legislative documents including listing advice for Threatened Ecological Communities.

Vegetation community descriptions and mapping prepared by Bell and Driscoll (2013) were used to design the field survey described in this current report.

3.1.5 The Vertebrate Fauna of Sugarloaf State Conservation Area (DECC 2008)

This report presents the vertebrate fauna species recorded within the SSCA based on extensive surveys undertaken by Department of Environment and Climate Change in 2008 in combination with Atlas of NSW Wildlife data on the terrestrial vertebrate fauna of the reserve.

The survey involved 49 DECC systematic survey sites and recorded 216 species of native terrestrial vertebrate fauna. This included 17 frog, 31 reptile, 124 native diurnal bird, seven nocturnal bird and 37 native mammal species. In addition, nine introduced species of mammals and one introduced bird species were recorded.

Key findings of the report are provided below:

- Seventeen threatened species have been confirmed to occur within SSCA, comprising 17 vulnerable species (as listed on the TSC Act), one endangered and two vulnerable species (as listed on the EPBC Act).
- Of these threatened fauna species, the spotted-tailed quoll (*Dasyurus maculatus*) is considered to be the highest priority for conservation management. A further three threatened species are considered a high priority for conservation management, being the brown treecreeper (*Climacteris picumnus victoriae*), black-chinned honeyeater (*Melithreptus gularis)* and the east-coast freetailbat (*Mormopterus norfolkensis*).
- A small population of the koala (*Phascolarctos cinereus*) is present in the reserve and the survey recorded regionally rare and localised threatened species, such as the Stephens' banded snake (*Hoplocephalus stephensii*).

- Pest species are widespread across the reserve, with the fox (*Vulpes vulpes*) being the most commonly recorded species. A small population of the feral goat (*Capra hircus*) is present and there are scattered records of the feral pig (*Sus scrofa*). Both species have the potential to have significant impacts on native fauna in the future if not actively managed. The majority of the remaining feral species, such as the common myna (*Acridotheres tristis*) and rabbit (*Oryctolagus cuniculus*) are uncommon and largely restricted to the margins of the reserve.

3.2 Flora Survey

Flora surveys were undertaken by Umwelt on 25 and 26 March 2013. The locations of the flora survey sites are identified on **Figure 3.1**. The vegetation mapping of the SSCA prepared as part of the Vegetation mapping of Lake Macquarie LGA: Stages 1-3, 5 report by Bell and Driscoll (2013) (which covers most of the Project Area), was ground-truthed during the survey.

Vegetation survey and mapping was carried out to sample and describe flora and vegetation communities present in the Project Area. In particular, literature review and vegetation survey aimed to identify threatened species, EPs, TECs and species of local or regional significance present or potentially occurring within the Project Area. Key steps involved in the vegetation survey included:

- aerial photograph interpretation (API);
- field survey site selection using stratification;
- field survey and associated plant identification; and
- vegetation community description and delineation.

3.2.1 Aerial Photograph Interpretation

Aerial photographs of the Project Area were viewed prior to and after vegetation survey to identify spatial patterns in vegetation, land use and landscape features. These informed field survey design and implementation, ecological assessment and vegetation community mapping in the Project Area. Aerial photography of the Project Area from 2008 was sourced from Oceanic Coal Australia Pty Ltd (OCAL 2008).

The Manifold System 8.0 Enterprise Edition geographical information system (GIS) was used to view these aerial photos on-screen, using a 32 bit mode. Use of GIS allowed zooming to a relatively large scale. Using this method, mapping was carried out at a scale of up to approximately 1:700, since at higher magnification than this the gain in scale was outweighed by the loss in resolution.

3.2.2 Field Survey Site Selection & Stratification of the Project Area

Designing an appropriate flora survey requires consideration of both survey methods and effort. In other words, surveys should be undertaken during periods of optimal climatic and seasonal conditions and the use of stratification should be employed to ensure that the full range of potential habitats present are assessed and adequately surveyed. Reference was made to the OEH flora survey guidelines (DEC 2004) when designing the field survey, with appropriate survey methods selected that maximised the opportunities of identifying the full suite of flora species (and vegetation communities) that occur within the Project Area.

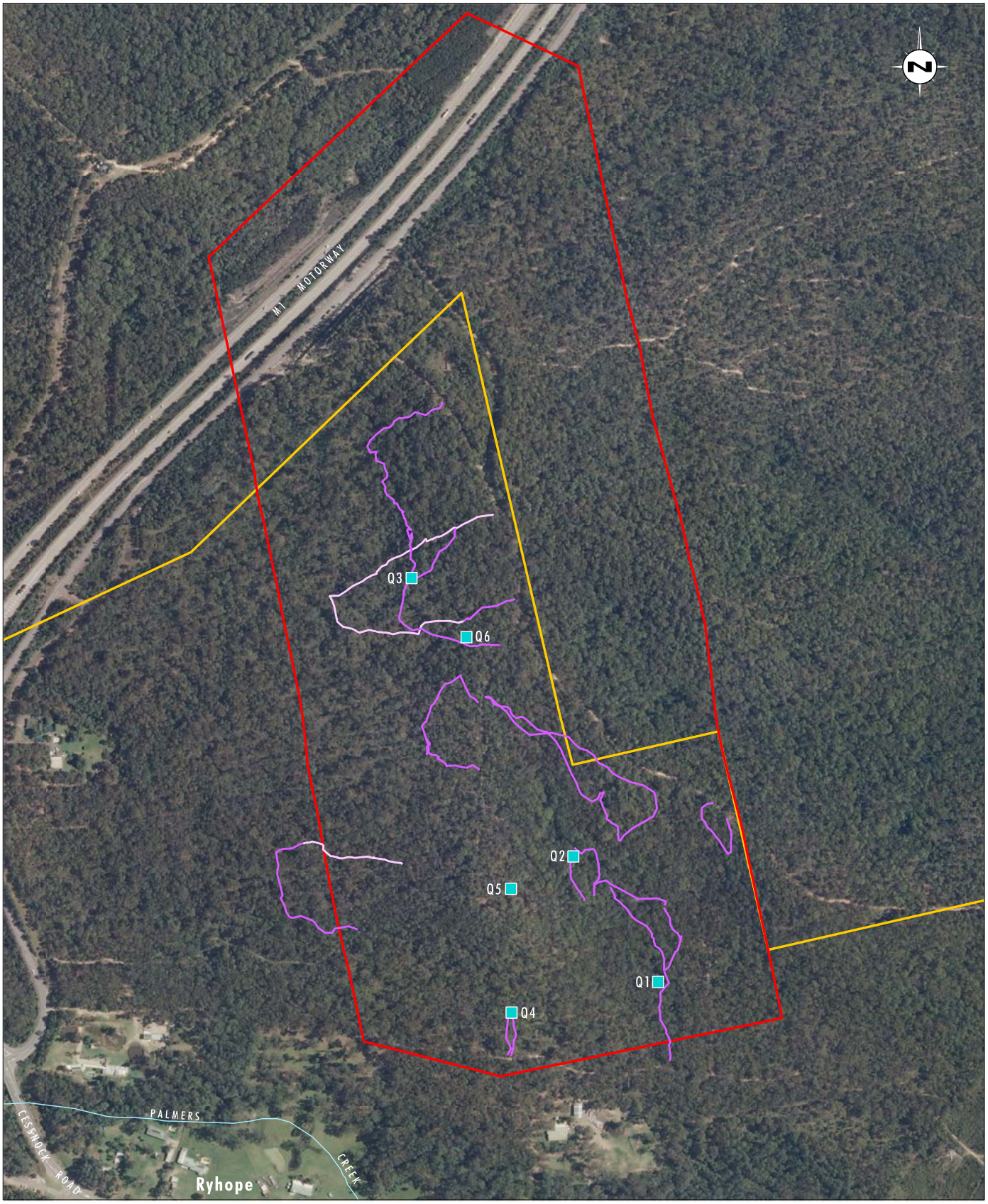

Image Source: OCAL (2008)
Data Source: OCAL (2013), Umwelt (2013)

0 100 200 400m
1:7 500

Legend

- Project Area
- Approved Continued Underground Mining Area
- Meandering Transect
- Floristic Transect
- Flora Quadrat

FIGURE 3.1

Flora Survey Sites

Survey sites were selected by considering a range of attributes that were thought to influence or determine the type of vegetation communities present. The vegetation survey of the Project Area was stratified using biophysical attributes. This stratification was done intuitively, but based on existing topographic, soil, vegetation and geological mapping. Other factors considered included the spreading the survey sites across the Project Area, as well as topographic position and aspect.

3.2.3 Flora Field Survey

The flora field survey was carried out in early autumn 2013. Field survey allowed sampling of vegetation and field reconnaissance to identify spatial vegetation patterns. Survey methods included:

- quadrat vegetation sampling – semi-quantitative 400 m^2 quadrats placed within distinctive vegetation units;
- meandering transects – non-quantitative sampling along transects through vegetation units; and
- field reconnaissance – identifying spatial arrangement of vegetation across the Project Area.

These survey methods are described in the following sections.

3.2.3.1 Quadrat Survey

Quadrat survey of flora was undertaken using methods that are relatively standard in most NSW government vegetation management agencies and elsewhere. This ensured that data collected by other relevant surveys could be compared to the current survey results, and that the data from the Project could be analysed in an equivalent way to that collected by other recognised studies.

Quadrat survey involved semi-quantitative sampling flora in systematic 400 m^2 areas. The typical dimensions of the quadrats were 20 metres by 20 metres, although in some places this was altered to 10 metres by 40 metres to allow sampling of linear vegetation communities, particularly along watercourses.

When undertaking systematic sampling to facilitate vegetation community mapping and description, quadrat surveys have several distinct advantages over non-quantitative transects, including:

- providing a quantitative examination of species distribution and abundance;
- being likely to detect inconspicuous or rare species (especially forbs and grasses) within the given sampling area, as a smaller area is surveyed in a concentrated search; and
- providing a basis for any subsequent monitoring required.

The location of each quadrat was recorded using aerial photography and/or a hand-held GPS with accuracy of ± 5 metres. The Map Grid of Australia (MGA) coordinate system was used. The location of the six vegetation quadrats completed within the Project Area is provided on **Figure 3.1**.

At each quadrat, about 45 to 60 minutes were spent searching for all vascular flora species present within the 400 m^2. These were recorded on a standard proforma with a cover-

abundance value to reflect their percentage cover in the quadrat. A modified Braun-Blanquet 6-point scale was used to estimate cover-abundances of all plant species within each quadrat (Braun-Blanquet 1927), with selected modifications sourced from Poore (1955) and Austin *et al*. (2000). **Table 3.1** shows the cover-abundance categories used. Additional searches were carried out for extra species located outside of the quadrat and within the vegetation unit being sampled. These were recorded without a cover-abundance value. Voucher specimens were collected of cryptic and significant species as well as any species that could not be identified in the field for later identification.

Table 3.1 – Modified Braun-Blanquet Crown Cover-abundance Scale

Class	Cover-abundance*	Notes
1	Few individuals (less than 5% cover)	Herbs, sedges and grasses: <5 individuals Shrubs and small trees: <5 individuals
2	Many individuals (less than 5% cover)	Herbs, sedges and grasses: 5 or more individuals Shrubs and small trees: 5 or more individuals Medium-large overhanging tree
3	5 – less than 20% cover	-
4	20 – less than 50% cover	-
5	50 – less than 75% cover	-
6	75 – 100% cover	-

Note: * Modified Braun-Blanquet scale (Poore 1955; Austin *et al*. 2000)

Additional details were also recorded in each quadrat, including soil texture, drainage and depth; site disturbances; physiography (position in the landscape); and vegetation structure (strata percentage covers, heights and dominant species). Photographic records were also taken at each site.

3.2.3.2 Flora Transects

Flora transects were walked through vegetation units across much of the Project Area (refer to **Figure 3.1**). Flora transects enable floristic sampling across a much larger area than systematic quadrats. Records along transects supplemented floristic sampling carried out in quadrats, however, the data collected was in the form of presence records, rather than semi-quantitative cover abundance scores.

Additional details were also recorded along flora transects, including soil texture, drainage and depth; site disturbances; physiography (position in the landscape); and vegetation structure (strata percentage covers, heights and dominant species). Photographic records were also along flora transects.

Flora transects targeted specific vegetation units and provided valuable information on spatial patterns of vegetation that informed vegetation community mapping of the proposed disturbance area.

3.2.3.3 Field Reconnaissance

Field reconnaissance was carried out during all field surveys and while travelling throughout the Project Area. Field reconnaissance contributed to the ground-truthing of vegetation community boundaries, refinement of community descriptions, and providing a more comprehensive understanding of the floristic features across the proposed disturbance area.

All areas walked during the field reconnaissance surveys were recorded with a GPS and shown in **Figure 3.1**.

3.2.4 Targeted Threatened Flora Surveys

Throughout flora surveys of the proposed disturbance area, targeted searches were carried out for threatened flora species that are known to occur in, or near to the Project Area or were considered likely to occur in the Project Area based on the species' known distribution and the presence of suitable habitat. Searches for these species were undertaken in suitable habitat during field reconnaissance, along, flora transects and within flora quadrats (shown in **Figure 3.1**). The list of species that were specifically targeted during targeted threatened flora surveys was compiled through database searches and literature reviews (see **Section 3.1**).

3.2.5 Plant Identification and Nomenclature Standards

All vascular plants recorded or collected within quadrats, along ransects and during field reconnaissance were identified using keys and nomenclature in Harden (1992, 1993, 2000 & 2002) and Wheeler *et al.* (2002). Where known, changes to nomenclature and classification have been incorporated into the results, as derived from *PlantNET* (Botanic Gardens Trust 2013), the on-line plant name database maintained by the National Herbarium of New South Wales.

Common names used follow Harden (1992, 1993, 2000 & 2002) where available, and draw on other sources such as local names where these references do not provide a common name. Where the identity of a specimen was unknown or uncertain, it was lodged with the National Herbarium of New South Wales at the Royal Botanic Gardens Sydney for expert identification.

3.3 Vegetation Mapping

Vegetation mapping was undertaken using best-practice techniques to delineate vegetation communities across the Project Area. Vegetation mapping involved the following key steps:

- review of most current regional vegetation community mapping (Bell and Driscoll 2013);
- ground-truthing of vegetation map based on survey effort documented in **Section 3.2**;
- revision of vegetation community floristic delineations based on plot data; and
- revision of vegetation map based on ground-truthing.

Vegetation communities were delineated through the identification of repeating patterns of plant species assemblages in each of the identified strata. Communities were then compared to those vegetation communities identified in the *Vegetation mapping of Lake Macquarie LGA: Stages 1-3, 5* report (Bell and Driscoll 2013) which were interrogated to identify those communities that contain similarities in species and structural composition to ensure that the communities identified in the Project Area were not aligned with similar or intergrade communities known to occur elsewhere in the local area.

Communities were then named in accordance with those communities described by Bell and Driscoll (2013), for consistency.

3.4 Summary and Adequacy of Flora Field Survey Effort

The majority of the Project Area comprises the SSCA, which was mapped for OEH by Bell and Driscoll (2009). The detailed vegetation survey and assessment undertaken by Bell and Driscoll (2009) of the SSCA used multivariate cluster analysis and non-metric multi-dimensional scaling on plot based data to classify the vegetation into 23 native communities, with each compared to a larger regional dataset to consolidate their regional affiliations (Bell and Driscoll 2009).

The survey methodology undertaken by Bell and Driscoll (2009) for the mapping of the SSCA is considered to be comprehensive and appropriate with adequate levels of sampling. The result of the mapping, with particular focus on vegetation community boundaries, was ground-truthed by Umwelt as part of this Project. The ground-truthing of the vegetation mapping concluded that the vegetation map prepared by Bell and Driscoll (2009) is highly accurate and informative and the assessment of the vegetation and floristics of the SSCA provides an accurate description of vegetation community floristics identified by Umwelt during field surveys in the Project Area.

Approximately 750 metres of flora transects were sampled along with 6 vegetation quadrats which is considered appropriate survey effort to target the range of threatened flora species, and their habitats and TECs predicted to occur in the Project Area.

The results of the flora assessment and vegetation mapping are robust and applicable at the scale of the assessment, and therefore are adequate for the purpose.

3.5 Fauna Survey

The following sections document the methods employed for the fauna survey components of the Ecological Assessment. Fauna survey effort was generally undertaken in accordance with the OEH Draft *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* (DEC 2004).

The fauna surveys undertaken across the Project Area employed a variety of fauna survey methods, targeting the full suite of vertebrate fauna species that could occur. Fauna surveys were undertaken on 25 and 26 March 2013. The locations of the various fauna surveys are shown in **Figure 3.2**.

3.5.1 Hair Funnels

Three hair funnel survey lines containing 10 terrestrial and 10 arboreal Faunatech hair funnels were sampled within the Project Area (refer to **Figure 3.2**). Terrestrial hair funnels were baited with either meat (raw chicken necks) or a rolled oats and peanut butter mixture. All terrestrial hair funnels were positioned amongst habitat features such as logs, fallen bark, rocks and ground cover.

Arboreal hair funnels were baited with a rolled oats, peanut butter and honey mixture. Arboreal hair funnels were positioned 1.5 to 2.0 metres above the ground on tree trucks or branches. The entrance to the hair funnel and the tree trunk were sprayed with a honey and water emulsion as an attractant.

All hair funnels were left in position for 14 nights and all hair samples collected were identified by Barbara Triggs (a recognised expert in the field of hair and scat identification).

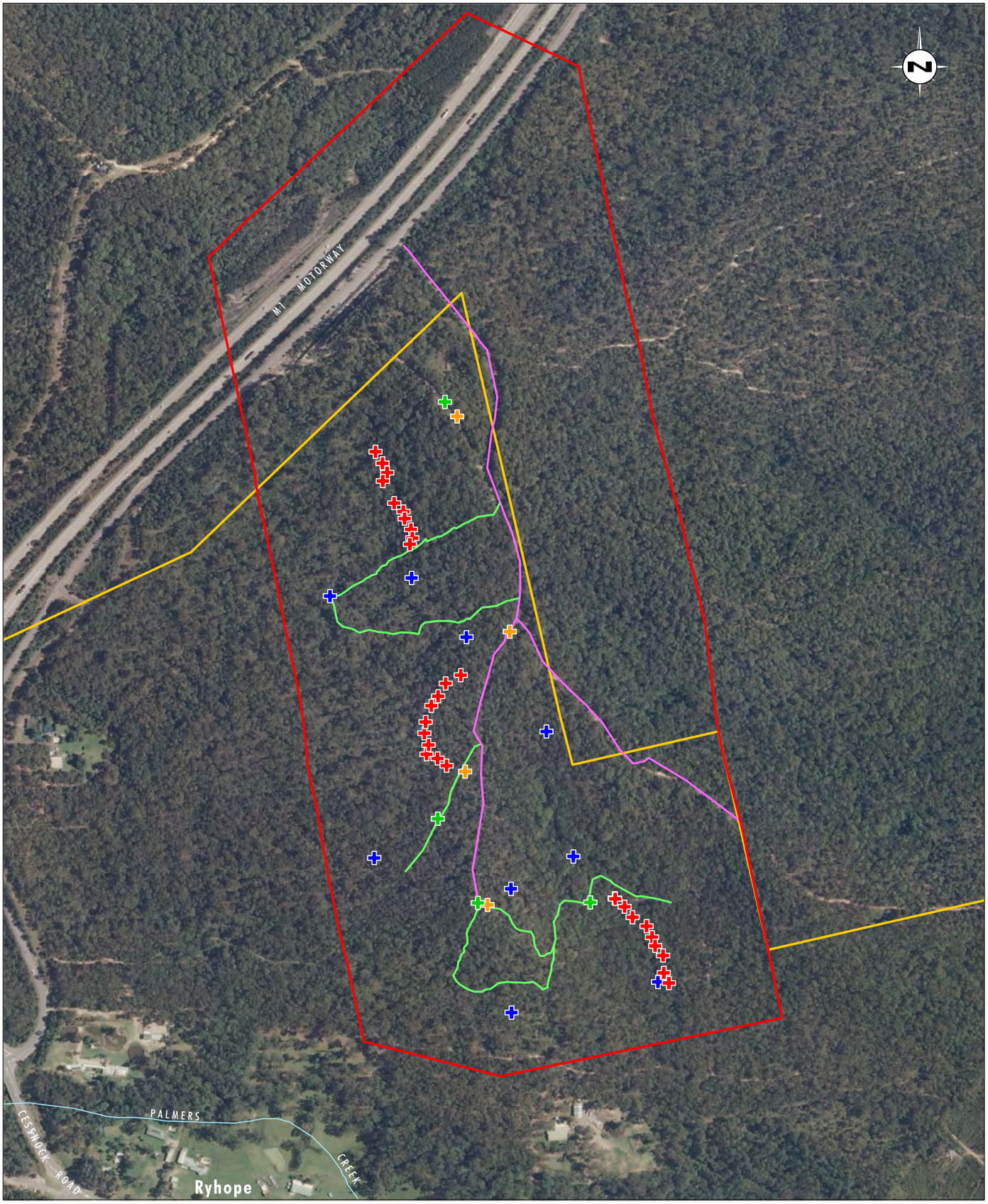

Image Source: OCAL (2008)
Data Source: OCAL (2013), Umwelt (2013)

0 100 200 400m
1:7 500

Legend

- Project Area
- Approved Continued Underground Mining Area
- Driving Spotlighting
- Walking Spotlighting
- Hairtube Line
- Anabat Recorder
- Call-playback
- Diurnal Bird and Herpetological Surveys

FIGURE 3.2

Fauna Survey Sites

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3.5.2 Diurnal Bird Survey

Nine diurnal bird surveys, each of one person hour in duration, were undertaken within the Project Area. Each survey consisted of a slow walking transect within a 2 hectare area. Species were identified from characteristic calls and by observation, using 10 x 42 binoculars. Opportunistic observations were also recorded during other aspects of the survey effort.

3.5.3 Herpetological Survey

Nine targeted diurnal herpetological (reptile and amphibian) surveys, each of half a person hour in duration, were undertaken within the Project Area. Searches targeted areas of likely habitat including areas of exposed rock and along watercourses. During the search likely microhabitats were examined including beneath rocks and logs, in tree bark and in ground litter.

3.5.4 Spotlighting Survey

Spotlighting searches were undertaken both on foot and from a moving vehicle. Walking spotlighting searches were undertaken by two observers for a period of at least 30 minutes (total of one person hour) on each occasion over two consecutive nights. Vehicle spotlighting searches were undertaken by the passenger from a slowly moving (first gear, low range) four wheel drive vehicle for a minimum of 1 kilometre. Opportunistic vehicle spotlighting was undertaken whenever driving through the Project Area at night. Walking and vehicle spotlighting searches were undertaken using 30 watt Lightforce handheld spotlights and head torch.

Spotlight searches specifically targeted: flying mammals such as flying foxes; arboreal mammals such as possums and gliders; terrestrial mammals such as kangaroos, wallabies, wombats, quolls, foxes and cats; nocturnal birds such as owls and nightjars; and nocturnal herpetofauna (amphibian and reptile species). Spotlighting also included opportunistic searches for nocturnal reptiles, amphibians and micro-bats.

A total of four hours of walking spotlighting surveys and approximately 3 kilometres of opportunistic driving spotlighting surveys were undertaken across the Project Area. **Figure 3.2** provides the locations of all spotlighting surveys.

3.5.5 Call Playback Surveys

Nocturnal call playback sessions were undertaken within the first four hours after dusk. Calls were broadcast using a 10 watt directional loud hailer. Call playback sessions commenced with a quiet listening period of approximately five minutes. Each call was played for a minimum of four minutes followed by a listening period of two minutes before the beginning of the next call. Mammal calls were played before bird calls to prevent the calls of predators (such as owls) decreasing the likelihood of prey species (such as gliders) responding to call playback. Call playback sessions included the calls of:

- squirrel glider (*Petaurus norfolcensis*);
- yellow-bellied glider (*Petaurus australis);*
- koala (*Phascolarctos cinereus*);
- masked owl (*Tyto novaehollandiae*);

- sooty owl (*Ninox connivens*); and
- powerful owl (*Ninox strenua*).

Four nocturnal call playback sessions were completed in the Project Area over two consecutive nights (refer to **Figure 3.2**).

3.5.6 Micro-bat Echolocation Recording

Micro-bat echolocation recordings were made using an 'Anabat SD2 Bat Detector', hereafter referred to as an 'Anabat detector'. Four Anabat detectors (refer to **Figure 3.2**) were positioned at a 45 degree angle approximately 1 metre off the ground in a purpose built PVC pipe that protects the detector from rain for two full nights. This enabled the Anabat detectors to capture calls regardless of weather conditions.

All night Anabat detectors were positioned with a clear view of potential micro-bat flyways. The recorders were automated and programmed to start recording one hour before dusk and to stop recording one hour after sunrise the following morning. All night recordings were collected over two nights at each Anabat survey site, shown in **Figure 3.2**.

All Anabat detector recordings were analysed by Glenn Hoye (a recognised expert in the field) of Fly by Night. The echolocation calls of species were identified to one of three levels of confidence:

- confident;
- probable; and
- possible.

As a precautionary approach, all three levels of confidence have been included in the results and considered as occurring within the Project Area.

3.5.7 Habitat Assessment

A habitat assessment was undertaken at nine locations identifying potential habitat and resources for threatened fauna species. Observations of the following habitat features were made:

- evidence of fire;
- nature of and extent of erosion;
- extent of introduced species;
- presence of feral animals;
- type of ground cover (e.g. litter, rock, soil);
- ground fauna resources;
- wet soaks/drainage lines;
- degree of dieback;
- presence of mistletoe;

- structure and floristics of vegetation cover; and
- number of habitat trees, including size and abundance of hollows/nests.

In addition to these general habitat features, observations of the likely specific requirements of threatened fauna species considered to have potential to occur within the locality were also made, including matters such as the presence of winter-flowering eucalypt species, which are important foraging resources for migratory species such as the regent honeyeater (*Anthochaera phrygia*) and the swift parrot (*Lathamus discolor*).

All habitat features observed were considered when assessing the likely presence or absence of any threatened fauna species. The known habitat requirements of each potentially occurring threatened fauna species were compared with the habitat features recorded within the Project Area.

3.5.8 Indirect Evidence of Faunal Presence

Indirect evidence of faunal presence was recorded throughout the Project Area. Evidence included tracks, scats, scratches, burrows, bones, nests and drays. Scat and hair samples, as required, were forwarded to Barbara Triggs for expert analysis. All opportunistic fauna observations were recorded during all aspects of the survey effort.

Targeted habitat features, such as tree hollows and fallen logs, were examined for any evidence of fauna occupation such as scratches on the trunks of trees, chewed entrances to hollows, scratchings or diggings near logs and scats at the base of trees or in or near logs.

3.5.9 State Environmental Planning Policy (SEPP) 44 (Koala Habitat) Assessment Methodology

Any proposed development occurring within an LGA specified under State Environmental Planning Policy 44 (SEPP 44) – Koala Habitat Protection, affecting an area of 1 hectare or greater, must be assessed under SEPP 44. This policy, however does not apply to land dedicated or reserved under the NPW Act. Nonetheless, as a precaution, an assessment of the Project Area under the provisions of SEPP 44 was undertaken for the Project.

Assessment under SEPP 44 is based on an initial determination of whether the land constitutes potential koala (*Phascolarctos cinereus*) habitat. This is determined by assessing whether the eucalypt species present in Schedule 2 of the policy (refer to **Table 3.2**) constitute 15 per cent or more of the total number of trees in the upper or lower strata of the tree component. If potential koala habitat is present, the area must be further assessed to determine if the land is core koala habitat. Should an area be identified as core koala habitat, a Koala Plan of Management is required to be developed in accordance with the SEPP 44 guidelines.

Table 3.2 – Eucalypt Species Listed Under Schedule 2 of SEPP 44

Scientific Name	Common Name
Eucalyptus tereticornis	forest red gum
Eucalyptus microcorys	tallowwood
Eucalyptus punctata	grey gum
Eucalyptus viminalis	ribbon or manna gum
Eucalyptus camaldulensis	river red gum
Eucalyptus haemastoma	broad-leaved scribbly gum
Eucalyptus signata	scribbly gum

Table 3.2 – Eucalypt Species Listed Under Schedule 2 of SEPP 44 (cont.)

Scientific Name	Common Name
Eucalyptus albens	white box
Eucalyptus populnea	bimble box or poplar box
Eucalyptus robusta	swamp mahogany

An assessment of the presence of trees listed on Schedule 2 of SEPP 44 was undertaken at the nine habitat surveys locations, identified in **Figure 3.2**. All SEPP 44 listed canopy species were recorded, along with an estimate of the percentage of the total trees that comprise SEPP 44 species within each vegetation quadrat. This allowed an assessment as to whether Schedule 2 species comprised greater than 15 per cent of canopy species in any of the vegetation communities recorded in the Project Area.

Further searches were made to identify preferred koala food trees and evidence of koala faecal pellets during walking transects in the vicinity of koala assessment sites and when moving between survey sites.

3.6 Summary of Fauna Survey Effort

Table 3.3 below summarises the total fauna survey effort undertaken within the Project Area

Table 3.3 – Summary of Fauna Survey Effort within the Project Area

Survey Method	Total Effort
Hair funnels (hair funnel nights[1])	840
Bird surveys (person hours)	9
Diurnal reptile and amphibian surveys (person hours)	4.5
Walking spotlight surveys (person hours)	4
Driving spotlight surveys (km)	5 km
Nocturnal call playback (sessions)	4
Habitat assessments (including SEPP 44)	9
Anabat echolocation recording (entire nights)	8

[1] One hair funnel night equals one hair funnel for one night

Fauna surveys have previously been undertaken over much of the Project Area, either during the field survey component of the Vertebrate Fauna of the SSCA study (DECC 2008), the Environmental Assessment for the OCAL: Continued Operations Project (Umwelt 2010a) or as part of the West Wallsend Colliery Annual Biodiversity Monitoring (Umwelt 2010b, 2011 and 2012). As a result, the species composition of the Project Area and the surrounding habitats is well understood.

The fauna surveys undertaken during this study supplement the high level of survey previously undertaken within the Project Area and include adequate effort and rigor to accurately describe the fauna species composition and specific fauna habitats across the Project Area.

4.0 Results

4.1 Flora

The following sections describe the floristic diversity and vegetation communities of the Project Area, in addition to significant ecological values such as threatened flora species, EPs, TECs and any records of regional significance.

4.1.1 Database Searches

The threatened flora species, EPs and TECs results from the OEH Atlas of NSW Wildlife and DEWHA Protected Matters database are included in **Appendix A**.

4.1.2 General Flora

A total of 112 species were recorded within the Project Area from 50 families. Myrtaceae (myrtaceous plants) was the most speciose plant family (14 species), followed by Fabaceae (Faboideae) (pea plants) (11 species recorded), and Poaceae (grasses) with nine species recorded. Of the 112 species recorded, 107 (96 per cent) were native and five (4 per cent) were introduced. A full list of the flora species recorded during the survey effort is presented in **Appendix B**.

4.1.2.1 Introduced Species

A total of five introduced species were recorded in native vegetation communities within the Project Area during surveys, including wild aster (*Aster subulatus*), cobbler's pegs (*Bidens pilosa*), *Conyza* sp., catsear (*Hypochaeris radicata*), purpletop (*Verbena bonariensis*). Introduced species are not currently dominating any large areas within native vegetation and their distribution is largely restricted to disturbed and cleared areas.

4.2 Vegetation Communities

Six vegetation communities have been delineated within the Project Area. The following descriptions are derived from the results of the flora survey undertaken for this Project by Umwelt with reference Bell and Driscoll (2013) where appropriate.

Vegetation communities include:

- Freemans Peppermint – Apple – Bloodwood Forest;
- Sugarloaf Uplands Smooth-barked Apple Forest;
- Riparian Paperbark – Peppermint Forest;
- Coastal Wet Gully Forest;
- Disturbed Areas; and
- Cleared Land.

The locations of the vegetation communities are shown on **Figure 4.1**. In addition to the communities recorded in the Project Area, the following communities were recorded in the WWC Continued Underground Mining Area and are described in detail in the Ecological Assessment prepared for that project (Umwelt 2010). Communities include:

- Sugarloaf Uplands Dry Spotted Gum – Ironbark Forest; and
- Coastal Foothills Spotted Gum – Ironbark Forest.

4.2.1 Freemans Peppermint – Apple – Bloodwood Forest

Freemans Peppermint – Apple – Bloodwood Forest is the most extensive vegetation community in the Project Area, covering an area of approximately 43 hectares. The community is characterised by the dominant canopy species Sydney peppermint (*Eucalyptus piperita*), smooth-barked apple (*Angophora costata*) and red bloodwood (*Corymbia gummifera*). The canopy height within this community is approximately 17 – 23 metres, while the foliage cover ranged between 40 and 50 per cent.

A mid stratum of the above canopy species with additional species forest oak (*Allocasuarina torulosa*) and lemon-scented tea tree (*Leptospermum polygalifolium*) also occurred. This stratum was variable in height, ranging four to 13 metres in height, while the foliage cover ranged between 10 and 15 per cent.

The shrub stratum was consistently less than 3 metres in height. The commonly recorded shrub species include hairpin banksia (*Banksia spinulosa* var. *collina*), *Dillwynia retorta*¸ prickly shaggy pea (*Podolobium ilicifolium*), broad-leaved Geebung (*Persoonia levis*) and chaffy bush-pea (*Pultenaea paleacea*). Additional species that occurred in lesser numbers included Gymea lily (*Doryanthes excelsa*), *Xanthorrhoea macronema* and prickly Moses (*Acacia ulicifolia*).

Characteristic species present in the ground stratum include kangaroo grass (*Themeda australis*), silvertop wallaby grass (*Rytidosperma pallidum*), fishbones (*Lomandra obliqua*), wiry panic (*Entolasia stricta*), *Gonocarpus tetragynus*, saw sedge (*Gahnia clarkei*) and *Dampiera stricta*. A number of populations of the large tongue orchid (*Cryptostylis subulata*) were recorded in this community. This species is not listed under the TSC Act or EPBC Act.

The threatened flora species, black-eyed Susan (*Tetratheca juncea*) and small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*) were often recorded in the ground stratum of this community. This stratum was found to be less than 1 metre in height, with a typical foliage cover of 60 per cent.

4.2.2 Sugarloaf Uplands Smooth-barked Apple Forest

Sugarloaf Uplands Smooth-barked Apple Forest was recorded within the Project Area, covering an area of approximately 19 hectares. The community is characterised by the dominant canopy species smooth-barked apple (*Angophora costata*), however a wide range of other canopy species also occur, namely red bloodwood (*Corymbia gummifera*) and broad-leaved white mahogany (*Eucalyptus umbra*). The canopy height within this community was approximately 23–30 metres, while the foliage cover was approximately 40 per cent. A sub canopy that included the above species as well as turpentine (*Syncarpia glomulifera* subsp*. glomulifera*) and forest oak (*Allocasuarina torulosa*) also occurred, ranging between 4 and 10 metres in height, while the foliage cover ranged between 10 and 20 per cent. The canopy height within this community is approximately 15–20 metres, while the foliage cover ranges between 20 and 30 per cent.

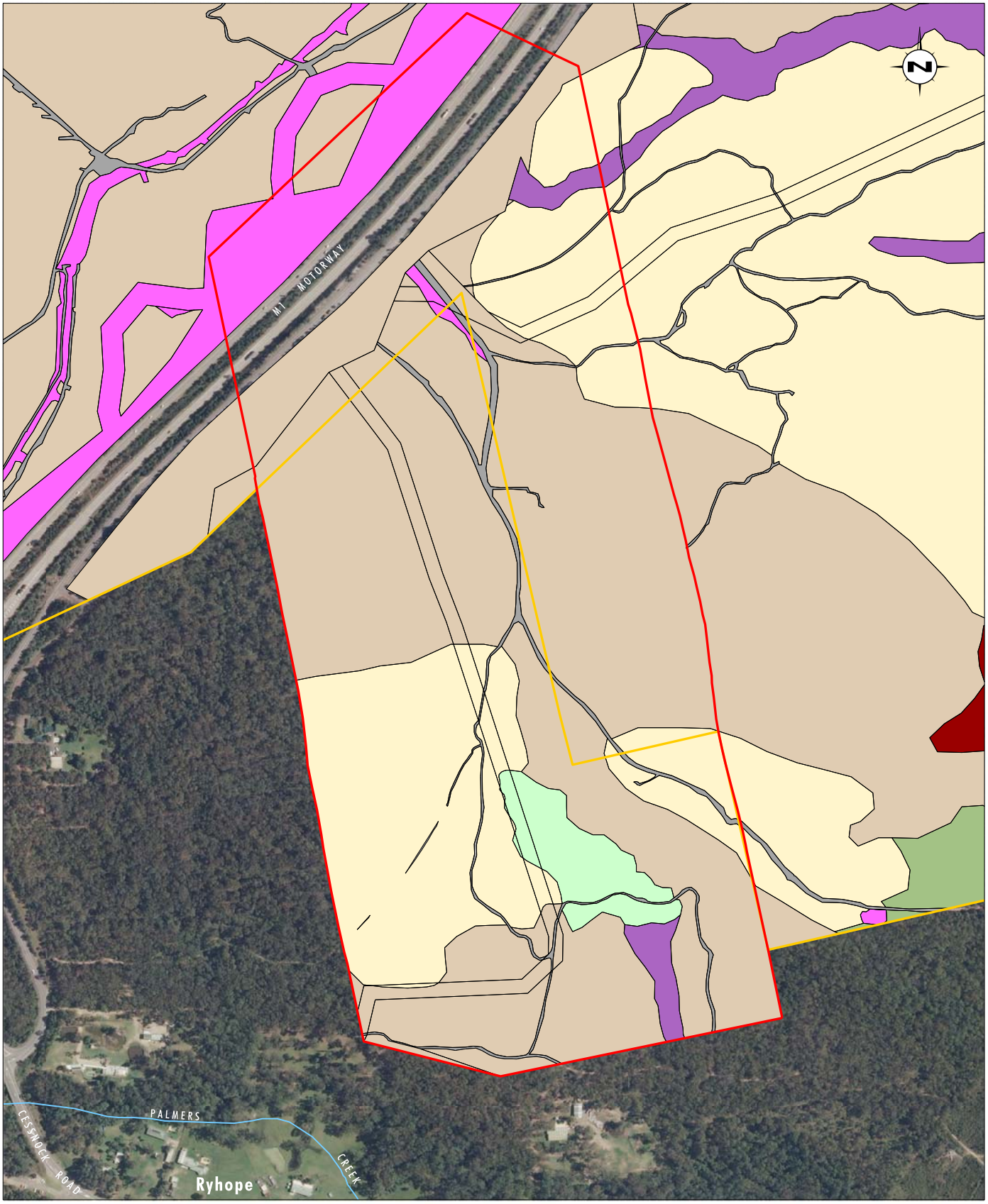

Image Source: OCAL (2008)
Data Source: OCAL (2013), Bell & Driscoll (2009), Umwelt (2013)

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Legend

- Project Area
- Approved Continued Underground Mining Area
- Cleared Land
- Disturbed - Regrowth
- Coastal Wet Gully Forest
- Coastal Foothills Spotted Gum-Ironbark Forest
- Freemans Peppermint-Apple-Bloodwood Forest
- Riparian Paperbark-Peppermint Forest
- Sugarloaf Uplands Smooth-barked Apple Forest
- Sugarloaf Uplands Dry Spotted Gum-Ironbark Forest

FIGURE 4.1

Vegetation Communities

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20131219 16.53

The shrub stratum is typically sparse, generally with 10–30 per cent cover. This stratum is consistently between 1 and 3 metres in height. The commonly recorded shrub stratum species include narrow-leaved geebung (*Persoonia linearis*), prickly shaggy pea (*Podolobium ilicifolium*), Gymea lily (*Doryanthes excelsa*), mountain devil (*Lambertia formosa*), prickly Moses (*Acacia ulicifolia*), blue flax-lily (*Dianella caerulea* var. *producta*), *Dillwynia retorta* and *Leucopogon lanceolatus* var. *lanceolatus*.

Characteristic species present in the ground stratum include kangaroo grass (*Themeda australis*), fishbones (*Lomandra obliqua*), *Lepidosperma laterale*, wiry panic (*Entolasia stricta*), tall basket grass (*Oplismenus aemulus*), threeawn speargrass (*Aristida vagans*), *Gonocarpus tetragynus*, rough Guinea flower (*Hibbertia aspera*) and wattle mat-rush (*Lomandra filiformis* subsp. *filiformis*). The threatened flora species, black-eyed Susan (*Tetratheca juncea*) and small-flower Grevillea (*Grevillea parviflora* subsp. *parviflora*) were often recorded in the ground stratum of this community. This stratum was found to be less than 1 metre in height, with a typical foliage cover of 60 per cent.

4.2.3 Coastal Wet Gully Forest

Coastal Wet Gully Forest occurs in protected gullies and lower slopes of the Project Area, covering an area of approximately 2 hectares. A tall emergent layer of Sydney blue gum (*Eucalyptus saligna*) occurred up to 40 metres in height. The dominant canopy species recorded within this community was Sydney blue gum (*Eucalyptus saligna*), while Sydney peppermint (*Eucalyptus piperita*) and rough-barked apple (*Angophora floribunda*) also occurred in low numbers. The height of the canopy stratum was 25-35 metres, while the foliage cover reached approximately 40 per cent. A sub-canopy layer of forest oak (*Allocasuarina torulosa*), turpentine (*Syncarpia glomulifera* subsp. *glomulifera*) and cheese tree (*Glochidion ferdinandi* var. *ferdinandi*) was also recorded between seven and 15 metres in height and approximately 25 per cent cover.

The ground layer consisted of two formations: an upper (1–2 metres tall) and lower (less than 1 metre tall) layer. The upper layer had a combined cover of approximately 25 per cent and was dominated by gristle fern (*Blechnum cartilagineum*), prickly rasp fern (*Doodia aspera*) and saw sedge (*Gahnia clarkei*). The lower layer comprised approximately 15 per cent cover and included scrambling lily (*Geitonoplesium cymosum*), tall basket grass (*Oplismenus aemulus*), creeping beard grass (*Oplismenus imbecillis*), lawyer vine (*Smilax australis*), kidney weed (*Dichondra repens*) and common maidenhair (*Adiantum aethiopicum*).

4.2.4 Riparian Paperbark – Peppermint Forest

Riparian Paperbark Peppermint Forest has been mapped in one drainage line in the southern eastern portion of the Project Area, covering an area of approximately 1 hectare. This community is known to occur in lower elevation, undulating country in the south east portion of the SSCA (Bell and Driscoll 2013). The community is dominated by a canopy of Sydney peppermint (*Eucalyptus piperita*) and white mahogany (*Eucalyptus acmenoides*) to 25 metres tall and 30 per cent cover. A sub canopy of flax-leaved paperbark (*Melaleuca linariifolia*), cheese tree (*Glochidion ferdinandi* var. *ferdinandi*) and forest oak (*Allocasuarina torulosa*) was also present to 10 metres tall and 40 per cent cover. Turpentine (*Syncarpia glomulifera* subsp. *glomulifera*) was also relatively common within the community.

A ground layer of saw sedge (*Gahnia clarkei*), Gymea lily (*Doryanthes excelsa*) and common silkpod (*Parsonsia straminea*) were the dominant species in a tall ground layer, forming a dense thicket in places to a height of approximately 2 metres and 15 per cent cover. A lower ground layer of ivy-leaved violet (*Viola hederacea*), tall basket grass (*Oplismenus aemulus*), creeping beard grass (*Oplismenus imbecillis*), common maidenhair (*Adiantum aethiopicum*) and *Carex* sp. also occurred with approximately 40 per cent cover.

4.2.5 Cleared Land

Cleared Land consisted entirely of fire trails and tracks within the Project Area. These areas had previously been cleared of vegetation and are regularly managed for access purposes. Generally the only vegetation that occurred were colonised weed species, including purpletop (*Verbena bonariensis*), cobblers pegs (*Bidens pilosa*), flatweed (*Hypochaeris radicata*) and fleabane (*Conyza* sp.). These areas comprise approximately 1 hectare and do not represent naturally occurring vegetation communities.

4.3 Threatened Flora Species, Endangered Flora Populations and Threatened Ecological Communities

4.3.1 Threatened Flora Species

Two threatened flora species were recorded in the Project Area, being black-eyed Susan (*Tetratheca juncea*) and small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*). The locations of records of these species are shown in **Figure 4.2**.

Black-eyed Susan (*Tetratheca juncea*) was recorded widely within the Project Area, however was found to be less common in riparian communities. The species is considered to be one of a number of dominant groundcover species in Freemans Peppermint Apple Bloodwood Forest. A small number of records were also made within the Sugarloaf Uplands Smooth-barked Apple Forest. A total of 18 locations of this species were mapped however, due to the abundance of specimens recorded, these mapped locations generally indicate the extent of populations of this species, rather than a documentation of the total area covered. The actual extent of this species' distribution throughout the Project Area is expected to be greater than that mapped on **Figure 4.2** based on the extent of available habitat and the common nature of the species. Bell and Driscoll (2013) regarded the species as common in the SSCA.

The small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*) was recorded at five locations within the Project Area and a further three locations in proximity to the Project Area (refer to **Figure 4.2**). It is likely that the actual number of individuals of this species occurring in the Project Area would be greater, due to the cryptic nature of the species in the understorey, and given the species was not in flower at the time of the field survey. Bell and Driscoll (2013) regarded the species as abundant on the eastern slopes and ridgetops of the main Sugarloaf range and also on the lowlands in the south.

In addition to those threatened flora species recorded, a number of species were assessed for their potential to occur in the Project Area, based on their known distribution and habitat requirements. None of these additional species were recorded during surveys for this Project. These species were identified from database searches, literature review and expert knowledge, and are listed in **Appendix A**. Of the 19 threatened flora species assessed, 10 (in addition to the two recorded) were found to have reasonable potential, on the basis of suitable habitat, to occur in the Project Area, and are listed in **Table 4.1** below.

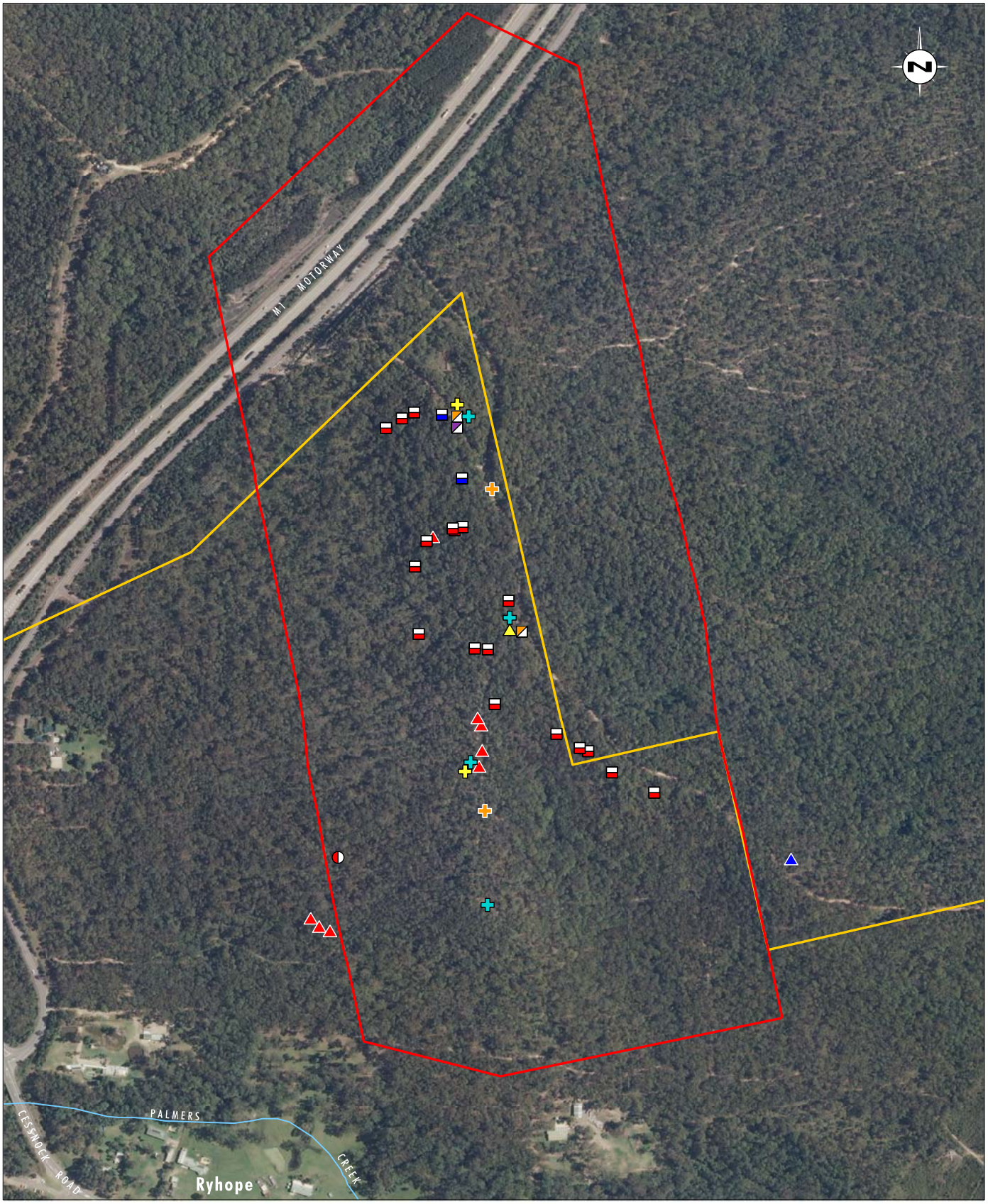

Image Source: OCAL (2008)
Data Source: OCAL (2013), Atlas (2013), Umwelt (2013)

0 100 200 400m
1:7 500

Legend

- Project Area
- Approved Continued Underground Mining Area

Atlas Site Data:

- *Grevillea parviflora* subsp. *parviflora*
- *Tetratheca juncea*

Umwelt Site Data:

- Little Lorikeet
- Eastern Bentwing-bat
- Eastern Freetail-bat
- Greater Broad-nosed Bat
- Grey-headed Flying-fox
- Large-eared Pied Bat
- Little Bentwing-bat
- *Grevillea parviflora* subsp. *parviflora*
- *Tetratheca juncea*

FIGURE 4.2

Threatened Species Locations

File Name (A4): R03/3149_009.dgn
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Table 4.1 – Threatened Flora Species with Potential to Occur in the Project Area

Species	Legal Status
Bynoe's wattle (*Acacia bynoeana*)	E (TSC) V (EPBC)
Charmhaven apple (*Angophora inopina*)	V (TSC) V (EPBC)
netted bottle brush (*Callistemon linearifolius*)	V (TSC)
leafless tongue orchid (*Cryptostylis hunteriana*)	V (TSC) V (EPBC)
white-flowered wax plant (*Cynanchum elegans*)	E (TSC) E (EPBC)
biconvex paperbark (*Melaleuca biconvexa*)	V (TSC) V (EPBC)
eastern underground orchid (*Rhizanthella slateri*)	V (TSC) E (EPBC)
heath wrinklewort (*Rutidosis heterogama*)	V (TSC) V (EPBC)
magenta lilly pilly (*Syzygium paniculatum*)	V (TSC) E (EPBC)
glandular pink-bell (*Tetratheca glandulosa*)	V (TSC) V (EPBC)

4.3.2 Endangered Flora Populations

No endangered flora populations were recorded within the Project Area, and none are expected to occur.

4.3.3 Threatened Ecological Communities

None of the vegetation communities recorded in the Project Area conform to the description provided by the NSW Scientific Committee of a listed TEC. Vegetation communities identified in the Project Area were compared to TECs listed under the NSW TSC Act and the Commonwealth EPBC Act and an assessment of similarity with TECs was undertaken using the following approach:

- comparison with published species lists, including lists of 'important species' as identified on the listing advice provided by the OEH and Department of Environment scientific committees;
- comparison with habitat descriptions and distributions for listed TECs; and
- assessment using guidelines published by the Commonwealth Department of Environment and the NSW OEH.

4.4 Fauna Results

4.4.1 Fauna Habitat Assessment Results

Two broad fauna habitat types were identified within the Project Area comprising Dry Forest and Riparian and Mesic habitats.

4.4.1.1 Dry Forest Habitats

The dry forest habitat dominates the Project Area covering approximately 62 hectares and comprising two vegetation communities. The dry forest habitat ranges in the landscape from ridge-top to sheltered catchments. The general structure is continuous throughout the forest habitat however the heights and composition of each stratum can vary across its range.

The structure of the forest habitats comprises a canopy cover ranging from 15 to 25 metres with less than 30 per cent canopy cover, generally with an open understorey and dense ground cover. The canopy trees provide flowering resources for honeyeaters, parrots and arboreal mammals during most of the year. Mature hollow-bearing trees are common throughout this habitat providing potential nesting resources for large arboreal mammals, owls, micro-bats and other hollow-dependent fauna. The sub-canopy stratum, where it occurs, provides potential foraging resources for cockatoos (Cacatuidae), including the glossy black-cockatoo (*Calyptorhynchus lathami*), listed as vulnerable under the TSC Act.

The open understorey provides potential foraging habitat for micro-bats, macropods, birds and some limited nesting potential in protected areas for small woodland birds. The ground cover is dense with many small rocks and several fallen hollow branches and trees providing foraging and refuge resources for reptiles and small terrestrial mammals. Water resources are limited within this habitat type.

Small areas of rocky-outcropping are present within the dry forest habitat. These areas provide potential habitat for reptile species. The survey effort targeted habitats for micro-bats around the rocky outcrop areas however no areas of caves large enough to support micro-bats were identified.

There are no cliff lines within the Project Area.

4.4.1.2 Riparian and Mesic Habitats

The riparian and mesic habitat covers approximately 3 hectares within the Project Area comprising two vegetation communities: Coastal Wet Gully Forest; and Riparian Paperbark Peppermint Forest occurring on lower slopes and flats within the Project Area.

The structure of the riparian and mesic habitat comprises an open canopy cover, to 30 metres, with a dense sub-canopy stratum comprising wet sclerophyll and rainforest vegetation. The canopy and sub-canopy stratums provide flowering and fruiting resources for honeyeaters, rainforest specialist birds and arboreal mammals during most of the year. Hollow bearing trees are not as common however occasional large eucalypt species provide valuable hollow resources for hollow-dependent fauna.

The understorey and ground cover are generally open providing valuable foraging and nesting resources for small rainforest birds and small mammals. The ground cover provides many small rocks and fallen timber providing foraging and refuge resources for small terrestrial mammal, reptile and amphibian species. The riparian and mesic habitat contain ephemeral creeklines, providing water resources in medium to high rainfall events.

4.4.2 Fauna Species

A total of 59 vertebrate fauna species were recorded within the Project Area, comprising 34 bird species, 18 mammal species, four reptile species and three amphibian species. An outline and discussion of the species recorded within each of the four major vertebrate fauna groups is presented in the following sections. A full list of the fauna species recorded is provided in **Appendix B**.

4.4.2.1 Birds

Thirty-four bird species from 22 families were recorded during surveys. The most speciose families recorded within the Project Area were Meliphagidae (honeyeaters) and Atamidae (butcherbirds, magpies and currawongs) with four species each followed by Acanthizidae (thornbills and scrubwrens) with three species.

The most abundant species recorded throughout the Project Area were the spotted pardalote (*Pardalotus punctatus*), white-throated treecreeper (*Corombates leucophaea*), eastern yellow robin (*Eopsaltria australis*), grey fantail (*Rhipidura albiscapa*) and noisy miner (*Manorina melanophrys*). The most abundant species in the drier forest habitat was the yellow-faced honeyeater (*Lichenostomus chrysops*), grey butcherbird (*Cracticus torquatus*) and pied currawong (*Strepera graculina*). The most abundant species in the riparian habitat was the golden whistler (*Pachycephala pectoralis*), Lewin's honeyeater (*Meliphaga lewinii*) and brown gerygone (*Gerygone mouki*).

One threatened bird species, little lorikeet (*Glossopsitta pusilla)*, which is listed as vulnerable under the TSC Act was recorded in the Project Area on one occasion during surveys (refer to **Figure 4.2**).

4.4.2.2 Mammals

Thirty-three mammal species from 13 families were recorded within the Project Area. The most speciose families recorded were from Vespertilionidae (evening micro-bats) with six species recorded, Molossidae (freetail micro-bats) with three species recorded and Miniopteridae (bentwing micro-bats) with two species recorded.

The most common mammal species recorded were the common brushtail possum (*Trichosurus vulpecula*), Gould's wattled bat (*Chalinolobus gouldii*) and little forest bat (*Vespadelus vulturnus*). These species were recorded in all habitats types throughout the Project Area.

Six threatened mammal species were recorded within the Project Area during surveys, being grey-headed flying fox (*Pteropus poliocephalus*), east coast freetail bat (*Mormopterus norfolkensis*), eastern bentwing-bat (*Miniopterus schreibersii oceanensis*), little bentwing-bat (*Miniopterus australis*), large-eared pied bat (*Chalinolobus dwyeri*) and greater broad-nosed bat (*Scoteanax rueppellii*) (refer to **Figure 4.2**).

4.4.2.3 Reptiles

Four reptile species from three families were identified within the Project Area during the survey. This result in not expected to be representative of the diversity of reptile species in the Project Area. The most abundant reptile species recorded were the grass skink (*Lampropholis delicata*) and three-toed skink (*Saiphos equalis*).

No threatened reptile species were recorded within the Project Area.

4.4.2.4 Amphibians

Three amphibian species from two families were identified within the Project Area, comprising the common eastern froglet (*Crinia signifera*), red-backed toadlet (*Pseudophryne coriacea*) and dwarf tree frog (*Litoria fallax*). Moderate to high quality amphibian habitat occurred within the Project Area.

No threatened amphibian species were recorded within the Project Area during the survey effort.

4.4.3 Threatened Fauna Species and Endangered Fauna Populations

A total of seven threatened fauna species were recorded within the Project Area during field surveys. An additional 43 have been previously recorded within 10km of the Project Area, either during previous studies within the SSCA or on the OEH Atlas of NSW Wildlife database or are considered to have the potential to occur based on broad scale habitat mapping by the Department of the Environment Protected Matters Search Tool (PMST). **Table 4.2** identifies those threatened fauna species recorded in the Project Area during the current survey period, those recorded within 10 kilometres, either by Umwelt (Umwelt 2010 or identified in the OEH Atlas of NSW Wildlife (OEH 2013), and those considered to have the potential to occur within 10 kilometres of the Project Area based on the results of the PMST (Department of the Environment 2013). No species or populations listed under the FM Act were recorded in the Project Area and none are expected to occur.

Table 4.2 – Threatened Fauna recorded within 10 kilometres of the Project Area

Species	Status	Recorded in the Project Area?	Recorded within 10 kilometres of the Project Area?	Identified on the EPBC PMST?
giant barred frog *Mixophyes iteratus*	E (TSC) E (EPBC)	✗	✓	✓
giant burrowing frog *Heleioporus australiacus*	V (TSC) V (EPBC)	✗	✗	✓
green and golden bell frog *Litoria aurea*	E (TSC) V (EPBC)	✗	✓	✓
stuttering frog *Mixophyes balbus*	E (TSC) V (EPBC)	✗	✓	✓
wallum froglet *Crinia tinnula*	V (TSC)	✗	✓	N/A
Stephens' banded snake *Hoplocephalus stephensii*	V (TSC)	✗	✓	N/A
black-necked stork (*Ephippiorhynchus asiaticus*)	E (TSC)	✗	✓	N/A
black bittern *Ixobrychus flavicollis*	V (TSC)	✗	✓	N/A
Australasian bittern *Botaurus poiciloptilus*	E (TSC) E (EPBC)	✗	✓	✓

Table 4.2 – Threatened Fauna recorded within 10 kilometres of the Project Area (cont.)

Species	Status	Recorded in the Project Area?	Recorded within 10 kilometres of the Project Area?	Identified on the EPBC PMST?
red goshawk *Erythrotriorchis radiatus*	CE (TSC) V (EPBC)	✗	✓	✓
eastern osprey *Pandion cristatus*	V (TSC)	✗	✓	N/A
little eagle *Heiraaetus morphnoides*	V (TSC)	✗	✓	N/A
comb-crested Jacana *Irediparra gallinacea*	V (TSC)	✗	✓	N/A
Australian painted snipe *Rostratula australis*	E (TSC) E (EPBC)	✗	✓	✓
glossy black-cockatoo *Calyptorhynchus lathami*	V (TSC)	✗	✓	N/A
gang-gang cockatoo *Callocephalon fimbriatum*	V (TSC)	✗	✓	N/A
little lorikeet *Glossopsitta pusilla*	V (TSC)	✓	✓	N/A
swift parrot *Lathamus discolor*	E (TSC) E (EPBC)	✗	✓	✓
turquoise parrot *Neophema pulchella*	V (TSC)	✗	✓	N/A
powerful owl *Ninox strenua*	V (TSC)	✗	✓	N/A
barking owl *Ninox connivens*	V (TSC)	✗	✓	N/A
sooty owl *Tyto tenebricosa*	V (TSC)	✗	✓	N/A
masked owl *Tyto novaehollandiae*	V (TSC)	✗	✓	N/A
brown treecreeper (eastern form) *Climacteris picumnus victoriae*	V (TSC)	✗	✓	N/A
eastern bristlebird *Dasyornis brachypterus*	E (TSC) E (EPBC)	✗	✗	✓
speckled warbler *Chthonicola sagittata*	V (TSC)	✗	✓	N/A
regent honeyeater *Anthochaera phrygia*	CE (TSC) E (EPBC)	✗	✓	✓
white-fronted chat *Epthianura albifrons*	V (TSC)	✗	✓	N/A
grey-crowned babbler (eastern subspecies) *Pomatostomus temporalis temporalis*	V (TSC)	✗	✓	N/A

Table 4.2 – Threatened Fauna recorded within 10 kilometres of the Project Area (cont.)

Species	Status	Recorded in the Project Area?	Recorded within 10 kilometres of the Project Area?	Identified on the EPBC PMST?
varied sittella *Daphoenositta chrysoptera*	V (TSC)	×	✓	N/A
scarlet robin *Petroica boodang*	V (TSC)	×	✓	N/A
hooded robin (south-eastern form) *Melanodryas cucullata cucullata*	V (TSC)	×	✓	N/A
spotted-tailed quoll *Dasyurus maculatus*	V (TSC) E (EPBC)	×	✓	✓
koala *Phascolarctos cinereus*	V (TSC) V (EPBC)	×	✓	✓
eastern pygmy-possum *Certartetus nanus*	V (TSC)	×	✓	N/A
yellow-bellied glider *Petaurus australis*	V (TSC)	×	✓	N/A
squirrel glider *Petaurus norfolcensis*	V (TSC)	×	✓	N/A
long-nosed potoroo *Potorous tridactylus tridactylus*	V (TSC) V (EPBC)	×	✓	✓
brush-tailed rock-wallaby *Petrogale penicillata*	E (TSC) V (EPBC)	×	✓	✓
grey-headed flying-fox *Pteropus poliocephalus*	V (TSC) V (EPBC)	✓	✓	✓
east-coast freetail-bat *Mormopterus norfolkensis*	V (TSC)	✓	✓	N/A
golden-tipped bat *Kerivoula papuensis*	V (TSC)	×	✓	N/A
little bentwing-bat *Miniopterus australis*	V (TSC)	✓	✓	N/A
eastern bentwing bat *Miniopterus schreibersii oceanensis*	V (TSC)	✓	✓	N/A
large-eared pied bat *Chalinolobus dwyeri*	V (TSC) V (EPBC)	✓	✓	✓
eastern false pipistrelle *Falsistrellus tasmaniensis*	V (TSC)	×	✓	N/A
southern myotis *Myotis macropus*	V (TSC)	×	✓	N/A
greater broad-nosed bat *Scoteanax rueppellii*	V (TSC)	✓	✓	N/A

Table 4.2 – Threatened Fauna recorded within 10 kilometres of the Project Area (cont.)

Species	Status	Recorded in the Project Area?	Recorded within 10 kilometres of the Project Area?	Identified on the EPBC PMST?
eastern cave bat *Vespadelus troughtoni*	V (TSC)	✗	✓	N/A
New Holland mouse *Pseudomys novaehollandiae*	V (EPBC)	✗	✗	✓

TSC = Threatened Species Conservation Act 1995

EPBC = *Environment Protection and Biodiversity Conservation Act 1999*

E = Endangered

CE= Critically Endangered

V = Vulnerable

4.4.3.1 Endangered Fauna Populations

No endangered fauna populations were recorded within the Project Area, and none are expected to occur.

4.4.4 SEPP 44 Koala Habitat Protection

An assessment of the Project under the provision of SEPP 44 revealed that the Project Area does not contain any areas of 'potential koala habitat', that is, any areas of vegetation that contain greater than 15 per cent of schedule 2 koala feed tree species.

Further surveys including nocturnal call playback and spotlighting were also undertaken throughout the Project Area, however this species was not recorded.

4.4.5 Groundwater Dependent Ecosystems

Based on the detailed groundwater assessment no alluvial aquifers or perched groundwater aquifers have been identified above the proposed longwall extraction area. No vegetation community in the Project Area is considered likely to be dependent on groundwater resources (Aurecon 2013).

5.0 Impact Assessment

A total of 66 hectares of native vegetation occurs within the Project Area, providing known habitat for nine threatened species and potential habitat for a further 56 threatened species, based on the results of the literature review and database searches.

The following section outlines the likely impacts of the Project on the ecological characteristics of the Project Area and outlines the Project changes that have been made to avoid and minimise impacts as well as the mitigative measures that are proposed to minimise the potential for impact on the threatened species known, or considered likely to occur within the Project Area.

5.1 Potential Ecological Impacts of the Project

5.1.1 Potential Subsidence Impacts

5.1.1.1 Vertical and Horizontal Displacement

Subsidence can be generically described as the downward movement of the ground surface in response to the rock layers above the coal extraction area temporarily separating and then interfacing again, each one moving down sequentially to fill the gap created by movement of the layer below. It is noted that subsidence can also result in horizontal ground movements and changes to the slope of the ground surface. These movements are significantly smaller in magnitude in comparison to the vertical component, and are not considered in this assessment.

A comprehensive subsidence assessment was completed for the Project by Ditton Geotechnical Services (DGS, 2013). The report assessed the potential subsidence impacts resulting from the Project and determined that the greatest vertical subsidence is likely to occur over the centre of each longwall panel. This vertical subsidence is predicted to typically range from 2.41 metres to 2.61 metres (57 to 58 per cent of mining height).

Subsidence movements will permanently displace the ground surface, with a series of hollows over the centre of each longwall panel and a series of humps over each solid pillar of coal. These will not be uniform either laterally or longitudinally over the longwall panel. This undulating surface profile is usually not noticeable to the naked eye because they are small relative to the large horizontal distances across each longwall panel.

5.1.1.2 Subsidence Cracking

The proposed underground mining operations will result in subsidence above the extracted longwall panels. Subsidence of the ground surface itself does not typically adversely impact ecological values, however, it can lead to surface cracking, changes to surface drainage and tree falls that may impact ecological values. The subsidence impacts associated with this Project are predicted to include potential tree falls on steep slopes in high tilt areas adjacent to the outer extent of the longwall panels, with the most likely impacts predicted to occur on the western edge of Longwall 51 (refer to Appendix 3 of the EA).

As a result of the predicted vertical subsidence, surface cracking is likely to occur where tensile stresses develop, on the edges of longwall panels and along tops of topographic high points. Cracking may also occur at regular intervals along the centre of the panels and be interspersed with compression humps. Based on the predicted range of maximum tensile strains from 11 to 50 mm/m for the proposed longwalls, maximum surface cracking typical

widths of between 110 millimetres and 250 millimetres may occur within the limits of mining and in areas with moderately undulating terrain (i.e. slopes < 18°). Cracks of up to approximately 830 millimetres may occur near ridge crests due to rigid body rotations of steep slopes. Similar 'scarps' or vertical rock displacements could also develop as a result of subsiding steep slope by the same order of magnitude.

There are several small areas of low depth of cover (80 metres to 100 metres) within the Project Area. The proposed longwall 51 and longwall 52 have been designed to minimise the potential for connective cracking as a result of underground mining. However, to further minimise the potential for surface water impacts and subsequently any mine safety issues, any subsidence cracks which occur will be remediated as soon as possible following identification of the cracks.

5.1.1.3 Tree Fall

It is expected that the predicted subsidence movements may cause tree fall or failure on steep slopes in high tilt and tension zones on the eastern and western edges of the longwalls.

5.1.2 Surface Water Impacts

The potential impacts of the subsidence affectation zone for proposed Longwalls 51 and 52 is limited to the uppermost reaches of two first order tributaries of Palmers Creek. As a result, the potential for the subsidence to impact flows within Palmers Creek is limited to negligible changes in flow depths and velocities within the impacted reaches of the two first order tributaries. A surface water assessment undertaken for the Project has identified that the soil characteristics indicate that the creek lines are potentially subject to erosion with the potential for erosion being increased where vegetation cover is absent. However, the predicted subsidence associated with proposed Longwalls 51 and 52 is not expected to result in significant changes to remnant ponding, flow volumes or flow characteristics within Palmers Creek. Therefore the Project is considered unlikely to significantly impact on the creek lines in Project Area or on its associated riparian vegetation as a result of surface water impacts.

5.1.3 Subsidence Remediation Works

Based on subsidence predictions and experience from previous mining at WWC, including extensive mining under the SSCA, it is expected that subsidence remediation works will be undertaken on access tracks and in steep slope areas within the Project Area. However, it is also possible that subsidence remediation work make be required in other parts of the Project Area above the longwall extraction area. It is expected that subsidence remediation works, being predominately grouting or minor earthworks to repair cracking, will be utilised to remediate subsidence cracks in areas where vegetation remains intact, to minimise the potential for disturbance to these areas.

In the event that subsidence remediation within intact vegetation is required, it would be necessary to remove elements of the shrub and ground layers to allow for access for earthmoving machinery. Limited small tree removal may also be required where it is not possible to gain access without some tree removal. The remediation of surface cracking within vegetation communities would be managed to reduce the amount of vegetation that would be disturbed or removed as a result of earthworks. In order to achieve this, WWC would use small earthmoving machinery would be used in these areas as much as possible. The use of small machinery would reduce the potential to require the clearing of small trees, shrubs and other vegetation layers. It is considered unlikely that mature trees will need to be cleared to complete the required subsidence remediation; however, in the unlikely circumstances where it is required, clearing would be undertaken in accordance with WWCs

existing detailed pre-clearance procedure. In addition, subsidence remediation may also be undertaken via the utilisation of grouting, which involves the usage of approved grouting material to fill subsidence cracks. This process is currently being implemented for WWC's existing mining operations beneath the SSCA.

In forest/woodland areas, shrub and ground layers will typically be the strata that would be most substantially impacted by remediation activities. Regular monitoring of remediated forest/woodland areas will be required to ensure that the shrub and ground layers regenerate from the soil seed bank following subsidence remediation works. Should natural regeneration not be successful, WWC will facilitate the revegetation of these sites through the spreading of a suitable native seed mix, in consultation with OEH.

5.2 Impact of the Project on Flora Species

In terms of general diversity of flora species, the Project Area is considered to be representative of surrounding areas. Overall, plant species diversity is considered to be moderate, with a total of 112 species recorded during surveys. Of these, only five species (4 per cent) were not native to the Project Area. A total of 376 taxa have been recorded within the wider SSCA (Bell and Driscoll, 2009) and the species diversity of the Project Area is considered to be generally representative of the diversity in the SSCA.

The Project is not expected to result in the reduction of flora species diversity from within the Project Area, due to the small area of disturbances predicted as a result of subsidence and the limited surface remediation works expected to be required to repair potential subsidence impacts.

5.3 Impact of the Project on Vegetation Communities

The vegetation within the Project Area is considered to be of high ecological significance, as the majority of the Project Area falls within the Sugarloaf State Conservation Area (refer to **Section 2.6**). The Project has the potential to result in the creation of instable landscapes on steep slopes (>35 degrees) within the Project Area due to water ingress/erosion. Additionally, fire trails, steep slope areas and potentially other sections of the land surface above the longwall extraction area are also likely to be impacted by cracking and some areas of cracking will require remedial works. As a result, subsidence remediation works with tracked equipment is likely to be required in some areas, primarily along tracks and in steep slope areas, including up-slope runoff deviation and grout repairs. This may involve filling subsidence cracks with grout and potentially using small tracked equipment to compact subsidence cracks.

A detailed subsidence assessment has been undertaken for the project and is included within the Environmental Assessment. As a result of the predicted vertical subsidence, surface cracking is likely occur where tensile stresses develop, on the edges of longwall panels and along tops of topographic high points. Cracking may also occur at regular intervals along the centre of the panels and be interspersed with compression humps. Based on the results of the subsidence assessment undertaken for the project, it is predicted that surface subsidence cracks with typical widths of between 110 millimetres and 250 millimetres may occur within the area which has been mined, or up to 28 metres outside of the longwall extraction limits. Cracks of up to 600 millimetres may occur near ridge crests. Based on the subsidence predictions OCAL has advised it does not envisage that large scale remediation works will be required to be undertaken within the Project Area, with the subsidence remediation works to be managed by OCAL to minimise impacts to existing vegetation where possible. Remediation works will be developed and undertaken in

consultation with relevant stakeholders. The impacts to vegetation are expected to be limited to the direct cracking impacts, some potential tree fall in steep slope areas and circumstances where machinery is required to repair subsidence cracking, with grouting the preferred method for subsidence crack remediation.

No surface water ponding is anticipated to occur within the Project Area as a result of the proposed works (refer to **Section 5.1.2**) and therefore no impact on vegetation will occur due to ponding.

As disturbance to vegetation communities will only occur where it is necessary to repair areas of severe cracking, clearing of canopy vegetation is unlikely to be required and the majority of vegetation will remain largely undisturbed. Tree fall impacts and subsidence remediation works are likely to be localised within the Project Area. The predicted impacts are not expected to result in a significant loss of floristic diversity or community composition of the Project Area, the SSCA or the region.

5.4 Impact on Groundwater-dependent Ecosystems

Groundwater dependent ecosystems (GDEs) are ecosystems which have their species composition and their natural ecological processes determined by groundwater (DLWC 2002). According to the Groundwater Dependent Ecosystem Policy (DLWC 2002), ecosystems which depend on groundwater are:

- wetlands and red gum forests;
- other terrestrial vegetation;
- ecosystems in streams fed by groundwater;
- limestone cave systems;
- springs; and
- hanging valleys and swamps.

No vegetation community occurring in the Project Area is considered likely to be dependent on groundwater resources (Aurecon 2013).

5.5 Impact of the Project on Fauna Habitat and Fauna Species

It is unlikely that the Project will result in a significant loss or deterioration of fauna habitat within the Project Area. The existing fauna habitat consists broadly of remnant forest vegetation (approximately 91 per cent of the Project Area); with a limited area of riparian and mesic habitat (6 per cent of Project Area). The remaining 3 per cent of the Project Area comprises cleared or disturbed lands.

The Project is not expected to result in the reduction of fauna species diversity or abundance from within the Project Area, due to the small area of disturbance predicted to result from subsidence and the limited surface disturbance associated with surface remediation works expected to be required to repair potential subsidence impacts. This expectation is supported by the results of previous ecological monitoring conducted by Umwelt in WWC between 2005 and 2013 (Umwelt 2005, 2006, 2007, 2009, 2010, 2011 and 2012).

5.6 Impact of the Project on Threatened Species, Endangered Populations and Threatened Ecological Communities

The Project may result in a potential loss of threatened flora and fauna habitat as a result of the predicted subsidence however limited surface remediation works are expected to be required to repair potential subsidence impacts. The basic principles of protecting threatened species are to:

- avoid direct impacts and retain habitat;
- minimise impacts wherever possible;
- mitigate or ameliorate impacts; and as a last resort; and
- compensate or offset for any unavoidable impacts.

The Project will not result in the removal of a substantial area of threatened species habitat, with impacts on vegetation communities and fauna habitats expected to be limited to minor subsidence impacts (refer to **Sections 5.3** and **5.5**).

5.6.1 Threatened Species Assessed Under the *Environmental Planning and Assessment Act 1979*

An assessment of the significance of the impact of the Project on threatened species was undertaken using an initial screening process to identify threatened species that have been recorded in the Project Area or may be potentially impacted by the Project (Tables 1 and 2 of **Appendix A**). A full assessment of the likely significance of impacts was completed for these species. The Assessment of Significance does not take into account the full range of impact mitigation strategies proposed as part of the Project, rather it considers the impacts of the Project without mitigation. The Assessment of Significance was completed for the following threatened species, either due to their recorded presence or the potential for species' to be impacted:

- black-eyed Susan (*Tetratheca juncea*);
- small-flower grevillea (*Grevillea parviflora* subsp *parviflora*);
- Stephens banded snake (*Hoplocephalus stephensii*);
- yellow-bellied glider (*Petaurus australis*);
- squirrel glider (*Petaurus norfolcensis*);
- spotted-tailed quoll (*Dasyurus maculatus*);
- sooty owl (*Tyto tenebricosa*);
- masked owl (*Tyto novaehollandiae*);
- powerful owl (*Ninox strenua*);
- glossy black-cockatoo (*Calyptorhynchus lathami*);
- gang-gang cockatoo (*Callocephalon fimbriatum*);
- little lorikeet (*Glossopsitta pusilla*);

- swift parrot (*Lathamus discolor*);
- regent honeyeater (*Anthochaera phrygia*);
- varied sittella (*Daphoenositta chrysoptera*);
- koala (*Phascolarctos cinereus*);
- grey-headed flying-fox (*Pteropus poliocephalus*);
- little bentwing-bat (*Miniopterus australis*);
- large-eared pied bat (*Chalinolobus dwyeri*);
- eastern freetail bat (*Mormopterus norfolkensis*);
- eastern false pipistrelle (*Falsistrellus tasmaniensis*);
- yellow-bellied sheathtail-bat (*Saccolaimus flaviventris*);
- greater broad-nosed bat (*Scoteanax rueppellii*); and
- eastern bentwing-bat (*Miniopterus schreibersii oceanensis*).

The assessment of significance conducted for each of the threatened species recorded in the Project Area or considered likely to be potentially impacted is included in **Appendices C** and **D**. The Assessments of Significance conclude that the Project will not have a significant impact on threatened species known or with potential to occur in the Project Area.

An Impact Mitigation Strategy (refer to **Section 6.0**) has been designed to minimise potential impacts of the Project on ecological values, including threatened species.

For its existing operations WWC has made a commitment that should unpredicted adverse ecological impacts occur as a result of its operations, a biodiversity offset will be developed to counterbalance these unpredicted adverse impacts. This same approach will be implemented for the Project.

Consistent with the approach in the existing WWC approval, in the event that unpredicted, adverse impacts on threatened species are identified during management and monitoring of the Project Area, WWC will respond to the issues identified and engage appropriate experts where required. WWC will investigate appropriate remediation and mitigation requirements, in consultation with the relevant government authorities and in the event that significant impacts on threatened species are identified and cannot be adequately mitigated, WWC will engage a suitably qualified and experienced ecologist to prepare a Biodiversity Offset Strategy in consultation with OEH and DP&I.

5.6.2 Threatened Species Assessed Under the *Fisheries Management Act 1994*

Neither the upper catchment of Lake Macquarie, nor the lower catchment of the Hunter River, are known to support any threatened species, endangered populations or EECs listed under the *Fisheries Management Act 1994.* No species, populations or ecological communities listed under the FM Act were recorded in the Project Area; therefore threatened aquatic species, endangered populations, or EECs listed under the FM Act will not be impacted by the Project.

5.6.3 SEPP 44 Assessment

No potential or core koala habitat as defined by the SEPP 44 Assessment methodology was recorded within the Project Area.

5.6.4 Threatened Species Assessed under the *Environment Protection and Biodiversity Conservation (EPBC) Act 1999*

Under the Commonwealth EPBC Act, the approval of the Commonwealth Minister for the Environment is required for any action that may have a significant impact on matters of national environmental significance (MNES). These matters are:

- listed threatened species and ecological communities;
- migratory species protected under international agreements;
- Ramsar wetlands of international importance;
- the Commonwealth marine environment;
- World Heritage properties;
- National Heritage places;
- Great Barrier Reef Marine Park;
- nuclear actions; and
- a water resource, in relation to coal seam gas development and large coal mining development.

5.6.4.1 Threatened Species

Four EPBC Act listed vulnerable species were recorded in the Project Area during surveys: black-eyed Susan (*Tetratheca juncea*), small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*), grey-headed flying-fox (*Pteropus poliocephalus*) and the large-eared pied bat (*Chalinolobus dwyeri*). A further 10 species were identified as having the potential to occur within 10 kilometres of the site in the results of the PMST (Department of the Environment 2013).

The results of the assessment of significance indicate that the Project is not expected to result in a significant impact on any EPBC Act listed threatened species recorded, or predicted to occur in the Project Area.

5.6.4.2 Migratory Species

Thirteen EPBC listed migratory species (excluding strictly aquatic or pelagic species) were identified as having the potential to occur within 10 kilometres of the Project Area based on the Protected Matters Search Tool (Department of the Environment 2013). These species were considered in an Assessment of Significance provided in **Appendix D**. The Project Area is not considered to provide habitat for an important population of any migratory species, as defined by the EPBC Act impact assessment guidelines, and a significant impact on migratory species is not expected to occur.

The Project is not expected to result in a significant impact on migratory species.

5.7 Impact of the Project on SSCA

The Project is not expected to have a significant impact on the ecological values of the SSCA. As discussed in **Sections 5.2** to **5.6**, the Project will not result in a substantial loss of vegetation communities or the floristic composition of vegetation communities; fauna species or habitat; or threatened species, endangered populations and TECs or their habitat.

While subsidence of between 2.44 and 2.61 metres is predicted to occur across the SSCA within the Project Area, subsidence impacts are not expected to compromise the ecological values and integrity of the SSCA and a significant detrimental impact is not expected. The results of ecological monitoring in previously mined areas at WWC indicate that while some impacts such as cracking and tree fall have occurred, mining has not resulted in significant impacts to ecological values and the impact mitigation strategy and monitoring proposed for the Project will ensure that the potential impacts of the Project on the SSCA will be adequately managed and monitored as mining progresses.

Consistent with the process in place for the existing WWC operations, in the event that unpredicted, adverse impacts on ecological values are identified during management and monitoring of the Project Area, WWC will respond to the issues identified and engage appropriate experts where required. If required WWC will investigate appropriate remediation and mitigation requirements, in consultation with the relevant government authorities and in the event that significant impacts on the ecological values of the SSCA are identified and cannot be adequately remediated, WWC will engage a suitably qualified and experienced ecologist to prepare a Biodiversity Offset Strategy in consultation with OEH and DP&I.

6.0 Impact Mitigation Strategy

Consistent with the strategy in place for the existing operations, one of the key goals of the impact mitigation strategy is to maintain or improve ecological features and functions within the Project Area, in order to mitigate the impacts associated with underground mining in the Project Area. To achieve this, current management actions that are being employed across the Project Area are described, as well as additional actions that will be adopted as part of this Project to mitigate potential impacts of the Project.

6.1 Project Changes to Avoid and Minimise Impacts

The conceptual mine layout for the Project has been undertaken following consideration of a range of features including:

- the depth of cover within the Project Area. The WWC EA (Umwelt, 2010) committed to mining not being undertaken below a depth of cover of 70 metres, or 80 metres within the Diega Creek Catchment due to the potential for connective cracking to occur in areas of a low depth of cover. This limitation has been applied to the Project Area, limiting the extent of mining;

- the extent of mapped alluvium to the south of the Project Area. A setback from this area was included in the mine plan to avoid the potential for adverse impacts on the alluvial zone and hence the riparian vegetation associated with it; and

- the proximity of Aboriginal archaeological site Palmers Creek Grinding Groove 2. Whilst not directly related to reduction of impacts on ecology, the setback from this significant site reduced the extent of mining and therefore the area of native vegetation potentially impacted by the Project.

The mine plan widths, orientations and panel locations have all been developed in consideration of the above factors, with the economic limit of mining also taken into consideration.

6.2 Subsidence Monitoring and Remediation Measures

Prior to mining, subsidence monitoring lines are installed to allow OCAL to quantitatively assess the level of subsidence. The installation of these monitoring lines requires the trimming of shrub and ground cover vegetation within 1 metre of the line to a height of approximately 100 millimetres. The ecological impact of these subsidence monitoring lines is expected to be negligible, however, OCAL will ensure that an ecological due diligence inspection of any proposed subsidence monitoring lines is undertaken by a suitably qualified ecologist prior to the installation of the lines.

Where subsidence occurs and requires remediation, OCAL will ensure that an ecological due diligence inspection of any proposed subsidence remediation areas is undertaken by a suitably qualified ecologist prior to the commencement of any remediation works. The purpose of these inspections is to ensure that the subsidence has not caused any further impact, other than that predicted in the ecological assessment, and provide that the remediation works will not significantly impact any threatened species, EPs or TECs.

Due diligence inspections will also be undertaken at the location of any proposed boreholes to ensure that the boreholes will not result in an adverse impact on threatened flora and fauna species or their habitat.

To reduce the potential for ecological impact resulting from the subsidence monitoring and remediation works, it is recommended that all future works be undertaken either using manual techniques or using the smallest possible machinery.

6.3 Biodiversity Monitoring Requirements

OCAL has an existing program of annual biodiversity monitoring which commenced in spring 2005 (Umwelt 2005) and ran until November 2008, recommencing in 2010 and continuing through to 2012 (Umwelt 2010, 2011 & 2012).

The current WWC biodiversity monitoring program aims to establish two permanent monitoring plots above each longwall panel at least two years prior to mining. The location of the monitoring plots are selected based on the highest potential for ecological impact as a result of longwall mining; being their proximity to riparian areas, steep slopes and proximity to the end of a longwall panel. Each monitoring plot is then monitored on an annual basis during the time of mining of the corresponding longwall panel and for two years following mining (usually five years in total). Currently, a total of 18 biodiversity monitoring sites have been examined within the WWC continued operation area (refer to **Figure 6.1**).

The current biodiversity monitoring program is tailored to focus on the potential impacts of longwall mining, mainly subsidence and subsidence related impacts such as ponding and tree fall. Ecological surveys undertaken at each biodiversity monitoring site include:

- Remnant Vegetation Surveys including:
  - semi-quantitative plot based floristic surveys (20 metre x 20 metre plots); and
  - photo monitoring;
- Reptile and Amphibian Surveys, including:
  - two diurnal reptile searches at each site (each one person hour in duration); and
  - two nocturnal amphibian searches at each site (each one person hour in duration); and
- Habitat Condition Assessments.

Additional monitoring plots were included in 2012 focusing specifically on the impacts on threatened flora species (specifically *Tetratheca juncea*) and TECs occurring above or in proximity to current or future longwall panels (refer to **Figure 1.2**). The TEC monitoring will consist of remnant vegetation surveys as detailed above, whereas the *Tetratheca juncea* monitoring will include the following:

- Remnant Vegetation Surveys including:
  - semi-quantitative plot based floristic surveys (20 metre x 20 metre plots); and
  - photo monitoring;
- Counts of *Tetratheca juncea* clumps (as defined by Payne *et. al*. 2002) within the 20 metre x 20 metre plot;

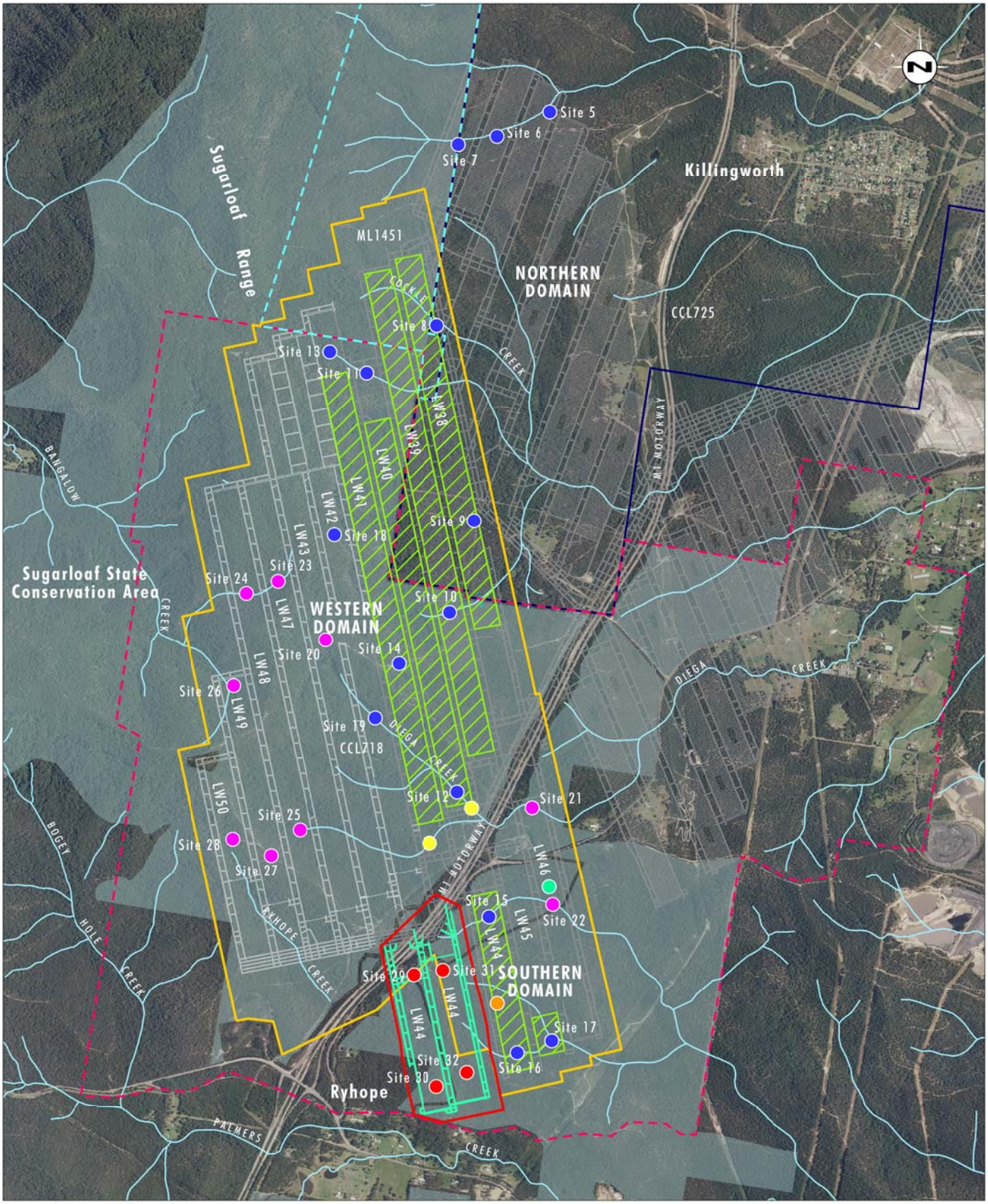

Image Source: OCAL (2008)
Data Source: OCAL (2013)

0 0.5 1.0 1.5km
1:35 000

Legend

- Project Area
- Approved Continued Underground Mining Area
- Approved Underground Workings in the West Borehole Seam
- Proposed Longwall Panels 51 and 52
- Longwall Progression as of October 2013
- Former Underground Workings
- Sugarloaf State Conservation Area
- CCL725
- CCL718
- ML1451
- Existing Biodiversity Monitoring Site
- Existing *Tetratheca juncea* Monitoring Site
- Existing Alluvial Tall Moist Forest EEC Monitoring Site
- Proposed Biodiversity Monitoring Site
- Proposed Additional Biodiversity Monitoring Site
- Proposed *Grevillea parviflora* subsp. *parviflora* Monitoring Site

FIGURE 6.1

Ecological Monitoring Sites

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- Specific *Tetratheca juncea* condition assessments in two nested plots (2 metres x 2 metres) recording the following:
  - number of individual clumps of black-eyed Susan (*Tetratheca juncea*);
  - age cohort;
  - height;
  - reproductive status;
  - number of plants in flower;
  - minimum, maximum and average number of flowers per plant; and
  - percentage seed set.

It is proposed to build on WWC's previous monitoring schedule as mining progresses. Sites will be added to the monitoring schedule with the advancement of mining into each new longwall and sites will be removed from the monitoring schedule once it can be demonstrated that subsidence impacts have resulted in no discernible impact on the vegetation and fauna characteristics of the sites. This approach will be applied to the current Project with the ecological monitoring used for the remainder of WWC extended to cover the two additional proposed longwall blocks.

The results of each year's monitoring will be compared to the pre-mining data and the results evaluated to determine if the mining and any subsidence related impacts are detrimentally affecting the biodiversity within the area. As outlined in **Section 5.6**, in the event that unpredicted, adverse impacts on ecological values are identified during biodiversity monitoring, WWC will respond to the issues identified and engage appropriate experts where required. WWC will investigate all appropriate remediation, mitigation or offset requirements, in consultation with the relevant government authorities and in the event that significant ecological impacts are identified and cannot be adequately remediated, WWC will engage a suitably qualified and experienced ecologist to prepare a Biodiversity Offset Strategy in consultation with OEH and DP&I.

6.4 Summary of Net Ecological Impacts

As a result of the impact mitigation measures listed above, including impact avoidance during the mine planning phase and proposed biodiversity management and monitoring commitments, the Project is considered unlikely to significantly impact vegetation communities and fauna species, including identified threatened species and EECs.

WWCs commitment to the implementation of a Biodiversity Offset Strategy in the event that ecological values are significantly impacted beyond those minor impacts predicted in **Sections 5.2** to **5.6** will ensure that the Project will not result in a loss of significant vegetation communities and fauna habitats, including threatened species and EECs.

As a result of the implementation of the Impact Mitigation Strategy it is considered likely that there will be no significant impact on threatened species, TECs or their habitats, and that the objective to maintain the biodiversity values of the surrounding region in the medium to long term will be achieved.

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APPENDIX A

Threatened Species Assessment

Appendix A – Threatened Species Assessment

Threatened species, endangered populations, and threatened ecological communities (TECs) listed under the TSC Act and/or EPBC Act, recorded or considered likely to occur within 10 kilometres of the Project Area have been identified based on the results of the searches of the OEH Atlas of NSW Wildlife Database and DSEWPC Protected Matters Database as well as the results of the literature review described in Section 3.1 of the Ecological Assessment report.

Table 1 contains the results of these searches for threatened flora species, TECs and endangered flora populations.

Table 2 contains the results of the searches for threatened fauna species and endangered fauna populations.

Table 3 contains the results of the searches for migratory and marine species listed under international conventions.

Tables 1, **2** and **3** contain the relevant ecological details for threatened flora, TECs, threatened fauna and marine and migratory species (as described in OEH 2013, DSEWPC 2013 and DPI 2013). These tables contain information including habitat requirements, known range and reservation within conservation reserves in the region, as well as an assessment as to whether the entity is likely to occur in the Project Area and whether there is the potential for the entity to be impacted by the Project. It should be noted that some species are listed in both **Table 2** and **Table 3** as they are listed under both threatened species legislation and international migratory species conventions. In these cases the information presented is identical, except for the legal listing (which are relevant to the table under which they are listed).

An assessment of significance was prepared in accordance with the requirements of the TSC and EPBC Acts for each threatened and migratory species or ecological community recorded or for which there is the potential for impact as a result of the Project. These assessments of significance are provided in **Appendices D** and **E**.

Table 1 – Threatened Flora Species and Ecological Communities Recorded or with Potential to Occur within the Project Area or Local Area

Species	Legal Status	Specific Habitat	Distribution in relation to the Project Area	Reservation in the Region	Potential to Occur/Potential for Impact	Further Assessment Required?
Threatened Flora Species						
Bynoe's wattle *Acacia bynoeana*	E (TSC) V (EPBC)	Occurs in heath or dry sclerophyll forest on sandy soils. Seems to prefer open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds and in recently burnt patches.	This species has been found in central eastern NSW, from the Hunter District (Morisset) south to the Southern Highlands and west to the Blue Mountains. It has recently been found in the Colymea and Parma Creek areas west of Nowra.	Lake Macquarie SCA	This species was not recorded in the Project Area however there is potential for this species to occur. Considering the likely minimal disturbance to the Project Area, there is no potential for a significant impact on this species.	No
Charmhaven apple *Angophora inopina*	V (EPBC) V (TSC)	Habitat for this species typically occurs on the shallow sandy soils of the Narrabeen Group, on exposed ridges and slopes with westerly or northerly aspect. It has also been recorded on shallow alluvial soils of this geological type, in upper catchments and in embedded clay soil lenses with sandstone. This species is known to naturally hybridise with *A. floribunda*, particularly around major drainage lines.	This species has a restricted distribution, being confined to the Wyong, Lake Macquarie and Port Stephens Shires of NSW. Pure forms of this species have been recorded from the Wallarah catchment in the south and north to the Toronto area. Disjunct populations have been identified at Karuah.	Lake Macquarie SCA	This species was not recorded in the Project Area however there is potential for this species to occur. Considering the minimal disturbance to the Project Area, there is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to the Project Area	Reservation in the Region	Potential to Occur/Potential for Impact	Further Assessment Required?
Asterolasia elegans	E (TSC) E (EPBC)	This species occurs on Hawkesbury sandstone on the mid to lower slopes of valleys within sheltered forests. This species is typically associated with turpentine (*Syncarpia glomulifera* subsp. *glomulifera*), smooth-barked apple (*Angophora costata*), Sydney Peppermint (*Eucalyptus piperita*), forest oak (*Allocasuarina torulosa*) and Christmas bush (*Ceratopetalum gummiferum*).	This species is known to the Baulkham Hills, Hawkesbury and Hornsby LGAs and is predicted to occur in the Gosford LGA. Only six populations of this species are known, all of which are within either the Colo or Hawkesbury River Catchment. Only one of the known populations of this species occurs within a conservation reserve.	This species is not known to occur in any reserves in the region.	This species was not recorded in the Project Area however there is potential for this species to occur. Considering the minimal disturbance to the Project Area, there is no potential for a significant impact on this species.	No
netted bottle brush *Callistemon linearifolius*	V (TSC)	The species typically grows in dry sclerophyll forest on the coast and adjacent ranges.	Occurs chiefly from the Georges River to the Hawkesbury River.	Munmorah SRA Heaton SF	This species was not recorded in the Project Area however there is potential for this species to occur. Considering the minimal disturbance to the Project Area, there is no potential for a significant impact on this species.	No
leafless tongue orchid *Cryptostylis hunteriana*	V (TSC) V (EPBC)	This species appears to favour moist soils on the flat coastal plains. Occupies swamp heath, but also in sclerophyll forest and woodland, often on sandy soils. Typically found in communities containing *Eucalyptus haemastoma, E. capitellata* and *Corymbia gummifera*.	This species is known to occur in the Karuah Manning and Wyong CMA sub-regions in the Hunter Central Rivers region.	Olney SF	This species was not recorded in the Project Area however there is potential for this species to occur. Considering the minimal disturbance to the Project Area, there is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to the Project Area	Reservation in the Region	Potential to Occur/Potential for Impact	Further Assessment Required?
white-flowered wax plant *Cynanchum elegans*	E (TSC) E (EPBC)	The species has been recorded from rainforest gullies and scree slopes, but is thought to mainly occur at the ecotone between dry rainforest and sclerophyll forest or woodland (DECCW 2010). The species has been recorded in dry subtropical rainforest, littoral rainforest, coastal scrub, open forest and woodland and open scrub.	*Cynanchum elegans* is restricted to eastern NSW from Yabbra State Forest in the north to Gerroa in the south and Merriwa in the west (DECCW 2010).	This species is not known to occur in any reserves in the region.	This species was not recorded in the Project Area however there is potential for this species to occur. Considering the minimal disturbance to the Project Area, there is no potential for a significant impact on this species.	No
Parramatta red gum *Eucalyptus parramattensis* subsp. *decadens*	V (TSC) V (EPBC)	Generally occupies deep, low-nutrient sands, often those subject to periodic inundation or where water tables are relatively high. It occurs in dry sclerophyll woodland with dry heath understorey. It also occurs as an emergent in dry or wet heathland. Often where this species occurs, it is a community dominant.	There are two separate meta-populations of *E. parramattensis* subsp. decadens. The Kurri Kurri meta-population is bordered by Cessnock—Kurri Kurri in the north and Mulbring—Abedare in the south. Large aggregations of the sub-species are located in the Tomalpin area. The Tomago Sandbeds meta-population is bounded by Salt Ash and Tanilba Bay in the north and Williamtown and Tomago in the south.	This species is not known to occur in any reserves in the region.	This species was not recorded in the Project Area however there is limited potential for this species to occur. Considering the minimal disturbance to the Project Area, there is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to the Project Area	Reservation in the Region	Potential to Occur/Potential for Impact	Further Assessment Required?
small-flower grevillea *Grevillea parviflora* subsp. *parviflora*	V (TSC) V (EPBC)	Grows in sandy or light clay soils usually over thin shales. Occurs in a range of vegetation types from heath and shrubby woodland to open forest and a range of altitudes from flat, low-lying areas to upper slopes and ridge crests. Often occurs in open, slightly disturbed sites such as along tracks.	Sporadically distributed throughout the Sydney Basin with the main occurrence centred around Picton, Appin and Bargo (and possibly further south to the Moss Vale area). Separate populations are also known further north from Putty to Wyong and Lake Macquarie on the Central Coast and Cessnock and Kurri Kurri in the Lower Hunter.	Olney SF	This species has been identified during ecological surveys within the Project Area. There is little potential for the proposed project to impact on this species however due to the recorded presence of the species an assessment of significance has been conducted.	**Yes**
Maundia triglochinoides	V (TSC)	Grows in swamps, creeks or shallow freshwater 30-60 cm deep on heavy clay, low nutrients. This species is typically associated with wetland species such as water ribbons (*Triglochin procerum*) and flowers between November and January.	Restricted to coastal NSW and extending into southern Queensland. The current southern limit is Wyong; former sites around Sydney are now extinct.	This species is not known to occur in any reserves in the region.	This species was not recorded in the Project Area and there is no habitat for this species in the Project Area. There is no potential for an impact on this species.	No
biconvex paperbark *Melaleuca biconvexa*	V (TSC) V (EPBC)	Biconvex paperbark generally grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects.	Scattered and dispersed populations of this species are known to occur in the Karuah Manning and Wyong sub-regions of the Hunter/Central Rivers Catchment.	Awaba SF Olney SF	This species was not recorded in the Project Area however there is potential for this species to occur. Considering the minimal disturbance to the Project Area, there is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to the Project Area	Reservation in the Region	Potential to Occur/Potential for Impact	Further Assessment Required?
Prasophyllum sp. Wybong	CE (EPBC)	This species generally occurs in grassy and scrubby habitats in open eucalypt woodland and grasslands.	This species is endemic to NSW, from which there are only seven known populations from near NSW near Ilford, Premer, Muswellbrook, Wybong, Yeoval, Inverell and Tenterfield. It is not known to occur outside the Sydney Basin, New England Tablelands, Brigalow Belt South and NSW South Western Slopes bioregions. Its area of occupancy is estimated at 1.5km².	This species is not known from any conservation reserves in the region.	This species was not recorded in the Project Area however there is potential for this species to occur. Considering the minimal disturbance to the Project Area, there is no potential for a significant impact on this species.	No
Illawarra greenhood *Pterostylis gibbosa*	E (TSC) E (EPBC)	All known populations grow in open forest or woodland, on flat or gently sloping land with poor drainage.	Known from a small number of populations in the Hunter region (Milbrodale), the Illawarra region (Albion Park and Yallah) and the Shoalhaven region (near Nowra).	This species is not known to occur in any reserves in the region.	This species was not recorded in the Project Area however there is potential for this species to occur. Considering the minimal disturbance to the Project Area, there is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to the Project Area	Reservation in the Region	Potential to Occur/Potential for Impact	Further Assessment Required?
eastern underground orchid *Rhizanthella slateri*	V (TSC) E (EPBC)	Habitat requirements are poorly understood and no particular vegetation type has been associated with the species, although it is known to occur in sclerophyll forest. Highly cryptic given that it grows almost completely below the soil surface, with flowers being the only part of the plant that can occur above ground. Therefore usually located only when the soil is disturbed.	Occurs from south-east Queensland to south-east NSW. In NSW, currently known from fewer than 10 locations, including near Bulahdelah, the Watagan Mountains, the Blue Mountains, Wiseman's Ferry area, Agnes Banks and near Nowra.	This species is not known to occur in any reserves in the region.	This species was not recorded in the Project Area however there is potential for this species to occur. Considering the minimal disturbance to the Project Area, there is no potential for a significant impact on this species.	No
heath wrinklewort *Rutidosis heterogama*	V (TSC) V (EPBC)	Occurs mostly in heath, often along disturbed roadsides, and also in open forest, primarily in coastal districts.	In coastal districts from Maclean to the Hunter Valley and inland to Torrington. It has also been recently recorded at Cooranbong on the Central Coast and extensively around the Cessnock district.	Munmorah SRA	This species was not recorded in the Project Area however there is potential for this species to occur. Considering the minimal disturbance to the Project Area, there is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to the Project Area	Reservation in the Region	Potential to Occur/Potential for Impact	Further Assessment Required?
Siah's backbone *Streblus pendulinus*	E (EPBC)	This species occurs in warmer rainforest, mostly along watercourses, north from Milton. Listing advice for this species indicates that the species is endangered on Norfolk Island and taxonomic revisions may have unintentionally included mainland occurrences of the species. For the purposes of this assessment it is assumed that the listing relates only to the Norfolk Island population of the species.	This species does not occur in NSW. *Streblus brunonianus*, which was formerly known as *Streblus pendulinus* occurs in NSW but is not included in the Listing Advice (Threatened Species Scientific Committee 2003).	This species is not known from any conservation reserves in the region.	This species does not occur in NSW. There is no potential for this species to be impacted.	No
magenta lilly pilly *Syzgium paniculatum*	V (TSC) V (EPBC)	This species grows in subtropical and littoral rainforests on sandy soils or stabilised dunes near the sea.	Occurs in widely separated localities between Bulahdelah and Jervis Bay.	Pulbah Island NR Munmorah SRA	This species was not recorded in the Project Area however there is potential for this species to occur. Considering the minimal disturbance to the Project Area, there is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to the Project Area	Reservation in the Region	Potential to Occur/Potential for Impact	Further Assessment Required?
glandular pink-bell *Tetratheca glandulosa*	V (TSC) V (EPBC)	Associated with shale-sandstone transition habitat where shale-cappings occur over sandstone, with associated soil landscapes such as Lucas Heights, Gymea, Lambert and Faulconbridge. Topographically, the plant occupies ridgetops, upper-slopes and to a lesser extent mid-slope sandstone benches. Soils are generally shallow, consisting of a yellow, clayey/sandy loam.	Restricted to the following LGAs: Baulkham Hills, Gosford, Hawkesbury, Hornsby, Ku-ring-gai, Pittwater, Ryde, Warringah, and Wyong. There are approximately 150 populations of this plant ranging from Sampsons Pass (Yengo NP) in the north to West Pymble (Lane Cove NP) in the south. The eastern limit is at Ingleside (Pittwater LGA) and the western limit is at East Kurrajong (Wollemi NP).	This species is not known to occur in any reserves in the region.	This species was not recorded in the Project Area however there is potential for this species to occur. Considering the minimal disturbance to the Project Area, there is no potential for a significant impact on this species.	No
black-eyed Susan *Tetratheca juncea*	V (TSC) V (EPBC)	Usually found in low open forest or woodland with a shrub understorey and grass groundcover on low nutrient soils, however it has also been found in heathland and moist forest. This species generally prefers well-drained sites and ridges, although it also found on upper and mid-slopes and occasionally in gullies. There appears to be a preference for southerly aspects, although the species will occur on slopes with a variety of aspects.	This species is confined to the Wyong, Lake Macquarie, Newcastle, Port Stephens, Great Lakes and Cessnock LGAs.	Lake Macquarie SCA Wallarah NP Jilliby SCA Awabakal NR Munmorah SCA Sugarloaf SCA	This species has been identified during ecological surveys within the Project Area. There is little potential for the proposed project to impact on this species however due to the recorded presence of the species an assessment of significance has been conducted.	**Yes**

Species	Legal Status	Specific Habitat	Distribution in relation to the Project Area	Reservation in the Region	Potential to Occur/Potential for Impact	Further Assessment Required?
Endangered Populations						
Eucalyptus parramattensis subsp. *paramattensis* in the Wyong and Lake Macquarie LGAs	EP (TSC)	This species is associated with low moist areas alongside drainage lines and adjacent to wetlands. It is often found in woodland on sandy soils. The endangered population occurs on sandy alluvium within a floodplain community which also supports *Eucalyptus robusta* (swamp mahogany), *E. tereticornis* (forest red gum), *E. gummifera* (Sydney bloodwood) as well as *Melaleuca* (paperbark) species.	The species usually occurs from the Goulburn Valley on the Central West slopes to Hill Top on the Central Coast. The endangered population in the Lake Macquarie and Wyong LGA is at the north-eastern limit of the species range and is quite separate from other known populations. The majority of the population occurs within Wyong in the Porter's Creek and the Wallarah Creek catchments.	Lake Macquarie SCA	This population was not recorded in the Project Area and there is low potential for it to occur. There is no potential for an impact on this population.	No

Species	Legal Status	Specific Habitat	Distribution in relation to the Project Area	Reservation in the Region	Potential to Occur/Potential for Impact	Further Assessment Required?
Threatened Ecological Communities						
Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	EEC (TSC)	Associated with coastal areas subject to periodic flooding and in which standing fresh water persists for at least part of the year in most years. Typically occurs on silts, muds or humic loams in low-lying parts of floodplains, alluvial flats, depressions, drainage lines, backswamps, lagoons and lakes but may also occur in backbarrier landforms where floodplains adjoin coastal sandplains. Generally occur below 20 metres elevation on level areas.	Known from along the majority of the NSW coast. There is less than 150 hectares remaining on the Tweed lowlands (estimate in 1985); about 10,600 hectares on the lower Clarence floodplain (in 1982); about 11,200 hectares on the lower Macleay floodplain (in 1983); about 3,500 hectares in the lower Hunter – Central Hunter region (in 1990s); less than 2,700 hectares on the NSW south coast from Sydney to Moruya (in the mid 1990s), including about 660 hectares on the Cumberland Plain (in 1998) and about 100 hectares on the Illawarra Plain (in 2001); and less than 1,000 hectares in the Eden region (in 1990).	Pambalong NR	No native wetlands occur within the Project Area. Therefore there is no potential for the EEC to occur. There is no potential for an impact on this community.	No

Species	Legal Status	Specific Habitat	Distribution in relation to the Project Area	Reservation in the Region	Potential to Occur/Potential for Impact	Further Assessment Required?
Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions	CEEC (EPBC) EEC (TSC)	Occurs on sand dunes and on soil derived from underlying rocks. Stands on headlands exposed to strong wind-action may take the form of dense, wind-pruned thickets. Stands are generally taller in sheltered sites such as hind dunes, although wind-pruning may still occur on their windward sides. Most stands occur within two kilometres of the sea, though are occasionally found further inland within reach of the maritime influence.	Littoral Rainforest occurs only on the coast and is found at locations in the NSW North Coast Bioregion, Sydney Basin Bioregion and South East Corner Bioregion.	Lake Macquarie SCA	This EEC was not recorded in the Project Area and there is no potential for it to occur. There is no potential for an impact on this community.	No

Species	Legal Status	Specific Habitat	Distribution in relation to the Project Area	Reservation in the Region	Potential to Occur/Potential for Impact	Further Assessment Required?
Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregion	EEC (TSC)	May be associated with a range of high-nutrient geological substrates, notably basalts and fine-grained sedimentary rocks, on coastal plains and plateaux, footslopes and foothills. In the north of its range, this EEC is found up to 600 metres above sea level, but in the Sydney Basin bioregion it is limited to elevations below 350 metres. Lowland Rainforest, when optimally developed, has the structural and floristic form of subtropical rainforest, but may be interspersed with stands of dry rainforest as moisture status declines or topographic exposure increases.	The Hawkesbury River notionally marks the southern limit of Lowland Rainforest in the NSW North Coast and Sydney Basin bioregions.	This EEC is not known from any conservation reserves in the region.	No rainforest community or other community within the Project Area is considered to conform to this EEC. There is no potential for an impact on this community.	No

Species	Legal Status	Specific Habitat	Distribution in relation to the Project Area	Reservation in the Region	Potential to Occur/Potential for Impact	Further Assessment Required?
Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions	EEC (TSC)	Associated with humic clay loams and sandy loams, on waterlogged or periodically inundated alluvial flats and drainage lines associated with coastal floodplains. Generally occurs below 20 metres (though sometimes up to 50 metres) elevation. The composition of the community is primarily determined by the frequency and duration of waterlogging and the texture, salinity nutrient and moisture content of the soil, and latitude. The composition and structure of the understorey is influenced by grazing and fire history, changes to hydrology and soil salinity and other disturbance, and may have a substantial component of exotic grasses, vines and forbs.	This community is known from parts of the LGAs of Tweed, Byron, Lismore, Ballina, Richmond Valley, Clarence Valley, Coffs Harbour, Bellingen, Nambucca, Kempsey, Hastings, Greater Taree, Great Lakes and Port Stephens, Lake Macquarie, Wyong, Gosford, Hornsby, Pittwater, Warringah, Manly, Liverpool, Rockdale, Botany Bay, Randwick, Sutherland, Wollongong, Shellharbour, Kiama and Shoalhaven but may occur elsewhere in these bioregions.	This EEC is not known from any conservation reserves in the region.	No native vegetation community within the Project Area is considered to conform to this EEC. There is no potential for an impact on this community.	No
River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions	EEC (TSC)	Associated with silts, clay-loams and sandy loams, on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains.	This EEC occurs in the NSW North Coast, Sydney Basin and South-east corner bioregions. The Project Area is within the known distribution of this species.	Sugarloaf SCA	No native vegetation community within the Project Area is considered to conform to this EEC. There is no potential for an impact on this community.	No

Species	Legal Status	Specific Habitat	Distribution in relation to the Project Area	Reservation in the Region	Potential to Occur/Potential for Impact	Further Assessment Required?
Lower Hunter Spotted Gum Ironbark Forest in the Sydney Basin Bioregion	EEC (TSC)	This EEC occurs in the central to lower Hunter Valley, principally on Permian geology.	The EEC is restricted to a range of approximately 65 kilometres by 35 kilometres centred on the Cessnock – Beresfield area.	Sugarloaf SCA.	No native vegetation community within the Project Area is considered to conform to this EEC. There is no potential for an impact on this community.	No
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	CEEC (EPBC) EEC (TSC)	This EEC can occur as either a woodland or derived grassland (grassy woodland from which trees have been removed). Groundlayer consists of native tussock grasses and herbs, and a sparse, scattered shrub layer. White box (*Eucalyptus albens*), yellow box (*E. melliodora*), or Blakely's red gum (*E. blakelyi*), dominate, where trees remain. Sites dominated by other tree species that do not have white box, yellow box, or Blakely's red gum as co-dominants are not considered to be part of the community, except in the Nandewar bioregion. In the Nandewar Bioregion, grey box (*E. moluccana* or *E. microcarpa*) may also be dominant or co-dominant in the community.	This EEC is found from the Queensland border in the north, to the Victorian border in the south. It occurs in the tablelands and western slopes of NSW.	This EEC is not known from any conservation reserves in the region.	No native vegetation community within the Project Area is considered to conform to this EEC. There is no potential for an impact on this community.	No

E: endangered
C: recorded in a conservation reserve (ROTAP)
CEEC: critically endangered ecological community
EEC: endangered ecological community
EPBC: *Environment Protection and Biodiversity Conservation Act 1999*
NP: National Park

R:	rare (ROTAP)	V:	vulnerable
ROTAP:	Rare or Threatened Australian Plants	2:	species found over <100km (ROTAP)
TSC:	*Threatened Species Conservation Act 1995*		

REFERENCES

Botanic Gardens Trust 2013

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Table 2 – Threatened Fauna Species Recorded or with Potential to Occur within in the Project Area or Local Area

Species	Legal Status	Specific Habitat	Distribution in relation to the Project Area	Reservation in the Region	Potential to Occur/Potential for Impact	Further Assessment Required?
Amphibians						
giant burrowing frog *Heleioporus australiacus*	V (TSC) V (EPBC)	Found in heath, woodland and open forest with sandy soils.	Occurs from the NSW Central Coast to eastern Victoria, but is most common on the Sydney sandstone. It has been found from the coast to the Great Dividing Range.	Olney SF	This species was not recorded in the Project Area and, due to its habitat requirements there is low potential for it to occur. There is no potential for a significant impact on this species.	No
wallum froglet *Crinia tinnula*	V (TSC)	Wallum froglets are found only in acid paperbark swamps and sedge swamps of the coastal 'wallum' country.	This species is known to occur in the Hunter, Karuah Manning, Wyong and Macleay Hastings sub-regions of the Hunter/Central Rivers Catchment.	Awabakal NR Lake Macquarie SCA Munmorah SCA	This species was not recorded in the Project Area and, due to its habitat requirements there is low potential for it to occur. There is no potential for a significant impact on this species.	No
stuttering frog *Mixophyes balbus*	E (TSC) V (EPBC)	Found in rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range.	Occur along the east coast of Australia from southern Queensland to the north-eastern Victoria.	Watagans NP Jilliby SCA	This species was not recorded in the Project Area and, due to its habitat requirements there is low potential for it to occur. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to the Project Area	Reservation in the Region	Potential to Occur/Potential for Impact	Further Assessment Required?
giant barred frog *Mixophyes iteratus*	E (TSC) E (EPBC)	This species forages and lives amongst deep, damp leaf litter in rainforests, moist eucalypt forest and nearby dry eucalypt forest, at elevations below 1,000 metres. They breed around shallow, flowing rocky streams.	Coast and ranges from south-eastern Queensland to the Hawkesbury River in NSW. North-eastern NSW, particularly the Coffs Harbour-Dorrigo area, is now a stronghold.	Watagans NP Jilliby SCA	This species was not recorded in the Project Area and, due to its habitat requirements there is low potential for it to occur. There is no potential for a significant impact on this species.	No
green and golden bell frog *Litoria aurea*	E (TSC) V (EPBC)	Occurs amongst emergent aquatic or riparian vegetation and amongst vegetation, fallen timber, including grassland, cropland and modified pastures. Breeds in still or slow flowing waterbodies with some vegetation such as *Typha* spp. and *Eleocharis* spp.	NSW North Coast near Brunswick Heads, southwards along the NSW Coast to Victoria where it extends into east Gippsland. The study area is close to the inland limit of this species' known distribution.	This species is not known from any conservation reserves in the region.	This species was not recorded in the Project Area and, due to its habitat requirements there is low potential for it to occur. There is no potential for a significant impact on this species.	No
Littlejohns tree frog *Litoria littlejohni*	V (TSC) V (EPBC)	Occurs along permanent rocky streams with thick fringing vegetation associated with eucalypt woodlands and heaths among sandstone outcrops.	Distribution includes the plateaus and eastern slopes of the Great Dividing Range from Watagan State Forest south to Buchan in Victoria.	Olney SF	This species was not recorded in the Project Area and, due to its habitat requirements there is low potential for it to occur. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to the Project Area	Reservation in the Region	Potential to Occur/Potential for Impact	Further Assessment Required?
Reptiles						
broad-headed snake *Hoplocephalus bungaroides*	E (TSC) V (EPBC)	Nocturnal. Shelters in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter and spring. Moves from the sandstone rocks to shelters in hollows in large trees within 200 metres of escarpments in summer.	The Broad-headed Snake is largely confined to Triassic and Permian sandstones, including the Hawkesbury, Narrabeen and Shoalhaven groups, within the coast and ranges in an area within approximately 250 kilometres of Sydney.	This species is not known to occur in any reserves in the region.	This species was not recorded in the Project Area and, due to its habitat requirements there is low potential for it to occur. There is no potential for a significant impact on this species.	No
Stephens banded snake *Hoplocephalus stephensii*	V (TSC)	Rainforest and eucalypt forests and rocky areas up to 950 metres in altitude.	Coast and ranges from Southern Queensland to Gosford in NSW.	Watagans NP Sugarloaf SCA	This species was not recorded in the Project Area during field surveys. This species has been identified during ecological surveys within the Sugarloaf SCA (DECC 2008). There is little potential for the Project to impact this species however an assessment of significance has been conducted for this species due to its recorded proximity to the Project Area and the identification of potential habitat.	**Yes**

Species	Legal Status	Specific Habitat	Distribution in relation to the Project Area	Reservation in the Region	Potential to Occur/Potential for Impact	Further Assessment Required?
Birds						
Australasian bittern *Botaurus poiciloptilus*	E (TSC) E (EPBC)	Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (*Typha* spp.) and spikerushes (*Eleocharis* spp.).	This species may be found over most of the state except for the far north-west.	Hunter Wetlands NP	This species was not recorded in the Project Area and, due to its habitat requirements there is low potential for it to occur. There is no potential for a significant impact on this species.	No
black bittern *Ixobrychus flavicollis*	V (TSC)	Inhabits both terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. Where permanent water is present, the species may occur in flooded grassland, forest, woodland, rainforest and mangroves.	Records of the species are scattered along the east coast, with individuals rarely being recorded south of Sydney or inland.	Munmorah SRA	This species was not recorded in the Project Area and, due to its habitat requirements there is low potential for it to occur. There is no potential for a significant impact on this species.	No
black-necked stork *Ephippiorhynchus asiaticus australis*	E (TSC)	Inhabits permanent freshwater wetlands including margins of billabongs, swamps, shallow floodwaters, and adjacent grasslands and savannah woodlands; can also be found occasionally on inter-tidal shorelines, mangrove margins and estuaries.	This species is widespread across coastal northern and eastern Australia, becoming uncommon further south into NSW, and rarely found south of Sydney.	Munmorah SRA	This species was not recorded in the Project Area and, due to its habitat requirements there is low potential for it to occur. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to the Project Area	Reservation in the Region	Potential to Occur/Potential for Impact	Further Assessment Required?
eastern osprey *Pandion cristatus*	V (TSC)	Favours coastal areas, especially the mouths of large rivers, lagoons and lakes.	Ospreys are found right around the Australian coast line, except for Victoria and Tasmania. They are common around the northern coast, especially on rocky shorelines, islands and reefs. The species is uncommon to rare or absent from closely settled parts of south-eastern Australia. There are a handful of records from inland areas.	Munmorah SRA	This species was not recorded in the Project Area and, due to its habitat requirements there is low potential for it to occur. There is no potential for a significant impact on this species.	No
red goshawk *Erythrotriorchis radiates*	V (EPBC) CE (TSC)	Red Goshawks inhabit open woodland and forest, preferring a mosaic of vegetation types, a large population of birds as a source of food, and permanent water, and are often found in riparian habitats along or near watercourses or wetlands. In NSW, preferred habitats include mixed subtropical rainforest, *Melaleuca* swamp forest and riparian *Eucalyptus* forest of coastal rivers.	This species is distributed sparsely through northern and eastern Australia, from the western Kimberley Division of northern Western Australia to north-eastern Queensland and south to far north-eastern NSW, and with scattered records in central Australia. The species is very rare in NSW, extending south to about 30°S, with most records north of this, in the Clarence River Catchment, and a few around the lower Richmond and Tweed Rivers. Formerly, it was at least occasionally reported as far south as Port Stephens.	This species is not known to occur in any reserves in the region	This species was not recorded in the Project Area and, due to its currently known range there is low potential for it to occur. There is no potential for an impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to the Project Area	Reservation in the Region	Potential to Occur/Potential for Impact	Further Assessment Required?
little eagle *Heiraaetus morphnoides*	V (TSC)	This species is typically identified in open eucalypt forests, woodlands and open woodlands, and other areas where prey are plentiful. The nest in tall living trees within remnant patches. This species occurs as a single population within Australia.	The little eagle is distributed throughout mainland Australia except for the most densely forested parts of the Great Dividing Range escarpment.	Awaba SF	This species was not recorded in the Project Area and, due to its habitat requirements there is low potential for it to occur. There is no potential for a significant impact on this species.	No
comb-crested Jacana *Irediparra gallinacea*	V (TSC)	Inhabits permanent wetlands with a good surface cover of floating vegetation, especially water-lilies.	Occurs throughout coastal Australia and well inland in the north from the Kimberley to Sydney. Vagrants occasionally appear further south, possibly in response to unfavourable conditions further north in NSW.	This species is not known to occur in any reserves in the region.	This species was not recorded in the Project Area and, due to its habitat requirements there is low potential for it to occur. There is no potential for a significant impact on this species.	No
Australian painted snipe *Rostratula benghalensis australis*	E (EPBC) E (TSC)	Favours the fringes of swamps, dams and nearby marsh areas with associated grass, lignum, low-scrub or open-timber vegetation. This species nests amongst tall ground vegetation in created scrapes lined with leaves and grasses. The painted snipe forages in mud-flats and shallow waters.	In NSW, this species has been recorded at the Paroo wetlands, Lake Cowal, Macquarie Marshes and Hexham Swamp. Most common in the Murray-Darling Basin.	Hunter Wetlands NP Pambalong NR	This species was not recorded in the Project Area and, due to its habitat requirements there is low potential for it to occur. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to the Project Area	Reservation in the Region	Potential to Occur/Potential for Impact	Further Assessment Required?
Glossy black-cockatoo *Calyptorhynchus lathami*	V (TSC)	Habitat for this species includes forests on low-nutrient soils, specifically those containing key *Allocasuarina* feed species. They will also eat seeds from eucalypts, angophoras, acacias, cypress pine and hakeas, as well as eating insect larvae. Breeding occurs in autumn and winter, with large hollows required.	The glossy black-cockatoo has a sparse distribution along the east coast and adjacent inland areas from western Victoria to Rockhampton in Queensland. In NSW, it has been recorded as far inland as Cobar and Griffith.	Lake Macquarie SCA Watagans NP Jilliby SCA	This species was not recorded in the Project Area. This species has been previously identified within the Sugarloaf SCA in proximity to the Project Area. There is little potential for the Project to impact this species however due to the recorded presence of the species in proximity to the Project Area an assessment of significance has been conducted.	**Yes**
gang-gang cockatoo *Callocephalon fimbriatum*	V (TSC)	In summer this species occurs in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In winter this species moves to drier more open eucalypt forests and woodlands. It favours old growth trees for nesting and roosting.	In NSW this species occurs from the south east coast to the Hunter region and inland to the Central Tablelands and South-west Slopes.	Watagans NP Jilliby SCA	This species was not recorded in the Project Area. This species has been previously identified within the Sugarloaf SCA in proximity to the Project Area. There is little potential for the Project to impact this species however due to the presence of likely habitat in proximity to the Project Area an assessment of significance has been conducted for this species.	**Yes**

Species	Legal Status	Specific Habitat	Distribution in relation to the Project Area	Reservation in the Region	Potential to Occur/Potential for Impact	Further Assessment Required?
little lorikeet *Glossopsitta pusilla*	V (TSC)	This species can be found in dry-open eucalypt forests and woodlands, and have been identified in remnant vegetation, old growth vegetation, logged forests, and roadside vegetation. The little lorikeet usually forages in small flocks, not always with birds of their own species. They nest in hollows, mostly in living smooth-barked apples.	This species is distributed from just north of Cairns, around the east coast of Australia down to Adelaide. In NSW this species is found from the coast to the western slopes of the Great Dividing Range, extending as far west as Albury, Dubbo, Parkes and Narrabri.	Munmorah SCA Olney SF Awaba SF	This species was recorded during ecological surveys within the Project Area. There is little potential for the Project to impact this species however due to the recorded presence of the species an assessment of significance has been conducted.	**Yes**
swift parrot *Lathamus discolor*	E (EPBC) E (TSC)	This species often visits box-ironbark forests, feeding on nectar and lerps. In NSW, typical tree species in which it forages include mugga ironbark, grey box, swamp mahogany, spotted gum, red bloodwood, narrow-leaved red ironbark, forest red gum and yellow box.	In NSW this species has been recorded from the western slopes region along the inland slopes of the Great Dividing Range, as well as forests along the coastal plains from southern to northern NSW.	Lake Macquarie SCA	This species was not recorded in the Project Area. Although there is potential for this species to occur, considering the minimal disturbance to the Project Area, there is little potential for an impact on this species.	No
turquoise parrot *Neophema pulchella*	V (TSC)	This species lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. It nests in tree hollows, logs or posts, from August to December.	The turquoise parrots range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range.	This species is not known to occur in any reserves in the region.	This species was not recorded in the Project Area and, due to its habitat requirements there is low potential for it to occur. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to the Project Area	Reservation in the Region	Potential to Occur/Potential for Impact	Further Assessment Required?
barking owl *Ninox connivens*	V (TSC)	Habitat for this species includes dry forests and woodlands, often in association with hydrological features such as rivers and swamps.	The barking owl is distributed sparsely throughout temperate and semi-arid areas of mainland Australia; however it is most abundant in the tropical north. Most records for this species occur west of the Great Dividing Range.	This species is not known to occur in any reserves in the region.	This species was not recorded in the Project Area and, due to its habitat requirements there is low potential for it to occur. There is no potential for a significant impact on this species.	No
powerful owl *Ninox strenua*	V (TSC)	The powerful owl inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. It generally requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation.	The powerful owl occurs in eastern Australia, mostly on the coastal side of the Great Dividing Range, from south western Victoria to Bowen in Queensland.	Lake Macquarie SCA Wallarah NP Jilliby SCA Awabakal NR	This species has not been recorded within the Project Area. There is little potential for the Project to impact this species however due to the presence of likely habitat an assessment of significance has been conducted for this species	**Yes**
masked owl *Tyto novaehollandiae*	V (TSC)	This species is generally recorded from open forest habitat with sparse mid-storey but patches of dense, low ground cover. It is also recorded from ecotones between wet and dry eucalypt forest, along minor drainage lines and near boundaries between forest and cleared land.	The masked owl occurs sparsely throughout the continent and nearby islands, including Tasmania and New Guinea.	Lake Macquarie SCA Watagans NP Jilliby SCA Awabakal NR Sugarloaf SCA	This species has not been recorded within the Project Area. There is little potential for the Project to impact this species however due to the presence of likely habitat an assessment of significance has been conducted for this species.	**Yes**

Species	Legal Status	Specific Habitat	Distribution in relation to the Project Area	Reservation in the Region	Potential to Occur/Potential for Impact	Further Assessment Required?
sooty owl *Tyto novaehollandiae*	V (TSC)	Occurs in rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as moist eucalypt forests. Nests in very large tree hollows.	Occupies the easternmost one-eighth of NSW, occurring on the coast, coastal escarpment and eastern tablelands.	Watagans NP Jilliby SCA Lake Macquarie SCA Sugarloaf SCA	This species has not been recorded within the Project Area. There is little potential for the Project to impact this species however due to the presence of likely habitat an assessment of significance has been conducted for this species	**Yes**
brown treecreeper (eastern subsp.) *Climacteris picumnus victoriae*	V (TSC)	Typical habitat for this species includes drier forests, woodlands and scrubs with fallen branches; river red gums on watercourses and around lake-shores; paddocks with standing dead timber; and margins of denser wooded areas. This species prefers areas without a dense understorey.	This species occurs over central NSW, west of the Great Dividing Range and sparsely scattered to the east of the divide in drier areas such as the Cumberland Plain of Western Sydney, and in parts of the Hunter, Clarence, Richmond and Snowy River valleys.	Awaba SF	This species was not recorded in the Project Area and there is little potential for this species to occur. Considering the minimal disturbance to the Project Area, there is no potential for a significant impact on this species.	No
eastern bristlebird *Dasyornis brachypterus*	E (TSC) E (EPBC)	Dense, low vegetation including heath and open woodland with a heathy understorey; in northern NSW occurs in open forest with tussocky grass understorey; all of these vegetation types are fire prone. Age of habitat since fires (fire-age) is of paramount importance to this species.	The distribution of the Eastern Bristlebird has contracted to three disjunct areas of south-eastern Australia: southern Queensland /northern NSW, the Illawarra Region and in the vicinity of the NSW/Victorian border.	This species is not known to occur in any reserves in the region.	This species was not recorded in the Project Area and there is little potential for this species to occur. Considering the minimal disturbance to the Project Area, there is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to the Project Area	Reservation in the Region	Potential to Occur/Potential for Impact	Further Assessment Required?
speckled warbler *Chthonicola saggitata*	V (TSC)	The speckled warbler occurs in eucalypt-dominated communities that have a grassy understorey, leaf litter and shrub cover, often on rocky ridges or in gullies.	Patchy distribution throughout south-eastern Queensland, eastern half of NSW and into Victoria, as far west as the Grampians.	Awaba SF	This species was not recorded in the Project Area and there is little potential for this species to occur. Considering the minimal disturbance to the Project Area, there is no potential for a significant impact on this species.	No
regent honeyeater *Anthochaera phrygia*	E (EPBC) CE (TSC)	This species generally occurs in temperate eucalypt woodlands and open forests of south eastern Australia. It is commonly recorded from box-ironbark eucalypt associations, wet lowland coastal forests dominated by swamp mahogany, spotted gum and riverine casuarina woodlands. An apparent preference exists for the wettest, most fertile sites within these associations, such as creek flats, river valleys and foothills.	Once recorded between Adelaide and the central coast of Queensland, its range has contracted dramatically in the last 30 years to between north-eastern Victoria and south-eastern Queensland.	Olney SF Sugarloaf SCA	This species was not recorded in the Project Area. Although there is potential for this species to occur, considering the minimal disturbance to the Project Area, there is little potential for an impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to the Project Area	Reservation in the Region	Potential to Occur/Potential for Impact	Further Assessment Required?
black-chinned honeyeater (eastern subsp.) *Melithreptus gularis gularis*	V (TSC)	Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially mugga Ironbark (*Eucalyptus sideroxylon*), white box (*Eucalyptus albens*), grey box (*Eucalyptus microcarpa*), yellow box (*Eucalyptus melliodora*) and forest red gum (*Eucalyptus tereticornis*). Also inhabits open forests of smooth-barked gums, stringybarks, ironbarks and tea-trees.	The subspecies is widespread, from the tablelands and western slopes of the Great Dividing Range to the north-west and central-west plains and the Riverina. It is rarely recorded east of the Great Dividing Range, although regularly observed from the Richmond River district. It has also been recorded at a few scattered sites in the Hunter, Central Coast and Illawarra regions.	This species is not known to occur in any reserves in the region.	This species was not recorded in the Project Area and there is little potential for this species to occur. Considering the minimal disturbance to the Project Area, there is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to the Project Area	Reservation in the Region	Potential to Occur/Potential for Impact	Further Assessment Required?
white-fronted chat *Epthianura albifrons*	V (TSC)	This bird can mostly be found in temperate to arid climates (rarely ever sub-tropical areas). It is typically identified in lowlands and foothills below 1000m above sea level. They seem to prefer habitats near waterways and damp areas (particularly wetlands containing salt marsh that are bordered by grassland or lightly timbered woodland).	The white-fronted chat is distributed across the southern half of Australia from the southern end of Queensland to the southern areas of Tasmania and across to WA. In NSW this species is mostly known from the southern half of the state and is most densely recorded along the coast from Newcastle down to the Victorian border; although records of the species have been made from as far west as the NSW-SA border, the far north-west corner of the state and Inverell in the north-east. Records of this species are sparse in the Hunter region (excluding Newcastle) as well as the North Coast Bioregion and the North Western Plains Bioregion.	This species is not known from any conservation reserves in the region.	This species was not recorded in the Project Area and there is little potential for this species to occur. Considering the minimal disturbance to the Project Area, there is no potential for a significant impact on this species.	No
grey-crowned babbler (eastern subsp.) *Pomatostomus temporalis temporalis*	V (TSC)	Open box-gum woodlands on the slopes. Box-cypress-pine and open box woodlands on alluvial plains. Also found in acacia shrubland and adjoining areas.	Occurs throughout northern and south-eastern Australia. In NSW, this species occurs on the western slopes of the Great Dividing Range and on the western plains reaching as far west as Louth and Hay. It also occurs in woodlands in the Hunter Valley and in several locations on the north coast of NSW. The Project Area is not at the limit of this species' known distribution.	Munmorah SRA	This species was not recorded in the Project Area and there is little potential for this species to occur. Considering the minimal disturbance to the Project Area, there is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to the Project Area	Reservation in the Region	Potential to Occur/Potential for Impact	Further Assessment Required?
varied sittella *Daphoenositta chrysoptera*	V (TSC)	The varied sittella can typically be found in eucalypt forests and woodlands, especially of rough-barked species and mature smooth-barked gums with dead branches, it can also be identified in mallee and acacia woodlands. This species builds a cup shaped nest made of plant fibres and spiders webs which is placed at the canopy level in the fork of a living tree.	The varied sittella is a sedentary species that inhabits the majority of mainland Australia with the exception of the treeless deserts and open grasslands. Its NSW distribution is basically continuous from the coast to the far west.	Olney SF Awaba SF	This species has not been recorded within the Project Area. There is little potential for the Project to impact this species however due to the presence of likely habitat an assessment of significance has been conducted for this species.	**Yes**
scarlet robin *Petroica boodang*	V (TSC)	This robin can be found in woodlands and open forests from the coast through to inland slopes. The birds can sometimes be found on the eastern fringe of the inland plains in the colder months of the year. Woody debris and logs are both important structural elements of its habitat. It forages from low perches on invertebrates either on the ground or in woody debris or tree trunks.	The scarlet robin can be found in south-eastern Australia, from Tasmania to the southern end of Queensland, to western Victoria and south SA.	This species is not known to occur in any reserves in the region.	This species has not been recorded within the Project Area. There is little potential for the Project to impact this species however due to the presence of likely habitat an assessment of significance has been conducted for this species.	**Yes**

Species	Legal Status	Specific Habitat	Distribution in relation to the Project Area	Reservation in the Region	Potential to Occur/Potential for Impact	Further Assessment Required?
hooded robin (south-eastern form) *Melanodryas cucullata cucullata*	V (TSC)	This species occupies a range of eucalypt woodlands, acacia shrublands and open forests. In temperate woodlands it favours open areas adjoining large woodland blocks, with areas of dead timber and sparse shrub cover. In semi-arid western NSW, the hooded Robin favours open woodlands of belah, rosewood, mulga and cypress.	This form of the hooded Robin is distributed throughout south-eastern Australia, from central Queensland to the Spencer Gulf, South Australia. This form occurs throughout NSW except for the north-west, where it intergrades with the northern form *M. cucullata picata*.	This species is not known to occur in any reserves in the region.	This species was not recorded in the Project Area and there is little potential for this species to occur. Considering the minimal disturbance to the Project Area, there is no potential for a significant impact on this species.	No
Mammals						
spotted-tailed quoll *Dasyurus maculatus*	E (EPBC) V (TSC)	Habitat for this species is highly varied, ranging from sclerophyll forest, woodlands, coastal heathlands and rainforests. Records exist from open country, grazing lands and rocky outcrops. Suitable den sites including hollow logs, tree hollows, rocky outcrops or caves.	In NSW the spotted-tailed quoll occurs on both sides of the Great Dividing Range, with the highest densities occurring in the north east of the state. It occurs from the coast to the snowline and inland to the Murray River.	Lake Macquarie SCA Olney SF Watagans NP Heaton SF Awaba SF	This species was not recorded in the Project Area however there is potential for this species to occur. Considering the minimal disturbance to the Project Area, there is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to the Project Area	Reservation in the Region	Potential to Occur/Potential for Impact	Further Assessment Required?
brush-tailed rock-wallaby *Petrogale penicillata*	V (EPBC) E (TSC)	This species occupies rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges facing north. It browses on vegetation in and adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees. This species shelters or bask during the day in rock crevices, caves and overhangs and is most active at night.	The brush-tailed rock-wallaby was once abundant and ubiquitous throughout the mountainous country of south-eastern Australia. Its distribution roughly followed the Great Dividing Range for 2,500 kilometres from the Grampians in West Victoria to Nanango in south-east Queensland, with outlying populations in coastal valleys and ranges to the east of the divide, and the slopes and plains as far west as Cobar in NSW and Injune (500 kilometres NW of Brisbane) in Queensland.	This species is not known to occur in any reserves in the region.	This species was not recorded in the Project Area and, due to its habitat requirements, there is no potential for it to occur. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to the Project Area	Reservation in the Region	Potential to Occur/Potential for Impact	Further Assessment Required?
koala *Phascolarctos cinereus*	V (EPBC) V (TSC)	This species inhabits eucalypt forest and woodland, with suitability influenced by tree species and age, soil fertility, climate, rainfall and fragmentation patterns. The species is known to feed on a large number of eucalypt and non-eucalypt species, however it tends to specialise on a small number in different areas. *Eucalyptus tereticornis, E. punctata, E. cypellocarpa, E. viminalis, E. microcorys, E. robusta, E. albens, E. camaldulensis* and *E populnea* are some preferred species.	The koala has a fragmented distribution throughout eastern Australia, with the majority of records from NSW occurring on the central and north coasts, as well as some areas further west. It is known to occur along inland rivers on the western side of the Great Dividing Range.	Lake Macquarie SCA Watagans NP Jilliby SCA	This species was not recorded in the Project Area however there is potential for this species to occur. Considering the minimal disturbance to the Project Area, there is no potential for a significant impact on this species.	No
long-nosed potoroo (SE mainland) *Potorous tridactylus tridactylus*	V (TSC) V (EPBC)	Inhabits coastal heaths and dry and wet sclerophyll forests. Dense understorey with occasional open areas is an essential part of habitat, and may consist of grass-trees, sedges, ferns or heath, or of low shrubs of tea-trees or melaleucas. A sandy loam soil is also a common feature.	This species is found on the south-eastern coast of Australia, from Queensland to eastern Victoria and Tasmania, including some of the Bass Strait islands. In NSW it is generally restricted to coastal heaths and forests east of the Great Dividing Range.	This species is not known to occur in any reserves in the region.	This species was not recorded in the Project Area however there is potential for this species to occur. Considering the minimal disturbance to the Project Area, there is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to the Project Area	Reservation in the Region	Potential to Occur/Potential for Impact	Further Assessment Required?
eastern pygmy-possum *Cercartetus nanus*	V (TSC)	Found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred, except in north-eastern NSW where they are most frequently encountered in rainforest.	The Eastern Pygmy-possum is found in south-eastern Australia, from southern Queensland to eastern South Australia and in Tasmania. In NSW it extends from the coast inland as far as the Pilliga, Dubbo, Parkes and Wagga Wagga on the western slopes.	This species is not known to occur in any reserves in the region.	This species was not recorded in the Project Area however there is potential for this species to occur. Considering the minimal disturbance to the Project Area, there is no potential for a significant impact on this species.	No
yellow-bellied glider *Petaurus australis*	V (TSC)	Occur in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. Forest type preferences vary with latitude and elevation; mixed coastal forests to dry escarpment forests in the north; moist coastal gullies and creek flats to tall montane forests in the south.	The yellow-bellied glider is found along the eastern coast to the western slopes of the Great Dividing Range, from southern Queensland to Victoria.	Watagans NP Jilliby SCA	This species was not recorded in the Project Area however there is potential for this species to occur. Considering the minimal disturbance to the Project Area, there is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to the Project Area	Reservation in the Region	Potential to Occur/Potential for Impact	Further Assessment Required?
squirrel glider *Petaurus norfolcensis*	V (TSC)	Inhabits a variety of mature or old growth habitats, including box, box-ironbark woodlands, river red gum forest, and blackbutt-bloodwood forest with heath understorey. It prefers mixed species stands with a shrub or acacia mid-storey, and requires abundant tree hollows for refuge and nest sites.	The species is widely though sparsely distributed in eastern Australia, from northern Queensland to western Victoria.	Lake Macquarie SCA Wallarah NP	This species was not recorded during ecological surveys within the Project Area. There is little potential for the Project to impact this species however due to the presence of likely habitat an assessment of significance has been conducted for this species.	**Yes**
New Holland mouse *Pseudomys novaehollandiae*	V (EPBC)	The New Holland Mouse has a fragmented distribution across Tasmania, Victoria, New South Wales and Queensland. Across the species' range the New Holland Mouse is known to inhabit open heathlands, open woodlands with a heathland understorey and vegetated sand dunes. The species peaks in abundance during early to mid stages of vegetation succession typically induced by fire.	The New Holland Mouse has a fragmented distribution across Tasmania, Victoria, New South Wales and Queensland. In 2006 there were known to be 6 - 8 meta-populations of the species (NSW Atlas of Wildlife, VIC Atlas of Wildlife, TAS Natural Values Atlas). Across the species' range, the total population size of mature individuals is estimated to be less than 10,000 individuals.	This species is not known to occur in conservation reserves in the region.	This species was not recorded in the Project Area and, due to its habitat requirements, it is unlikely to occur. Considering the minimal disturbance to the Project Area, there is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to the Project Area	Reservation in the Region	Potential to Occur/Potential for Impact	Further Assessment Required?
grey-headed flying-fox *Pteropus poliocephalus*	V (EPBC) V (TSC)	This species feeds on a variety of flowering and fruiting plants, including native figs and palms, blossoms from eucalypts, angophoras, tea-trees and banksias (Tidemann 2002). Camps sites are usually formed in gullies, usually in vegetation with a dense canopy and not far from water (Tidemann 2002).	Recorded along the eastern coastal plain from Bundaberg in Queensland, through NSW and south to eastern Victoria. The Project area is within the known distribution of this species.	Lake Macquarie SCA Munmorah SCA	The species was recorded within the Project Area. Limited foraging habitat occurs in the Project Area, but no roost sites have been identified. There is little potential for the Project to impact this species however due to the recorded presence of the species an assessment of significance has been conducted.	**Yes**
yellow-bellied sheathtail bat *Saccolaimus flaviventris*	V (TSC)	This species forages for insects, flies high and fast over the forest canopy, but lower in more open country. It forages in most habitats across its very wide range, with and without trees; and appears to defend an aerial territory. It roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to use mammal burrows.	The yellow-bellied sheathtail-bat is a wide-ranging species found across northern and eastern Australia. In the most southerly part of its range - most of Victoria, south-western NSW and adjacent South Australia - it is a rare visitor in late summer and autumn. There are scattered records of this species across the New England Tablelands and North West Slopes.	This species is not known to occur in any reserves in the region.	This species was not recorded during ecological surveys within the Project Area. There is little potential for the Project to impact this species however due to the presence of likely habitat an assessment of significance has been conducted for this species.	**Yes**

Species	Legal Status	Specific Habitat	Distribution in relation to the Project Area	Reservation in the Region	Potential to Occur/Potential for Impact	Further Assessment Required?
east coast freetail-bat (syn. eastern freetail-bat) *Mormopterus norfolkensis*	V (TSC)	This species occurs in dry sclerophyll forest and woodland east of the Great Dividing Range. It roosts mainly in tree hollows but will also roost under bark or in man-made structures.	The eastern freetail-bat is found along the east coast from south Queensland to southern NSW.	Munmorah SCA Olney SF Awaba SF	This species was identified during ecological surveys within the Project Area. There is little potential for the Project to impact this species however due to the recorded presence of the species an assessment of significance has been conducted.	**Yes**
golden-tipped bat *Kerivoula papuensis*	V (TSC)	Found in rainforest and adjacent wet and dry sclerophyll forest up to 1000m. Roost mainly in abandoned hanging Yellow-throated Scrubwren and Brown Gerygone nests and will fly up to two kilometres to forage.	T he golden-tipped bat is distributed along the east coast of Australia in scattered locations from Cape York Peninsula in Queensland to south of Eden in southern NSW.	This species is not known to occur in any reserves in the region.	This species was not recorded during ecological surveys within the Project Area and, due to its habitat requirements, it is unlikely to occur. Considering the minimal disturbance to the Project Area, there is no potential for a significant impact on this species.	No
little bentwing-bat *Miniopterus australis*	V (TSC)	Prefers moist eucalypt forest, rainforest or dense coastal banksia scrub. This species roost in caves, tunnels and sometimes tree hollows during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats.	Occurs in coastal north-eastern NSW and eastern Queensland.	Lake Macquarie SCA	This species has been identified during ecological surveys within the Project Area. There is little potential for the Project to impact this species however due to the recorded presence of the species an assessment of significance has been conducted.	**Yes**

Species	Legal Status	Specific Habitat	Distribution in relation to the Project Area	Reservation in the Region	Potential to Occur/Potential for Impact	Further Assessment Required?
eastern bentwing-bat *Miniopterus schreibersii oceanensis*	V (TSC)	This species hunts in forested areas and uses caves as the primary roosting habitat, but also uses derelict mines, storm-water tunnels, buildings and other man-made structures. It forms discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young.	Eastern bentwing-bats occur along the east and north-west coasts of Australia.	Lake Macquarie SCA	This species was identified during ecological surveys within the Project Area. There is little potential for the Project to impact this species however due to the recorded presence of the species an assessment of significance has been conducted.	**Yes**
large-eared pied bat *Chalinolobus dwyeri*	V (TSC) V (EPBC)	The large-eared pied bat is generally found in a variety of drier habitats, including dry sclerophyll forests and woodlands, however, it probably tolerates a wide range of habitats. It tends to roost in the twilight zones of mines and caves, generally in colonies or common groups.	This species has a distribution from south western Queensland to NSW from the coast to the western slopes of the Great Dividing Range.	Watagans NP	This species was identified during ecological surveys within the Project Area. There is little potential for the Project to impact this species however due to the recorded presence of the species an assessment of significance has been conducted.	**Yes**
eastern false pipistrelle *Falsistrellus tasmaniensis*	V (TSC)	Habitat for this species includes sclerophyll forest. It prefers wet habitats, with trees over 20 metres high, and generally roosts in tree hollows or trunks.	This species has a range from south eastern Queensland, through NSW, Victoria and into Tasmania, and occurs from the Great Dividing Range to the coast.	Lake Macquarie SCA	This species was not recorded during ecological surveys within the Project Area. There is little potential for the Project to impact this species however due to the presence of likely habitat an assessment of significance has been conducted for this species.	**Yes**

Species	Legal Status	Specific Habitat	Distribution in relation to the Project Area	Reservation in the Region	Potential to Occur/Potential for Impact	Further Assessment Required?
southern myotis *Myotis macropus*	V (TSC)	This species generally roosts in groups of 10-15 close to water in caves, mine shafts, hollow-bearing trees, stormwater channels, buildings, under bridges and in dense foliage. It forages over streams and pools catching insects and small fish by raking its feet across the water surface.	The large-footed myotis is found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. It is rarely found more than 100 kilometres inland, except along major rivers.	Olney SF	This species was not recorded during ecological surveys within the Project Area and, due to its habitat requirements, it is unlikely to occur. Considering the minimal disturbance to the Project Area, there is no potential for a significant impact on this species.	No
greater broad-nosed bat *Scoteanax rueppellii*	V (TSC)	The greater broad-nosed bat appears to prefer moist environments such as moist gullies in coastal forests, or rainforest. They have also been found in gullies associated with wet and dry sclerophyll forests and open woodland. It roosts in hollows in tree trunks and branches and has also been found to roost in the roofs of old buildings.	The greater broad-nosed bat is found mainly in the gullies and river systems that drain the Great Dividing Range, from north-eastern Victoria to the Atherton Tableland. It extends to the coast over much of its range. In NSW it is widespread on the New England Tablelands, however it does not occur at altitudes above 500 metres.	Munmorah SCA Olney SF Awaba SF	This species was identified during ecological surveys within the Project Area. There is little potential for the Project to impact this species however due to the recorded presence of the species an assessment of significance has been conducted.	**Yes**

Species	Legal Status	Specific Habitat	Distribution in relation to the Project Area	Reservation in the Region	Potential to Occur/Potential for Impact	Further Assessment Required?
eastern cave bat *Vespadelus troughtoni*	V (TSC)	This species is a cave-roosting bat that is usually found in dry open forest and woodland, near cliffs or rocky overhangs. It has been recorded roosting in disused mine workings, occasionally in colonies of up to 500 individuals, and is occasionally found along cliff-lines in wet eucalypt forest and rainforest.	The eastern cave bat is found in a broad band on both sides of the Great Dividing Range from Cape York to Kempsey, with records from the New England Tablelands and the upper north coast of NSW. The western limit appears to be the Warrumbungle Range, and there is a single record from southern NSW, east of the ACT.	This species is not known to occur in any reserves in the region.	This species was not recorded during ecological surveys within the Project Area and, due to its habitat requirements, it is unlikely to occur. Considering the minimal disturbance to the Project Area, there is no potential for a significant impact on this species.	No

NOTE:
CE: Critically Endangered
E: endangered
EPBC: *Environment Protection and Biodiversity Conservation Act 1999*
NR: Nature Reserve
NP: National Park
TSC: *Threatened Species Conservation Act 1995*
V: vulnerable

Table 3 – Migratory and Marine Species Listed under International Treaties and Recorded or with Potential to Occur within the Project Area or Local Area

Species	Legal Status	Specific Habitat	Distribution in relation to the Project Area	Reservation in the region	Potential to Occur/Potential for Impact	Further Assessment Required?
MIGRATORY AND MARINE SPECIES						
white-bellied sea-eagle *Haliaeetus leucogaster*	MAR (EPBC) MIG (EPBC) CAMBA	These birds are typically sighted perched in tall trees and soaring above bodies of water and land. They are territorial and form permanent breeding pairs.	This species is distributed across Australia, China, India, Indonesia, New Guinea, and South-east Asia. Within Australia it is distributed along and near the coast.	Lake Macquarie SCA	This species is commonly recorded on the east coast of NSW. The Project Area provides some foraging habitat and potential nesting habitat for this species. However, given the nature of the impacts associated with underground mining, no impact is predicted on this species.	No
white-throated needletail *Hirundapus caudacutus*	MAR (EPBC) MIG (EPBC) CAMBA JAMBA ROKAMBA	This species only occurs in Australia between the months of October and May. It forages on flying insects and drinks whilst in flight. Feeding is typically associated with rising thermal currents typical with storm fronts and bushfires.	This species is distributed over eastern and northern Australia.	Lake Macquarie SCA Olney SF Watagans NP Heaton SF Awaba SF	This species is commonly recorded across NSW. The Project Area provides some foraging habitat for this species. However, given the nature of the impacts associated with underground mining, no impact is predicted on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to the Project Area	Reservation in the region	Potential to Occur/Potential for Impact	Further Assessment Required?
MIGRATORY AND MARINE SPECIES						
rainbow bee-eater *Merops ornatus*	MAR (EPBC) MIG (EPBC) JAMBA	The preferred habitat of the rainbow bee-eater is open forests and woodlands, shrublands, and cleared or semi-cleared areas (commonly farmland). These areas are usually in proximity to permanent water, however, during migration this bird may fly over areas of non-preferential habitat.	This species is distributed throughout most of mainland Australia as well as several near-shore islands. It is not found in Tasmania and has only been identified in a thin strip in the most arid regions of central WA.	Lake Macquarie SCA Olney SF Watagans NP Heaton SF Awaba SF	This species is commonly recorded in the Lower and Central Hunter regions. The Project Area provides some foraging habitat and potential nesting habitat for this species. However, given the nature of the impacts associated with underground mining, no impact is predicted on this species.	No
malleefowl *Leipoa ocellata*	MIG (EPBC) JAMBA	The mallefowl is typically found in semi-arid and arid areas of temperate Australia, in shrubland and low woodlands dominated by dense but discontinuous mallee vegetation. They are usually on loamy or sandy soils with an annual average rainfall between 200 and 450 mm. The mallefowl has been known to forage in open grassland and farmland areas; and breeds in areas with plentiful leaf litter.	The mallefowl is distributed across southern Australia. Typically found west of the Great Dividing Range, from the Pilliga south-west through to the Griffith and Wentworth districts. A small number of records have been identified from east of the Great Dividing Range in the Goulburn River NP. This species is predicted to occur in the region based upon a search of the Liverpool Plains (Part B) CMA Sub-region.	This species is not known to occur in any reserves in the region.	The Project Area does not provide suitable habitat for this species. There is no potential for a significant impact on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to the Project Area	Reservation in the region	Potential to Occur/Potential for Impact	Further Assessment Required?
MIGRATORY AND MARINE SPECIES						
black-faced monarch *Monarcha melanopsis*	MAR (EPBC) MIG (EPBC) Bonn	This bird occurs in coastal scrub, damp gullies, eucalypt woodlands and rainforests. It can be seen foraging for insects amongst foliage, and builds a deep, cup-shaped nest in a tree fork (3 to 6 m above the ground) which is made up of cobwebs, casuarinas needles, bark, moss and roots.	The black-faced monarch is distributed along the eastern coast of Australia, gradually becoming less common towards the south.	Lake Macquarie SCA Olney SF Watagans NP Heaton SF Awaba SF	This species is commonly recorded on the east coast of NSW. The Project Area provides some foraging habitat and potential nesting habitat for this species. However, given the nature of the impacts associated with underground mining, no impact is predicted on this species.	No
satin flycatcher *Myiagra cyanoleuca*	MAR (EPBC) MIG (EPBC) Bonn	This species typically inhabits wet areas of tall forests, particularly in gullies. The satin flycatcher moves north in the winter and is seldom seen in NSW, Tasmania, Victoria or SA during these times. It nests in loose colonies in broad-based cup-shaped nests on a bare horizontal branch. These nests are constructed from bark, grass, lichen and cobwebs.	The satin flycatcher can be found in both Australia and New Guinea. In Australia it is distributed along the east coast from Cape York through to Tasmania, also covering parts of south-eastern SA.	Lake Macquarie SCA Olney SF Watagans NP Heaton SF Awaba SF	This species is commonly recorded on the east coast of NSW. The Project Area provides some foraging habitat and potential nesting habitat for this species. However, given the nature of the impact associated with underground mining, no impact is predicted on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to the Project Area	Reservation in the region	Potential to Occur/Potential for Impact	Further Assessment Required?
MIGRATORY AND MARINE SPECIES						
rufous fantail *Rhipidura rufifrons*	MAR (EPBC) MIG (EPBC) Bonn	The rufous fantail typically inhabits areas of dense wet forest, mangrove, rainforest or swamp woodlands. It prefers areas where there is intense shade available and is often seen close to ground. In winter it is seldom found in NSW or Victoria. Nests are about 5 m from the ground in a small cup shape and constructed from thin grasses held together by cobwebs.	This species is distributed across the north and eastern coast of Australia, but is also found in Guam, New Guinea, the Solomon Islands and Sulawesi.	Lake Macquarie SCA Olney SF Watagans NP Heaton SF Awaba SF	This species is commonly recorded in the Lower and Central Hunter regions. The Project Area provides some foraging habitat and potential nesting habitat for this species. However, given the nature of the impact associated with underground mining, no impact is predicted on this species.	No
regent honeyeater *Anthochaera phrygia*	MIG (EPBC) JAMBA	Semi-nomadic, generally occurs in temperate eucalypt woodlands and open forests, commonly recorded from box-ironbark eucalypt associations, wet lowland coastal forests dominated by swamp mahogany, spotted gum and riverine *Casuarina* woodlands.	Patchily distributed across the eastern states of Australia, from Adelaide, to Dalby, Queensland, and from the coast to the western foothills of the Great Dividing Range (Garnett and Crowley 2000). The Project Area is within the known distribution of this species.	Olney SF Sugarloaf SCA	The Project Area provides some foraging habitat and potential nesting habitat for this species. However, given the nature of the impact associated with underground mining, no impact is predicted on this species.	No

Species	Legal Status	Specific Habitat	Distribution in relation to the Project Area	Reservation in the region	Potential to Occur/Potential for Impact	Further Assessment Required?
MIGRATORY AND MARINE SPECIES						
fork-tailed swift *Apus pacificus*	MAR (EPBC) MIG (EPBC) CAMBA JAMBA ROKAMBA	This species is almost exclusively aerial, flying from less than 1 m to at least 300 m above ground and probably much higher. In Australia, they mostly occur over inland plains but sometimes above foothills or in coastal areas.	The fork-tailed swift can be found throughout Australia during migrating. In Australia it is most common west of the Great Dividing Range. This species is uncommon in Tasmania.	This species is not known to occur in any reserves in the region.	This species is commonly recorded on the east coast of NSW. The species has not been recorded within the Project Area and is unlikely to utilise the habitats in Project Area.	No
eastern great egret *Ardea modesta*	MAR (EPBC) MIG (EPBC) CAMBA JAMBA	The eastern great egret typically inhabits areas of shallow, flowing waters, but also uses damp grasslands and other watered areas. It can be observed both in flocks and on its own, and roost during the night in groups.	The eastern great egret is distributed throughout the world, and is common throughout most areas of Australia, with the exception of extremely arid areas.	This species is not known to occur in any reserves in the region.	This species is commonly recorded across NSW. The species has not been recorded within the Project Area and is unlikely to utilise the habitats in Project Area.	No
cattle egret *Ardea ibis*	MAR (EPBC) MIG (EPBC) CAMBA JAMBA	The cattle egret can be found in grasslands, wetlands and woodlands and has never been identified in arid areas. These birds are commonly sighted at garbage dumps and pastures in croplands (especially where poor drainage is present).	The cattle egret is distributed throughout Asia, Africa, Europe and Australia. It is most commonly found in north-eastern WA, the NT and in south-eastern Australia from Bundaberg Queensland through to Port Augusta SA. It has also been identified in Tasmania.	This species is not known to occur in any reserves in the region.	This species is commonly recorded on the east coast of NSW. The species has not been recorded within the Project Area and is unlikely to utilise the habitats in Project Area.	No

Species	Legal Status	Specific Habitat	Distribution in relation to the Project Area	Reservation in the region	Potential to Occur/Potential for Impact	Further Assessment Required?
MIGRATORY AND MARINE SPECIES						
Lathams snipe *Gallinago hardwickii*	MAR (EPBC) MIG (EPBC) Bonn CAMBA JAMBA ROKAMBA	Lathams snipe can be found in permanent and ephemeral wetlands up to 2000 m above sea level. These water bodies are usually freshwater with low, dense vegetation. It forages in areas of mud with some vegetation cover and roosts nearby. Lathams snipe does not breed in Australia, only passing through for migration.	This species has been recorded from Cape York through to south-east SA. The range of this species extends from inland of the eastern tablelands in south-east Queensland to west of the Great Dividing Range in NSW. Richmond River, NSW is a favourite area for non-breeding birds.	This species is not known to occur in any reserves in the region.	This species is mainly recorded in selected areas of east coast in NSW. The species has not been recorded within the Project Area and is unlikely to utilise the habitats in Project Area.	No
Australian painted snipe *Rostratula benghalensis australis*	MAR (EPBC) MIG (EPBC) CAMBA	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber.	In NSW, this species has been recorded at the Paroo wetlands, Lake Cowall, Macquarie Marshes and Hexham Swamp. Most common in the Murray-Darling Basin.	This species is not known to occur in any reserves in the region.	This species is mainly recorded in selected areas of east coast in NSW. The species has not been recorded within the Project Area and is unlikely to utilise the habitats in Project Area.	No

Bonn	Bonn Convention
CAMBA	China-Australia Migratory Bird Agreement
EPBC	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
JAMBA	Japan-Australia Migratory Bird Agreement
MAR	marine
MIG	migratory
NP	National Park
ROKAMBA	Republic of Korea Migratory Bird Agreement
SF	State Forest

APPENDIX B

Flora and Fauna Species Lists

Appendix B – Flora and Fauna Species Lists

The following species tables were developed using the data collected during the field surveys of the Project Area detailed in **Section 3.0** of the main report.

Table 1 contains the flora species recorded during Umwelt flora surveys of the Project Area.

Table 2 contains the fauna species recorded during Umwelt fauna surveys of the Project Area.

Flora Species List

The following flora list was developed from surveys of the Project Area detailed in **Section 3.2** of the main report. It includes all species of vascular plants observed in Project Area during field surveys undertaken by Umwelt on 25 and 26 March 2013.

Not all species are readily detected at any one time of the year; therefore the list does not include all plant species likely to occur in the Project Area. Many species flower only during restricted periods of the year, and some flower only once in several years. In the absence of flowering material, many species cannot be identified, or even detected.

Names of classes and families follow a modified Cronquist (1981) system.

Any species that could not be identified to the lowest taxonomic level are denoted in the following manner:

sp. specimens that are identified to genus level only.

The following abbreviations or symbols are used in the list:

asterisk (*) denotes species not indigenous to the site.

All vascular plants recorded or collected by Umwelt were identified using keys and nomenclature in Harden (1992, 1993, 2000 & 2002) and Wheeler *et al*. (2002). Where known, changes to nomenclature and classification have been incorporated into the results, as derived from *PlantNET* (Botanic Gardens Trust 2013), the online plant name database maintained by the National Herbarium of New South Wales.

Common names used follow Harden (1992, 1993, 2000 & 2002) where available, and draw on other sources such as local names where these references do not provide a common name.

Table 1 – Flora Species Recorded within the Project Area

Family	Scientific Name	Common Name	Floristic Quadrats						Transects		Opportunistic
			Q1	Q2	Q3	Q4	Q5	Q6	T1	T2	
Cycadopsida											
Zamiaceae	*Macrozamia communis*	burrawang								1	
Filicopsida											
Adiantaceae	*Adiantum aethiopicum*	common maidenhair	3	3							
Blechnaceae	*Blechnum cartilagineum*	gristle fern		2							
Blechnaceae	*Doodia aspera*	prickly rasp fern		2							
Dennstaedtiaceae	*Pteridium esculentum*	bracken	2	3		2		2		1	
Polypodiaceae	*Platycerium bifurcatum*	elkhorn		1							
Magnoliopsida (Liliidae)											
Anthericaceae	*Thysanotus* sp.									1	
Araceae	*Gymnostachys anceps*	settler's flax	3								
Cyperaceae	*Carex* sp.		3								
Cyperaceae	*Gahnia clarkei*	tall saw-sedge	3	3		4	2			1	
Cyperaceae	*Lepidosperma laterale*						2	2	1		
Cyperaceae	*Lepidosperma* sp.				1	2					
Dioscoreaceae	*Dioscorea transversa*	native yam	2	2							
Doryanthaceae	*Doryanthes excelsa*	gymea lily	3		9	2		3		1	
Hypoxidaceae	*Hypoxis* sp.			1							
Iridaceae	*Patersonia sericea*	silky purple-flag			2			2			
Lomandraceae	*Lomandra filiformis* subsp. *filiformis*						3			1	
Lomandraceae	*Lomandra longifolia*	spiny-headed mat-rush	2	2	2	2					
Lomandraceae	*Lomandra obliqua*				4	3	2	3	1	1	
Luzuriagaceae	*Eustrephus latifolius*	wombat berry	1				3				
Luzuriagaceae	*Geitonoplesium cymosum*	scrambling lily	2	3							
Orchidaceae	*Cryptostylis subulata*	large tongue orchid				2		1			

Family	Scientific Name	Common Name	Floristic Quadrats						Transects		Opportunistic
			Q1	Q2	Q3	Q4	Q5	Q6	T1	T2	
Orchidaceae	*Cymbidium suave*	snake orchid								1	
Orchidaceae	*Genoplesium* sp.										1
Orchidaceae	*Pterostylis acuminata*	pointed greenhood									1
Phormiaceae	*Dianella caerulea* var. *producta*					2	2	2		1	
Poaceae	*Aristida vagans*	threeawn speargrass					3	3			
Poaceae	*Enneapogon* sp.								1	1	
Poaceae	*Entolasia stricta*	wiry panic			4	4	4	3	1	1	
Poaceae	*Imperata cylindrica*						2				
Poaceae	*Joycea pallida*	silvertop wallaby grass			3	3	3	3	1	1	
Poaceae	*Oplismenus aemulus*		3	3			2	3			
Poaceae	*Oplismenus imbecillis*		3	3			3				
Poaceae	*Panicum effusum*	poison or hairy panic				2					
Poaceae	*Themeda australis*	kangaroo grass			3	3	4	3	1	1	
Smilacaceae	*Smilax australis*	sarsaparilla	2	3							
Xanthorrhoeaceae	*Xanthorrhoea macronema*						1		1		1
Magnoliopsida (Magnoliidae)											
Acanthaceae	*Brunoniella australis*	blue trumpet	1								
Acanthaceae	*Pseuderanthemum variabile*	pastel flower	2								
Apiaceae	*Hydrocotyle* sp.		2								
Apocynaceae	*Parsonsia straminea*	common silkpod	3	2							
Asteraceae	**Aster subulatus*	wild aster	2				2				
Asteraceae	**Bidens pilosa*	cobbler's pegs									1
Asteraceae	**Conyza* sp.										1
Asteraceae	**Hypochaeris radicata*	catsear									1
Asteraceae	*Lagenifera stipitata*	blue bottle-daisy					1				
Bignoniaceae	*Pandorea pandorana*	wonga wonga vine								1	
Casuarinaceae	*Allocasuarina torulosa*	forest oak	3	3	3	3	3	3	1	1	

Family	Scientific Name	Common Name	Floristic Quadrats						Transects		Opportunistic
			Q1	Q2	Q3	Q4	Q5	Q6	T1	T2	
Celastraceae	*Maytenus silvestris*	narrow-leaved orangebark	2								
Convolvulaceae	*Dichondra repens*	kidney weed		2	2						
Dilleniaceae	*Hibbertia aspera*	rough guinea flower						4			
Dilleniaceae	*Hibbertia* sp.								1	1	
Epacridaceae	*Epacris pulchella*					1					
Epacridaceae	*Leucopogon lanceolatus*						1	3			
Epacridaceae	*Lissanthe strigosa*	peach heath						2	1	1	
Euphorbiaceae	*Breynia oblongifolia*	coffee bush	2	1			1				
Euphorbiaceae	*Glochidion ferdinandi* var. *ferdinandi*	cheese tree	3	3							
Euphorbiaceae	*Phyllanthus hirtellus*					2	2	2	1	1	
Eupomatiaceae	*Eupomatia laurina*	bolwarra		1							
Fabaceae (Faboideae)	*Daviesia ulicifolia*	gorse bitter pea				2	2				
Fabaceae (Faboideae)	*Desmodium gunnii*			2			1				
Fabaceae (Faboideae)	*Dillwynia retorta*				1	2	2	1	1		
Fabaceae (Faboideae)	*Glycine clandestina*									1	
Fabaceae (Faboideae)	*Glycine* sp.			1							
Fabaceae (Faboideae)	*Glycine tabacina*						2	2	1		
Fabaceae (Faboideae)	*Hardenbergia violacea*	false sarsaparilla				2	2	1			
Fabaceae (Faboideae)	*Platylobium formosum* subsp. *formosum*						1				

Family	Scientific Name	Common Name	Floristic Quadrats						Transects		Opportunistic
			Q1	Q2	Q3	Q4	Q5	Q6	T1	T2	
Fabaceae (Faboideae)	*Podolobium ilicifolium*	prickly shaggy pea			3	1	1	2			
Fabaceae (Faboideae)	*Pultenaea paleacea*				3		2				
Fabaceae (Faboideae)	*Pultenaea* sp.					2					
Fabaceae (Mimosoideae)	*Acacia irrorata*	green wattle	1								
Fabaceae (Mimosoideae)	*Acacia terminalis*	sunshine wattle						1	1		
Fabaceae (Mimosoideae)	*Acacia ulicifolia*	prickly moses					2	1			
Goodeniaceae	*Dampiera stricta*					2	2	2	1	1	
Goodeniaceae	*Goodenia heterophylla* subsp. *heterophylla*				2			2			
Goodeniaceae	*Goodenia* sp.						1				
Haloragaceae	*Gonocarpus tetragynus*					2	2		1	1	
Lauraceae	*Cassytha glabella*					2	2	2		1	
Lauraceae	*Cassytha pubescens*								1		
Lobeliaceae	*Pratia purpurascens*	whiteroot		2			2				
Loranthaceae	*Amyema* sp.							1			
Malvaceae	*Sida corrugata*			1							
Menispermaceae	*Stephania japonica* var. *discolor*	snake vine	2								
Myrtaceae	*Angophora costata*	smooth-barked apple				4	4	4	1	1	
Myrtaceae	*Angophora floribunda*	rough-barked apple		3							
Myrtaceae	*Callistemon salignus*	willow bottlebrush									1
Myrtaceae	*Corymbia gummifera*	red bloodwood			3	3	3	3	1	1	

Family	Scientific Name	Common Name	Floristic Quadrats						Transects		Opportunistic
			Q1	Q2	Q3	Q4	Q5	Q6	T1	T2	
Myrtaceae	*Eucalyptus acmenoides*	white mahogany	3								
Myrtaceae	*Eucalyptus canaliculata*	large-fruited grey gum				3					
Myrtaceae	*Eucalyptus costata*	ridge-fruited mallee			4						
Myrtaceae	*Eucalyptus piperita*	Sydney peppermint	3	3	2	3				1	
Myrtaceae	*Eucalyptus saligna*	Sydney blue gum		4							
Myrtaceae	*Eucalyptus umbra*						3	3	1		
Myrtaceae	*Leptospermum polygalifolium*				3	3		3	1		
Myrtaceae	*Melaleuca linariifolia*		4	2							
Myrtaceae	*Melaleuca styphelioides*	prickly-leaved tea tree								1	
Myrtaceae	*Syncarpia glomulifera* subsp. *glomulifera*		3	3				3		1	
Polygalaceae	*Comesperma ericinum*					1					
Polygalaceae	*Comesperma sphaerocarpum*				2			2		1	
Proteaceae	*Banksia spinulosa* var. *collina*				3	3		2	1	1	
Proteaceae	***Grevillea parviflora* subsp. *parviflora***									**1**	
Proteaceae	*Lambertia formosa*	mountain devil							1		
Proteaceae	*Persoonia levis*	broad-leaved geebung			3			3	1	1	
Proteaceae	*Persoonia linearis*	narrow-leaved geebung				2	1	3			
Ranunculaceae	*Clematis glycinoides*	headache vine	1	1							
Rosaceae	*Rubus molluccanus* var. *trilobus*	molucca bramble	2	2							
Thymelaeaceae	*Pimelea linifolia*				1	1				1	
Tremandraceae	***Tetratheca juncea***							**1**		**1**	
Verbenaceae	**Verbena bonariensis*	purpletop									1
Violaceae	*Hybanthus monopetalus*	slender violet-bush			2						
Violaceae	*Viola hederacea*		3								
Vitaceae	*Cayratia clematidea*	slender grape		1							

Fauna Species List

The following fauna list was developed from surveys of the Project Area detailed in **Section 3.5** of the main report. It includes all species of fauna observed in the Project Area during field surveys undertaken by Umwelt on 25 and 26 March 2013.

The following abbreviations or symbols are used in the list:

asterisk (*) denotes species not indigenous to the site;

MAR Marine species listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act);

MIG Migratory species listed under the EPBC Act;

V Vulnerable species listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act) or EPBC Act;

E Endangered species listed under the TSC Act or EPBC Act; and

bold text is used to indicate a threatened species.

Birds recorded were identified using descriptions in Slater *et al*. (2003) and the scientific and common name nomenclature and taxonomy adopted by Birds Australia. Reptiles recorded were identified using keys and descriptions in Cogger (2000), Swan *et al*. (2004), Weigel (1990) and Wilson & Swan (2003) and the scientific and common name nomenclature and taxonomy adopted by Cogger (2000).

Amphibians recorded were identified using keys and descriptions in Cogger (2000), Robinson (1998), Anstis (2002) and Barker *et al*. (1995) and the scientific and common name nomenclature of Cogger (2000). Mammals recorded were identified using keys and descriptions in Strahan (2002), Churchill (2008) and Menkhorst & Knight (2004) and the scientific and common name nomenclature of Strahan (2002) for non-bat species and Churchill (2008) for bats.

Table 2 – Fauna Species Recorded within the Project Area

Scientific Name	Common Name	Conservation Status	
		TSC Act	EPBC Act
AMPHIBIANS			
Myobatrachidae			
Crinia signifera	common eastern froglet		
Pseudophryne coriacea	red-backed toadlet		
Hylidae			
Litoria fallax	dwarf tree frog		
REPTILES			
Varanidae			
Varanus varius	lace monitor		
Agamidae			
Amphibolurus muricatus	jacky lizard		
Scincidae			

Scientific Name	Common Name	Conservation Status	
		TSC Act	EPBC Act
Lampropholis delicata	grass skink		
Saiphos equalis	three-toed skink		
BIRDS			
Columbidae			
Ocyphaps lophotes	crested pigeon		
Accipitridae			
Accipiter novaehollandiae	grey goshawk		
Cacatuidae			
Calyptorhynchus funereus	yellow-tailed black-cockatoo		
Cacatua roseicapillus	galah		
Cacatua galerita	sulphur-crested cockatoo		
Psittacidae			
Glossopsitta pusilla	**little lorikeet**	**V**	
Alisterus scapularis	Australian king-parrot		
Platycercus eximius	eastern rosella		
Cuculidae			
Cacomantis flabelliformis	fan-tailed cuckoo		
Halcyonidae			
Dacelo novaeguineae	laughing kookaburra		
Climacteridae			
Corombates leucophaea	white-throated treecreeper		
Maluridae			
Malurus cyaneus	superb fairy-wren		
Acanthizidae			
Sericornis frontalis	white-browed scrubwren		
Acanthiza lineata	striated thornbill		
Acanthiza pusilla	brown thornbill		
Pardalotidae			
Pardalotus punctatus	spotted pardalote		
Meliphagidae			
Acanthorhynchus tenuirostris	eastern spinebill		
Lichenostomus chrysops	yellow-faced honeyeater		
Manorina melanocephala	noisy miner		
Philemon corniculatus	noisy friarbird		
Campephagidae			
Coracina novaehollandiae	black-faced cuckoo-shrike		
Pachycephalidae			
Pachycephala pectoralis	golden whistler		
Colluricincla harmonica	grey shrike-thrush		
Artamidae			
Cracticus torquatus	grey butcherbird		
Cracticus nigrogularis	pied butcherbird		
Gymnorhina tibicen	Australian magpie		
Strepera graculina	pied currawong		

Scientific Name	Common Name	Conservation Status	
		TSC Act	EPBC Act
Rhipiduridae			
Rhipidura albiscapa	grey fantail		
Rhipidura leucophrys	willie wagtail		
Corvidae			
Corvus coronoides	Australian raven		
Monarchidae			
Grallina cyanoleuca	magpie-lark		
Petroicidae			
Eopsaltria australis	eastern yellow robin		
Timaliidae			
Zosterops lateralis	silvereye		
Estrildidae			
Neochmia temporalis	red-browed finch		
MAMMALS			
Dasyuridae			
Antechinus stuartii	brown antechinus		
Petauridae			
Petaurus breviceps	sugar glider		
Phalangeridae			
Trichosurus vulpecula	common brushtail possum		
Pteropodidae			
Pteropus poliocephalus	**grey-headed flying-fox**	**V**	**V**
Molossidae			
Tadarida australis	white-striped freetail-bat		
Mormopterus norfolkensis	**east coast freetail-bat**	**V**	
Mormopterus sp.2	eastern freetail-bat		
Miniopteridae			
Miniopterus schreibersii oceanensis	**eastern bentwing-bat**	**V**	
Miniopterus australis	**little bentwing-bat**	**V**	
Rhinolophidae			
Rhinolophus megaphyllus	eastern horseshoe bat		
Vespertilionidae			
Chalinolobus dwyeri	**large-eared pied bat**	**V**	**V**
Chalinolobus gouldii	Gould's wattled bat		
Chalinolobus morio	chocolate wattled bat		
Scoteanax rueppellii	**greater broad-nosed bat**	**V**	
Scotorepens orion	eastern broad-nosed bat		
Vespadelus vulturnus	little forest bat		
Muridae			
Rattus fuscipes	bush rat		
Canidae			
*Vulpes vulpes**	fox		
Leporidae			
*Oryctolagus cuniculus**	rabbit		

APPENDIX C

Seven Part Tests under the *Environmental Planning and Assessment Act 1979*

Appendix C – Seven Part Tests under the *Environmental Planning and Assessment Act 1979*

Seven part tests are provided below for those threatened species, endangered populations (EPs) and threatened ecological communities (TECs) considered (refer to **Appendix A**) to have the potential to be impacted by the Project. The following species, EPs and TECs are assessed:

Threatened Flora Species

- black-eyed Susan (*Tetratheca juncea*)*;*
- small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*)*;*

Reptile Species

- Stephens banded snake (*Hoplocephalus stephensii*)*;*

Bird Species

- glossy black-cockatoo (*Calyptorhynchus lathami*)*;*
- gang-gang cockatoo (*Callocephalon fimbriatum*)*;*
- little lorikeet (*Glossopsitta pusilla*)*;*
- powerful owl (*Ninox strenua*)*;*
- masked owl (*Tyto novaehollandiae*)*;*
- sooty owl (*Tyto tenebricosa*)*;*
- varied sittella (*Daphoenositta chrysoptera*)*;*
- scarlet robin (*Petroica boodang*)*;*

Mammal Species

- yellow-bellied glider (*Petaurus australis*)*;*
- squirrel glider (*Petaurus norfolcensis*)*;*

Mega-bat Species

- grey-headed flying-fox (*Pteropus poliocephalus*)*;*

Micro-bat Species

- yellow-bellied sheathtail bat (*Saccolaimus flaviventris*)*;*
- east coast freetail-bat (*Mormopterus norfolkensis*)*;*
- little bentwing-bat (*Miniopterus australis*)*;*
- eastern bentwing-bat (*Miniopterus schreibersii oceanensis*)*;*
- large-eared pied bat (*Chalinolobus dwyeri*)*;*
- eastern false pipistrelle (*Falsistrellus tasmaniensis*)*;* and

- greater broad-nosed bat (*Scoteanax rueppellii*).

All assessments are undertaken without any consideration of impact mitigation or offsetting opportunities or commitments. Impact mitigation and biodiversity offsetting commitments are addressed in **Section 6.0** of the main report.

Vulnerable Species

Small-flower grevillea (*Grevillea parviflora* subsp *parviflora*)

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction;

Small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*) was recorded at five locations within the Project Area and a further three locations in the vicinity of the Project Area. The species is known to occur in dry sclerophyll forest and woodlands throughout the Sugarloaf SCA and Lake Macquarie LGA.

No direct clearing of native vegetation is required for the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would generally not be required in areas of intact vegetation and where required, will be undertaken in a manner that does not require significant clearing. Therefore it is considered unlikely that the Project would disrupt the life cycle of this species and a viable population would be placed at risk of extinction.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction;

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;

i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; and

Not applicable.

ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction;

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community;

i) the extent to which habitat is likely to be removed or modified as a result of the action proposed;

No direct clearing of native vegetation is required for the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would generally not be required in areas of intact vegetation and where required, will be undertaken in a manner that does not require significant clearing. No habitat for this species is expected to be removed during the Project.

ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

No direct clearing of native vegetation is required for the Project. Therefore, no area of habitat for this species is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality;

Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. As such, any habitat potentially modified as a result of subsidence is unlikely to be of importance to the survival of this species in the locality.

No direct clearing of native vegetation is required for the Project. Therefore, no area of habitat for this species is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

The Project Area is not located in proximity to any areas of declared or recommended critical habitat areas. The Project will not have an adverse effect on any critical habitat.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and

A recovery plan has not been prepared for this species. There are no threat abatement plans of relevance to the Project.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Alteration of habitat following subsidence due to longwall mining is a key threatening processes relevant to the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted.

No other key threatening processes are relevant to the Project.

Conclusion

Based on the information provided above, and considering the application of the precautionary principle, the Project is unlikely to result in a significant impact on small-flower grevillea *(Grevillea parviflora* subsp. *parviflora*).

Black-eyed Susan (*Tetratheca juncea*)

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction;

Black-eyed Susan (*Tetratheca juncea*) was recorded at 14 locations within the Project Area and a further two locations in the vicinity of the Project Area during field surveys. A further two records of this species in the Project Area were identified from a review of the OEH atlas of NSW Wildlife (OEH 2013). The species is known to occur in dry sclerophyll forest and woodlands throughout the Sugarloaf SCA and Lake Macquarie LGA. In many areas of the Sugarloaf SCA, this species is considered common and occurs as a dominant species in the groundcover (Bell and Driscoll 2008)

No direct clearing of native vegetation is required for the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would generally not be required in areas of intact vegetation and where required, will be undertaken in a manner that does not require significant clearing. No habitat for this species is expected to be removed during the Project. Therefore it is considered unlikely that the Project would disrupt the life cycle of this species and a viable population would not be placed at risk of extinction.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction;

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;

i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; and

Not applicable.

ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction;

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community;

i) the extent to which habitat is likely to be removed or modified as a result of the action proposed;

No direct clearing of native vegetation is required for the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would generally not be required in areas of intact vegetation and where required, will be undertaken in a manner that does not require significant clearing. No habitat for this species is expected to be removed during the Project.

ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

No direct clearing of native vegetation is required for the Project. Therefore, no area of habitat for this species is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality;

Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. As such, any habitat potentially modified as a result of subsidence is unlikely to be of importance to the survival of this species in the locality.

No direct clearing of native vegetation is required for the Project. Therefore, no area of habitat for this species is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

The Project Area is not located in proximity to any areas of declared or recommended critical habitat areas. The Project will not have an adverse effect on any critical habitat.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and

A recovery plan has not been prepared for this species. There are no threat abatement plans of relevance to the Project.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Alteration of habitat following subsidence due to longwall mining is a key threatening processes relevant to the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted.

No other key threatening processes are relevant to the Project.

Conclusion

Based on the information provided above, and considering the application of the precautionary principle, the Project is unlikely to result in a significant impact on Black-eyed Susan (*Tetratheca juncea*).

Stephens' banded snake (*Hoplocephalus stephensii*)

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction;

Stephens' banded snake **(***Hoplocephalus stephensii*) is a nocturnal, partially arboreal snake known to occur along the east coast of Australia, from the Sydney region through to southern Queensland. This snake occurs in rainforests, wet and dry eucalypt forests and rocky area along the coast and the ranges throughout its distribution. This species was not recorded within the Project Area however this species is known to occur in the Sugarloaf SCA (DECC 2008).

No direct clearing of native vegetation is required for the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would generally not be required in areas of intact vegetation and where required, will be undertaken in a manner that does not require significant clearing. No habitat for this species is expected to be removed during the Project. Surface water ponding is not predicted to occur. Therefore, the Project is considered unlikely to affect the life cycle of any potentially occurring population of the Stephen's banded snake, such that the species is likely to be placed at risk of extinction.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction;

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community;

i) the extent to which habitat is likely to be removed or modified as a result of the action proposed;

No direct clearing of native vegetation is required for the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would generally not be required in areas of intact vegetation and where required, will be undertaken in a manner that does not require significant clearing. No habitat for this species is expected to be removed during the Project.

ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

No direct clearing of native vegetation is required for the Project. Therefore, no area of habitat for this species is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality;

Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. As such, any habitat potentially modified as a result of subsidence is unlikely to be of importance to the survival of this species in the locality.

No direct clearing of native vegetation is required for the Project. Therefore, no area of habitat for this species is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

No critical habitat has been listed within or adjacent to the Project Area for this threatened species. The Project will not have an adverse effect on any critical habitat.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and

A recovery plan has not been prepared for this species. There are no threat abatement plans of relevance to the Project.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Alteration of habitat following subsidence due to longwall mining is a key threatening processes relevant to the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted.

No other key threatening processes are relevant to the Project.

Conclusion

Based on the information provided above, and considering the application of the precautionary principle, the Project is unlikely to result in a significant impact on Stephens' banded snake (*Hoplocephalus stephensii*).

Glossy black-cockatoo (*Calyptorhynchus lathami*);

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction;

The glossy black-cockatoo (*Calyptorhynchus lathami*) is known to occur along the east coast of Australia, from Victoria through to southern Queensland and inland to the southern tablelands and central western plains. On the coast, this species Inhabits open forest and woodlands where stands of sheoak occur. Black Sheoak (*Allocasuarina littoralis*) and Forest Sheoak (*A. torulosa*) are an important food resource for this species. This species was not recorded within the Project Area however this species is known to occur in the Sugarloaf SCA (DECC 2008).

No direct clearing of native vegetation is required for the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would generally not be required in areas of intact vegetation and where required, will be undertaken in a manner that does not require significant clearing. No habitat for this species is expected to be removed during the Project.Therefore, the Project is considered unlikely to affect the life cycle of a potentially occurring population of the glossy black-cockatoo, such that the species is likely to be placed at risk of extinction.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction;

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community;

i) the extent to which habitat is likely to be removed or modified as a result of the action proposed;

No direct clearing of native vegetation is required for the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would generally not be required in areas of intact vegetation and where required, will be undertaken in a manner that does not require significant clearing. No habitat for this species is expected to be removed during the Project.

ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

No direct clearing of native vegetation is required for the Project. Therefore, no area of habitat for this species is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality;

Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. As such, any habitat potentially modified as a result of subsidence is unlikely to be of importance to the survival of this species in the locality.

No direct clearing of native vegetation is required for the Project. Therefore, no area of habitat for this species is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

No critical habitat has been listed within or adjacent to the Project Area for this threatened species. The Project will not have an adverse effect on any critical habitat.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and

A recovery plan has not been prepared for this species. There are no threat abatement plans of relevance to the Project.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Alteration of habitat following subsidence due to longwall mining is a key threatening processes relevant to the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted.

No other key threatening processes are relevant to the Project.

Conclusion

Based on the information provided above, and considering the application of the precautionary principle, the Project is unlikely to result in a significant impact on the glossy black-cockatoo (*Calyptorhynchus lathami*).

Gang-gang cockatoo (*Callocephalon fimbriatum*)

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction;

The gang-gang cockatoo (*Callocephalon fimbriatum*) has not been recorded in the Project Area however this species is known to occur in the Sugarloaf SCA (DECC 2008). The species is known to occur along the east coast of Australia, from southern Victoria through to the Hunter region in the North.

No direct clearing of native vegetation is required for the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would generally not be required in areas of intact vegetation and where required, will be undertaken in a manner that does not require significant clearing. No habitat for this species is expected to be removed during the Project.Therefore, the Project is considered unlikely to affect the life cycle of a potentially occurring population of the gang-gang cockatoo, such that the species is likely to be placed at risk of extinction.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction;

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community;

i) the extent to which habitat is likely to be removed or modified as a result of the action proposed;

No direct clearing of native vegetation is required for the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would generally not be required in areas of intact vegetation and where required, will be undertaken in a manner that does not require significant clearing. No habitat for this species is expected to be removed during the Project.

ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

No direct clearing of native vegetation is required for the Project. Therefore, no area of habitat for this species is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality;

Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. As such, any habitat potentially modified as a result of subsidence is unlikely to be of importance to the survival of this species in the locality.

No direct clearing of native vegetation is required for the Project. Therefore, no area of habitat for this species is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

No critical habitat has been listed within or adjacent to the Project Area for this threatened species. The Project will not have an adverse effect on any critical habitat.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and

A recovery plan has not been prepared for this species. There are no threat abatement plans of relevance to the Project.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Alteration of habitat following subsidence due to longwall mining is a key threatening processes relevant to the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted.

No other key threatening processes are relevant to the Project.

Conclusion

Based on the information provided above, and considering the application of the precautionary principle, the Project is unlikely to result in a significant impact on the gang-gang cockatoo (*Callocephalon fimbriatum*).

Little lorikeet (*Glossopsitta pusilla*)

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction;

The little lorikeet (*Glossopsitta pusilla*) was recorded within the Project Area on one occasion during fauna surveys. This species is seasonally nomadic, with their presence in any given area influenced by seasonal abundance of flowering eucalypt trees. The species is known to occur across the coastal and Great Dividing Range regions of eastern Australia from Cape York to South Australia.

No direct clearing of native vegetation is required for the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would generally not be required in areas of intact vegetation and where required, will be undertaken in a manner that does not require significant clearing. No habitat for this species is expected to be removed during the Project.Therefore, the Project is considered unlikely to affect the life cycle of a potentially occurring population of the little lorikeet, such that the species is likely to be placed at risk of extinction.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction;

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community;

i) the extent to which habitat is likely to be removed or modified as a result of the action proposed;

No direct clearing of native vegetation is required for the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would generally not be required in areas of intact vegetation and where required, will be undertaken in a manner that does not require significant clearing. No habitat for this species is expected to be removed during the Project.

ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

No direct clearing of native vegetation is required for the Project. Therefore, no area of habitat for this species is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality;

Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. As such, any habitat potentially modified as a result of subsidence is unlikely to be of importance to the survival of this species in the locality.

No direct clearing of native vegetation is required for the Project. Therefore, no area of habitat for this species is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

No critical habitat has been listed within or adjacent to the Project Area for this threatened species. The Project will not have an adverse effect on any critical habitat.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and

A recovery plan has not been prepared for this species. There are no threat abatement plans of relevance to the Project.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Alteration of habitat following subsidence due to longwall mining is a key threatening processes relevant to the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted.

No other key threatening processes are relevant to the Project.

Conclusion

Based on the information provided above, and considering the application of the precautionary principle, the Project is unlikely to result in a significant impact on the little lorikeet (*Glossopsitta pusilla*).

Powerful owl (*Ninox strenua*)

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction;

The powerful owl (*Ninox strenua*) has not been recorded in the Project Area, however it is known to occur in Sugarloaf SCA (DECC 2008) and potential habitat was identified in the Project Area. The species is known to occur in NSW throughout the eastern forests from the coast inland to tablelands, with scattered, mostly historical records on the western slopes and plains.

No direct clearing of native vegetation is required for the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would generally not be required in areas of intact vegetation and where required, will be undertaken in a manner that does not require significant clearing. No habitat for this species is expected to be removed during the Project. Therefore, the Project is considered unlikely to affect the life cycle of a potentially occurring population of the powerful owl, such that the species is likely to be placed at risk of extinction.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction;

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community;

i) the extent to which habitat is likely to be removed or modified as a result of the action proposed;

No direct clearing of native vegetation is required for the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would generally not be required in areas of intact vegetation and where required, will be undertaken in a manner that does not require significant clearing. No habitat for this species is expected to be removed during the Project.

ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

No direct clearing of native vegetation is required for the Project. Therefore, no area of habitat for this species is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality;

Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. As such, any habitat potentially modified as a result of subsidence is unlikely to be of importance to the survival of this species in the locality.

No direct clearing of native vegetation is required for the Project. Therefore, no area of habitat for this species is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

No critical habitat has been listed within or adjacent to the Project Area for this threatened species. The Project will not have an adverse effect on any critical habitat.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and

The 'NSW Recovery Plan for the Large Forest Owls' (DEC 2006) is applicable to this species. No direct native vegetation removal is required for the Project and therefore it is considered that the Project does not contravene any of the objectives of the management plan.

No threat abatement plans are applicable to this threatened species.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Alteration of habitat following subsidence due to longwall mining is a key threatening processes relevant to the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted.

No other key threatening processes are relevant to the Project.

Conclusion

Based on the information provided above, and considering the application of the precautionary principle, the Project is unlikely to result in a significant impact on the powerful owl (*Ninox strenua*).

Masked owl (*Tyto novaehollandiae*)

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction;

The masked owl (*Tyto novaehollandiae*) has not been recorded within the Project Area, however it is known to occur in the Sugarloaf SCA (DECC 2008). Some foraging and roosting habitat for this species potentially occurs in the Project Area, in suitable mature eucalypts. The species is known to occur in NSW in forests along the coastline, with scattered records in the western plains.

No direct clearing of native vegetation is required for the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would generally not be required in areas of intact vegetation and where required, will be undertaken in a manner that does not require significant clearing. No habitat for this species is expected to be removed during the Project.Therefore, the Project is considered unlikely to affect the life cycle of a potentially occurring population of the masked owl, such that the species is likely to be placed at risk of extinction.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction;

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community;

i) the extent to which habitat is likely to be removed or modified as a result of the action proposed;

No direct clearing of native vegetation is required for the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would generally not be required in areas of intact vegetation and where required, will be undertaken in a manner that does not require significant clearing. No habitat for this species is expected to be removed during the Project.

ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

No direct clearing of native vegetation is required for the Project. Therefore, no area of habitat for this species is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality;

Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. As such, any habitat potentially modified as a result of subsidence is unlikely to be of importance to the survival of this species in the locality.

No direct clearing of native vegetation is required for the Project. Therefore, no area of habitat for this species is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

No critical habitat has been listed within or adjacent to the Project Area for this threatened species. The Project will not have an adverse effect on any critical habitat.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and

The 'NSW Recovery Plan for the Large Forest Owls' (DEC 2006) is applicable to this species. No direct native vegetation removal is required for the Project and therefore it is considered that the Project does not contravene any of the objectives of the management plan.

No threat abatement plans are applicable to this threatened species.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Alteration of habitat following subsidence due to longwall mining is a key threatening processes relevant to the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted.

No other key threatening processes are relevant to the Project.

Conclusion

Based on the information provided above, and considering the application of the precautionary principle, the Project is unlikely to result in a significant impact on the masked owl (*Tyto novaehollandiae*).

Sooty Owl (*Tyto tenebricosa*)

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction;

The sooty owl (*Tyto tenebricosa*) has not been recorded in the Project Area, however is known to occur in Sugarloaf SCA (Umwelt 2013) The species is known to roost in rainforests and wet sclerophyll forest and occurs along the coast and ranges on NSW and potential habitat was identified in the Project Area for this species.

No direct clearing of native vegetation is required for the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would generally not be required in areas of intact vegetation and where required, will be undertaken in a manner that does not require significant clearing. No habitat for this species is expected to be removed during the Project.Therefore, the Project is considered unlikely to affect the life cycle of a potentially occurring population of the sooty owl, such that the species is likely to be placed at risk of extinction.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction;

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community;

i) the extent to which habitat is likely to be removed or modified as a result of the action proposed;

No direct clearing of native vegetation is required for the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would generally not be required in areas of intact vegetation and where required, will be undertaken in a manner that does not require significant clearing. No habitat for this species is expected to be removed during the Project.

ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

No direct clearing of native vegetation is required for the Project. Therefore, no area of habitat for this species is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality;

Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. As such, any habitat potentially modified as a result of subsidence is unlikely to be of importance to the survival of this species in the locality.

No direct clearing of native vegetation is required for the Project. Therefore, no area of habitat for this species is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

No critical habitat has been listed within or adjacent to the Project Area for this threatened species. The Project will not have an adverse effect on any critical habitat.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and

The 'NSW Recovery Plan for the Large Forest Owls' (DEC 2006) is applicable to this species. No direct native vegetation removal is required for the Project and therefore it is considered that the Project does not contravene any of the objectives of the management plan.

No threat abatement plans are applicable to this threatened species.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Alteration of habitat following subsidence due to longwall mining is a key threatening processes relevant to the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted.

No other key threatening processes are relevant to the Project.

Conclusion

Based on the information provided above, and considering the application of the precautionary principle, the Project is unlikely to result in a significant impact on the sooty owl (*Tyto tenebricosa*).

Varied sittella (*Daphoenositta chrysoptera*)

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction;

The varied sittella (*Daphoenositta chrysoptera*) was not recorded in the Project Area, however it is known to occur in Sugarloaf SCA and potential habitat for the species was identified in the Project Area. It is typically observed in eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gums with dead branches, mallee and *Acacia* woodland. The species distribution in NSW is nearly continuous from the coast to the far west.

No direct clearing of native vegetation is required for the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would generally not be required in areas of intact vegetation and where required, will be undertaken in a manner that does not require significant clearing. No habitat for this species is expected to be removed during the Project. Therefore, the Project is considered unlikely to affect the life cycle of a potentially occurring population of the varied sittella, such that the species is likely to be placed at risk of extinction.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction;

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community;

i) the extent to which habitat is likely to be removed or modified as a result of the action proposed;

No direct clearing of native vegetation is required for the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would generally not be required in areas of intact vegetation and where required, will be undertaken in a manner that does not require significant clearing. No habitat for this species is expected to be removed during the Project.

ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

No direct clearing of native vegetation is required for the Project. Therefore, no area of habitat for this species is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality;

Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. As such, any habitat potentially modified as a result of subsidence is unlikely to be of importance to the survival of this species in the locality.

No direct clearing of native vegetation is required for the Project. Therefore, no area of habitat for this species is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

No critical habitat has been listed within or adjacent to the Project Area for this threatened species. The Project will not have an adverse effect on any critical habitat.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and

No recovery plans have been prepared for this species. No threat abatement plans are pertinent to this threatened species.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Alteration of habitat following subsidence due to longwall mining is a key threatening processes relevant to the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted.

No other key threatening processes are relevant to the Project.

Conclusion

Based on the information provided above, and considering the application of the precautionary principle, the Project has potential to result in a significant impact on the varied sittella (*Daphoenositta chrysoptera*).

Scarlet robin (*Petroica boodang*)

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction;

The scarlet robin (*Petroica boodang*) has not been recorded within the Project Area, however it is known to occur in Sugarloaf SCA (Umwelt 2010) and potential habitat was identified in the Project Area. The species is found from south east Queensland to south-east South Australia and also in Tasmania and south-west Western Australia. In NSW, it occurs from the coast to the inland slopes.

No direct clearing of native vegetation is required for the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would generally not be required in areas of intact vegetation and where required, will be undertaken in a manner that does not require significant clearing. No habitat for this species is expected to be removed during the Project.Therefore, the Project is considered unlikely to affect the life cycle of a potentially occurring population of the scarlet robin, such that the species is likely to be placed at risk of extinction.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction;

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community;

i) the extent to which habitat is likely to be removed or modified as a result of the action proposed;

No direct clearing of native vegetation is required for the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would generally not be required in areas of intact vegetation and where required, will be undertaken in a manner that does not require significant clearing. No habitat for this species is expected to be removed during the Project.

ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

No direct clearing of native vegetation is required for the Project. Therefore, no area of habitat for this species is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality;

Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. As such, any habitat potentially modified as a result of subsidence is unlikely to be of importance to the survival of this species in the locality.

No direct clearing of native vegetation is required for the Project. Therefore, no area of habitat for this species is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

No critical habitat has been listed within or adjacent to the Project Area for this threatened species. The Project will not have an adverse effect on any critical habitat.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and

A recovery plan has not been prepared for this species. There are no threat abatement plans of relevance to the Project.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Alteration of habitat following subsidence due to longwall mining is a key threatening processes relevant to the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted.

No other key threatening processes are relevant to the Project.

Conclusion

Based on the information provided above, and considering the application of the precautionary principle, the Project is unlikely to result in a significant impact on the scarlet robin (*Petroica boodang*).

Spotted-tailed quoll (*Dasyurus maculatus*)

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction;

The spotted-tailed quoll (*Dasyurus maculatus*) has not been recorded within the Project Area, however is known to occur in Sugarloaf SCA (DECC 2008) and the Project Area provides potential habitat for the species. This species has been recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline.

No direct clearing of native vegetation is required for the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would generally not be required in areas of intact vegetation and where required, will be undertaken in a manner that does not require significant clearing. No habitat for this species is expected to be removed during the Project.Therefore, the Project is considered unlikely to affect the life cycle of a potentially occurring population of the spotted-tailed quoll, such that the species is likely to be placed at risk of extinction.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction;

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community;

i) the extent to which habitat is likely to be removed or modified as a result of the action proposed;

No direct clearing of native vegetation is required for the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would generally not be required in areas of intact vegetation and where required, will be undertaken in a manner that does not require significant clearing. No habitat for this species is expected to be removed during the Project.

ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

No direct clearing of native vegetation is required for the Project. Therefore, no area of habitat for this species is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality;

Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. As such, any habitat potentially modified as a result of subsidence is unlikely to be of importance to the survival of this species in the locality.

No direct clearing of native vegetation is required for the Project. Therefore, no area of habitat for this species is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

No critical habitat has been listed within or adjacent to the Project Area for this threatened species. The Project will not have an adverse effect on any critical habitat.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and

The 'Recovery plan for *Dasyurus maculatus* (Spotted-tailed Quoll) 2005 – 2009' (Long and Nelson 2004) is applicable to this species. No direct clearing of native vegetation is required for the Project and therefore, the Project does not contravene the aims and objectives of the recovery plan.

The 'Threat abatement plan for predation by the European red fox' (DEWHA 2008) is relevant to this threatened species. The Project does not contravene any of the objectives or actions of this plan.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Alteration of habitat following subsidence due to longwall mining is a key threatening processes relevant to the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted.

No other key threatening processes are relevant to the Project.

Conclusion

Based on the information provided above, and considering the application of the precautionary principle, the Project is unlikely to result in a significant impact on a potentially occurring local population of the spotted-tailed quoll (*Dasyurus maculatus*).

Yellow-bellied glider (*Petaurus australis*)

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction;

The yellow-bellied glider (*Petaurus australis*) has not been recorded within the Project Area, however it is known to occur within Sugarloaf SCA (DECC 2008). This species is generally found in wet forest associations and occurs along most of the east coast of NSW and potential habitat was identified in the Project Area.

No direct clearing of native vegetation is required for the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would generally not be required in areas of intact vegetation and where required, will be undertaken in a manner that does not require significant clearing. No habitat for this species is expected to be removed during the Project.Therefore, the Project is considered unlikely to affect the life cycle of a potentially occurring population of the yellow-bellied glider, such that the species is likely to be placed at risk of extinction.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction;

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community;

i) the extent to which habitat is likely to be removed or modified as a result of the action proposed;

No direct clearing of native vegetation is required for the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would generally not be required in areas of intact vegetation and where required, will be undertaken in a manner that does not require significant clearing. No habitat for this species is expected to be removed during the Project.

ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

No direct clearing of native vegetation is required for the Project. Therefore, no area of habitat for this species is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality;

Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. As such, any habitat potentially modified as a result of subsidence is unlikely to be of importance to the survival of this species in the locality.

No direct clearing of native vegetation is required for the Project. Therefore, no area of habitat for this species is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

No critical habitat has been listed within or adjacent to the Project Area for this threatened species. The Project will not have an adverse effect on any critical habitat.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and

A recovery plan has not been prepared for this species. There are no threat abatement plans of relevance to the Project.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Alteration of habitat following subsidence due to longwall mining is a key threatening processes relevant to the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted.

No other key threatening processes are relevant to the Project.

Conclusion

Based on the information provided above, and considering the application of the precautionary principle, the Project is unlikely to result in a significant impact on the yellow-bellied glider (*Petaurus australis*).

Squirrel glider (*Petaurus norfolcensis*)

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction;

The squirrel glider (*Petaurus norfolcensis*) has not been recorded within the Project Area, however it is known to occur in the Sugarloaf SCA (DECC 2008) and potential habitat was identified in the Project Area. The species is widely though sparsely distributed in eastern Australia, from northern Queensland to western Victoria. And occupies a range of woodland forest communities

No direct clearing of native vegetation is required for the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would generally not be required in areas of intact vegetation and where required, will be undertaken in a manner that does not require significant clearing. No habitat for this species is expected to be removed during the Project. Therefore, the Project is considered unlikely to affect the life cycle of a potentially occurring population of the squirrel glider, such that the species is likely to be placed at risk of extinction.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction;

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community;

i) the extent to which habitat is likely to be removed or modified as a result of the action proposed;

No direct clearing of native vegetation is required for the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would generally not be required in areas of intact vegetation and where required, will be undertaken in a manner that does not require significant clearing. No habitat for this species is expected to be removed during the Project.

ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

No direct clearing of native vegetation is required for the Project. Therefore, no area of habitat for this species is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality;

Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. As such, any habitat potentially modified as a result of subsidence is unlikely to be of importance to the survival of this species in the locality.

No direct clearing of native vegetation is required for the Project. Therefore, no area of habitat for this species is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

No critical habitat has been listed within or adjacent to the Project Area for this threatened species. The Project will not have an adverse effect on any critical habitat.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and

A recovery plan has not been prepared for this species. There are no threat abatement plans of relevance to the Project.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Alteration of habitat following subsidence due to longwall mining is a key threatening processes relevant to the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted.

No other key threatening processes are relevant to the Project.

Conclusion

Based on the information provided above, and considering the application of the precautionary principle, the Project is unlikely to result in a significant impact on the squirrel glider (*Petaurus norfolcensis*).

Grey-headed flying-fox (*Pteropus poliocephalus*)

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction;

The grey-headed flying-fox (*Pteropus poliocephalus*) has been recorded in the Project Area on two occasions and is also known to occur in Sugarloaf SCA (DECC 2008). The species is generally found within 200 kilometres of the eastern coast of Australia, from Bundaberg in Queensland to Melbourne in Victoria. The species roosts in 'camps' of many individuals (up to tens of thousands) in vegetation. A known grey-headed flying-fox camp occurs in an urban park (Blackbutt) in Newcastle approximately 10 kilometres east of the Project Area. Camp sites have not been identified and are not expected to occur in the Project Area due to a lack of preferred habitat.

No direct clearing of native vegetation is required for the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would generally not be required in areas of intact vegetation and where required, will be undertaken in a manner that does not require significant clearing. No habitat for this species is expected to be removed during the Project. Therefore, the Project is considered unlikely to affect the life cycle of a potentially occurring population of the grey-headed flying fox, such that the species is likely to be placed at risk of extinction.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction;

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community;

i) the extent to which habitat is likely to be removed or modified as a result of the action proposed;

No direct clearing of native vegetation is required for the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would generally not be required in areas of intact vegetation and where required, will be undertaken in a manner that does not require significant clearing. No habitat for this species is expected to be removed during the Project.

ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

No direct clearing of native vegetation is required for the Project. Therefore, no area of habitat for this species is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality;

Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. As such, any habitat potentially modified as a result of subsidence is unlikely to be of importance to the survival of this species in the locality.

No direct clearing of native vegetation is required for the Project. Therefore, no area of habitat for this species is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

No critical habitat has been listed within or adjacent to the Project Area for this threatened species. The Project will not have an adverse effect on any critical habitat.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and

The 'Draft National Recovery Plan for the Grey-headed Flying-fox *Pteropus poliocephalus*' (DECCW 2009) is relevant to this species. The Project does not contravene any of the objectives or actions of this recovery plan.

No threat abatement plans are pertinent to this threatened species.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Alteration of habitat following subsidence due to longwall mining is a key threatening processes relevant to the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted.

No other key threatening processes are relevant to the Project.

Conclusion

Based on the information provided above, and considering the application of the precautionary principle, the Project is unlikely to result in a significant impact on the grey-headed flying-fox (*Pteropus poliocephalus*).

Yellow-bellied sheathtail-bat (*Saccolaimus flaviventris*)

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction;

The yellow-bellied sheathtail-bat (*Saccolaimus flaviventris*) has not been recorded in the Project Area, however this species is known to occur in the Sugarloaf SCA (DECC 2008) and potential habitat was identified in the Project Area. The species is wide-ranging and found across northern and eastern Australia, roosting in tree hollows and buildings.

No direct clearing of native vegetation is required for the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would generally not be required in areas of intact vegetation and where required, will be undertaken in a manner that does not require significant clearing. No habitat for this species is expected to be removed during the Project.Therefore, the Project is considered unlikely to affect the life cycle of a potentially occurring population of the yellow-bellied sheathtail-bat, such that the species is likely to be placed at risk of extinction.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction;

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community;

i) the extent to which habitat is likely to be removed or modified as a result of the action proposed;

No direct clearing of native vegetation is required for the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would generally not be required in areas of intact vegetation and where required, will be undertaken in a manner that does not require significant clearing. No habitat for this species is expected to be removed during the Project.

ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

No direct clearing of native vegetation is required for the Project. Therefore, no area of habitat for this species is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality;

Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. As such, any habitat potentially modified as a result of subsidence is unlikely to be of importance to the survival of this species in the locality.

No direct clearing of native vegetation is required for the Project. Therefore, no area of habitat for this species is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

No critical habitat has been listed within or adjacent to the Project Area for this threatened species. The Project will not have an adverse effect on any critical habitat.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and

A recovery plan has not been prepared for this species. There are no threat abatement plans of relevance to the Project.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Alteration of habitat following subsidence due to longwall mining is a key threatening processes relevant to the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted.

No other key threatening processes are relevant to the Project.

Conclusion

Based on the information provided above, and considering the application of the precautionary principle, the Project is unlikely to result in a significant impact on the yellow-bellied sheathtail-bat (*Saccolaimus flaviventris*).

East coast freetail-bat (*Mormopterus norfolkensis*)

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction;

The east coast freetail-bat (*Mormopterus norfolkensis*) has been recorded within the Project Area using call echolocation recording. This species is also known to occur within the Sugarloaf SCA (DECC 2008). The species is found along the east coast from south Queensland to southern NSW and roosts mainly in tree hollows and bark.

No direct clearing of native vegetation is required for the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would generally not be required in areas of intact vegetation and where required, will be undertaken in a manner that does not require significant clearing. No habitat for this species is expected to be removed during the Project.Therefore, the Project is considered unlikely to affect the life cycle of a potentially occurring population of the east coast freetail-bat, such that the species is likely to be placed at risk of extinction.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction;

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community;

i) the extent to which habitat is likely to be removed or modified as a result of the action proposed;

No direct clearing of native vegetation is required for the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would generally not be required in areas of intact vegetation and where required, will be undertaken in a manner that does not require significant clearing. No habitat for this species is expected to be removed during the Project.

ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

No direct clearing of native vegetation is required for the Project. Therefore, no area of habitat for this species is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality;

Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. As such, any habitat potentially modified as a result of subsidence is unlikely to be of importance to the survival of this species in the locality.

No direct clearing of native vegetation is required for the Project. Therefore, no area of habitat for this species is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

No critical habitat has been listed within or adjacent to the Project Area for this threatened species. The Project will not have an adverse effect on any critical habitat.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and

A recovery plan has not been prepared for this species. There are no threat abatement plans of relevance to the Project.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Alteration of habitat following subsidence due to longwall mining is a key threatening processes relevant to the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted.

No other key threatening processes are relevant to the Project.

Conclusion

Based on the information provided above, and considering the application of the precautionary principle, the Project is unlikely to result in a significant impact on the east coast freetail-bat (*Mormopterus norfolkensis*).

Little bentwing-bat (*Miniopterus australis*)

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction;

The little bentwing-bat (*Miniopterus australis*) has been recorded in Project Area using call echolocation recording. This species is also known to occur within the Sugarloaf SCA (DECC 2008). The species is found along the east coast and ranges of Australia from Cape York in Queensland to Wollongong in NSW and roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and occasionally buildings.

No direct clearing of native vegetation is required for the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would generally not be required in areas of intact vegetation and where required, will be undertaken in a manner that does not require significant clearing. No habitat for this species is expected to be removed during the Project.Therefore, the Project is considered unlikely to affect the life cycle of a potentially occurring population of the little bentwing-bat, such that the species is likely to be placed at risk of extinction.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction;

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community;

i) the extent to which habitat is likely to be removed or modified as a result of the action proposed;

No direct clearing of native vegetation is required for the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would generally not be required in areas of intact vegetation and where required, will be undertaken in a manner that does not require significant clearing. No habitat for this species is expected to be removed during the Project.

ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

No direct clearing of native vegetation is required for the Project. Therefore, no area of habitat for this species is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality;

Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. As such, any habitat potentially modified as a result of subsidence is unlikely to be of importance to the survival of this species in the locality.

No direct clearing of native vegetation is required for the Project. Therefore, no area of habitat for this species is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

No critical habitat has been listed within or adjacent to the Project Area for this threatened species. The Project will not have an adverse effect on any critical habitat.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and

A recovery plan has not been prepared for this species. There are no threat abatement plans of relevance to the Project.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Alteration of habitat following subsidence due to longwall mining is a key threatening processes relevant to the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted.

No other key threatening processes are relevant to the Project.

Conclusion

Based on the information provided above, and considering the application of the precautionary principle, the Project is unlikely to result in a significant impact on the little bentwing-bat (*Miniopterus australis*).

Eastern bentwing-bat (*Miniopterus schreibersii oceanensis*)

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction;

The eastern bentwing-bat (*Miniopterus schreibersii oceanensis*) has been recorded in the Project Area using call echolocation recording. This species is also known to occur within the Sugarloaf SCA (DECC 2008). The species is found along the east and north-west coasts of Australia and roost in caves, tunnels, buildings and other man-made structures.

No direct clearing of native vegetation is required for the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would generally not be required in areas of intact vegetation and where required, will be undertaken in a manner that does not require significant clearing. No habitat for this species is expected to be removed during the Project.Therefore, the Project is considered unlikely to affect the life cycle of a potentially occurring population of the eastern bentwing-bat, such that the species is likely to be placed at risk of extinction.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction;

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community;

i) the extent to which habitat is likely to be removed or modified as a result of the action proposed;

No direct clearing of native vegetation is required for the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would generally not be required in areas of intact vegetation and where required, will be undertaken in a manner that does not require significant clearing. No habitat for this species is expected to be removed during the Project.

ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

No direct clearing of native vegetation is required for the Project. Therefore, no area of habitat for this species is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality;

Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. As such, any habitat potentially modified as a result of subsidence is unlikely to be of importance to the survival of this species in the locality.

No direct clearing of native vegetation is required for the Project. Therefore, no area of habitat for this species is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

No critical habitat has been listed within or adjacent to the Project Area for this threatened species. The Project will not have an adverse effect on any critical habitat.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and

A recovery plan has not been prepared for this species. There are no threat abatement plans of relevance to the Project.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Alteration of habitat following subsidence due to longwall mining is a key threatening processes relevant to the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted.

No other key threatening processes are relevant to the Project.

Conclusion

Based on the information provided above, and considering the application of the precautionary principle, the Project is unlikely to result in a significant impact on the eastern bentwing-bat (*Miniopterus schreibersii oceanensis*).

Large-eared pied bat (*Chalinolobus dwyeri*)

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction;

The large-eared pied bat (*Chalinolobus dwyeri*) has been recorded in the Project Area using call echolocation recording. This species is also known to occur within Sugarloaf SCA (DECC 2008). The species is mainly found in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. It is generally rare with a very patchy distribution in NSW. The species mainly roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (*Petrochelidon ariel)*.

No direct clearing of native vegetation is required for the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would generally not be required in areas of intact vegetation and where required, will be undertaken in a manner that does not require significant clearing. No habitat for this species is expected to be removed during the Project.Therefore, the Project is considered unlikely to affect the life cycle of a potentially occurring population of the large-eared pied bat, such that the species is likely to be placed at risk of extinction.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction;

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community;

i) the extent to which habitat is likely to be removed or modified as a result of the action proposed;

No direct clearing of native vegetation is required for the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would generally not be required in areas of intact vegetation and where required, will be undertaken in a manner that does not require significant clearing. No habitat for this species is expected to be removed during the Project.

ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

No direct clearing of native vegetation is required for the Project. Therefore, no area of habitat for this species is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality;

Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. As such, any habitat potentially modified as a result of subsidence is unlikely to be of importance to the survival of this species in the locality.

No direct clearing of native vegetation is required for the Project. Therefore, no area of habitat for this species is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

No critical habitat has been listed within or adjacent to the Project Area for this threatened species. The Project will not have an adverse effect on any critical habitat.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and

A recovery plan has not been prepared for this species. There are no threat abatement plans of relevance to the Project.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Alteration of habitat following subsidence due to longwall mining is a key threatening processes relevant to the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted.

No other key threatening processes are relevant to the Project.

Conclusion

Based on the information provided above, and considering the application of the precautionary principle, the Project is unlikely to result in a significant impact on large-eared pied bat (*Chalinolobus dwyeri*).

Eastern false pipistrelle (*Falsistrellus tasmaniensis*)

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction;

The eastern false pipistrelle (*Falsistrellus tasmaniensis*) has not been recorded in the Project Area, however, this species is known to occur within the Sugarloaf SCA (DECC 2008) and potential habitat was identified in the Project Area. The species is mainly found in the wet eucalypt forests where it roosts predominately in tree hollows. In NSW, it occurs along the coast and ranges from the Victorian border through to Queensland.

No direct clearing of native vegetation is required for the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would generally not be required in areas of intact vegetation and where required, will be undertaken in a manner that does not require significant clearing. No habitat for this species is expected to be removed during the Project. Therefore, the Project is considered unlikely to affect the life cycle of a potentially occurring population of the eastern false pipistrelle, such that the species is likely to be placed at risk of extinction.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction;

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community;

i) the extent to which habitat is likely to be removed or modified as a result of the action proposed;

No direct clearing of native vegetation is required for the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would generally not be required in areas of intact vegetation and where required, will be undertaken in a manner that does not require significant clearing. No habitat for this species is expected to be removed during the Project.

ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

No direct clearing of native vegetation is required for the Project. Therefore, no area of habitat for this species is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality;

Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. As such, any habitat potentially modified as a result of subsidence is unlikely to be of importance to the survival of this species in the locality.

No direct clearing of native vegetation is required for the Project. Therefore, no area of habitat for this species is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

No critical habitat has been listed within or adjacent to the Project Area for this threatened species. The Project will not have an adverse effect on any critical habitat.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and

A recovery plan has not been prepared for this species. There are no threat abatement plans of relevance to the Project.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Alteration of habitat following subsidence due to longwall mining is a key threatening processes relevant to the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted.

No other key threatening processes are relevant to the Project.

Conclusion

Based on the information provided above, and considering the application of the precautionary principle, the Project is unlikely to result in a significant impact on eastern false pipistrelle (*Falsistrellus tasmaniensis*).

Greater broad-nosed bat (*Scoteanax rueppellii*)

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction;

The greater broad-nosed bat (*Scoteanax rueppellii*) has been recorded in the Project Area using call echolocation recording. This species is also known to occur within the Sugarloaf SCA (DECC 2008). The species is mainly found in the gullies and river systems that drain the Great Dividing Range, from north-eastern Victoria to the Atherton Tableland and extends to the coast over much of its range. The species mainly roosts in tree hollows, but also in buildings.

No direct clearing of native vegetation is required for the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would generally not be required in areas of intact vegetation and where required, will be undertaken in a manner that does not require significant clearing. No habitat for this species is expected to be removed during the Project. Therefore, the Project is considered unlikely to affect the life cycle of a potentially occurring population of the greater broad-nosed bat, such that the species is likely to be placed at risk of extinction.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction;

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed;

Not applicable.

d) in relation to the habitat of a threatened species, population or ecological community;

i) the extent to which habitat is likely to be removed or modified as a result of the action proposed;

No direct clearing of native vegetation is required for the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would generally not be required in areas of intact vegetation and where required, will be undertaken in a manner that does not require significant clearing. No habitat for this species is expected to be removed during the Project.

ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

No direct clearing of native vegetation is required for the Project. Therefore, no area of habitat for this species is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality;

Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. As such, any habitat potentially modified as a result of subsidence is unlikely to be of importance to the survival of this species in the locality.

No direct clearing of native vegetation is required for the Project. Therefore, no area of habitat for this species is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

No critical habitat has been listed within or adjacent to the Project Area for this threatened species. The Project will not have an adverse effect on any critical habitat.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and

A recovery plan has not been prepared for this species. There are no threat abatement plans of relevance to the Project.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Alteration of habitat following subsidence due to longwall mining is a key threatening processes relevant to the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted.

No other key threatening processes are relevant to the Project.

Conclusion

Based on the information provided above, and considering the application of the precautionary principle, the Project is unlikely to result in a significant impact on greater broad-nosed bat (*Scoteanax rueppellii*).

Conclusion

No direct clearing of native vegetation is required for the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would generally not be required in areas of intact vegetation and where required, will be undertaken in a manner that does not require significant clearing. The assessments of significance do not take into account the full range of impact mitigation strategies and any required biodiversity offsets proposed as part of the Project, rather they consider the impacts of the Project without any mitigation or offsetting, consistent with the requirements of both state and Commonwealth significant impact assessment guidelines (DECC 2007a; DEHWA 2009a). Based on the threatened species assessment detailed above, the Project is considered unlikely to result in a significant impact on any species listed under the NSW TSC Act.

APPENDIX D

Assessment of Significance under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

Appendix D – Assessment of Significance under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) requires an Assessment of Significance relating to the potential impacts of a Project on listed matters of national environmental significance (MNES).

Under the EPBC Act, the approval of the Commonwealth Minister responsible for the Department of the Environment is required for any action that may have a significant impact on MNES. These matters are:

- listed threatened species and ecological communities;
- migratory species protected under international agreements;
- Ramsar wetlands of international importance;
- the Commonwealth marine environment;
- World Heritage properties;
- National Heritage places;
- Great Barrier Reef Marine Park;
- nuclear actions; and
- a water resource, in relation to coal seam gas development and large coal mining development.

A search of the DSEWPC Protected Matters Search Tool (June 2013) and collated information from literature reviews identified three threatened ecological communities (TECs), 24 threatened species and 14 migratory species known to occur, or considered to have the potential to occur on the basis of habitat modeling, within the Project Area. Each of these has been included in tables in **Appendix A**, together with an indication of those species that warrant further assessment by way of an Assessment of Significance.

As outlined in **Appendix A**, the following EPBC Act listed species are considered to have the potential to occur or be impacted by the Project and are subject to an Assessment of Significance below:

Vulnerable Species

- black-eyed Susan (*Tetratheca juncea*),
- small-flower grevillea *(Grevillea parviflora* subsp. *parviflora*)
- grey-headed flying-fox (*Pteropus poliocephalus*); and
- large-eared pied bat (*Chalinolobus dwyeri*).

Assessment of Significance

In this case, an *important population* is a population that is necessary for a species' long-term survival and recovery. This may include populations that are:

- key source populations either for breeding or dispersal; or
- populations that are necessary for maintaining genetic diversity, and/or
- populations that are near the limit of the species range.

The identification of habitat or potential habitat for these vulnerable species within the Project Area does not constitute the presence of an '*important population*' as defined by the criteria listed above, as the records of the species in the Project Area do not represent a key source population either for breeding or dispersal; the Project Area is not important for the maintenance of genetic diversity of the species; and the species are not at the limits of their ranges in the Project Area.

Black-eyed Susan (*Tetratheca juncea*)

Black-eyed Susan (*Tetratheca juncea*) was recorded at 14 locations within the Project Area and a further two locations in the vicinity of the Project Area during field surveys. A further two records of this species in the Project Area were identified from a review of the OEH atlas of NSW Wildlife (OEH 2013). The species is known to occur in dry sclerophyll forest and woodlands throughout the Sugarloaf State Conservation Area (SSCA) and Lake Macquarie LGA. The black-eyed Susan (*Tetratheca juncea*) within the Project Area is not considered to represent a key source population for breeding or dispersal or necessary for maintaining genetic diversity and is not conserved to be at or near the limit of its range. As such, the black-eyed Susan (*Tetratheca juncea*) within the Project Area is not considered to represent an *important population*.

Small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*)

Small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*) was recorded at five locations within the Project Area and a further three locations in the vicinity of the Project Area. The species is known to occur in dry sclerophyll forest and woodlands throughout the SSCA and Lake Macquarie LGA. The small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*) within the Project Area is not considered to represent a key source population for breeding or dispersal or necessary for maintaining genetic diversity and is not considered to be at or near the limit of its range. As such, the small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*) within the Project Area is not considered to represent an *important population*.

Grey-headed Flying-fox *(Pteropus poliocephalus)*

The grey-headed flying-fox was recorded during nocturnal surveys within the Project Area. All woodland vegetation within the Project Area is considered to provide potential foraging habitat for this species. Camp sites (breeding habitat) have not been identified and are not expected to occur due to a lack of preferred habitat. The Project Area is considered to comprise an area of foraging habitat for this species and is unlikely to contain significant breeding and roosting habitat.

The nearest substantial roost camp sites of the grey-headed flying-fox to the Project Area Blackbutt Reserve, Newcastle (approximately 10 kilometres from the Project Area). The population estimate for the grey-headed flying-fox population at Blackbutt Reserve population is 40,000 individuals (OEH 2013). As the Project Area is located within 50 kilometres of a population of the grey-headed flying-fox that supports more than 30,000

individuals it is considered the Project Area contains foraging habitat critical to the survival of this species (DECCW 2009).

Although the Project Area contains important foraging habitat, the records of the grey-headed flying-fox within the Project Area is not considered to represent a key source population for breeding or dispersal or necessary for maintaining genetic diversity and is not considered to be at or near the limit of its range. As such, the grey-headed flying-fox records within the Project Area are not considered to represent an *important population*.

Large-eared Pied Bat (*Chalinolobus dwyeri)*

The large-eared pied bat has been recorded through analysis of echolocation calls at two locations within the Project Area. This species is also known to occur in SSCA (DECC 2008). All woodland vegetation within the proposed disturbance area is expected to provide potential foraging habitat for this species, however no roosting habitat for this cave roosting species has been identified. The proposed disturbance area is considered to comprise an area of foraging habitat for this species however is unlikely to contain significant breeding and roosting habitat.

The records of the large-eared pied bat within the Project Area is not considered to represent a key source population for breeding or dispersal or necessary for maintaining genetic diversity and is not considered to be at or near the limit of its range. As such, the large-eared pied bat records within the Project Area are not considered to represent an *important population*.

An assessment of significance has been prepared for these species below.

An action has, will have, or is likely to have a significant impact on threatened species if it does, will, or is likely to:

- **lead to a long-term decrease in the size of an important population of a species;**

Given that there is not considered to be an *important population* of the black-eyed Susan, small-flower grevillea, grey-headed flying-fox or large-eared pied bat present within the Project Area, the Project will not lead to a long-term decrease in the size of an *important population* of these species.

- **reduce the area of occupancy of an important population, or;**

The Project Area does not contain an *important population* of black-eyed Susan, small-flower grevillea, grey-headed flying-fox or large-eared pied bat and therefore will not reduce the area of occupancy of an *important population* of these species.

- **fragment an existing important population into two or more populations, or;**

The Project Area does not contain an *important population* of black-eyed Susan, small-flower grevillea, grey-headed flying-fox or large-eared pied bat and therefore the Project will not result in the fragmentation of an *important population* of these species

- **adversely affect habitat critical to the survival of a species, or;**

Black-eyed Susan, small-flower grevillea, grey-headed flying-fox and large-eared pied bat are commonly recorded across much of the Lake Macquarie LGA and are all known to occur within the SSCA (DECC 2008). The Project Area in not known to provide critical habitat for black-eyed Susan, small-flower grevillea or large-eared pied bat.

As discussed above, due to its proximity to the large grey-headed flying-fox camp at Blackbutt Reserve, the Project Area is considered to provide foraging habitat critical to the survival of this species. No direct clearing of native vegetation is required for the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would generally not be required in areas of intact vegetation and where required, will be undertaken in a manner that does not require significant clearing. As such, the Project is not considered likely to impact the critical foraging habitat of the grey-headed flying-fox within the Project Area.

Given the above, the Project is not expected to adversely affect habitat critical to the survival of these species.

- **disrupt the breeding cycle of an important population, or;**

No important populations of black-eyed Susan, small-flower grevillea, grey-headed flying-fox or large-eared pied bat have been identified in the Project Area. Consequently, the Project is not expected to disrupt the breeding cycle of an important population of these species.

- **modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, or;**

No direct clearing of native vegetation is required for the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines) however, subsidence remediation works would generally not be required in areas of intact vegetation and where required, will be undertaken in a manner that does not require significant clearing. Therefore, the Project will not modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that these species are likely to decline.

- **result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;**

There are not any invasive species that are likely to become established as a result of the Project that may impact habitat relevant to black-eyed Susan, small-flower grevillea, grey-headed flying-fox or large-eared pied bat.

- **introduce disease that may cause the species to decline; or**

There are no diseases associated with the decline of black-eyed Susan, small-flower grevillea, grey-headed flying-fox or large-eared pied.

The Project is not expected to introduce or exacerbate any diseases that may cause these species to decline.

- **interfere substantially with the recovery of the species.**

No direct clearing of native vegetation is required for the Project. Subsidence will result in some surface cracking and steeper slope areas are predicted to be more susceptible to cracking impacts. Some tree fall may also occur, particularly in steep slope areas. However this subsidence is not expected to impact the floristic composition or vegetation structure specific to this species such that an adverse impact is predicted. Some minor vegetation disturbance will occur as a result of subsidence management works (e.g. subsidence remediation works and survey lines), however, subsidence remediation works would generally not be required in areas of intact vegetation and where required, will be undertaken in a manner that does not require significant clearing.

Conclusion

The Project is unlikely to result in a significant impact upon an *important population* of black-eyed Susan, small-flower grevillea, grey-headed flying-fox or large-eared pied as the Project Area is not considered to support an important population of these species.

Migratory Species

The following 13 migratory species were identified on the Protected Matters Search Tool as known, may or are likely to occur within the Project Area:

- eastern great egret (*Ardea modesta*);
- cattle egret (*Ardea ibis*);
- Lathams snipe (*Gallinago hardwickii*);
- Australian painted snipe (*Rostratula benghalensis australis*);
- Satin flycatcher (*Myiagra cyanoleuca*);
- white-bellied sea eagle (*Haliaeetus leucogaster*);
- white-throated needletail (*Hirundapus caudacutus*);
- fork-tailed swift (*Apus pacificus*);
- rainbow bee-eater (*Merops ornatus*);
- black-faced monarch (*Monarcha melanopsis*);
- rufous fantail (*Rhipidura rufifrons*);
- regent honeyeater (*Anthochaera phrygia*); and
- malleefowl (*Leipoa ocellata*).

None of these species were recorded within the Project area and based on the habitat requirements of each, none of these species were considered likely to occur within the Project Area therefore the Project Area is not likely to support an *important population* of these species, as described by the significant impact criteria (DEWHA 2009). The Project will not result in an adverse impact on an *important population* of a migratory species and no further assessment is required.

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APPENDIX 6

Archaeological Assessment

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ABORIGINAL ARCHAEOLOGICAL AND CULTURAL HERITAGE ASSESSMENT

Proposed Longwalls 51 & 52

West Wallsend Colliery

December 2013

Oceanic Coal Australia Pty Limited

ABORIGINAL ARCHAEOLOGICAL AND CULTURAL HERITAGE ASSESSMENT

Proposed Longwalls 51 & 52

West Wallsend Colliery

December 2013

Prepared by
Umwelt (Australia) Pty Limited

on behalf of
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Report No. **3149/R02/FINAL**
Date: **December 2013**

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1.0 Introduction

West Wallsend Colliery (WWC) is seeking to modify its 2012 Project Approval (09_0203) (Project Approval) to allow for the longwall mining of two additional longwall panels, longwalls 51 and 52, within the Southern Domain (hereafter the Project Area, also refer to **Section 2.2**). This modification will consist of the development and mining of the two longwall panels with no changes proposed to the infrastructure which supports the mining operations. All infrastructure for the site will be consistent with the infrastructure as detailed within the WWC Environmental Assessment (Umwelt 2010a). Project Approval was granted for continued mining at West Wallsend Colliery on 25 January 2012, with the Project classified as a Major Project under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The proposed modification to the Project Approval is being sought under Section 75W of the EP&A Act.

WWC is an underground coal mine located in Western Lake Macquarie (refer to **Figure 1.1**), within the Newcastle Coalfield of New South Wales (NSW). WWC is located approximately 1 kilometre east of Killingworth and approximately 1.25 kilometres south-west of Barnsley (refer to **Figure 1.2**). Underground mining has previously extended to the north and south of the pit top, using both bord and pillar and longwall mining methods. Longwall mining is currently progressing to the south of the M1 Motorway, as shown in **Figure 1.2**. In accordance with existing approvals and with the implementation of management measures incorporated in the WWC Subsidence Management Plan and Extraction Plan, mining has, and continues to be, undertaken beneath the Sugarloaf State Conservation Area (SSCA).

WWC is operated by Oceanic Coal Australia Pty Limited (OCAL) on behalf of the Macquarie Coal Joint Venture (MCJV). OCAL is the major joint venture participant of MCJV with 70 per cent ownership. Other participants include Marubeni Coal Pty Ltd (17%), OCAL Macquarie Pty Ltd (10%) and JFE Minerals (Aust) Pty Ltd (3%). OCAL, which also owns OCAL Macquarie Pty Ltd, is wholly owned by Glencore Coal Pty Limited (Glencore Coal).

1.1 Statutory Policy and Framework

1.1.1 The EP&A Act

The EP&A Act regulates development activity in New South Wales. Part 3A (now repealed) of the EP&A Act previously applied to projects that were declared to be a 'Major Project'. The WWC Continued Operations Project (WWCCOP) was assessed as a Major Project and approved under Part 3A of the EP&A Act. Under Section 75U of the EP&A Act it was not necessary for WWC to obtain an Aboriginal Heritage Impact Permit (AHIP) under Section 90 of the *National Parks and Wildlife Act 1974* (NPW Act) in relation to approved activities that would/may result in harm to an Aboriginal object. Rather, the project approved under Part 3A of the EP&A Act was subject to conditions of approval and Aboriginal cultural heritage was addressed by appropriate conditions and is managed under an Aboriginal Cultural Heritage Management Plan (ACHMP). The ACHMP (Umwelt 2012a) for the WWCCOP was approved by the Office of Environment and Heritage (OEH) and the Department of Planning and Infrastructure (DP&I) on 20 July 2012.

The proposed Project, as a modification to an existing Project Approval will be assessed under Section 75W of the EP&A Act. As with the existing Project Approval in place for the existing mining operations, the proposed modification, if approved, will be exempt from the requirement to obtain an AHIP for approved activities that may cause harm to an Aboriginal object.

FIGURE 1.1

Locality Plan

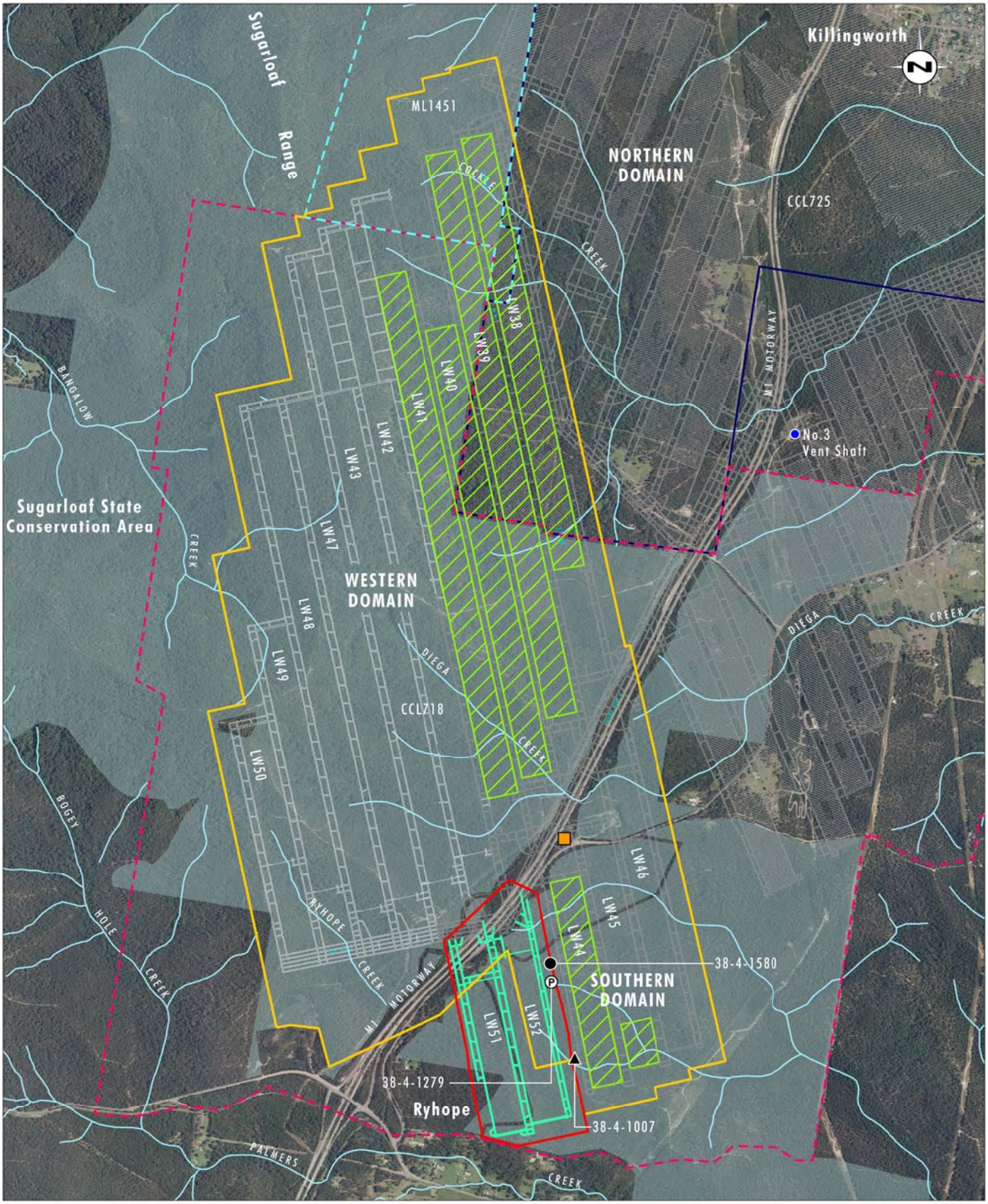

Image Source: OCAL (2008)
Data Source: OCAL (2013), LPI (2003)

0 0.5 1.0 1.5km
1:30 000

Legend

- Project Area
- Approved Continued Underground Mining Area
- Approved Underground Workings in the West Borehole Seam
- Proposed Longwall Panels 51 and 52
- Longwall Progression as of October 2013
- Former Underground Workings
- Sugarloaf State Conservation Area
- CCL725
- CCL718
- ML1451
- Proposed Mining Services Facility
- Grinding groove with PAD
- Isolated Find
- Axe Grinding Groove

FIGURE 1.2

Project Area and WWCCOP

File Name (A4): R02/3149_012.dgn
20131220 11.22

1.1.2 NPW Act (1974)

The OEH is the governing body that is primarily responsible for regulating the management of Aboriginal cultural heritage in New South Wales under the *National Parks and Wildlife Act 1974* (NPW Act, as amended October 2010). The NPW Act is accompanied by the *National Parks and Wildlife Amendment (Aboriginal Objects and Aboriginal Places) Regulation 2010* (the Regulation), the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (Due Diligence Code – DECCW 2010a), *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (Code of Practice – DECCW 2010b), *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (ACHC Requirements – DECCW 2010c), *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW* (ACH Guide – OEH 2011) and other industry-specific codes.

The objectives of the NPW Act include:

> The conservation of objects, places or features (including biological diversity) of cultural value within the landscape, including, but not limited to: (i) places, objects and features of significance to Aboriginal people.

The NPW Act defines an Aboriginal object as:

> …any deposit, object or material evidence (not being a handicraft made for sale) relating to the Aboriginal habitation of the area that comprises New South Wales.

Under Section 84 of the NPW Act, an Aboriginal Place must be declared by the Minister as a place that, in the opinion of the Minister, is or was of special significance with respect to Aboriginal culture.

In accordance with Section 86(1) of the NPW Act, it is an offence to harm or desecrate a known Aboriginal object, whilst it is also an offence to harm an Aboriginal object under Section 86(2). Similarly, Section 86(4) states that a person must not harm or desecrate an Aboriginal place. Harm to an object or place is defined as any act or omission that:

a) destroys, defaces or damages an object or place, or
b) in relation to an object – moves the object from the land on which it had been situated, or
c) is specified by the regulations, or
d) causes or permits the object or place to be harmed in a manner referred to in paragraph (a), (b) or (c),

but does not include any act or omission that:

e) desecrates the object or place, or
f) is trivial or negligible, or
g) is excluded from this definition by the regulations.

Section 87(1) of the NPW Act specifies that it is a defence to prosecution under Section 86(1) and Section 86(2) if the harm or desecration of an Aboriginal object was authorised by an AHIP, issued by OEH under s.90 of the NPW Act and the activities were carried out in accordance with that permit.

As discussed in **Section 1.1.1**, Major Projects approved under Part 3A or Part 4 of the EP&A Act do not require the proponent to obtain an AHIP to impact on Aboriginal cultural heritage sites/objects. However, DP&I will distribute the assessment report to the OEH for its review and input on the conditions for any Project Approval (or requirements for further information if it is perceived by the OEH that adequate information is not within the assessment report; or if it is not demonstrated within the assessment report that appropriate Aboriginal consultation

has taken place). For the OEH to be able to complete this process it is necessary that the assessment report addresses not only the type of management/mitigation measures to be undertaken for each site to be impacted/protected within a Project Area, but also that an appropriate research design and methodology is provided for any salvage works proposed (if required) and that this has been assessed by the registered Aboriginal parties. Thus the Aboriginal consultation process for a Major Project must address not only the survey, assessment and management process, but also the questions to be posed for the research design and the methodology for any salvage proposed (if required) and for the management/conservation of sites outside proposed impact areas (where relevant). In preparing this report the requirements of the Code (DECCW 2010b) and the ACH Guide (OEH 2011) have been addressed.

1.2 Objectives and Structure of the Report

This report documents the environmental, cultural and archaeological contexts for the SSCA, including the Project Area, as well as the Aboriginal cultural heritage and archaeological assessment results and recommendations. This report consists of the following sections:

Section 2.0 provides a summary of the key components and objectives of the proposed modification.

Section 3.0 identifies the Aboriginal parties with a registered interest in the WWCCOP and proposed modification, and outlines the Aboriginal party consultation and involvement in all stages of the assessment for the modification.

Section 4.0 provides Aboriginal cultural information provided about the WWC area and wider Sugarloaf Range and summarises how this may be reflected in the Project Area.

Section 5.0 provides the context for the Aboriginal archaeological assessment, reviewing literature related to the key environmental, ethnohistoric and land use history and discusses the implications of this research for the Project Area.

Section 6.0 provides the archaeological context for the Project Area, reviewing the available OEH Aboriginal Heritage Information Management System (AHIMS) data and relevant previous archaeological research.

Section 7.0 presents the archaeological predictive model developed for the Project Area, specifying likely site type occurrence, site type content, site type distribution and site type integrity.

Section 8.0 details the survey strategy for the proposed modification, spanning aims, objectives, methods and outlines the results of the archaeological survey, including survey coverage and effective visibility. An evaluation of the predictive model following archaeological survey is also presented to further refine the understanding of the Project Area.

Section 9.0 provides a summary of the Aboriginal cultural significance of the Project Area and discusses the archaeological significance of the Project Area.

Section 10.0 reviews the works proposed for the modification and discusses likely impacts to identified Aboriginal archaeological sites and landforms of Aboriginal cultural significance and/or archaeological significance and/or research potential.

Section 11.0 discusses the various management options available for Aboriginal archaeological sites of Aboriginal cultural heritage significance and/or archaeological significance and/or research potential within the Project Area. It also considers management options in terms of intergenerational equity.

Section 12.0 provides the management strategy for the Project Area.

Section 13.0 lists reports and publications cited in the text.

2.0 Description of Modification Proposal

2.1 Project Description

OCAL is seeking to modify the approved WWC mine plan to enable mining of Longwalls 51 and 52. There are no further changes to the WWC Project sought as part of this Section 75W modification. Key features of the WWC Project as detailed within the WWC EA (Umwelt, 2010a) and an overview of whether they are to be amended as part of this project are detailed in **Table 2.1** below.

Table 2.1 – Key Features of the Project

Major Project Components/Aspects	Proposed Operations	Changes As a Result of This Modification
Limits on Extraction	Up to 5.5 Mtpa Run of Mine (ROM)	No
Estimated Mine Life	Approximately 12 to 15 years of mining	No
Operating Hours	24 hours per day, 7 days per week	No
Number of Employees	Approximately 390 full time equivalents	No
Mining Methods	Underground Mining – longwall method	No
Mining Lease Areas	All existing and proposed mining within CCL 718, 725 and ML 1451	No
Mining Area	Longwall mining in the northern, southern and western domains at WWC	Extraction of two new longwalls in the southern domain, nos. 51 and 52.
Infrastructure	Existing West Wallsend Pit Top infrastructure Existing No. 2, No. 3 Vent Shafts and existing ballast borehole Existing Longwall 11 borehole facility Proposed future ventilation infrastructure and minor surface infrastructure Proposed Mining Services Facility	No

As detailed in **Table 2.1**, it is proposed that there will be no changes to the production limits at WWC, with the peak potential production rate for the Project to remain at 5.5 million tonnes per annum (Mtpa). There will also be no changes to the estimated mine life as a result of the project. Since the granting of the current WWC approval in 2012, there have been some areas identified by WWC that will no longer be mined. The project will not result in any modifications to the existing WWC pit top facilities. As a result of the detailed environmental studies for this Project, the mine plan has been designed to minimise impacts to identified areas of alluvium, the M1 Motorway, as well as avoiding impacts to two significant Aboriginal archaeological grinding groove sites and areas with low depth of cover. The details of these project changes are discussed further in **Section 6.2.5**.

2.2 Project Area

The Project Area is located in what has previously been referred to as the Southern Domain. The Southern Domain is located between the villages of Ryhope and Wakefield (refer to **Figure 1.1**). The east side of the Project Area overlaps with part of the Southern Domain of the approved WWC underground mining area (**Figure 1.2**). The majority of the landscape within the approved WWC underground mining area located to the east and south of the M1 Motorway is undeveloped bushland in undulating terrain with several ridges and gullies. This bushland, formerly Awaba and Heaton State Forests, is now part of the SSCA. The Project Area includes the Longwall 51 and Longwall 52 panels as the subsidence affectation zone for the project, which is the predicted vertical limit of measurable subsidence and is defined by the 20 millimetre subsidence contour (refer to **Figure 1.2**).

2.3 Known Aboriginal Archaeological Sites

The Project Area contains three known Aboriginal archaeological sites (two sets of grinding grooves and an isolated find) within an area of overlap between the Project Area and the existing WWC mine area (refer to **Figure 1.2**). The two grinding groove sites were assessed as part of the Environmental Assessment for the WWCCOP and in view of their extremely high Aboriginal cultural heritage and archaeological significance the originally proposed mine plan was modified to avoid subsidence impact on these sites (refer to **Section 11.1.1** and Umwelt 2010b). Previously the mine plan for the Southern Domain had been revised to avoid impact to the Palmers Creek Grinding Grooves 1 (#38-4-1279) site (Umwelt 2005). The isolated artefact, IF4 (#38-4-1580), was not identified until after the Environmental Assessment for the WWCCOP and was subsequently collected under the protocols of the ACHMP (Umwelt 2012a).

The three sites are within the Project Area but are outside the longwall extraction area and thus outside the area predicted to be impacted by subsidence.

3.0 Aboriginal Party Consultation and Participation

Consultation with the Aboriginal community is an integral part of identifying and assessing the significance of Aboriginal objects (sites) and/or places and determining and carrying out appropriate strategies to mitigate impact upon Aboriginal heritage. Registered Aboriginal party consultation for the currently approved WWC mine plan has been ongoing since 2008. Since then, WWC has worked closely with the registered Aboriginal parties to understand and manage the Aboriginal cultural values of the sites in the approved underground mining area. WWC recognises the cultural attachments that the Awabakal people and other registered Aboriginal parties have to the Aboriginal heritage sites, landscape features and the overall landscape of the WWC area and the Sugarloaf Range in general. WWC works with the registered Aboriginal parties to ensure appropriate management of cultural values is implemented through compliance with an ACHMP (Umwelt 2102a).

Consultation for the proposed modification was undertaken as a continuation of the ongoing consultation for the WWC, with the consultation also in compliance with the ACHMP (Umwelt 2012a).

3.1 Aboriginal Party Identification

Initial consultation for the WWCCOP Environmental Assessment was undertaken in compliance with the DECC's[1] *Interim Community Consultation Requirements for Applicants* (ICCRs 2004). The notification process required under the ICCRs resulted in the registration of five Aboriginal parties: Awabakal Descendents Traditional Owners Aboriginal Corporation (ADTOAC), Awabakal Local Aboriginal Land Council (ALALC), Awabakal Traditional Owners Aboriginal Corporation (ATOAC), Cacatua Culture Consultants (CCC) and Koompahtoo Local Aboriginal Land Council (KLALC – please note that KLALC closed in 2010).

Extensive consultation with the registered Aboriginal parties for the WWCCOP has been ongoing since 2008. The Aboriginal archaeological assessment report included as part of the Environmental Assessment for the WWCCOP had detailed contributions from all of the registered Aboriginal parties involved (Umwelt 2010b), while the ACHMP was prepared in co-authorship with the registered Aboriginal parties (Umwelt 2012a). As the proposed modification is a modification to the existing Project Approval and there has been continuous consultation with the registered Aboriginal parties for WWC since 2008, continuation of consultation with registered Aboriginal parties has been undertaken for this proposed modification. Additional notification and registration was not required (refer to **Appendix A**).

3.1.1 Native Title Registrants

Since the Environmental Assessment (Umwelt 2010b), a Native Title claim has been registered on behalf of the 'Awabakal People' over an area of the Sugarloaf Range approximately 10 kilometres north of the Project Area. The claim was accepted for registration by the National Native Title Tribunal on 2 August 2012 (NC12/3-1). Members of ADTOAC (Shane Frost) and ATOAC (Kerrie Brauer) are applicants on the Native Title claim and have been involved in the ongoing consultation for the WWC and proposed modification.

A recent Native Title search (24 June 2013) identified that an additional Native Title claim was registered (13 June 2013) on behalf of the 'Awabakal and Guringai People' (NC2013/002). The Native Title claim included an area stretching from Broken Bay in the south to Newcastle and Maitland in the north and incorporates the proposed Project Area. On 5 July 2013 consultation was undertaken with Kerrie Brauer (ATOAC), who is a registrant

[1] Department of Environment and Climate Change (DECC) now OEH

on both above-mentioned Native Title claims. The aim of the discussion was to determine if the consultation process should be extended to incorporate other persons listed on claim NC2013/002. Kerrie Brauer confirmed that the prior consultation with herself and Shane Frost (ADTOAC – also an applicant on NC2013/002) was sufficient to ensure that the consultation process had included all relevant Native Title registrants (refer to **Appendix B**).

WWC has also continued to consult with ALALC and CCC who have previously registered interest in the WWC.

3.2 Aboriginal Party Consultation and Involvement

The proposed modification was first brought to the attention of the registered Aboriginal parties in November 2012, during a regular six monthly meeting held between WWC and the registered Aboriginal parties. The meetings are a requirement of the ACHMP (Umwelt 2012a).

An inspection of the proposed Project Area was undertaken on 20 February 2013 by Amanda Reynolds (Umwelt Archaeologist) and Peter Townsend (ALALC) and Adam Sampson (CCC) to identify any items that may have been an Aboriginal cultural heritage constraint in regards to the conceptual mine plan.

A brief on site meeting was held on 11 April 2013 prior to other fieldwork to ensure that all registered Aboriginal parties understood the nature of the project, the location of the Project Area and had an opportunity to ask questions of WWC and to raise any known constraints from an Aboriginal cultural perspective. A summary of the inspection undertaken as part of the constraints phase and the results were also presented at this meeting. Participants at the meeting were Amanda Hawken and Kerrie Brauer (ATOAC), Shane Frost (ADTOAC) and Peter Townsend (ALALC).

As an outcome of the meeting a second inspection of the proposed Project Area was undertaken on 17 April 2013 by Amanda Reynolds, Peter Townsend, Jodie Wilson (ATOAC) and Tegan McCormack (CCC).

This report includes cultural input provided by the registered Aboriginal Parties in lieu of a separate Aboriginal Cultural Heritage Assessment report. Registered Aboriginal party statements and cultural input have been included throughout the main text of the report.

Appendix A contains a copy of all registered Aboriginal party statements provided during the course of the Project, including comments on the draft survey strategy, cultural significance and management options and recommendations.

Table 3.1 presents a summary of the consultation and involvement of the registered Aboriginal parties for the project.

Table 3.1 – Consultation Summary

Date	Action	Registered Aboriginal Parties Involved
28/11/2012	Project initially discussed at the six monthly meeting between WWC and registered Aboriginal parties	ADTOAC ALALC ATOAC
20/02/2013	Initial constraints analysis inspection	ALALC CCC
06/03/2013	Brief summary of inspection results provided	ADTOAC ATOAC
11/04/2013	Meeting to present a detailed project description and discuss the results of the constraints analysis inspection	ADTOAC ALALC ATOAC CCC
17/04/2013	Second inspection of the Project Area	ADTOAC ALALC ATOAC CCC
31/05/2013	Project status discussed at third six monthly meeting	ADTOAC ALALC ATOAC
05/08/2013	Draft Aboriginal archaeological assessment provided to registered Aboriginal parties	ADTOAC ALALC ATOAC CCC
15/08/2013	Workshop to discuss an incorporate Aboriginal cultural values into the assessment report	ADTOAC ALALC ATOAC CCC
January 2014	Final Aboriginal Cultural heritage and archaeological assessment report provided to registered Aboriginal parties	ADTOAC ALALC ATOAC CCC

As shown in **Table 3.1**, the registered Aboriginal parties have been involved in the project from an early stage and have had been afforded the opportunity to provide input during the assessment process.

Further detail on registered Aboriginal party participation in the fieldwork program is provided in **Sections 8.2** and **8.3**.

3.2.1 Review of Draft Aboriginal Cultural Heritage and Archaeological Assessment Report

The draft Aboriginal cultural heritage and archaeological assessment report was provided to all registered Aboriginal parties on 5 August 2013. A workshop was held during this comment period on 15 August 2013 to discuss the draft report and to incorporate cultural information provided by the registered Aboriginal parties. This information is included throughout **Sections 4.0** to **12.0** and any additional letters of comment provided by the registered Aboriginal parties are included in **Appendix A**.

4.0 Aboriginal Cultural Context

From all of the Aboriginal cultural value statements provided in previous assessments (Umwelt 2003a, Umwelt 2010a), it has been demonstrated that the Sugarloaf Range area has high Aboriginal cultural value to the Awabakal and to the Aboriginal people who make Awabakal lands their home. This section of the report presents cultural information provided by the registered Aboriginal parties to form the cultural context for the assessment.

4.1 Aboriginal Cultural Knowledge and Values – Sugarloaf Range and Environs

Sections 4.1.1 to 4.1.4 provide transcripts of earlier statements of significance provided by the registered Aboriginal parties. The registered Aboriginal parties indicated during review of the draft report that they felt that these statements continue to be valid and appropriate for this assessment.

4.1.1 Awabakal Descendants Traditional Owners Aboriginal Corporation

> We know that the roadways and logging tracks present in the continued underground mining area today have been constructed along the original tracks that were used by our People, the Awabakal, as they used these areas and travelled through to the various other areas within their Traditional Country. We would then expect to find areas that were camp sites on the ridgelines and spur crests where the tracks are, or close by. (Shane Frost ADTOAC – 29 October 2009).
>
> As children growing up, we lived in and were taken into many areas of the Traditional Country of our Ancestors. As a result, we were told 'stories' that had been passed down for centuries that related to these areas. These vivid 'stories' that were told to us then and viewed through children's eyes, now give us a clearer insight into our Cultural Heritage as adults. These 'stories' told about the lake, creeks and waterholes, the mountains and landscapes within the surrounding areas and how they are intrinsically connected. One of these 'stories' gives us insight into the importance of the Sugarloaf Range in its entirety, from one end to the other and the connection that several important features that exist within its terrain have with each other and also with other features within our Traditional Country, but then, how they also separately exist in their own right. We would love to tell these 'stories' here but we believe it is not for others at this time. So we would reserve this right as Awabakal People to hold onto this part of Our Cultural Heritage for the present moment.
>
> What we are trying to say here is that although the Sugarloaf Range is quite a large physical feature within this area, it is but one of many significant features (both large and small) that are fused together into a much larger picture but at the same time uniquely separate. This is conveyed through our Oral history which in turn can divulge certain Spiritual accounts also of our People, the Awabakal. This is why we reserve the right not to reveal certain information here. (Awabakal Descendants Traditional Owners Aboriginal 25 March 2010).

4.1.2 Awabakal Traditional Owners Aboriginal Corporation

Mt Sugarloaf still to this day is an impressive Awabakal Dreamtime landmark, bearing physical reminders of our Awabakal ancestral families' lifestyle and presence. The amount of physical sites may never be fully known, but even if every single site is not found, we believe that the cultural integrity and organic value still remains a constant for our lives.

When we visit Mt Sugarloaf, there is an inexplicable spiritual reaction to the landscape and at times someone becomes intuitively drawn to or affected by a particular site, as if the ethereal environmental space is meshing with someone's 'cultural DNA' (Awabakal Traditional Owners Aboriginal Corporation 10 & 30 March 2010).

Additionally, there are some of us who are fortunate enough to have stories passed down through the generations of time but this communication or 'oral history' is meaningless unless we keep these ancient whispers alive. To me oral history is a 'living letter' passed between generations, making sure that those who are following in the footprints of their ancestors will hear these same whispers that are essential to life.

Of course we as a family have been told stories about past generations, their personalities, their relationships and what they all did here in their traditional lands. However at the end of the day, all the stories, customs and traditions are there for people to connect with each other and, explore the mysteries of life.

One day I hope we all realise the importance of this before it's too late. This is one of my Awabakal dreams (Nola Hawken, ATOAC 17 March 2010).

Additionally, when the Sugarloaf Mountain Range is viewed from any direction we know we are looking at a place our People have continually visited, and it is something that is symbolic to us. When we go up there and visit the sites it is like looking at a reflection of our ancestors. We know these sites are part of our lives and that familiarity can sometimes be taken for granted, but it is those landmarks and features that define us within our Awabakal country. It is a special place, and the connectivity between other special places like Nobbys, Wollombi and Sugarloaf, just to name a few, it's not just about the place, but what our culture means to us as Awabakal people and how we are connected with our cultural places (Kerrie Brauer, ATOAC 17 March 2010).

4.1.3 Awabakal Local Aboriginal Land Council

In the past ALALC has spoken of the ceremonial importance of the Sugarloaf Range area, the restriction of access to some areas that were related to men's business, to the fact that there are stone arrangements, scarred trees, burials, grinding grooves, and potholes in association with grinding grooves that have been ground out to make them larger so they hold water for longer, and also direction markers (some were stones and some were grooves in the rocks). The following quotes are excerpts from a report that ALALC prepared in relation to the importance of the Sugarloaf Range area in 2003.

The Sugarloaf Range is ... important to us – it allows us to keep our ties with the past. We must preserve our ties with the past; we must not lose our traditions which are all part of our connection to the land and our sense of belonging. We must try and keep Sugarloaf as natural as we possibly can. We have to have progress … but we as Aboriginal people are losing our identity as a community and we need to be able to get back to places like the Sugarloaf area, it's very important that we have these places to show our young people, educate our kids back to our culture.

Our [Aboriginal] culture is written there in the Sugarloaf Range, written in the caves, written on the ground, written on the trees, it's all around. We need to be able to go to these places to teach the kids how to read the land. Our kids have been missing out; sadly they do not respect their Elders. Getting back to the land with the Elders will teach our kids respect for the Elders, for the land and for themselves. We would not have jails bulging with young Aboriginal people if they had the chance to learn about their culture, to have the chance to preserve their past, to preserve the land as natural as it can be, we must not lose our tradition and connection to the land.

Sugarloaf has a big toolmaking area … they ground axe heads all over the top of there, there is a lot of places where they rubbed them… It was very important to have this sandstone to grind the axe heads which was a very important part of tribal life, the axe. It played a big role in the survival of the Awabakal people, not only for hunting but it was used too, in defence at odd times. This will give you some idea … how important and how significant these sites are up at Sugarloaf.

They used ground out pot holes to hold water to use as part of the rubbing down of the axe, they would have a little bark bowl there to scoop up the water and it is very important that water was used. That's why you can see how well it has been used over thousands of years. Some of these pot holes are pretty deep you know, especially up there. … When it was a bit dry the water would stay there, in the deep pools, there where water would stay well covered over where the sun wouldn't dry the water out….in this area too there is one waterhole, you know the Aboriginal oral tradition reckons it never runs dry, you know orally speaking, but there's a few waterholes up there. This area is rich in stuff like that, Sugarloaf, and it's very important. It's not only as it has a physical significance to Aboriginal people, but spiritual side too, because this is where we are going to bring our young men back up and show them how they actually done the waterhole and to make tools and that. It is very important to pass the knowledge on to this young generation, actually how they done that, and the importance of it, so Sugarloaf is very important.

Direction markers were important things. Oh yes. People made different signs for different things, it's very important to read the land, very important. Just like today we have road signs, street signs to give directions to the people travelling.

We have different grinding grooves to show where the waterholes are and things like this. This stuff is very important and we have signs on the ground, prints, emu prints and things like that pointing to different areas. … The idea is to leave a story behind and it was for the survival of the whole clan, and there is stuff there anyone coming through from different tribal areas, they could look, and they have the same thing up there. They can understand. It was left there for them for directions to the waterholes and for what to eat.

From the oral histories that have been passed onto the membership at the ALALC we are certain that the women and men both played a large part in the stories that are associated with the range, these stories will not be shared within this document but are available to the members from the knowledge holders if they are considered appropriate (ALALC 8 April 2010).

4.1.4 Cacatua Cultural Consultants

CCC (17 June 2010) comments were for restricted access in the Environmental Assessment.

4.2 Summary of Aboriginal Cultural Values

The Sugarloaf Range area has high Aboriginal cultural value to the Awabakal as well as to Aboriginal people who have other levels of connection with Awabakal lands.

The restriction of access to some parts of the upper Sugarloaf Range (to the west of the Project Area) has been mentioned by some groups who have indicated that some areas were for access by men only. The widespread contemporary knowledge of the use of Mount Sugarloaf as an area for male initiation suggests that initiated males and males going through the rites of initiation may have been the only persons allowed to visit this area. How far reaching this restriction was in terms of the broader Sugarloaf Range has not been identified.

In relation to sites, the Aboriginal oral history suggests that the Sugarloaf Range contains the site types listed below and this has been confirmed through surveys of the Sugarloaf Range and identification of these site types:

- grinding groove sites associated with waterholes and potholes within the creeklines and that the potholes in creeklines may have been enlarged by grinding so that they would hold water for longer;
- rockshelters used for occupation and possibly art;
- scarred trees which may be related to ceremony;
- stone arrangements related to ceremony;
- artefact scatters and isolated finds on ridge and spur crests; and
- direction markers which may be erected stones or grooves.

The Project Area is limited in size and has limited landscape variability within it. This does not diminish its Aboriginal cultural significance in relation to its connection with the wider Sugarloaf Range, however, the sites from the list above that are likely to be present within the Project Area are likely to be limited to artefact scatters and isolated finds and less likely to include scarred trees (dependent on the degree of prior tree clearance), direction markers and stone arrangements. Grinding grooves, waterholes and potholes are unlikely due to the lack of any suitable creeklines and rockshelters are not likely due to the lack of suitable topography and outcropping sandstone.

5.0 Environmental and Ethnohistoric Context

This section provides the context and background information required to formulate a predictive model for site location, type and contents within the Project Area.

5.1 Landscape Context

5.1.1 Topography and Hydrology

The Project Area is located at the south eastern extent of the Sugarloaf Range. The Project Area is comprised of a north-south oriented spur which extends from a northwest – southeast major spurline which is running from the main Sugarloaf Ridge (refer to **Figure 5.1**). The southern extent of the Sugarloaf Range is characterised by rolling hills with slopes of varying gradients below long broad crests (Matthei 1995: 61, 132). The maximum elevation of the spur within the Project Area is approximately 100 metres above sea level.

Two upper order tributaries of Palmers Creek commence just inside the eastern side of the Project Area, while the main channel of Palmers Creek is approximately 250 metres south of the Project Area. Approximately four kilometres to the southeast of the Project Area, Palmers Creek joins Stony Creek which, in turn, flows into Lake Macquarie. The main channel just south of the Project Area is a third order creek that is generally incised two to four metres within an extensive alluvial valley. The banks and adjacent alluvial areas in this section of the creek have been cleared and/or are now densely overgrown with introduced species, limiting visibility in and around the creek channel. Private residences and their grounds border the creek. One major tributary joins Palmers Creek approximately 300 metres west of the Project Area (Ryhope Creek). This tributary drains the southern slopes of the Sugarloaf Range. Its lower reaches comprise alluvial deposits up to 150 metres wide.

The most northerly of the two Palmers Creek tributaries that begin just inside the Project Area commences in the lower, moderately steep slopes of the Sugarloaf Ranges as a small V-shaped gully. This widens to an alluvial valley fill up to 200 metres wide. During previous surveys this section of the Project Area was swampy and characterised by a series of small water holes often not connected by a well defined channel. Slopes adjacent to the creek were long and gentle to moderately sloping. The lower accretionary portion of this tributary was densely covered with native and introduced vegetation.

The southern tributary, that being in the eastern portion of the Project Area, consists of two first order tributaries joining a second order tributary (all of the creeks in this area are ephemeral). These tributaries were characterised by small V-shaped gullies in their upper portions, with channels generally one to two metres wide. Sandstone often outcropped within these channels as well as within minor adjoining channels. These channels widen further east and become swampier and less defined within a 15–20 metre wide steep sided valley.

It is generally understood from prior research that spurs running from the main Sugarloaf Range ridge formed the easiest walking routes for Aboriginal people between the mountains and the lake (Umwelt 2010). The major spur line associated with the Project Area provides a direct route from the Sugarloaf Range to two substantial tributaries of northern Lake Macquarie (Palmers Creek and Stony Creek). The major spur line has been intersected by the construction of Wakefield Road and the Sydney – Newcastle Freeway.

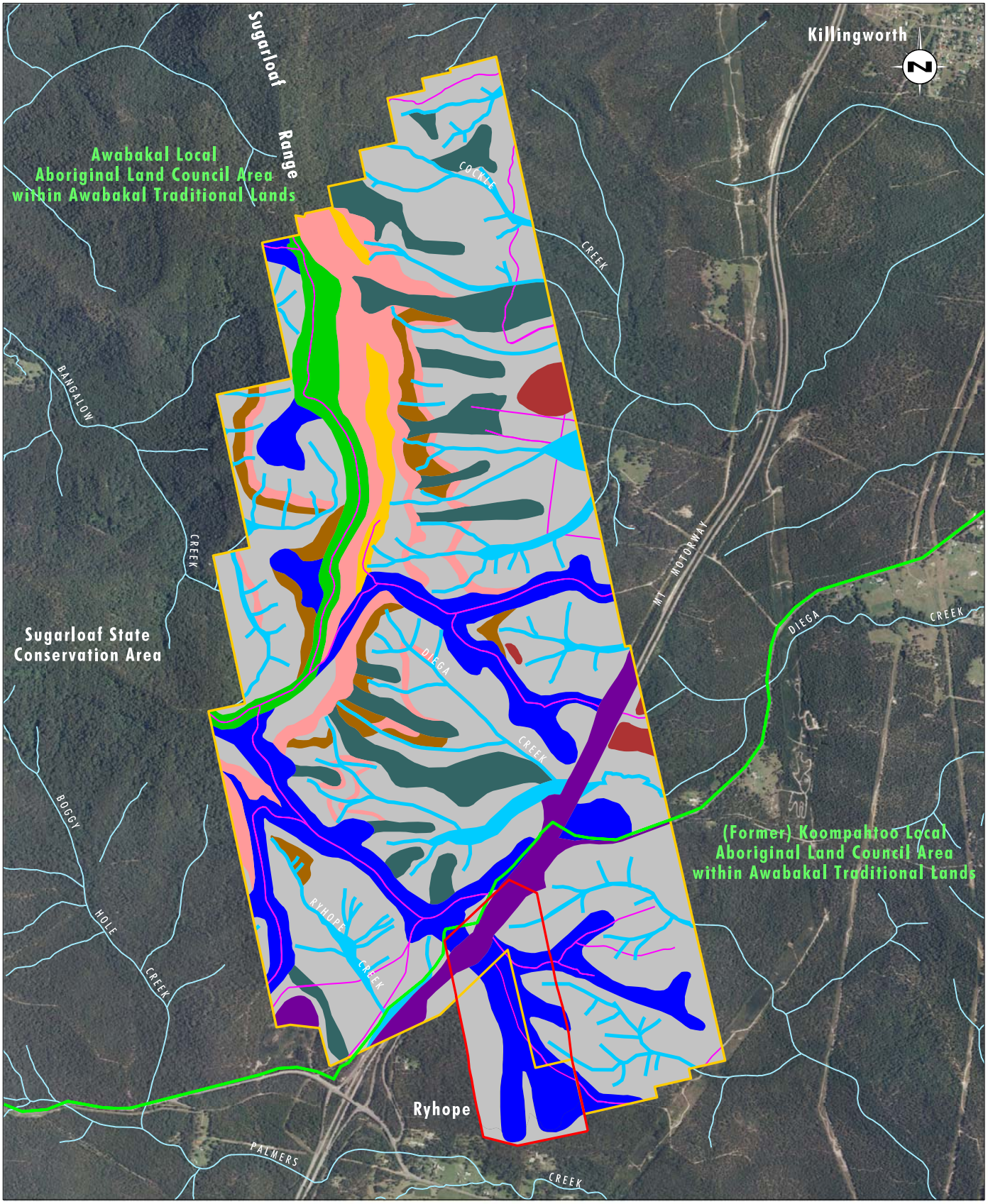

Image Source: OCAL (2008)
Data Source: OCAL (2013), Department of Lands (2003), LPI (2003)

0 0.5 1.0 1.5km
1:30 000

Legend

- Project Area
- Approved Continued Underground Mining Area
- LALC Boundary
- Drainage Lines

Landform Elements:

- Simple Slope
- Steep Slope
- Knoll
- Disturbed Area
- Mid Slope Bench
- Riparian Zone
- Sugarloaf Range Ridgeline
- Major Spur Running off the Sugarloaf Range Ridgeline
- Secondary Spur
- Graded Vehicle Track / Motorcycle Track / Vehicle Track
- Escarpment (Very Steep Gradient)
- Scree Slope / Conglomerate / Sandstone Cliff

FIGURE 5.1

Project Area Landscape Elements

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20130805 16.11

The creek lines in and immediately next to the Project Area are ephemeral in nature, and hold small amounts of water after rainfall. More permanent fresh water is available in nearby lower order tributaries to the south of the Project Area.

5.1.2 Geology and Soils

The Project Area comprises two soil landscapes, the Warners Bay residual soil landscape and the Killingworth soil landscape (**Figure 5.2**). The soils in the Killingworth and Warners Bay soil landscapes are typically comprised of shallow poorly drained Podzols on crests and moderately deep poorly drained Podzols on slopes. In drainage lines poorly drained loams may be present. Sheet erosion occurs on slopes in areas that have been cleared, while unvegetated drainage lines experience gully erosion. In many exposed areas topsoil has been completely removed (Matthei 1995). The spur crest and its upper slopes are characterized by Killingworth soil landscape, while the lower areas are within the Warners Bay soil landscape. The differing soil landscapes provide increased variety in resources within the Project Area, with vegetation resources similar to those in the higher reaches of the Sugarloaf Range on the spur, with the addition of nearby swampy resources in the lower areas.

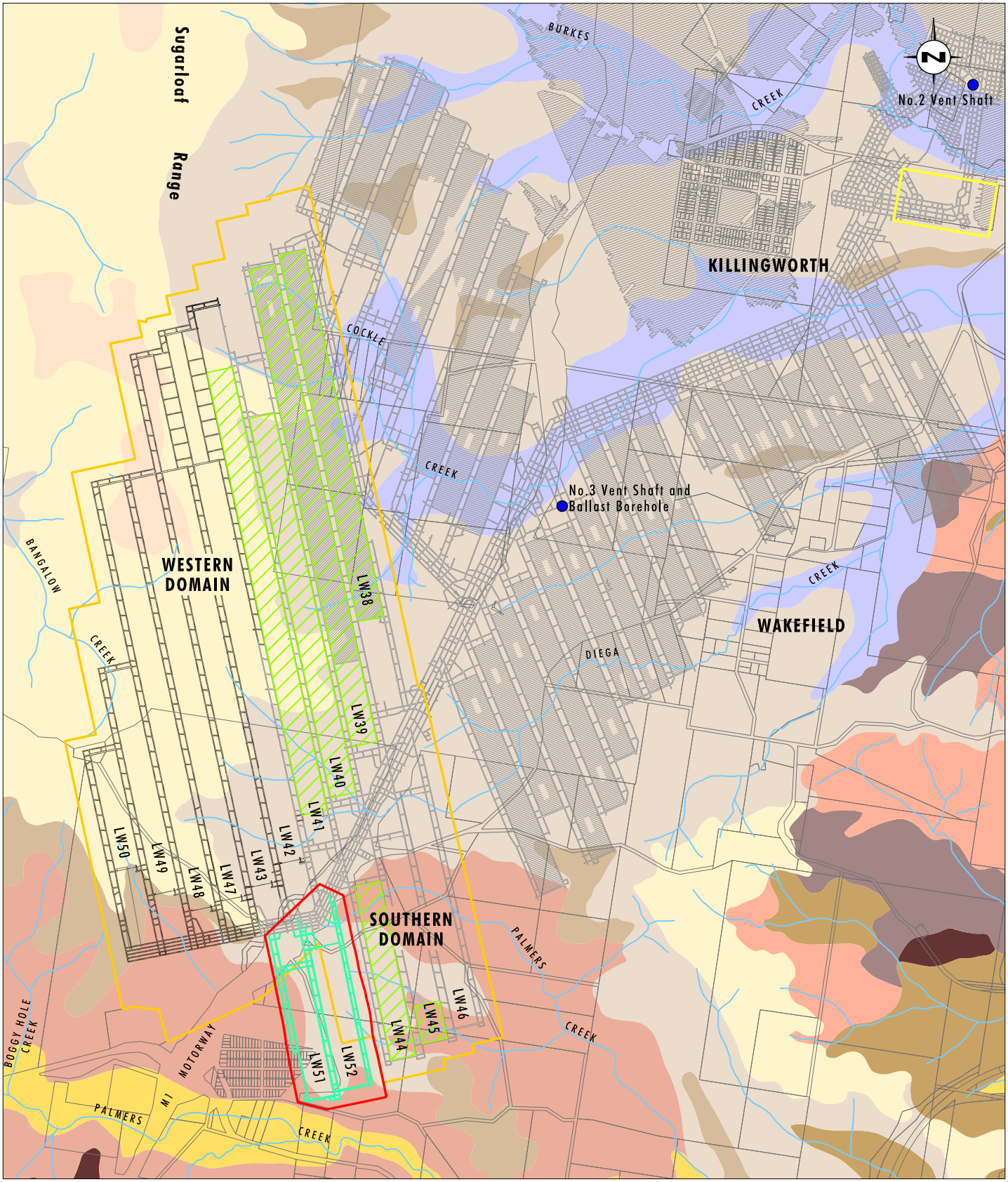
The geology of the Project Area includes the Narrabeen Group quartz and lithic sandstones, conglomerates, siltstones and reddish shales over the Boolaroo and Lambton subgroups of the Newcastle Coal Measures, comprising coal seams, tuff, sandstone, conglomerate and shale (Matthei 1995).

Stone sources suitable for the manufacture of flaked stone tools (of a raw material type previously recorded within the Sugarloaf Range) are reported to occur in close proximity to (i.e. within an easy one or two day walk from) the Project Area. Kuskie and Kamminga (2000:358) report tuff outcropping in Woods Gully located east of Black Hill and West of Beresfield, approximately 8 to 9 kilometres north-east of the Project Area. Kuskie (1994a, 1994b) has also reported a readily accessible source of silcrete in the vicinity of Woodberry Swamp approximately 19 kilometres north-east of the Project Area.

A raw material commonly located within sites in the Sugarloaf Range is Nobbys tuff, available from Nobbys Head (which would have been an island during the time Aboriginal people were using this resource) or washed up onto beaches north of Nobbys Head approximately 20 kilometres northeast of the Project Area (Umwelt 2007). ADTOAC (Shane Frost pers.com. 4 June 2010) also reports basalt and silcrete artefacts in sites in the Sugarloaf Range area and that basalt is available as cobbles in creeklines in the Sugarloaf Range. Furthermore, ADTOAC (Shane Frost pers.com. 4 June 2010) reports that silcrete could be obtained from Shortland (20 kilometres north-east of the Project Area). In addition there were sizable quartz pebbles observed in the conglomerates of the WWC underground mining area during prior field survey (Umwelt 2003, 2005, 2006a, 2006c, 2010) that would have been suitable for use for stone implement manufacture. Sandstone is part of the geology of both soil landscapes within the Project Area and outcropping sandstone, suitable for grinding is known to occur in the creek tributaries that start in the eastern side of the Project Area.

5.1.3 Flora and Fauna

Six vegetation communities were identified within the Project Area, Freemans Peppermint – Apple – Bloodwood Forest, Sugarloaf Uplands Smooth-barked Apple Forest, Riparian Paperbark – Peppermint Forest, Coastal Wet Gully Forest, Disturbed Areas and Cleared Land (Umwelt 2013b). Vegetation within and around the Project Area has been impacted by land uses such as forestry and recreational activities such as use by off road motorcycles and 4WDs. Despite this, vegetation communities in the Sugarloaf Range are largely endemic



Data Source: OCAL, Department of Lands (2006), LPI (2003)

0 0.5 1.0 2km

1:35 000

Legend

- Existing West Wallsend Colliery Pit Top Facilities
- Approved Continued Underground Mining Area
- Project Area
- Approved Underground Workings in the West Borehole Seam
- Proposed Longwall Panels 51 and 52
- Longwall Progression as of October 2013
- Former Underground Workings
- Ventilation Shaft
- Drainage Lines

Soil Landscapes:

- Awaba
- Disturbed Terrain
- Doyalson
- Cockle Creek
- Gateshead
- Killingworth
- Killingworth Variant
- Sugarloaf
- Sugarloaf Variant
- Warners Bay
- Wyong

FIGURE 5.2

Soil Landscapes within the Continued Underground Mining Area and Project Area

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20131218 11.35

and many plants known ethnographically to be used by Aboriginal people occur within the Project Area, with a larger number present in the broader Sugarloaf Range area. Aboriginal resource plants observed within the Project Area are summarised in **Table 5.1**.

Table 5.1 – Aboriginal Economic Plants recorded within the Project Area

Common and Scientific Name	Use	Reference
banksia *Banksia* sp.	Flowers sucked as a source of nectar, smouldering cones used to transport fire.	Low 1989:170; Umwelt 2003a; Stewart and Percival 1997:13
wattle *Acacia* sp.	Gum that exudes from wounds on trunk eaten, leaves crushed and soaked with nets to waterproof them - wood used for boomerangs, clubs and digging sticks- big fat pink witchetty grub ('Jubum') lives under tree.	Umwelt 2003a
blady grass *Imperata cylindrical*	Food and economic plant - the grass roots were eaten by the children as sugarcane and the leaves were used for making dilly bags.	Organ and Speechley 1997: 9.
bracken fern *Pteridium esculentum*	Underground fibrous stem roasted and beaten with a stone to remove starch.	Zola & Gott 1992: 37 Threlkeld (in Gunson 1974:55)
cycad *Macrozamia communis*	Initially poisonous the seed of the Cycad are treated to leach toxins then used to make flour.	Botanic Gardens Trust (undated)
flax lily *Dianella cerulea*	Blue berries edible raw, seeds inside can be chewed and are nutty in flavour, leaves split and used for weaving, base of leaves edible, roots edible after pounding and roasting, whistle that attracts birds can be made from base of leaves.	Low 1989:8 Umwelt 2003a Stewart and Percival 1997:24
fringe lily *Thysanotus tuberosus*	Small sugary tubers eaten.	Low 1989: 112-113
geebung *Persoonia* sp.	Broad and narrow leaf Geebung present in the proposed continued underground mining area - fruit eaten.	Zola & Gott 1992: 35
grass tree *Xanthorrhoea* sp.	Resin used for hafting stone tools, flowering stems used for spear shafts, base of the leaves are sweet and nutty; nectar collected from the flower spike.	Low 1989: 130; Zola & Gott 1992:58-59 Umwelt 2003a
gum tree *Eucalyptus* sp.	The bark of some species was used to make shields and bowls, the leaves and sap were used to make inhalants and washes for sores and green leaves were used to 'smoke' people for various ailments.	Umwelt 2003a
gymea lily *Doryanthes excelsa*	Stem cut when young and roasted; roots roasted, pulverised and made into 'cake'.	Umwelt 2003a
headache vine *Clematis glycinoides*	Crushed leaves inhaled for headache.	Low 1990: 226
kangaroo grass *Themeda* sp.	Seeds ground for flour. Leaves and stem used for fibre, Aboriginal women from the Kimberley visiting MLALC made baskets from this grass May 2001.	Greenway 1910:16 Zola & Gott 1992:58 pers. obs. 2001

Table 5.1 – Aboriginal Economic Plants recorded within the Project Area (cont.)

Common and Scientific Name	Use	Reference
matt rush *Lomandra* sp.	Long pliable leaves used for weaving baskets, leaf bases and flowers edible.	Low 1989: 131, 174; Zola & Gott 1992:59
mistletoe *Amyema* sp.	Berries eaten.	Low 1989:14; Zola & Gott 1992:54
mountain devil *Lambertia formosa*	Nectar sucked from flowers.	Low 1989: 170
native grape *Cayratia clematidea*	Fruit eaten.	PlantNet (1999-2009)
rushes and sedges *Carex & Cyperu.*	Underground stem or tuber can be eaten in some species, leaves used for weaving.	Low 1989:105; Zola & Gott 1992:60
false sarsaparilla *Hardenbergia violacea*	Medicine plant - the leaves of the plant are crushed and then sucked or mixed with water and taken as an elixir for stomach ache.	Umwelt 2003a
smooth-barked apple *Angophora costata*	Economic and medicine plant – burls removed and hollowed out to make bowls which could be heated over the fire to boil water - the Aboriginal oral history states that the water would boil before the bowl burnt – the leaves and sap were used for inhalants, washes for sores and diarrhoea.	Australian National Botanic Gardens Education Services 2000: 21. Umwelt 2003a
wombat berry vine *Eustrephus latifolius*	Small sugary tubers eaten.	Low 1989: 17

The variety of Aboriginal resource plants within the Project Area could have supported small groups of transient hunters and gatherers as they moved through the area. However, longer term occupation and use of the Project Area is not envisaged as the resource plants are highly seasonal in nature and there would have been insufficient staple carbohydrate plant foods to support longer term occupation.

A total of 59 vertebrate fauna species were identified during the ecological survey of the Project Area, comprising 18 mammal species, 34 bird, four reptile species and three amphibian species (Umwelt 2013).

The most common mammal species recorded were bats, with possums also identified. None of the bird species recorded within the Project Area are known from ethnographic records to have been hunted, however, their eggs are likely to have been collected for food. Similarly none of the amphibious species recorded within the Project Area are known to have been used as food sources.

Goannas or Lace Monitors (*Varanus varius*) (a prized food resource) and freshwater crayfish claws (*Cherax destructor*) were noted during previous archaeological surveys in the WWC underground mining area. It is probable that these represent another source of food available within the Project Area or its near environs.

It is recognised that the contemporary economic faunal species available within the Project Area may not represent the diversity available in pre-contact times or within the broader Sugarloaf Range area. It is also noted that Aboriginal people utilising the Project Area had access to marine resources along the coast and inland riparian and swamp environments within a day's walk. With more varied marine and riparian food and plant resources available

nearby, if is more likely that Aboriginal people would have camped at these locations and the Project Area used more for transient use.

5.2 Land Use History

5.2.1 Historic Land Use

Typically, in the broader Sugarloaf Range, the main physical impact from historic land use relates to timber cutting. The demand for timber in the Lake Macquarie area increased with the establishment of coal mining and the construction of the Newcastle rail link in the 1880s. With the advent of coal mining, much of the timber cut from the Sugarloaf Range was supplied to the local underground mines for pit props and the developing rail networks resulted in a high demand for sleepers.

In 1889 Tomas Barnier established a sawmill in the Mount Vincent area (to the north of the WWC underground mining area) and cut and milled timber from the Sugarloaf Range and the Watagan Mountains. Timber was taken off the mountain by bullock teams and delivered to the site of a new colliery, rail line, rail bridge or building as required. Following the opening of the Awaba Railway Station in August 1887 timber was also delivered direct to the station for transportation further afield (Suters Architects Snell 1993:22).

Management for the production of timber for mining resulted in trees above pit prop size/not suitable for pit props, being removed and regrowth being harvested before it grew beyond optimum sizes (DECC 2008:2). Tracks were constructed in the early days of timber getting along ridges and spur crests, to allow for easier removal of the timber.

In more recent times the major impact to the broader Sugarloaf Range area of which the Project Area is part, is from recreational 4WD enthusiasts, off road motor bikes and rubbish dumpers, as well as various forms of infrastructure. Less frequently, there is evidence of bush fire in the Sugarloaf Range, usually in the form of burnt trees or stumps.

In the Project Area and surrounds historic land use has included vegetation clearance, access track construction, road construction, power easement construction and maintenance.

As a result of historic and more recent land use practices:

- numerous formed and unformed logging tracks were constructed along spur and ridge crests in the Sugarloaf Range area as these supplied the most easily navigable travel routes, with such as track occurring in the Project Area;
- the A1 and most of the A2 soil horizon has been lost from the crests and slopes exposing artefacts and sometimes redepositing them in the low gradient valleys where deposition and aggradation of soils may act to bury them and any existing Aboriginal archaeological sites/archaeological material (including grinding grooves in low gradient creeklines);
- the logging trails, including the track in the Project Area are now used by off road cyclists, 4WD enthusiasts and occasional rubbish dumping to access the area increasing erosion of the tracks, forming new tracks around obstacles and exposing and causing breakage to artefacts on the tracks; and
- due to cumulative impact of logging activities a very high percentage of the mature trees have been removed, greatly decreasing the likelihood of locating scarred or carved trees.

5.3 Ethnohistoric Research

Please note that this section provides background information about ethnographic and archaeological context of the Sugarloaf Range area and does not provide the information in relation to Aboriginal cultural values or perspectives. This is also a summary of information compiled and presented in Umwelt 2010b.

Historic records, such as official records, personal observations recorded in diaries or publications and paintings, can provide information on Aboriginal lifestyles of a region at the time of European contact. These can be a valuable source of information, however the limitations of these documents must be recognised as colonial observers generally tended to record unusual rather than everyday events, religious and social life rather than economic activity, and men's behaviour rather than that of women and children. As such, ethnohistoric records are neither unbiased nor complete, and they cannot provide a complete understanding of Aboriginal lifestyles at the time of contact.

The Sugarloaf Range is within the traditional country of the Awabakal. Although several different versions of Awabakal tribal boundaries have been documented in the past, it is generally understood that Awabakal country extended south from the Hunter River to Norah Head and Wyong, and extended west to include the Sugarloaf and Watagan Ranges. The traditional country of the Awabakal was bounded to the north by the Worimi, to the west by the Wonnarua, to the south-west by the Darkinjung and to the south along the coast by the Guringai people. Although separate tribes, early authors such as Threlkeld (a missionary in the Lake Macquarie area from 1825 to 1841) recognised the relationships between Aboriginal countries, stating that '*the natives here are connected in a kind of circle extending to the Hawkesbury and Port Stephens*' (Threlkeld 1825 in Gunson 1974).

5.3.1.1 Scarred Trees (bark removal)

Early settlers would have been unaware of the Aboriginal cultural significance of scarred trees in the region, and the movement of timber cutters through the region would have resulted in the destruction of the majority of these site types which are now assessed as being culturally significant. In addition, some authors have noted the brutal behaviour of early timber cutters towards Aboriginal people, particularly women (Bramble 1981:37), which is likely to have provided a powerful motive for retaliation. Tensions between Aboriginal people and timber cutters are well documented, for example, in November 1804 Governor King suspended operations of private cedar parties following 'a party of Natives being beaten on Paterson's River'. Aboriginal attacks on timber cutting parties are also recorded, with cedar cutters often being accompanied by a guard, both to prevent escapes and to protect them from attack (Bramble 1981:32).

A number of early descriptions of scarred trees focus on shelters, created by taking bark from the trees. Collins (1798 in Fletcher 1975) described huts of the Aboriginal people being made of the bark of a single tree, bent in the middle providing shelter for one tenant. Collins further noted that bark was never carried around, for whenever we found a hut, we found the tree from which it had been taken. Threlkeld (in Gunson 1974:3) describes coastal huts as being more substantial than inland huts. Collins (1798 in Fletcher 1975) also comments on this, noting that on the sea coast, huts were larger and formed of pieces of bark from several trees put together, and were large enough for six to eight people. Both Threlkeld (in Gunson 1974:45) and Collins (1798 in Fletcher 1975) also described individual fires at the mouth of each hut.

5.3.1.2 Subsistence

Consumption of specific foods appears to have been restricted by age and gender, for example, Threlkeld (in Turner and Blyton 1995:14) recorded that large lizards were a favourite item of the privileged class, and that snakes and wild dogs were considered a dish fit for a king. Historical accounts identify that a range of land animals were part of the Aboriginal diet at the time of contact, including kangaroos, reptiles, bandicoots and emus. Brayshaw (1986) identifies that animals were sometimes speared by an individual huntsman (such as observed by Dawson 1830:17) but hunting was more frequently a group exercise.

5.3.1.3 Implements

Accounts with specific or detailed references to implement types and raw materials are sparse. Threlkeld makes mention of quartz used to form serrated edges of spears (Threlkeld in Gunson 1974:67), while he and others observed Aboriginal people using stone hatchets, shell scrapers and stone axes (Threlkeld (in Gunson 1974), Barrallier (1802), Dawson (1830) and Matthews (1894)).

In addition to the stone tools, a number of implements made from organic materials are noted, including wooden coolamons used for carrying water and small sheets of stringybark tied at each end that had a twig as a handle and which were used for holding water (Turner and Blyton (1995:19)), forked poles for climbing trees (Dawson 1830), nets and bags for carrying food and equipment (Ebsworth 1826, Dawson 1830), string made from bark (Ebsworth 1826, Dawson 1830), tea tree bark for small baskets and water vessels and the shank bone of a kangaroo used as an awl (Threlkeld in Gunson 1974:54). Occasionally perishable implements used by women were also described, such as yam sticks, which were used for daily sourcing of food (Brayshaw 1986). Cord and string were all purpose items usually made from the bark of various trees, including the cabbage-tree, kurrajong and hibiscus (Threlkeld in Gunson 1974:191), and used for fishing lines, nets, binding and so on.

Threlkeld (in Gunson 1974:67) described three kinds of spears in use at Lake Macquarie; the fishing spear, the hunting spear and the war spear. Spears for all purposes appear in the Hunter region to have been of composite manufacture, usually comprising lengths of grass tree (*Xanthorrhoea australis*) to which were affixed points of hard wood.

Several types of clubs have also been described in the Hunter coastal region, all of hard wood (Brayshaw 1986). One, usually called a ‘waddy’, and was described by Dawson (1830:66) as ‘….like a large kitchen poker, and nearly as heavy, only much shorter in the handle’ or by Threlkeld (in Gunson 1974:54) as ‘...a short stick like a constable's staff only tapering from the middle to the end’. It was generally made of ironbark wood (Ebsworth 1826:77).

Boomerangs were recorded as made of hardwood, ironbark and myrtle (Breton 1833:237). Browne (in Brayshaw 1986) described the boomerang as being used to ‘disperse a crowd'. Threlkeld (in Gunson 1974:69) implied that the same instrument was used as either a source of entertainment or of destruction, thrown at man or beast.

5.3.1.4 Trade and Exchange

Some early authors note the trade links between the Awabakal and inland tribes. Threlkeld (in Gunson 1974:42) notes that coastal grass trees provided suitable material for spear manufacture, and were often sent into the interior in exchange for possum skin rugs and fur cord. Threlkeld (in Brayshaw 1986) reported that in the winter of 1826, Biraban went to the mountains with upwards of 60 spears to exchange for cord made of opossum fur. Haslam

(1985) also suggests that tuff found at Newcastle was also traded, as it has been reputedly found in the Moreton Bay area, the Hunter region and the Watagan Mountains.

Brayshaw (1986:63-64) described shields in the Hunter region being made of both wood and bark. Threlkeld (in Gunson 1974:68) described a shield used at Lake Macquarie as being made from a buttress of the nettle tree or the giant fig tree, and usually about three feet long by eighteen inches, or so at most; lozenge-shaped, pointed at top and bottom, and pigeon-breasted rather than flat. The thickness in the centre may be an inch, not more, and thins off to about a quarter of an inch to the edge. On the inside of the shield, in the centre, a piece of tough wood is bent and inserted like the handle of a basket, just sufficiently large to hold by, and a soft piece of tea tree-bark is fixed on which to rest the knuckles and preserve them from abrasion.

5.3.1.5 Ceremony in the Region

Ethnohistoric accounts note a number of locations to the north-east of the Project Area as being associated with the customary practices of the Awabakal. The *Wallsend and Plattsburg Sun* (3 January 1891:3) reports the location of 'man-making' (initiation involving the practice of tooth evulsion) and marriage ceremonies as being performed at the 'Doghole…a couple of miles from Minmi', the area currently known as Stockrington, (approximately 10 kilometres north-north-east of the Project Area) (Umwelt 2003b: 5.14). The *Wallsend and Plattsburg Sun* (13 December 1890:3) also reports the location of a place where large numbers of people gathered, a Corroboree Ground, in the vicinity of Nelson and John Streets, Wallsend (approximately 12 kilometres northeast of the Project Area) at the foot of the Sugarloaf Range (Umwelt 2004: 2.8).

5.3.1.6 Mythological Associations with the Sugarloaf Range

The Sugarloaf Range is the purported home of a monster man named Puttikan (Gunson 1974:61):

> …[there] is a being, in the Sugar-Loaf Mountains, resembling a man but taller in stature; with arms, legs. Face and hair, very long on the head, but the feet are placed contrarily to the face being behind; and the body hairy, like an animal. The flesh is so hard that in all parts of the body that it is impenetrable, except just behind the legs where a spear may penetrate, but at no other part. He is fierce devouring men, and often pursuing the Aborigines in the mountains.

While it has been suggested that the Puttikan legend may have been used to restrict access to parts of the Sugarloaf Range to initiated men and male initiates, the registered Aboriginal parties would like it noted that the legend does not limit the area with gender restrictions. There is both a female and male element to the legend that needs to be acknowledged.

5.3.1.7 Burials

References to burial places are made in a number of documents. In the Newcastle Sun, 23 April 1924, in an article entitled 'Fifty Years of Progress: Memorable Days in Wallsend's History' reference is made to a burial ground '…in the vicinity of Maryland, Glendor and Stles' (sic) Grove…but the signs of it have long since passed away' (Umwelt 2003a: 5.14).

In the freshwater section of Cockle Creek at Killingworth (approximately four kilometres north of the Project Area), 100 burials have been reported. The 100 burials were reported to have been marked by stone arrangements which have since been destroyed (Umwelt 2004:2.7).

5.4 Implications for the Project Area

The geology of the Project Area is the same as the existing WWC underground mining area, suitable for a wide variety of Aboriginal archaeological site types requiring specific geological conditions (e.g. sandstone for grinding grooves or rockshelters). This sandstone can occur as flat expanses (platforms) and can be selectively weathered to create shelters in clifflines and under boulders. Sandstone platforms were known to have been used for the grinding of axes (usually associated with a water source) and as a surface for the production of engraved and abraded art. Shelters are known to have been used by Aboriginal people for the production of rock art and/or as temporary habitations (Maynard 1979, Vinnicombe 1980, McDonald 2007).

The flora and fauna of the Project Area would have provided a variety and seasonality of useful resources to small groups of transient Aboriginal hunter and gatherers. These resources would have attracted people into the Sugarloaf Range and provided opportunities for Awabakal people to move through the steeper landforms and to camp for short periods of time on the higher ridge and spur crests of low gradient.

The topography of the Project Area would have provided access up to the main Sugarloaf Range ridgeline.

The location of the Project Area within two soil landscapes suggests that a wider variety of Aboriginal resource plants will be present within the Project Area, increasing the likelihood that Aboriginal people would have gathered resources from within the Project Area as they travelled through.

Limited raw materials for stone tool manufacture would have been available within the Project Area, however a wider variety would have been available nearby. Sandstone suitable for grinding is known to be present in the creek tributaries and upper slopes on the eastern side of the Project Area, and if outcrops of sandstone are present in the Project Area they may also be suitable for grinding.

Ethnohistoric accounts of Aboriginal life, while biased, provides an insight into the ways in which Aboriginal people were using the landscape and what physical evidence may remain in the Project Area. While early timber cutting is likely to have resulted in the loss of a large number of scarred trees, if scarred trees do survive they may give some indication of the types of implements being made and used by the Aboriginal people moving through the Project Area – or may suggest direction of movement if used as markers.

6.0 Previous Archaeological Research

This section of the report discusses the previous archaeological research and previously identified archaeological sites in the vicinity of the Project Area.

6.1 AHIMS Information/Searches

A large number and variety of sites are known to be present in the Sugarloaf Range, and the approved WWC underground mining area. A search of the OEH AHIMS register was undertaken on 16 January 2013. The search parameters included sites recorded within the grid reference MGA 56: 356000 – 365500E to 6348000 – 6356000N. The results of the search indicated that there are three previously registered Aboriginal archaeological sites within the Project Area, where it overlaps with the approved WWC underground mining area (**Figure 6.1**). The three sites include two sets of grinding grooves and an isolated artefact site.

The two grinding groove sites (38-4-1007 and 38-4-1279) were assessed as part of the WWCCOP and in view of their Aboriginal cultural heritage and archaeological significance the previously proposed mine plan was modified to avoid subsidence impact (Umwelt 2010b). Therefore, the existing approved WWC mine plan avoids impacting these two sites. The isolated artefact (38-4-1580) was identified and collected in 2013 under the protocols of the ACHMP (Umwelt 2012a) during inspection of an access track to check for artefacts that might be impacted by vehicles moving along the track to access areas within the Southern Domain.

An additional 40 sites are registered within two kilometres of the Project Area (refer to **Figure 6.1**), with a further 88 sites in a wider area incorporating the WWC underground mining area.

The previously identified sites within the two kilometre search area include grinding groove sites (7); grinding grooves with PAD (1), artefact scatters (13), isolated artefacts (16), scarred trees (2) and a stone arrangement. Most of the sites in the two kilometre search area are located 750 metres or greater to the north of the Project Area, within the WWC underground mining area. Ten of the sites are within the Southern Domain of the WWC underground mining area, to the east of the Project Area.

6.2 Previous Archaeological Research

A number of Aboriginal archaeological assessments have been conducted within or in proximity to the Project Area. Those assessments most relevant to the current Project Area are summarised below in chronological order, while assessments further afield are presented in **Appendix C**.

6.2.1 Newstan Colliery – Umwelt 1998 and 2004b

Umwelt (1998) undertook the archaeological survey and assessment of the Newstan Colliery Life Extension Area in consultation with Koompahtoo Local Aboriginal Land Council (KLALC) (now closed). The Newstan Colliery Life Extension Area is immediately south of the Project Area, and extends to up to eight kilometres from the Project Area. Umwelt assessed that a large percentage of the Life Extension Area had been disturbed by prior mining activities.

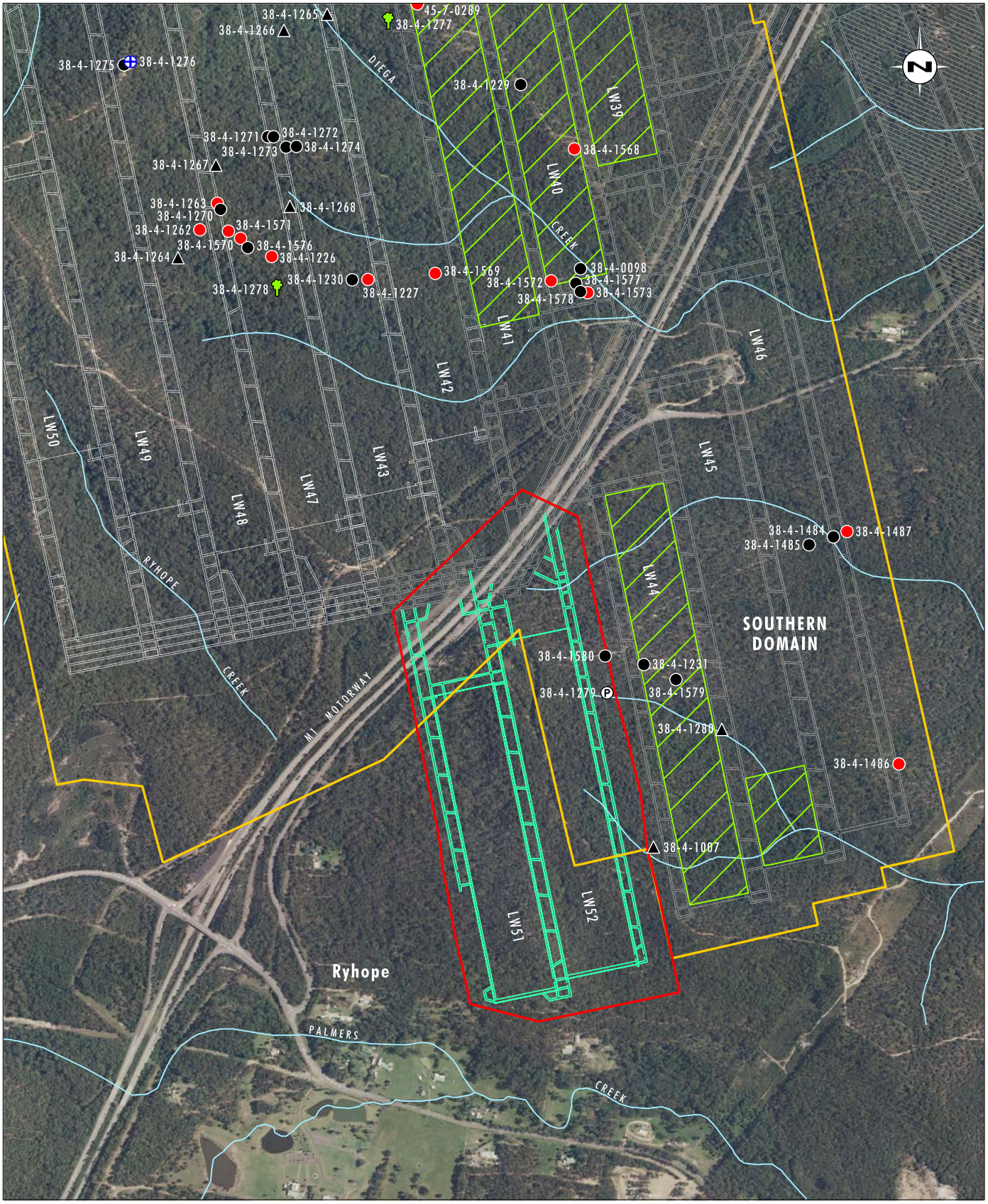

Image Source: OCAL (2008)
Data Source: OCAL (2013), LPI (2003)

0 250 500 750m
1:15 000

Legend

- Project Area
- Approved Continued Underground Mining Area
- Approved Underground Workings in the West Borehole Seam
- Proposed Longwall Panels 51 and 52
- Longwall Progression as of October 2013
- Former Underground Workings
- Artefact Scatter (Open Camp Site)
- Grinding groove with PAD
- Isolated Find
- Scarred Tree or Carved Tree
- Stone Arrangement
- Axe Grinding Groove
- Drainage Line

FIGURE 6.1

Previously Registered Archaeological Sites

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20131218 11.33

The Umwelt survey located three isolated finds; two on creeklines and one on a spur crest, as well as nine rockshelters. Three (LEA1, 3 and 4) of the rockshelters contained either shell or stone artefacts and six (LEA2, 5 through 9) contained potential archaeological deposit (PAD). A set of grinding grooves (LEA10) containing three sets of two grooves measuring from 15 to 20 centimetres in length and 5 to 7 centimetres in width; were also recorded at the head of a minor tributary. Only two of the grooves were recorded as 'well defined'.

Surface collection was recommended for the isolated find sites and it was proposed that any of the rockshelter sites to be impacted by subsidence be subsurface tested to evaluate their significance prior to undermining and that a monitoring program be implemented to gain a greater understanding of undermining on those rockshelter sites for which undermining was subsequently assessed as appropriate. No recommendations were proposed for the grinding groove site. Undermining of the rockshelters and grinding grooves was not proposed for 5 to 10 years after mining commenced.

As Newstan went under care and maintenance for a number of years following the 2004 assessment it is highly unlikely that the rockshelter sites or the grinding groove site have been impacted by subsidence at this time. No further information could be found in this regard.

6.2.2 Further Archaeological Assessment for West Wallsend Colliery (Umwelt 2005)

This report summarised the findings of a 2004 assessment of the 'Northern Domain', part of WWC underground mining operations located adjacent to, but outside of the current WWC underground mining area. The Northern Domain longwall layout proposed in 2005 was comprised of six longwalls, oriented north-east/south-west starting from the north-eastern tip of the current WWC underground mining area and extending south, terminating approximately 200 metres north of previously recorded grinding groove site AHIMS #38-4-0118. The report also assessed the archaeological constraints associated with a new longwall mining operation south of the M1 Motorway known as the 'Southern Domain', overlapping slightly the eastern portion of the Project Area ,and extending west of the Project Area.

Field survey of the Southern Domain area, west of the Project Area, was undertaken in May 2005. In this assessment area the creeklines were the focus of the survey as these were assessed as the most likely location for grinding groove sites (due to the differences in topography, rockshelters were not assessed as likely in this area). One grinding groove site (Palmers Creek 1 - #38-4-1007) was recorded. It was recommended that further consultation be undertaken with KLALC following a specific subsidence assessment of the site to determine appropriate management.

As part of the WWCCOP, the mine plan was revised to avoid impacting Palmers Creek 1 (#38-4-1007) (Umwelt 2010b).

6.2.3 Southern Domain within the Proposed Continued Underground Mining Area (Umwelt 2006c)

Following the results of previous investigations, the longwall layout of the Southern Domain was redesigned prior to approval being sought. This assessment report presented the results of the previous archaeological assessment and subsequent consultation with the KLALC in relation to grinding groove site Palmers Creek 1 (#38-4-1007). The five longwalls were reoriented north-west/south-east and the length of one of the longwalls was shortened so as to avoid any impact to Palmers Creek 1.

6.2.4 Western Domain Salvage, within the Proposed Continued Underground Mining Area (Umwelt 2010b)

In accordance with the recommendation of the Western Domain Archaeological Assessment (Umwelt 2006a) an AHIP under Section 87 of the *National Parks and Wildlife Act 1974* was sought from and granted by the then DECCW (7 April 2009) for the temporary surface collection of two isolated finds and three artefact scatters within the continued underground mining area (sites #38-4-0996, #38-4-0997, #38-4-098, #38-4-0999 and #38-4-1003). A total of 30 artefacts were collected from the site locations previously recorded in April 2006. In accordance with the conditions of the AHIP, the artefacts will be returned following underground mining, subsidence and any requisite subsidence remediation works. At this time revised site cards will be provided to the OEH.

The differences in the artefacts recorded in 2006 and those collected in 2009 demonstrate the highly mobile and erodible nature of the skeletal sandy soils within the Sugarloaf Range. Taphonomic processes such as erosion and mass movement from extreme weather events such as the June 2007 storm mean that the sites recorded within the Sugarloaf Range, especially sites containing stone artefacts and especially those found in disturbed contexts such as earthworks and vehicle tracks, are subject to ongoing impact (movement, burial, reburial, exposure).

6.2.5 Aboriginal Cultural Heritage and Archaeological Assessment West Wallsend Colliery Continued Operations Project (Umwelt 2010b)

In 2009 Umwelt undertook survey and assessment of the then proposed WWC continued underground mining area. Prior to the continued underground mining area assessment, 62 Aboriginal sites were registered within a 6 kilometre radius of the area. These consisted of 33 sites with stone artefacts (isolated finds and artefact scatters), 24 sets of grinding grooves, one set of grinding grooves associated with a waterhole/well, one set of grinding grooves in association with a rockshelter with potential archaeological deposit (PAD), one set of grinding grooves possibly associated with art (a possible macropod track), one scarred tree and one PAD.

During the survey, 62 archaeological sites were identified or re-identified and 17 landscape features were recorded that were assessed by the registered Aboriginal parties as having Aboriginal cultural value (refer to **Figures 6.2** and **6.3**) . The archaeological sites recorded were 19 grinding groove sites, one grinding groove site associated with a rockshelter with an isolated artefact, one rockshelter with artefacts and PAD, 36 artefact scatters or isolated find sites, three scarred trees and two stone arrangements. Of the 62 sites, 15 were previously recorded. The landscape features identified included a spring, a wet soak, a stone arch, a rock that had the appearance of a kangaroo's head (Kangaroo Rock), two stone cairns/stacks, a clay pigment source and 11 rockshelters. The landscape features did not have associated archaeological evidence (though Aboriginal archaeological sites were located in the general vicinity of some of the landscape features) and/or were not assessed as archaeological in nature and thus they were not recorded as Aboriginal archaeological sites; however the Aboriginal cultural significance of these landscape features was acknowledged. A number of mine plan modifications were made to protect some of the most culturally and/or archaeologically significant sites from the impacts of subsidence

Overall, from the site analysis conducted for the continued underground mining area assessment it appeared that the Cockle Creek and Diega Creek catchments were important resource areas/occupation areas that were favoured for most activities, as most site types were identified in both catchments. Stone implement grinding in the Cockle Creek catchment within the continued underground mining area, was not as prevalent as in the other catchments, and no rockshelters were identified in the Diega Creek catchment, a result of the

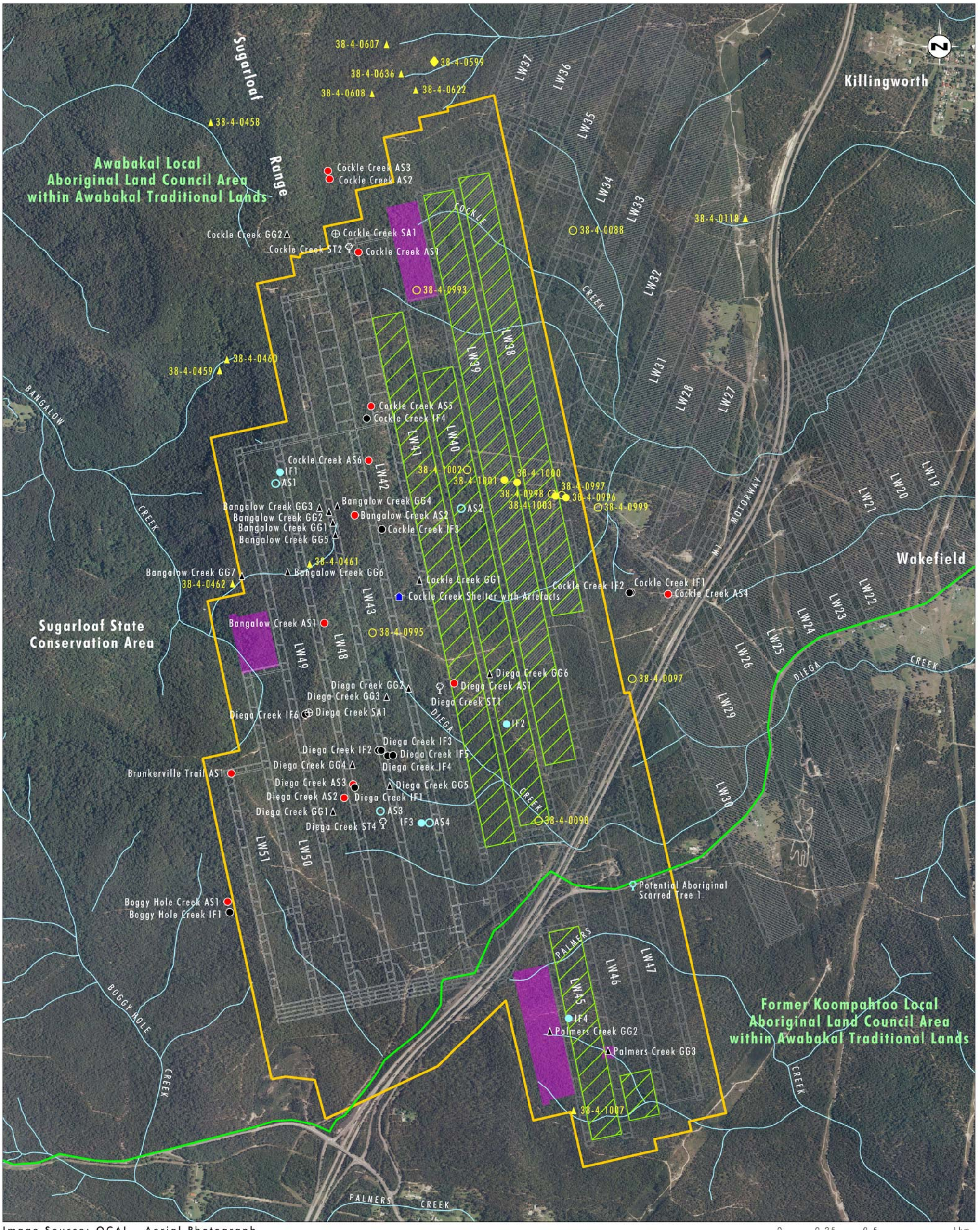

Image Source: OCAL - Aerial Photograph
Data Source: OCAL - Longwall Layout, LPI - Drainage Lines, Vitrus Heritage (2010)

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Legend

- Approved Continued Underground Mining Area
- Longwall Progression as of October 2013
- LALC Boundary
- Approved Underground Workings in the West Borehole Seam
- Former Underground Workings
- Drainage Line
- Revised Layout for Archaeology and Groundwater

- Artefact Scatter
- Isolated Find
- Axe Grinding Groove
- Shelter with Deposit
- Stone Arrangement
- Scarred Tree

Previously Recorded Artefacts
- Artefact Scatter
- Isolated Find
- Axe Grinding Groove
- Grinding Groove with Possible Art

Sites Recorded by Vitrus Heritage
- Isolated Find
- Artefact Scatter
- Potential Aboriginal Scarred Tree

FIGURE 6.2

New and Previously Located Aboriginal Archaeological Sites in 2010

File Name (A3): R02/3149_028.dgn
20131218 11.41

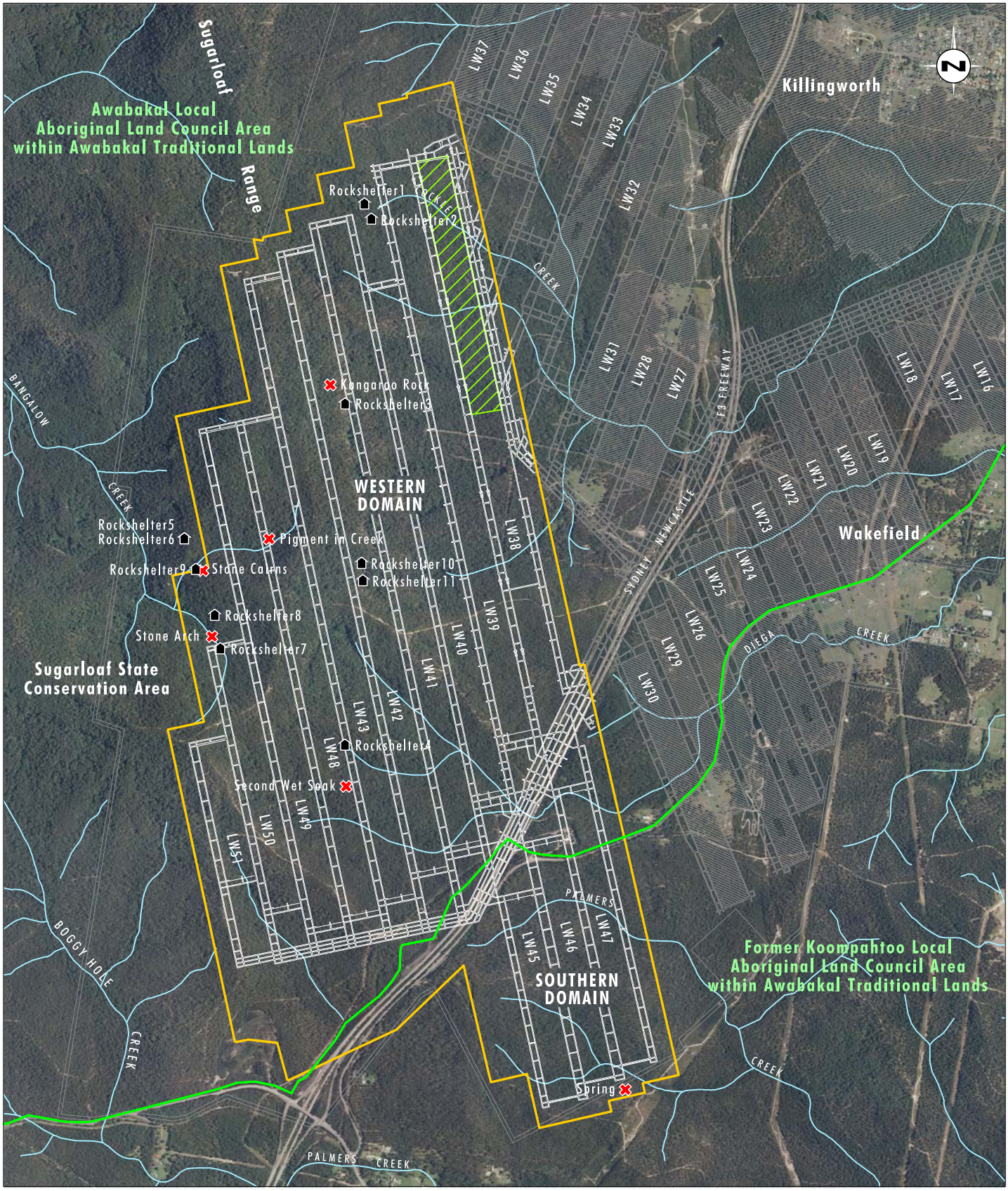

Image Source: OCAL (2008)
Data Source: OCAL (2013), LPI (2003)

0 0.5 1.0 1.5km
1:30 000

Legend

- Continued Underground Mining Area
- Longwall Progression in 2010
- LALC Boundary
- Proposed Underground Workings
- Former Underground Workings
- Drainage Line
- Feature of Aboriginal Cultural Value
- Rockshelter of Aboriginal Cultural Value

FIGURE 6.3

Landscape Features of Aboriginal Cultural Value in 2010

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20130719 15.04

topography. While being favoured areas for the grinding of stone implements, Bangalow Creek and Palmers Creek catchments appear to have been less favoured for other activities. However, it should be noted that a much larger area of the Cockle Creek and Diega Creek catchments were within then proposed WWC continued underground mining area while only the very upper reaches of Bangalow Creek, Palmers Creek and Boggy Hole Creek were within or in proximity to the area. Thus the differences observed in site types, site occurrence and site density were most likely being biased by the differences in landforms (especially related to gradient) and the size of the areas being surveyed between the catchments.

Based on the survey results, a revised predictive model for the WWC continued underground mining area was prepared and identified:

- that the mostly likely Aboriginal sites to occur are grinding grooves and sites containing stone artefacts (either artefact scatters or isolated finds);

- sites containing stone artefacts were located near watercourses but only where ground surface visibility is good, and on ridgelines and spurs, which were used as the major thoroughfares allowing people access to and from the steep sandstone landscape;

- grooves from the grinding of axes, hatchets, adzes and other implements occur and it is highly likely that further grinding grooves will be located, generally within the channels of drainage lines at the heads of valleys, in areas around rock pools on ridge tops, on rock platforms near seepages and on rock platforms within or alongside the drainage lines in the base of the valleys;

- the existence of rockshelters in the proposed continued underground mining area and immediate surrounds is possible should suitable sandstone formations be present (i.e. clifflines, large boulders); however, the majority of these will probably have no evidence of occupation;

- evidence contained within rockshelters (should they occur within the proposed continued underground mining area and immediate surrounds) may include stone artefacts and/or hearths either on the surface or within the floor deposits, and/or axe grinding grooves; and

- the spurs and ridges would have provided access to, and negotiation of, the steep escarpment country of the Sugarloaf Range and a travelway through the area to and from the swamp country in the north and the continuation of the steep escarpment country in the south/south-west. The spurs and ridges would have provided travel paths not only for the local Awabakal people but may also have provided access to other groups for whom entry into the area, possibly for trade or exchange as well as ceremonial activity was sanctioned by the Awabakal.

The artefact scatter and isolated find sites identified in the WWC continued underground mining area assessment were all recorded in areas of increased ground surface visibility, such as four wheel drive and motorbike tracks, or areas disturbed by earthworks or erosion. All of the newly identified sites were located on areas of gentle gradient on spur and ridge crests. The majority of sites contained small numbers of artefacts (<15), however three larger artefact scatters were identified in the Diega Creek catchment. Artefacts were primarily made from tuff and silcrete, with occurrences of basalt, quartz and quartzite. Many of the artefacts, those of tuff and silcrete especially, had signs of heat affect, predominantly colour change. The evidence of bushfire in the SSCA and nature of the heat affect suggested that there was a limited amount of controlled heating of the artefacts.

It was reported in 2010 that in total 44 of the sites recorded had the potential to be subject to impact by subsidence as mining progressed. Of the remaining sites, 11 were outside the WWC continued underground mining area and the mine plans were modified to protect three sites. Four sites had already been surface collected under AHIP# 1098480 and the artefacts are still to be returned to Country when all subsidence remediation works have been carried out.

A management strategy, identified as 'least objectionable' by the registered Aboriginal parties from an Aboriginal cultural perspective was prepared, which:

- modified the mine plan to remove three sites, including Palmers Creek 1 (#38-4-1007), Palmers Creek 2 (38-4-1279) and Western Domain 5 - wet soak with artefact scatter site (38-4-0993), as well as three rockshelters of cultural value and the stone arch landscape feature;

- modified the mine plan to lessen the potential of impacting Palmers Creek Grinding Groove 3 (38-4-1280);

- required further survey within the SSCA to demonstrate Intergenerational Equity for the impact to a grinding groove complex in Bangalow Creek;

- required monitoring of subsidence impacts to Diega Creek Grinding Groove sites 2 (38-4-1265, 38-4-1266, 38-4-1267, 38-4-1268, 38-4-1269) to 6 prior to obtaining approval to undermine Diega Creek Grinding Groove 1 (38-4-1264);

- committed to protecting six grinding groove sites to the north of the WWC continued underground mining area as an offset for potential loss of Aboriginal cultural and archaeological values associated with undermining Diega Creek Grinding Groove 1;

- required partial archaeological salvage of 30 per cent of the floor deposit in the Cockle Creek Rockshelter with Artefacts (38-4-1260) prior to undermining;

- required subsidence monitoring of grinding grooves, stone arrangements, rockshelters, scarred trees and landscape feature sites in the continued underground mining area;

- temporary surface collection of artefacts on vehicle tracks, or where subsidence remediation is required. Artefacts are to be returned to Country as close to the original site location as possible; and

- all Aboriginal cultural landscape features, as well as the grinding grooves, stone arrangements, scarred trees and rockshelters inside the continued underground mining area are required to be baseline recorded and monitored after every subsidence event. In addition to the baseline recording and monitoring, the Cockle Creek Rockshelter with Artefacts will undergo subsurface investigation.

The Project Approval for the continued underground mining area was granted in January 2012 and all the archaeological sites and landscape features of cultural value are being managed under the West Wallsend Colliery ACHMP (Umwelt 2012).

6.2.6 Due Diligence Archaeological Inspection (Virtus 2010)

In 2010, Virtus Heritage were commissioned to undertake a due diligence assessment of geotechnical boreholes to inform a Review of Environmental Factors required for drilling in the SSCA. Eight archaeological sites were identified during the inspections, four small artefact scatters and four isolated artefacts. All artefact sites were located on spur crests on four wheel drive access tracks or disturbed areas with high levels of exposure. A potential

Aboriginal scarred tree was also identified on the side of Wakefield Road (this was later determined not to be of cultural origin). It was recommended that drilling could be undertaken at the proposed borehole locations provided identified sites were demarcated and signposted prior to works occurring and the registered Aboriginal parties were provided the opportunity to monitor the ground disturbing works.

6.2.7 Aboriginal Cultural Heritage Management Plan West Wallsend Colliery (Umwelt 2012a)

Umwelt in partnership with the registered Aboriginal parties, co-authored the ACHMP for WWC, to guide management requirements as identified in the 2010 Aboriginal Cultural Heritage and Archaeological Assessment for all of the Aboriginal archaeological sites within the continued underground mining area. In addition to the 44 sites identified during the survey (Umwelt 2010) that had potential to be subject to impact by subsidence, the eight sites identified by Virtus were included in the ACHMP.

Artefact sites that may potentially be impacted by subsidence remediation works will be surface collected, and the artefacts subject to analysis and reporting. In addition, artefacts located on vehicle access tracks within the continued underground mining area are also proposed for surface collection and relocation, as the continued impacts on these sites by recreational vehicles and track maintenance was highlighted by the registered Aboriginal parties as a concern.

To date, 66 artefact sites have been surface collected from access tracks within the WWC continued operations area. All artefacts that have been collected from the continued underground mining area will be returned to Country to a safe location as close as possible to where they were found once mining and associated remediation impacts are complete.

Post subsidence inspections have been carried out at three archaeological sites. No impacts from subsidence were recorded at these sites, however only one of the sites had been directly undermined, the remaining two had been subject to one subsidence event, being the subsidence related to a preceding longwall.

6.3 Implications for the Project Area

The previous surveys and assessments of the SSCA and surrounding Sugarloaf Range area, discussed above and in **Appendix C**, have identified that small artefact scatters, isolated artefacts and grinding grooves are the most common site types located in the Sugarloaf Range area. Rockshelter sites, stone arrangements and scarred trees were also recorded but were rarer site types.

Grinding grooves require specific conditions – most often, outcropping sandstone in or near creek beds. The assessment for the continued underground mining area indicated that grinding grooves were most likely to be present in the upper reaches of the creek lines in the SSCA. The Project Area does not include any mapped creek lines. There are however likely to be some minor drainage depressions present on the western side of the spur and towards the south of the Project Area. These are not likely to be incised sufficiently to have exposed sandstone outcropping in the creek, therefore it is not expected that grinding grooves will be present in this area.

All artefact sites that have been identified in the SSCA have been identified in disturbed contexts where there was increased ground surface visibility, such as 4 wheel-drive and motorcycle tracks, or other disturbed contexts (resulting from earthworks, road construction and erosion). The previously identified artefact sites have been located on areas of relatively gentle gradient spur and ridge crests, or associated with water courses. Additionally there were artefacts located on low gradient crests/benches between upper tributary watercourses, rather than next to them. Artefact numbers at sites were generally low, with high degrees of breakage and high instances of heat affect, mostly from exposure to bushfire. Tuff and silcrete were the dominant raw materials, while quartz, mudstone, quartzite petrified wood and volcanic materials were also present in smaller numbers.

The Project Area includes the slopes, crest and minor drainage lines of a gentle gradient spur. Areas of modified landform also exist, however these are limited to the vehicle tracks within the Project Area. The Project Area includes areas of moderate to highly vegetated woodland with minimal levels of prior disturbance. There are previously disturbed access tracks and fire trails along the eastern edge of the Project Area. Previous research in the Sugarloaf area has shown that artefact sites are usually identified in previously disturbed contexts, such as cleared tracks, on gentle gradient spur and ridge crests. Typically the spur and ridge crests have been impacted heavily by erosion, often as a result of historic land clearance from logging and track construction. As identified in **Section 5.2.1** the A1 and much of the A2 horizon of crests and slopes in the Sugarloaf Range has been redeposited down slope in the low gradient valleys.

In the Sugarloaf Range, visibility off the access tracks and other disturbed areas is generally quite poor. Typically surface artefacts are not identified in areas of poor visibility, and it is not expected that large numbers of artefacts will be identified if there is limited visibility in the Project Area. However, depending on the amount of erosion that may have occurred on the spur crest due to logging and track construction there may be redeposited/buried Aboriginal archaeological sites in the Project Area.

Due to historic tree clearance the Project Area is only likely to have scarred trees if mature trees remain. Due to the Project Area being a travelway it is unlikely to have stone arrangements that may mark burials. Direction markers made of stone are also unlikely as even if they are present, they have most likely been destroyed by track construction.

Landscape features with Aboriginal cultural value may be present within the Project Area, however, these can only be identified by Aboriginal people at the time of survey.

7.0 Predictive Model

The environmental context of the Project Area, the Aboriginal cultural knowledge and values, ethnography, previously recorded Aboriginal sites, previous archaeological assessments conducted within and in close proximity to the Project Area and previously proposed models for site location within the Sugarloaf Range; have all informed the following predictions for the nature and location of previously unknown Aboriginal archaeological sites and values within the Project Area.

It is predicted that:

- the mostly likely Aboriginal sites to occur are sites containing stone artefacts (either small artefact scatters or isolated finds);
- sites containing stone artefacts are likely to be located on the spur crest, but are only likely to be visible in areas where ground surface visibility is favourable such as on vehicle tracks and areas of disturbance. A vehicle track passes along the eastern edge of the Project Area, it is therefore expected this will be where there may be visible artefacts;
- redeposited A1 and A2 eroded from the spur crest may be present in the Project Area, this may contain small numbers of artefacts moved downslope from the spur crest and redeposited/reburied on the lower slope/areas of low gradient;
- grooves from the grinding of axes, hatchets and adzes are known to occur within the Sugarloaf Range. Grinding grooves are generally located within the channels of drainage lines in areas of low gradient where water pools at the heads of valleys, in areas around rock pools on ridge tops, on rock platforms near seepages or on rock platforms within or alongside the drainage lines in the base of the valleys where water also pools. Due to the steepness of the first order tributaries in the Project Area, it is unlikely that grinding grooves will be located as there are not likely to be areas of low gradient were pools are likely to occur;
- the existence of rockshelters in the Project Area and immediate surrounds is unlikely as suitable sandstone formations are not present (i.e. clifflines, large boulders);
- Aboriginal oral history and ethnographic accounts suggest that burials marked by stone arrangements could occur, but are unlikely within the Project Area as burials are unlikely to exist on a travel way. Stone arrangements used as direction markers may have existed in the Project Area but are unlikely to have survived access track construction;
- Aboriginal oral history suggests that scarred trees (some of which may be related to ceremony) could occur, but are only likely within the Project Area if mature trees remain; and
- ethnographic accounts and the topography of the area, as well as previous regional models for Aboriginal landscape use within the Sugarloaf Range area suggest that the spurs and ridges would have provided the easiest access to and from the steep escarpment country and the Palmers Creek and the southern Lake Macquarie areas. The spurs and ridges would have provided travel paths not only for the local Awabakal but may also have provided access to other groups for whom entry into the area, possibly for trade or exchange as well as ceremonial activity was sanctioned by the Awabakal. Archaeological evidence of visitors to Awabakal traditional land may therefore occur in the Project Area in the form of stone artefacts manufactured from stone sources outside Awabakal lands. Should such stone artefacts occur, identification of their provenance could indicate the group affiliation of past visitors into Awabakal Country.

8.0 Survey

8.1 Survey Methodology

The draft survey strategy was prepared taking into consideration the DECCW *Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW* (DECCW 2010b), as well as the size of the area proposed for potential impact by subsidence. As the area in the north-eastern section of the Project Area had previously been surveyed for the WWCCOP Environmental Assessment, it was not required to be resurveyed and was not included in the survey (refer to **Figure 8.1**). As the impact area not previously surveyed was deemed to be small, it was decided that total survey of this area (hereafter the survey area) was feasible and would be undertaken.

The survey methodology approved by the registered Aboriginal parties included:

- dividing the survey area into four smaller areas for recording purposes (refer to **Figure 8.1**);
- total pedestrian survey of previously unsurveyed landforms;
- based on the topography of the Project Area, intensive investigation of unmapped drainage depressions;
- targeting of areas of exposure; and
- consideration of the likelihood that there may be A1 and A2 soils containing artefactual material that have moved down slope from the spur crest above as the result of erosion.

8.2 Survey Results

An inspection of the survey area was undertaken on 20 February 2013 by Amanda Reynolds (Umwelt Archaeologist), and representatives of the Aboriginal Advisory Committee (AAC) Peter Townsend (ALALC) and Adam Sampson (CCC). ADTOAC and ATOAC were invited to participate in the inspection, however were unavailable. After a meeting to discuss the project was held, a second inspection of the survey area was undertaken on 17 April 2013 by Amanda Reynolds, Peter Townsend, Jodie Wilson (ATOAC) and Tegan McCormack (CCC).

8.2.1 Archaeological Sites Identified

During the February 2013 inspection, a scarred tree was identified within the Project Area (refer to **Figure 8.2**). During the April 2013 inspection, an isolated artefact was identified on the main access track within the Project Area where it overlaps with the continued underground mining area. Site Cards for the newly identified sites are included in **Appendix D**.

Palmers Creek ST1

Palmers Creek ST1 (**Plate 1**) is a living white mahogany (*Eucalyptus acmenoides*) with an oval scar on its east side. The tree is in fair condition, with possible evidence of white ants. The tree is approximately 2.2 metres in circumference and has survived bushfire, as evidenced by burnt bark and outer layers of heartwood. The visible scar begins 40 centimetres from the ground, and is approximately 2.1 metres in height. The regrowth over the heartwood is 20 centimetres thick, leaving a maximum width of scar of

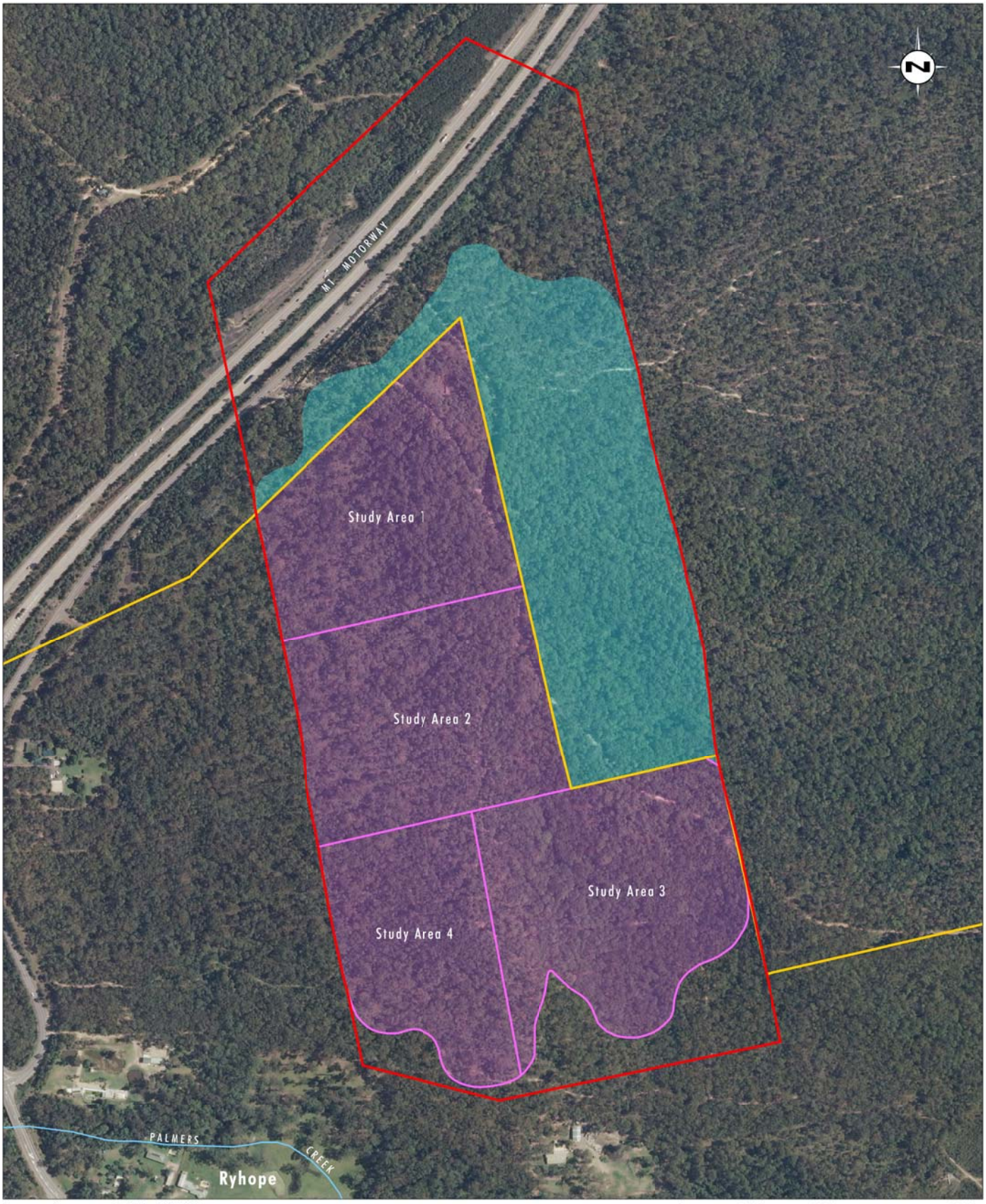

Image Source: OCAL (2008)
Data Source: OCAL (2013), LPI (2003)

0 100 200 400m
1:7 500

Legend

- Project Area
- Approved Continued Underground Mining Area
- Study Area
- Previously Surveyed (2009)

FIGURE 8.1

Aboriginal Cultural Heritage Study Areas

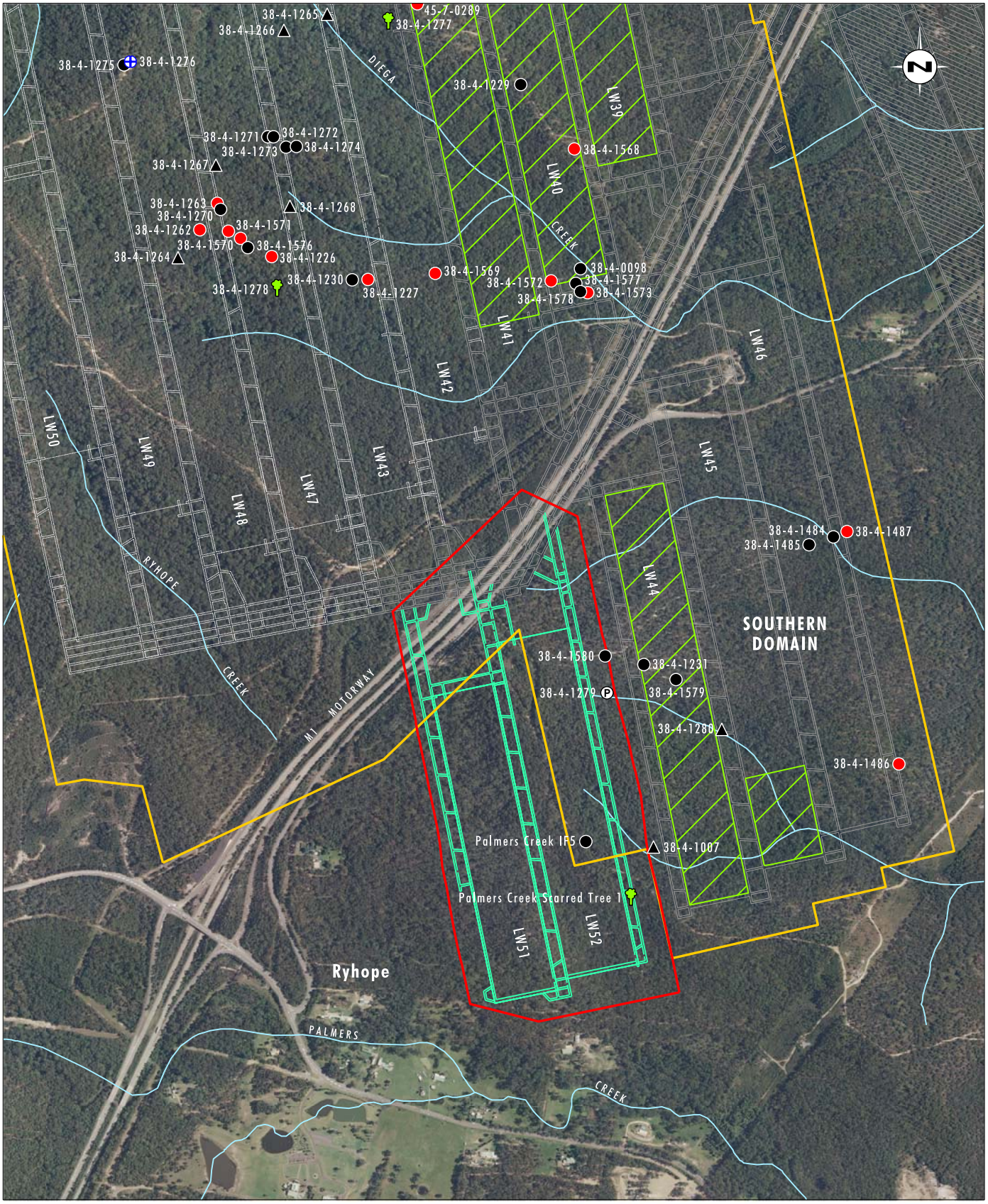

Image Source: OCAL (2008)
Data Source: OCAL (2013), LPI (2003)

0 250 500 750m
1:15 000

Legend

- Project Area
- Approved Continued Underground Mining Area
- Approved Underground Workings in the West Borehole Seam
- Proposed Longwall Panels 51 and 52
- Longwall Progression as of October 2013
- Former Underground Workings
- Artefact Scatter (Open Camp Site)
- Axe Grinding Groove
- Grinding groove with PAD
- Isolated Find
- Scarred Tree or Carved Tree
- Stone Arrangement
- Drainage Lines

FIGURE 8.2

Newly Identified and previously registered Aboriginal Archaeological Sites

File Name (A4): R02/3149_023.dgn
20131218 11.37

60 centimetres. The scar is in fair condition. The heartwood has been burnt, with some of the charred wood flaked off. The wood underneath seems to be solid and unaffected by insects or decay.

The tree is situated on an upper slope 50 metres south of the spur crest, with the scar on the east face of the tree, towards the spur crest. The scar is not visible from the track on the spur crest, which passes through a saddle between two high points in this area.

Palmers Creek IF5

Palmers Creek IF5 consists of a silcrete broken flake on a mid slope of a spur crest in the centre of a four wheel drive track. The track is used by WWC, Ausgrid, NPWS and motor bikes. Recreation four wheel drive access is limited as there is a locked gate at the access point from Wakefield Road.

The access track has been impacted by vegetation clearance, erosion and vehicle movements.

8.3 Registered Aboriginal Party Observations during the Survey

Peter Townsend (ALALC), identified the scarred tree during the survey, and felt strongly that it was an Aboriginal cultural scar. No additional statements or observations were made by the registered Aboriginal party representatives during the survey.

8.4 Survey Coverage and Effective Visibility

The survey area was broken into four areas (refer to **Figure 8.1**).

Table 8.1 – Survey Results and Effective Coverage

Area #	Area (m^2)	Landform	General Visibility		Exposures	Effective Coverage	
			%	Area (m^2)	Area (m^2)	%	Area (m^2)
SA1	97,386.7	Spur Crest, Upper slope, Modified	0	0	1,832	1.9	**1832**
SA2	102966.9	Upper slope, Modified	0	0	5,285.7	5.1	**5,285.7**
SA3	108,860.9	Mid slope, Lower slope, Drainage line, Modified	0	0	1,009.8	0.9	**1,009.8**
SA4	70,575.2	Spur Crest, Upper slope, Modified	0	0	1,151.9	1.6	**1,151.9**
Total	**379,789.7**		**0**	**0**	**9,279.4**	**2.4**	**9,279.4**

As shown in **Table 8.1**, overall ground surface visibility in the survey area was poor (2.4%), as it passes mainly through uncleared or revegetated bushland with extensive vegetation coverage. Poor ground surface visibility indicates that surface artefact scatters and isolated finds (if they existed in the area) may go undetected during survey. Visibility on the vehicle tracks (modified) was better (up to 5.1%).

Soils within the survey area were generally estimated to be between 5 and 15 centimetres in depth, depending on the level of vegetation clearance and gradient of slope. Soils on the spur crest tended to be shallow due to erosion following historic tree clearance. This has been exacerbated on the access track, where the lack of vegetation has allowed increased erosion to wash the topsoil down slope, leaving very skeletal soils, exposed sandstone bedrock or clay.

8.5 Archaeological Potential of the Landscape

The drainage lines present in the survey area were thickly vegetated and did not have any visible outcropping sandstone or areas where water would pool. The drainage lines were steep, first order tributaries of Palmers Creek assessed as unsuitable for the location of grinding grooves and thus as having low archaeological potential for this site type.

The spur crest was assessed as the most likely location for artefact scatters and isolated finds if they were to occur within the broader Project Area. This prediction was based on the identified use of the spur crests as Aboriginal travelways. Only skeletal soil remained on the track that runs along the spur crest, limiting the potential for subsurface archaeological deposit and leading to the exposure of only one artefact. Thus the spur crest was assessed as having low archaeological research potential.

No stone arrangements were located in the Project Area. As discussed in **Section 7.0**, if stone arrangements were located in the Project Area they would most likely have been on the travelway (spur crest) and acted as direction markers, rather than burial markers as burials were generally avoided by Aboriginal people, thus putting them on a travelway would not be appropriate. Similarly scarred trees used as direction markers would be on the spur crest. However, if these site types ever existed historic activities related to logging and track construction would have acted to destroy them within the Project Area. These conclusions reinforce the earlier assessment of low archaeological potential for the spur crest landform.

The presence of a scarred tree on the upper slope in the Project Area indicated that despite substantial logging occurring in the Sugarloaf Range, a few old growth trees do remain. The scarred tree was not visible from the track along the spur crest, and therefore was unlikely to have been a direction marker. It is assessed as unlikely that further scarred trees remain in the Project Area and thus the upper slopes and steep slopes in general are assessed as having low archaeological potential.

Overall, the landscape within the Project Area is assessed as having low archaeological potential.

8.6 Assessment of the Predictive Model

The predictive model presented in **Section 7.0** identified the likely site types to occur within the Project Area, and their likely distribution, content and integrity. It also presented site types that are known to occur in the Sugarloaf Range area, and why they are unlikely to be present in the Project Area.

As shown in **Table 8.2**, the predictive model was generally supported.

Table 8.2 – Assessment of the Predictive Model

Prediction	Survey Result	Assessment of Predictive Model
The mostly likely Aboriginal sites to occur are sites containing stone artefacts (either small artefact scatters or isolated finds).	One isolated artefact was identified during the survey.	The predictive model is supported.
Sites containing stone artefacts are likely to be located on the spur crest, but are only likely to be visible in areas where ground surface visibility is favourable such as on vehicle tracks and areas of disturbance.	One isolated artefact was identified on an access track on the midslope of a spur crest during the survey.	The predictive model is supported.
Redeposited A1 and A2 from the spur crest upslope may be present in the Project Area, this may contain small numbers of artefacts eroded from the spur crest and redeposited/reburied on the slope.	No surface artefacts were identified on the slopes. The increased soil depth on the slope suggests soil may be washing down slope and may have small numbers of buried artefacts redeposited on the slopes.	The predictive model is partially supported.
It is unlikely that further grinding grooves will be located within the Project Area, since there are only minor drainage depressions within the Project Area.	Only minor drainage depressions identified, with no outcropping sandstone or further grinding grooves identified.	The predictive model is supported.
The existence of rockshelters in the current Project Area and immediate surrounds is unlikely, as the topography is unsuitable.	No rockshelters were present within the Project Area.	The predictive model is supported.
Aboriginal oral history and ethnographic accounts suggest that burials marked by stone arrangements are unlikely but could occur within the Project Area. Stone arrangements as direction markers may be present on travel ways.	No stone arrangements were identified in the Project Area.	The predictive model was partially supported. No burials or direction markers marked by stone arrangements were identified.
Aboriginal oral history suggests that scarred trees (some of which may be related to ceremony) could occur within the Project Area if mature trees remain.	A scarred tree was identified in the Project Area.	The predictive model was supported.
Ethnographic accounts and the topography of the area, as well as previous regional models for Aboriginal landscape use within the Sugarloaf Range area suggest that the spurs and ridges would have provided access to, and negotiation of, the steep escarpment country and a travelway through the area to the south/south-west.	The location of the isolated find on the midslope of the spur crest supports the Aboriginal oral history. The stone used for artefact manufacture at the sites was Nobby's tuff which is available within Awabakal territory.	The predictive model is supported in relation to travelways, as the isolated artefact was located on a spur. The raw material used for artefact manufacture is locally available.

9.0 Significance Assessment

This section of the report assesses the Aboriginal cultural heritage and archaeological significance of the Project Area landscape, Palmers Creek ST1 and Palmers Creek IF5. Archaeological significance is a scientific value determined by archaeologists based on the research potential of the site. Aboriginal cultural heritage significance can only be determined by the registered Aboriginal parties. Even though a site may not have archaeological significance, it may still have cultural significance to Aboriginal people. It is important to assess both the Aboriginal cultural and archaeological significance of the landscape of the Project Area, Palmers Creek ST1 and Palmers Creek IF5 in order to develop an appropriate strategy for site management.

9.1 Aboriginal Cultural Significance

As stated above, Aboriginal cultural heritage significance can only be assessed by the relevant Aboriginal parties. For a particular site, the cultural significance can differ from the assessed archaeological significance. The Aboriginal cultural significance of a site is derived from the value and importance that the Aboriginal people place on that site.

Throughout the consultation process for the WWCCOP, the ACHMP (Umwelt 2012) and during ongoing consultation with ADTOAC, ALALC, ATOAC and CCC in relation to the current Project Area it has been made clear by the registered Aboriginal parties that the entire Sugarloaf Range (including the Project Area) is of traditional, historic and contemporary cultural significance to the Awabakal and the Aboriginal people that live within Awabakal Lands. This significance is not limited to the archaeological sites identified.

All of the registered Aboriginal parties agree that all of the sites identified are significant, and are interconnected. They stated that two sites on their own cannot be separated from the other sites in the surrounding landscape and that the cultural landscape as a whole is what makes them significant. Both Palmers Creek ST1 and Palmers Creek IF5 have been assessed as having extremely high Aboriginal cultural value. The registered Aboriginal parties have advised that:

- the two new sites have been given ‘Extremely High’ Aboriginal cultural significance due to their connection with the other sites in the landscape; and
- the mapping of recorded sites shows that there is continuous use of the landscape from Lake Macquarie all the way up to and including the Sugarloaf Range.

9.2 Archaeological Site Significance

9.2.1 Assessment Criteria

The archaeological significance of Aboriginal archaeological sites is primarily assessed according to their value to contribute to the archaeological/scientific understanding of Aboriginal culture (their research potential). Six criterion underlie the archaeological assessment process, being:

- **rarity**: whether site location and/or type, integrity, contents, and/or archaeological potential is common or rare within the local and regional context;

- **representativeness**: whether the site location and/or type, integrity, contents, and/or archaeological potential is common or uncommon within a local and regional context and whether sites of similar nature (or in better condition) are already set aside for conservation within the region;

- **integrity**: whether the site has the potential to contain subsurface archaeological material that has stratigraphic and/or spatial integrity;

- **connectedness**: whether the site is connected to sites in the local area or the region through chronology, site type, the use of an unusual raw material, knapping technique/reduction strategy, grinding technique and/or information provided by Aboriginal oral history, or has included within its boundary other site types (e.g. a grinding grove site with an associated rockshelter and surface artefact that are assumed to relate to the visit that resulted in the grinding groove);

- **complexity**: whether the site exhibits or is predicted to contain either a complex assemblage of stone artefacts in terms of artefact types and/or raw materials, artefacts of significance to understanding social interactions between Aboriginal groups, or features such as hearths or heat treatment pits, activity areas; or has included within its boundary other site types (e.g. a scarred tree/carved tree, grinding grooves, engravings etc. within an artefact scatter site); and

- **potential for archaeological deposit**: whether the site has the potential for artefactual material in a subsurface context. In this instance the artefactual material may or may not retain stratigraphic and/or spatial integrity, but has the potential by its investigation to provide information that would assist with gaining a greater understanding of the Aboriginal use of that part of the landscape or social interaction between Aboriginal groups.

9.2.1.1 Evaluation of Criteria

Local significance was ranked based on information known about the individual site and in relation to other sites (of the same type/within the same landscape) known from the local area (Sugarloaf Range area) and regional significance was based on a comparison with other sites known from the broader Newcastle/Lake Macquarie/lower Hunter Valley region.

One scarred tree (Palmers Creek ST1) was identified in the Project Area and one isolated artefact (Palmers Creek IF1) was identified during the survey within the area overlapping with the WWC continued underground mining area.

9.2.2 Palmers Creek IF5

Palmers Creek IF5 was assessed as having low archaeological significance. The low archaeological significance ranking was due to a combination of the following:

- small artefact scatters and isolated finds are common site types in the locality and region, and are not considered rare and thus the isolated find is assessed as having low archaeological significance for rarity;

- small artefact scatters and isolated finds are common site types in the locality and region, with numerous similar sites located outside the Project Area in similar landscape contexts, however, none of these are currently being actively managed for their long-term conservation. Thus the isolated find is assessed as having moderate archaeological significance for representativeness;

- the archaeological integrity of the site is low, due to its location in an area of high disturbance resulting from historic logging and track construction, use and maintenance and geomorphic processes (erosion). These activities/processes have resulted in a site with no potential for stratigraphic or spatial integrity. Thus the isolated find is assessed as having low archaeological significance for integrity;

- there is no archaeological evidence for connectedness between this isolated find site and other nearby sites. Thus, the isolated find site is assessed as having low archaeological significance for connectedness; and

- the site area has no potential for subsurface artefacts and thus does not retain potential archaeological deposits or archaeological research value. Thus the isolated find site has low archaeological significance for potential archaeological deposits.

9.2.3 Palmers Creek ST1

Palmers Creek ST1 was assessed as having moderate archaeological significance. The moderate archaeological significance ranking was due to a combination of the following:

- the moderate rarity of scarred trees in the locality and region. Thus the scarred tree was assessed as having moderate archaeological significance for rarity;

- scarred trees are not common site types in the locality or region, but there are a few similar sites located outside the Project Area in similar landscape contexts. These trees however are within mine leases and while being managed for subsidence impacts will not be actively managed for their long-term conservation following the cessation of mining. Overall, the scared tree is assessed as having moderate archaeological significance for representativeness;

- the scarred tree and the scar are in good condition. Thus the scarred tree is assessed as having moderate to high archaeological significance for integrity;

- as the tree has only a single scar and is not directly associated with any other archaeological material, it is assessed as having low archaeological significance for complexity; and

- the location of the scarred tree on an upper slope subject to erosion indicates that it has no potential for subsurface archaeological material. Thus the screed tree is assessed as having low archaeological significance for PAD.

9.2.4 Archaeological Research Potential

The research potential of a site is assessed on the basis of the potential for the site, through further investigation, to add significantly to our understanding of the Aboriginal past. As limited archaeological investigation has been undertaken within sites in the Sugarloaf Range area all new information gathered from site investigation is adding significantly to what is currently known about the Aboriginal use of the area. Thus there are no sites within the proposed continued underground mining area that can be assessed as having no archaeological research potential.

A number of factors contribute to the assessment of archaeological research potential, including the complexity of the site, how well preserved the site is, how the site relates to prevailing research themes, and whether the site is able to provide information that is not otherwise available. Based on these criteria Palmers Creek IF1 and Palmers Creek ST1 are assessed as having low research potential. However, as identified in the 2010 assessment

(Umwelt 2010), the broader Sugarloaf Range/SSCA in general is an area worthy of further archaeological investigation.

9.3 Archaeological Significance of the Landscape

The continued underground mining area assessment (Umwelt 2010) extrapolated from the identified archaeological significance of the sites located within the continued underground mining area, when assessing the level of archaeological significance of the various landform types. Higher levels of significance were afforded to the main Sugarloaf Ridgeline and the upper reaches of the creek lines with sites of higher archaeological significance (e.g. grinding groove, stone arrangement and rockshelter sites) with lower levels of significance afforded to landforms towards the base of the range where site types mainly included small artefact scatters and isolated finds.

The current Project Area is located in the lower reaches of the Range and does not contain any of the site types that increase the significance of the landscape within the continued underground mining area (e.g. grinding grooves, rockshelters, stone arrangements). The Project Area is assessed therefore as having low to moderate archaeological significance based on the moderate archaeological significance of Palmers Creek ST1, the low archaeological significance Palmers Creek IF5 and the low archaeological potential of the remainder of the Project Area.

9.4 Aboriginal Cultural Significance of the Landscape

ATOAC identified in correspondence (refer to **Appendix A**) that they believe that the Aboriginal cultural significance of Sugarloaf had already been covered within **Section 11.2.3**.

ADTOAC stated that this area is of high significance, being part of their Traditional Country and is considered to be of great importance within their Cultural Heritage.

> *This area has not just a physical presence within the Cultural Heritage of the Awabakal People but it is part of our oral history and a place of spiritual significance. Our apical Ancestor Mahrahkah, an Awabakal woman, and her two daughters, were recorded by Threlkeld and Warner as living in and around these areas which all formed part of their Traditional Country. This apart from everything else makes it a very important location for our family, knowing that Mahrahkah walked these areas before any white man was ever seen in the Newcastle and Lake Macquarie areas. She was intrinsically acquainted with her Land and she has left a legacy for us to carry on in this day and to pass onto our Descendants.*
>
> *It is our desire to see this legacy continue in the protection and preservation of our Cultural Heritage, not its demise and destruction. That is why it makes it a very hard task for us to be part of the process of making decisions when developments are proposed as they nearly always involve the degradation and destruction of our Cultural Heritage. It is very difficult for us to see our Cultural Heritage compromised by 'development' as it causes much heartache for our People knowing that due to 'progress' our physical connection to the past is becoming more of a chasm than a gap in time. This is our Cultural Heritage that is being put on the line!! This is our physical link to our Ancestors that can be destroyed in the process!! Once it is disturbed or destroyed it is this way forever!! It may be easy for others to make what we consider to be dismissive and erroneous decisions with good intentions about what has been passed down to us from our Ancestors; but what most consider to be progression and advancement, is for us, what ultimately cuts us off a little bit more from our Ancestors and Cultural Heritage!!*

ADTOAC has identified that the Project Area includes a culturally significant ridgeline that was used as a pathway by Awabakal people to access the southern end of the Sugarloaf Range. The number of registered sites associated with the ridgeline running from the lake to the mountain indicated that there was a high degree of usage of the area and it is important that there is no disturbance in the area.

10.0 Impact Assessment

The following discussion relates to the two newly recorded sites, Palmers Creek IF5 and Palmers Creek ST1 as well as the previously recorded grinding groove sites (#38-4-1007 and #38-4-1279). The two grinding groove sites were assessed as part of the WWCCOP and in view of their Aboriginal cultural heritage and archaeological significance the mine plan was modified to avoid subsidence impact at that time (refer to **Section 11.1.1** and Umwelt 2010b). The isolated artefact (#38-4-1580) was not identified until 2010 and has been collected under the protocols of the ACHMP (Umwelt 2012a) and thus will not be considered further here.

Direct impacts and indirect impacts are used to discuss potential impacts to the Palmers Creek Grinding Grooves 1 (#38-4-1007) and Palmers Creek Grinding Grooves 2 (#38-4-1279) sites. Direct impacts refer to potential subsidence impacts that would act directly on the grooves, such as cracking, should this be predicted to occur. Indirect impacts refer to potential impacts on the grooves that are the result of subsidence impacts elsewhere, such as the potential for increased sediment washing over the grooves should there be ground disturbance upstream of them associated with subsidence cracking or subsidence remediation works.

10.1 Surface Infrastructure

No impacts to Aboriginal sites are proposed due to surface infrastructure. The locations of possible future ventilation infrastructure will not be known until after mining has commenced. Similarly, the location of any further coal quality boreholes is currently unknown. It will be necessary for these areas to be assessed for their Aboriginal cultural and archaeological significance once they have been identified. They can then be managed in compliance with Section 8.9 of the ACHMP (Umwelt 2012a) which will be revised in consultation with the registered Aboriginal parties and the NPWS/OEH to incorporate all additional management measures arising from the modification to the existing Project Approval to include the Project Area.

10.2 Potential Subsidence Impacts

Subsidence can be generically described as the downward movement of the ground surface in response to the rock layers above the coal extraction area temporarily separating, moving down sequentially to fill the gap created by movement of the layer below, and then interfacing again once subsidence is complete. It is noted that subsidence can also result in horizontal ground movements and changes to the slope of the ground surface. These movements are significantly smaller in magnitude in comparison to the vertical component.

10.2.1 Vertical and Horizontal Displacement

Subsidence movements will permanently displace the ground surface, with a series of hollows over the centre of each of the longwall panels and a series of humps over each remaining solid pillar of coal. These will not be uniform either laterally or longitudinally over the longwall panel. This undulating surface profile is usually imperceptible to the naked eye because it is small relative to the large horizontal distances across each longwall panel.

10.2.2 Subsidence Cracking

The proposed underground mining operations will result in subsidence above the two extracted longwall panels. Subsidence can lead to surface cracking and changes to surface and subsurface groundwater movement that may impact on grinding grooves and scarred trees. The subsidence impacts associated with the Project may include cracking of the surface soil profiles and sandstone outcrops and there is also the potential for a small number of trees to fall over on steep slopes in high tilt areas. Tree falls within these areas are not expected to be widespread.

Cracking of soil profiles is less likely than sandstone outcrops for a given tensile strain due to the ability for soils to distribute strain more uniformly than stiffer bedrock with natural jointing. Cracking of surface bedrock on the other hand, is more likely in areas with wider spaced jointing present, as tensile strains tend to concentrate at open joints before generating fresh cracks. The likelihood of cracking due to the predicted tensile strain is presented in **Section 10.2.3** and has considered the observed pre-mining conditions at each of the sites and their likely response to the predicted strains.

Cracking of surface soils also has the potential to enhance erosion adding sediment load to creek lines, which in turn can act to erode and/or bury any grinding groove sites downslope of these areas. The level of risk associated with this potential impact is related to the area likely to be affected at any one time, the proposed rehabilitation measures to remediate this cracking and the time required for effective rehabilitation or natural stabilisation. In the case of the proposed additional two longwall panels and based on the subsidence assessment findings, it is unlikely that large areas will be disturbed at any one time. Rehabilitation works will effectively remediate these areas in a relatively short timeframe, making adverse effects on Aboriginal sites due to erosion and sedimentation highly unlikely.

As a result of the predicted vertical subsidence, there is the potential that surface cracking may occur where tensile stresses and strains develop along the edges of longwall panels and at the tops of topographic high points. Cracking may also occur at regular intervals along the centre of the panels and be interspersed with compression humps above the retreating longwall face. Surface cracking and shearing is expected to develop within tensile and compressive strain zones and range in width from 110 millimetres to 250 millimetres across the longwall panels, however, in areas of ridges or steep slopes subsidence cracks may develop up to approximately 830 millimetres.

Outside the longwall panels there is also the potential for surface cracking to occur in topsoil and within sandstone outcrops due to the angle of draw related to the removal of longwall panels at depth. This potential is assessed as being much lower and less likely than within the area directly above the longwall panel extraction limits.

There are several small areas of low depth of cover (80 metres to 100 metres) within the Project Area. The proposed Longwall 51 and Longwall 52 have been designed to minimise the potential for connective cracking as a result of underground mining. However, to further minimise the potential for surface water impacts and subsequently any mine safety issues, any subsidence cracks which occur will be remediated as soon as possible following identification of the cracks.

The presence of these cracks will be monitored as part of the subsidence monitoring program. In the event that such cracks are observed, options for re-sealing of the cracks will be assessed and implemented. Where possible, access to undertake the remediation works will use existing access tracks, however, due to the nature of the areas and the existing vegetation cover, the establishment of minor access tracks may be required to allow the remediation activities.

It is expected that remediation activities will involve the use of grout to fill any subsidence cracks and to minimise the requirement to clear vegetation. In the event that the remediation works are to be undertaken in an area of slope in excess of 35 degrees, it is likely that tracked machinery will be required to undertake works up slope of the area to direct water from the site.

The subsidence impacts detailed above have been estimated based on the subsidence modelling undertaken by Ditton Geotechnical Services (DGS) Pty Ltd (2013) and are also based on the experience of WWC's mining within the SSCA. The area of subsidence remediation required over Longwall 51 and Longwall 52 will be consistent with the nature of subsidence impacts observed for mining undertaken previously by WWC.

10.2.3 Assessed Potential Impact to Known Sites

The following potential impacts have been taken into account in this impact assessment:

- cracking of sandstone benches, platforms within creekbeds which has the potential to damage grinding groove sites outside of the mining area;
- cracking of sandstone benches, platforms, creekbeds which has the potential to cause waterflow to drain from the creekbed changing the environment of the grinding groove sites outside of the mining area;
- the potential for increased sediment loads in creeklines (due to erosive processes instigated by subsidence) to abrade and wear away grinding grooves and/or to bury grinding groove sites outside of the mining area;
- the cracking of sandstone bedrock which has the potential to change groundwater available to the living scarred tree which could result in its death;
- tree fall which may cause death of the scarred tree; and
- the potential for the cracking of soils within sites to damage sites directly or through the need to undertake subsidence remediation works.The following discussion of predicted and possible impacts to the known Aboriginal archaeological sites located within the Project Area is based on a recent subsidence prediction and impact assessment completed by DGS (2013). **Figure 10.1** shows the Project Area and the known Aboriginal archaeological sites as they relate to the predicted 20 millimeter subsidence contours. It is noted that the isolated find site (38-4-1580) has already been salvaged and thus is not discussed further.

DGS assessed the potential for damage to the Aboriginal archaeological site features based on predictions for 'final subsidence, tilt, strain and surface gradient change contours'. **Table 10.1** indicates the impact potential criteria used by DGS and provides a key for understanding **Table 10.2** provided in **Section 10.3**.

Table 10.1 – Impact Potential Criteria for Aboriginal Archaeological Sites

Key	Cracking Potential	Indicative Probabilities of Occurrence	Predicted 'Smooth profile' Tensile Strain (mm/m)
VL	Very Low	Very Unlikely (<5%)	<1.0
L	Low	Unlikely (5 -10%)	1.0 – 1.5
M	Moderate	Possible (10 - 25%)	1.5 – 2.5
H	High	Likely (>25%)	>2.5
Key	**Erosion Damage Potential**	**Indicative Probabilities of Occurrence**	**Predicted Surface Gradient Change**

Image Source: OCAL (2008)
Data Source: OCAL (2013), LPI (2003)

0 250 500 750m
1:15 000

Legend

- Project Area
- Approved Continued Underground Mining Area
- Approved Underground Workings in the West Borehole Seam
- Proposed Longwall Panels 51 and 52
- Longwall Progression as of October 2013
- Former Underground Workings
- Artefact Scatter (Open Camp Site)
- Axe Grinding Groove
- Grinding groove with PAD
- Isolated Find
- Scarred Tree or Carved Tree
- Stone Arrangement
- Drainage Lines
- 20mm Predicted Subsidence Contour

FIGURE 10.1

Aboriginal Archaeological Sites and Predicted Subsidence Contour

File Name (A4): R02/3149_030.dgn
20131218 11.47

Table 10.1 – Impact Potential Criteria for Aboriginal Archaeological Sites (cont.)

Key	Cracking Potential	Indicative Probabilities of Occurrence	Predicted 'Smooth profile' Tensile Strain (mm/m)
VL	Very Low	Very Unlikely (<5%)	<0.3%
L	Low	Unlikely (5-10%)	0.3-1%
M	Moderate	Possible (10 - 25%)	1-6%
H	High	Likely (>25%)	>6%

Data provided in DGS 2013

10.3 Analysis of Potential Subsidence Impacts to Sites/Predicted Loss of Aboriginal Cultural and Archaeological Value

Table 10.2 lists the sites located within the Project Area and the 'worst-case' level of impact predicted for each site by DGS (2013). The table also provides the assessed likely outcome of the predicted impact of subsidence and remediation works (mitigation options will be discussed in detail in **Section 10.4**). In order to assist with the assessment of the loss of Aboriginal cultural and archaeological values, **Table 10.2** also provides information in relation to the Aboriginal cultural significance of the site, the archaeological significance of the site and the site's assessed research potential.

Table 10.2 – Potential Site Impacts/Possible Mitigation Options

Site Name	Aboriginal Cultural Significance	Archaeological Significance	Research Potential	DGS Impact Potential	Assessed Outcome of Potential Impact
#38-4-1007 (Palmers Creek Grinding Groove 1)	Extremely High	High	Low to Moderate	VL	No direct impact – outside of longwall layout. Area to the north and south also outside of longwall layout. Possibility of indirect impact from increased sediment load in creekline which may act to abrade/bury grinding grooves. Potential mitigated by effective subsidence remediation strategy.
#38-4-1279 (Palmers Creek Grinding Groove 2)	Extremely High	High	Moderate to High	VL	No direct impact – outside of longwall layout. Area to the north and south also outside of longwall layout. Possibility of indirect impact from increased sediment load in creekline which may act to abrade/bury grinding grooves. Potential mitigated by effective subsidence remediation strategy.
Palmers Creek ST1 (scarred tree)	Extremely High	Low to Moderate	Low	VL to L	Impact from cracking of soil profile following subsidence is assessed as very low due to predicted tensile strains being <5 mm/m above the chain pillar between LWs 51 and 52. Impact from tree fall as a result of subsidence is also assessed as very low. Temporary loss of groundwater as a result of sandstone bedrock cracking is assessed as low to moderate up-stream of the scarred tree due to possible interaction with surface cracks and strata dilation. AND Remediation works to fix cracking/may damage tree/tree roots. Potential mitigated by subsidence remediation strategy for any works required in the vicinity of the tree to avoid impact. Requirements for clearing to allow access for remediation. Potential mitigated by WWC ensuring that any required access tracks do not impact on the tree.
Palmers Creek IF5	Extremely High	Low	Low	VL	Impact from cracking of soil profile following subsidence is assessed as high. Remediation works to fix cracking may damage surface artefact.

Table 10.2 indicates that:

- no direct impact is predicted for the two grinding groove sites (Palmers Creek Grinding Grooves 1 #38-4-1007 and Palmers Creek Grinding Grooves 2 #38-7-1279). These are sites of extremely high Aboriginal cultural significance and of low to moderate and moderate to high archaeological significance, as well as low to moderate and moderate to high research potential respectively. However, there is the potential for indirect impact from any increased sediment load in the creeklines due to subsidence. Any such additional sediment could act to abrade and/or bury the grinding grooves. This risk can be effectively mitigated through the implementation of an appropriate subsidence remediation strategy for any cracking that may result in erosion entering the creekline in which the grinding grooves occur;

- potential damage due to cracking of the soil profile and subsequent remediation is predicted for Palmers Creek IF5. This site is of extremely high Aboriginal cultural significance, low archaeological significance and low research potential; and

- potential impact to Palmers Creek ST1 due to tree fall and/or cracking of the soil profile/sandstone bedrock and subsequent remediation. This site is of extremely high cultural significance and moderate archaeological significance and low research potential.

10.4 Methods Available for Mitigation of Direct Impacts

Overall direct and/or indirect impact of varying extent is assessed as possible for all four of the known extant Aboriginal archaeological sites within the Project Area.

A number of methods/strategies are available to mitigate these direct and/or indirect impacts. Available mitigation options must be assessed for their appropriateness from an Aboriginal cultural and archaeological perspective. Examples of management/mitigation options include:

- design of the mine plan to avoid impact to sites/landscape features of high to very high and extremely high Aboriginal cultural value and/or of moderate, moderate to high and high archaeological significance and research potential (i.e. Palmers Creek 1 and 2 Grinding Groove sites). This has already been done as part of this Project with the mine plan designed to avoid impact on these sites;

- intervention to prevent damage (e.g. collection of artefacts prior to subsidence remediation works and their replacement when works completed);

- appropriate salvage of sites prior to impact (e.g. removal of the scarred tree and its conservation elsewhere);

- repairing cracks to the ground surface associated with the scarred tree;

- using clean imported fill, sourced from the closest available location, to repair soil cracking, rather than ripping/dozing;

- employing sediment retention measures upstream of the grinding groove sites to prevent abrasion/burial by additional sediment entering the creeklines following surface cracking; and

- after the implementation of the above mitigation measures, offsetting the potential for loss of Aboriginal archaeological sites through an offset/offsets assessed as appropriate by the registered Aboriginal stakeholders, DP&I, NPWS/OEH and from an archaeological perspective.

Typically a number of mitigation methods are compiled to form a management strategy for a project being assessed as a Major Project. The management strategy is implemented in compliance with an ACHMP prepared in consultation with the registered Aboriginal parties, the NPWS/OEH and a suitably qualified archaeologist. **Section 11.0** will discuss the management options available for the sites that may potentially be impacted by the project. The preferred management option for each site/landscape feature of Aboriginal cultural value will be incorporated into the management strategy provided in **Section 12.0**. **Section 12.1** will also summarise the requirements for the revision of the existing WWC ACHMP.

10.5 ADTOAC Comments

ADTOAC identified in their submission (refer to **Appendix A**) that they do not agree with the notion of indirect impacts on any of the Aboriginal sites within the Project Area, especially the grinding groove sites. They consider that any impacts are impacts.

ADTOAC states that for the previous mine plan (i.e. the currently approved mine plan) they were told that the Palmers Creek Grinding Grooves 1 and Palmers Creek Grinding Grooves 2 (#38-4-1007 and #38-4-1279) sites would not be impacted due to their high cultural value. The ADTOAC noted that Palmers Creek Grinding Groove 2 (#38-4-1279) is within the 20mm predicted subsidence contour line (refer to **Figure 10.1**). The ADTOAC expressed that they consider that this means it is within the probability of sustaining direct impacts due to subsidence not only indirect impacts of sediment wash.

ADTOAC note that they have no faith in the calculations made about what degree of damage or disturbance will be created due to subsidence as they believe that they are at best educated guesses based on very limited knowledge of what is really going on below the ground. They cited previous experience (damage to a set of grinding grooves on Cockle Creek) and the revelations of 'massive damage' within the SSCA regarding unprecedented subsidence to support this view.

WWC has indicated it notes the above comments from ADTOAC. WWC has advised that it is committed to ensuring that impacts to Palmers Creek Grinding Grooves 1 and 2 are effectively mitigated by leaving a substantial barrier of coal under the area. OCAL notes that the resource that has been sterilised to protect these two grinding grooves is approximately 670,000 tonnes of run-of-mine coal. WWC considers that the detailed subsidence assessment completed for the Project which indicates a very low potential for impact as accurate and appropriate. WWC also notes that the potential for indirect impacts due to sediment mobilisation due to cracking can be effectively managed and is confident that with the controls currently in place this potential impact will not occur.

11.0 Management Options and Intergenerational Equity

11.1 Management Options

From an archaeological perspective, Aboriginal archaeological sites are a finite and irreplaceable resource that has already been heavily impacted by residential, agricultural, infrastructure, mining and other development in the broader Hunter Valley. Thus OEH requires proposals for site damage/destruction to be accompanied by appropriate mitigation (site salvage and/or management) and to be balanced by site and/or other conservation offset measures. Therefore, the management options discussed within this section of the report span conservation, conservation offsets and impact mitigation. It is proposed that the WWC ACHMP (Umwelt 2012a) will be updated to include the management requirements for the new sites.

11.1.1 Conservation – Mine Plan Modification

It is noted that the currently approved WWC mine plan was modified from its originally proposed layout to exclude undermining of Palmers Creek Grinding Grooves 1 (#38-4-1007) and Palmers Creek Grinding Grooves 2 (#38-4-1279) due to their extremely high Aboriginal cultural value (Umwelt 2010). Similarly in 2005, undermining of the Palmers Creek Grinding Grooves 1 (#38-4-1007) was removed from the mine plan for the Southern Domain to protect its cultural values. Thus these sites have already been recognised for their conservation value and there are existing commitments for their ongoing protection from mine impacts (Umwelt 2010, 2012a). Consistent with this approach, the mine plan for longwalls 51 and 52 has been designed to not mine under Palmers Creek Grinding Grooves 1 (#38-4-1007) or Palmers Creek Grinding Grooves 2 (#38-4-1279).

Palmers Creek Grinding Grooves 1 (#38-4-1007) and Palmers Creek Grinding Grooves 2 (#38-4-1279) are not within the longwall layout for the Project and are at the extremity of the area of the predicted subsidence contours. Thus direct impact by subsidence is assessed highly unlikely (DGS 2013). However, without appropriate management, there is the potential for additional sediment load in the creeklines due to erosion of areas affected by subsidence cracking. As part of the Project, WWC will implement appropriate subsidence monitoring measures to ensure that impacts do not occur from sediment erosion.

Due to the economic considerations when designing the mine plan, the feasibility of reducing the extent of the proposed mine layout to avoid impacts to Palmers Creek ST1 and Palmers Creek IF5 is not assessed as a viable option.

11.1.2 Salvage

Palmers Creek IF5 is located on an access track which may require remediation following subsidence. The ACHMP (Umwelt 2012a) provides for temporary surface collection of artefacts identified on access tracks where vehicle use/track maintenance/subsidence remediation is assessed by the registered Aboriginal parties and a suitable qualified archaeologist as likely to result in harm to the artefacts. It is assessed that the most appropriate management option for Palmers Creek IF5 is to collect the surface artefact in compliance with a revised version of the ACHMP that includes the management of Aboriginal archaeological sites in the current Project Area. The artefact will be returned to the Palmers Creek IF5 site area following cessation of subsidence remediation works. The artefact will be returned as close as possible to its collection location. A new site card will be provided to OEH identifying the new location.

Salvage of Palmers Creek ST1 is not thought appropriate as a first option as it would be necessary to kill the tree in order to salvage it and move it from danger of impact. As there is a reasonable possibility that the scarred tree may not be impacted by subsidence, tree removal should only be considered as a last resort.

Thus it is considered that the most appropriate management option is to monitor the scarred tree following subsidence to assess the level of impact (if any) and to employ the most appropriate subsidence mitigation for the ongoing care of the tree. Mitigation options following cessation of subsidence could include:

a. there are no obvious subsidence impacts to the tree or the soil profile in its surrounds – management option: re-inspect the tree approximately at one and three months after undermining and if still in good health no further management required; OR

b. there are no obvious subsidence impacts to the tree but the soil profile in its surrounds has cracked – management option: infill the cracks as soon as practicable with clean imported fill, sourced from the local area - re-inspect the tree approximately at one and three months after undermining and if still in good health no further management required; OR

c. the tree has fallen and/or the tree is dying - management option – with the assistance of a suitably qualified aboriculturalist remove the section of the tree with the scar – treat the section of the tree removed for its preservation and in consultation with the registered Aboriginal parties determine an appropriate location for its ongoing storage.

11.1.3 Mitigation of Subsidence Impacts

It is assessed that the ACHMP (Umwelt 2102a) should be revised to incorporate all management/mitigation measures required for the modification (the current Project Area). The following mitigation measures should be undertaken in compliance with the revised ACHMP.

Palmers Creek Grinding Grooves 1 (#38-4-1007) and Palmers Creek Grinding Grooves 2 (#38-4-1279)

As noted in **Section 11.1.1**, mitigation for the Palmers Creek Grinding Grooves 1 (#38-4-1007) and Palmers Creek Grinding Grooves 2 (#38-4-1279) sites should be limited to preparing and implementing a monitoring program of Palmers Creek that identifies any additional sediment derived from ground surface cracking that may enter these sites, or other changes to the creek occur. The mine plan has been designed to avoid direct impact from subsidence on these two sites.

The registered Aboriginal parties stressed their view that there cannot be any damage to these sites. They indicated that as these sites have already been removed from the original mine plan, they would not consider it satisfactory even to limit impacts to increased sediment, as these are still impacts to the sites. If the prediction is that there won't be impacts to the sites, the registered Aboriginal parties have requested WWC advise what the offset measures for impacts would be, if any impacts occur.

The registered Aboriginal parties note that it is part of the previous mining approval that these sites were part of the offset package offered, therefore a new offset package should be offered, as the predicted subsidence contour shows a potential possible impact to the Palmers Creek Grinding Groove 2 (#38-4-1279) site.

Individual offset requests made by the groups in their comments on the report (refer to **Appendix A**) include:

- ATOAC feel that a new offset package should be discussed between the registered Aboriginal parties, which will need to be added within this document.
- ADTOAC note that consideration and discussion of what offsets will be offered if any sites are damaged must be a priority, and they do not feel that this has been adequately addressed.
- ALALC recommend that subsidence monitoring occur at one, three, six, 12 and 18 month subsidence monitoring intervals. It is felt that the current intervals are not sufficient and there is a need for ongoing monitoring as a result of subsidence issues that have recently been reported on in the media.

Palmers Creek IF5

As noted in **Section 11.1.2**, the most appropriate mitigation of the Palmers Creek IF5 site is to collect the artefact from the track to protect it from further harm by track use and from future subsidence remediation works (if required).

Palmers Creek ST1

As noted **Section 11.1.2**, there are several management options that may be applicable to the scarred tree depending on the level of impact is sustains during subsidence, if any. The mitigation option chosen must be decided based on monitoring of the condition of the tree following subsidence, with efforts directed towards keeping the tree alive and in its current location.

11.1.4 Impact without Mitigation

The registered Aboriginal parties note that from an Aboriginal cultural perspective, site impact without mitigation is not assessed as appropriate for any site. Thus impact without mitigation is not mitigation and is not discussed further.

11.1.5 Funding for Ongoing Monitoring/Reporting of Subsidence Impacts

It is assessed from an archaeological perspective, if underground mining is approved, that the monitoring and recording of the impacts of subsidence and the success of remediation is imperative. Data of this kind will be very useful for recalibrating impact assessments and very informative when assessing future underground mining proposals.

As part of the Project Approval for the existing WWC operations, there is a commitment to fund and manage a program of monitoring and reporting of subsidence impacts on Aboriginal archaeological sites and landscape features of Aboriginal cultural value recorded within the mining area. In compliance with the ACHMP (Umwelt 2012a) each site/landscape feature of Aboriginal cultural value has been/will be subject to pre-subsidence baseline recording followed by a post subsidence inspection in order to collect a detailed database on exactly how each of the sites/landscape features is impacted. The inspection and reporting is undertaken by the registered Aboriginal parties and a suitably qualified archaeologist.

In addition to recording subsidence impacts, the monitoring will provide a more detailed database of the outcomes of subsidence and the success of remediation works (where required) on all site types within the broader WWC area including the current Project Area (if approved). This level of recording has been rarely undertaken in relation to Aboriginal archaeological sites and landscape features of Aboriginal cultural value and will be extremely

informative to WWC, registered Aboriginal parties, archaeologists, NPWS/OEH and DP&I for undertaking and evaluating future assessments. A database of this nature will be an extremely valuable resource.

In this regard, for the current Project it is proposed to record the:

- impacts of subsidence (if any);
- requirements for remediation (if any);
- nature and extent of the remediation works;
- suitability of the remediation works;
- success of remediation works; and
- Project Approval compliance.

As part of the ongoing WWC compliance requirements baseline recording has already been undertaken for Palmers Creek Grinding Grooves 1 (#38-4-1007) and Palmers Creek Grinding Groove 2 (#38-4-1279). Post subsidence inspections and recording will be undertaken as required to inform the reporting process for OEH and DP&I. Baseline recording will be required as part of the proposed modification for Palmers Creek ST1 and Palmers Creek IF5 prior to subsidence.

11.2 Does the management approach proposed for the project give effect to these cultural concepts of Intergenerational Equity?

11.2.1 Cultural values: past, contemporary and future

The assessment process has provided the registered Aboriginal parties with the opportunity to provide information in relation to the contemporary and past cultural value of the Project Area and to identify those resources and landscape values that are/have been important to them through the survey and assessment process and from their oral history. Past and contemporary cultural values have been incorporated into the significance and impact assessments and have been used to justify/support the various management options presented in **Sections 11.1.1** to **11.1.5**. For the proposed modification, cultural values for the future have been addressed (as far as possible) through a variety of management outcomes aimed towards ensuring the conservation of the sites of extremely high cultural values into the future.

Cultural practice has been viewed in relation to the provision of access to the proposed underground mining area for the Awabakal participants (and the broader Aboriginal community) in order to continue the use and to participate in the management of an area of cultural importance. In this regard the approved ACHMP for WWC will be revised to support ongoing Aboriginal participation in the monitoring and management of the Project Area.

11.2.2 Sense of cultural identity (in this case what it means to be an Awabakal person or an Aboriginal person who lives within Awabakal lands)

Participating registered Aboriginal parties have been encouraged to provide information in relation to their sense of cultural identity and custodial rights and how these may be impacted by possible damage to Aboriginal archaeological sites within the Project Area. Information

provided has been used to assess site significance and to provide Awabakal people a voice in determining preferred management outcomes that will allow Awabakal descendents to maintain a sense of cultural identity/custodial rights when they visit the Project Area.

11.2.3 Attachment to the Awabakal traditional landscape

The participating registered Aboriginal parties and past Awabakal spokespeople provided as part of the WWCCOP a very heartfelt assessment of their attachment to the landscape of the WWC area and the Sugarloaf Range area in general, including the area that now forms part of the modification Project Area. This attachment to the landscape was recognised during the assessment process for the WWCCOP and mine plans modified in recognition of the significance of protecting a number of sites and landscape features identified as having particular Aboriginal cultural value. The Aboriginal cultural significance of the Project Area is the same as that identified for the whole of the Sugarloaf Range area and this was also taken into account when preparing the management strategy which aims to ensure that a representative sample of sites is conserved for the contemporary and future Awabakal peoples, whilst still allowing for mining feasibility.

11.2.4 The connection of culture and country – the dependence of cultural continuity on a 'healthy' natural landscape where biodiversity, watercourse health, land surface integrity etc are maintained or improved

During the survey period for the current project and for the WWCCOP, the participating registered Aboriginal stakeholders spoke of the importance of keeping their Country healthy. A great deal was said of the impacts to sites, places and resources that have occurred due to the construction of tracks into the Sugarloaf Range which have allowed access to 4WDs, motor bikes and rubbish dumpers. It is proposed that all data collected during ongoing monitoring be provided to OEH and DP&I to enable better management of the SSCA for contemporary and future generations of Awabakal people and that this will improve the health of the landscape.

11.2.5 Capacity to use cultural identity as a valid reason to influence approaches to land use, planning and management

WWC has recognised 'cultural identity' by encouraging the registered Aboriginal parties to bring their voice to this assessment report. WWC has recognised the validity of the use of 'cultural identity' to influence approaches to land use in its approach to mine planning and has for the existing WWC acted to sterilise an estimated 2.04 Mt of coal resource (calculated at the time of the WWCCOP Environmental Assessment, Umwelt 2010) based largely on the Aboriginal cultural value of sites and landscape features to the Awabakal. This includes conservation of Palmers Creek Grinding Grooves 1 (#38-4-1007) and Palmers Creek Grinding Groove 2 (#38-4-1279) within the boundaries of the current Project Area.

It is proposed that further influence in relation to land use will arise by participation of the registered Aboriginal stakeholders in the revision and ongoing implementation of the ACHMP for the approved WWC mining area and for the proposed modification mining area and by providing the registered Aboriginal parties with a means to provide advice in relation to the location and management of sites within the SSCA. In this manner the Aboriginal party representatives will have the opportunity to influence WWC and the NPWS/OEH's approach to land use planning and management, so that it is more culturally appropriate from an Awabakal perspective.

11.2.6 Protection of a diverse and accessible suite of physical evidence of cultural connectedness to the landscape, through sites, artefacts and landscape features of cultural value

It is proposed that the management outcomes presented within this report (prepared in consultation with the registered Aboriginal parties) will act to protect a 'suite of physical evidence of cultural connectedness to the landscape' through appropriate management of sites, through the conservation outcomes and by the management strategy proposed.

11.2.7 Ongoing awareness and passing on, within the community, of traditional knowledge (stories, resources, methods, rights, obligations and ceremonies)

It is proposed that this will be enabled through a greater understanding of the cultural resource of the SSCA that will arise as part of the management strategy and through the involvement of the registered Aboriginal parties in the management of that resource.

11.2.8 Aboriginal community well being, as indicated by feelings of involvement/engagement, respect, trust and cooperation

It is proposed that this will be achieved through the involvement of the registered Aboriginal parties in the management of Aboriginal cultural heritage within the approved WWC mining area, the current Project Area and broader SSCA and that as an outcome of the working relationship that has developed and will continue to develop between WWC and the registered Aboriginal parties and the NPWS/OEH, that mutual respect, trust and cooperation can grow.

11.3 Aboriginal Stakeholder Comment on Intergenerational Equity

The observations that the registered Aboriginal parties made to Intergenerational Equity in their comments (refer to **Appendix A**) on the report included:

- ADTOAC have asked what has been put in place to cover the Intergenerational Equity if these sites are destroyed. ADTOAC believe that this has not been adequately addressed and requires further consultation for WWC and the registered Aboriginal parties to come to a mutual agreement before the mining extension is approved and included in the ACHMP.

- ATOAC believe this needs to be discussed further as it should not be assumed that Intergenerational Equity has already been covered - as this is a new project.

WWC has indicated it notes the above comments from ADTOAC. WWC has advised that it is committed to ensuring that impacts to Palmers Creek Grinding Grooves 1 and 2 are effectively mitigated by leaving a substantial barrier of coal under the area. WWC is committed to undertaking ongoing consultation with ADTOAC regarding the implementation of the Project.

12.0 Management Strategy

The following management strategy has been prepared taking into account:

- the outcome of ongoing consultation with the registered Aboriginal parties;
- the results of a search of the OEH AHIMS register and archaeological literature relating to the proposed Project Area and its environs;
- the results of the survey;
- an assessment of the Aboriginal cultural heritage and archaeological significance of the Project Area and the sites it contains and the subsurface archaeological material it can be predicted to contain;
- an evaluation of the impacts of subsidence and subsidence remediation works proposed within the Project Area prepared by an independent geotechnical consultant;
- an evaluation of available management/mitigation options from an Aboriginal cultural heritage and archaeological perspective; and
- an assessment of the management outcomes proposed taking into account Intergenerational Equity.

12.1 Management Strategy for Aboriginal Archaeological Sites

A number of options to address the management aspects of the Aboriginal archaeological sites within the Project Area were discussed and preferred options proposed from an Aboriginal cultural and archaeological perspective throughout **Section 11.0**. **Table 12.1** provides a management strategy for the four Aboriginal sites within the Project Area. The Project Area and the sites it contains will be managed in accordance with the ACHMP (Umwelt 2012a) which will be revised to include the approved management strategies.

Table 12.1 – Management Strategy for Aboriginal Archaeological Sites

Site Name	Management Strategy
Palmers Creek 1 Grinding Grooves (#38-4-1007) **Palmers Creek Grinding Grooves 2 (#38-4-1279)**	The sites will be protected throughout the life of the mine through protocols and procedures to be implemented under the existing ACHMP that will be revised in consultation with the relevant registered Aboriginal parties and the OEH/DP&I. **No direct or indirect impact.** A suitable monitoring program to review the geomorphology of the creeks and consider sediment levels and erosion of the adjacent slopes and the potential for impacts to the sites will be implemented. Mitigation to include ongoing monitoring by the registered Aboriginal parties and a qualified archaeologist following the cessation of all subsidence impacts to record and report to OEH/DP&I any non-compliant impacts on the sites. This information will be used to inform future assessments.
Palmers Creek ST1	Manage in accordance with the revised ACHMP. Baseline recording of the scarred tree followed by monitoring to assess the level of subsidence impact (if any) and to employ the most appropriate subsidence mitigation for the tree's ongoing care. Mitigation options following cessation of subsidence include: a. if there are no obvious subsidence impacts to the tree or the soil profile in its surrounds post subsidence re-inspect the tree approximately one and three months after undermining and if still in good health no further management required; OR b. if there are no obvious subsidence impacts to the tree but the soil profile in its surrounds has cracked infill the cracks as soon as practicable with imported fill avoiding any damage to the tree. Re-inspect the tree approximately one and three months after undermining and if still in good health no further management required; OR c. if the tree has fallen and/or the tree is dying with the assistance of a suitably qualified aboriculturalist remove the section of the tree with the scar. Treat the section of the tree removed for its preservation and in consultation with the registered Aboriginal parties determine an appropriate location for its ongoing storage.
Palmers Creek IF1	Manage in accordance with the revised ACHMP. Baseline recording of the isolated find site. Collection of the surface artefact ahead of impact by track works/subsidence remediation. Reburial of isolated find as close as possible to collection location but away from the site. Provision of a revised site card to OEH identifying reburial location of the artefact.

12.2 Revision of the Aboriginal Cultural Heritage Management Plan (ACHMP)

WWC will revise the WWC ACHMP (Umwelt 2012a) to include the Aboriginal cultural and archaeological management commitments made in this report. The revised ACHMP will provide detailed management strategies for all identified Aboriginal archaeological sites within the WWC mining area including the Project Area.

The revised ACHMP will also review and revise as required and where appropriate, Aboriginal heritage management protocols from previous consents and approvals, to provide WWC with a single, consolidated framework for managing Aboriginal cultural heritage. The revised ACHMP will also clearly identify the responsibilities of all parties involved; WWC, registered Aboriginal parties, archaeologists, NPWS/OEH; and designate timeframes for required Aboriginal heritage management works.

The revised ACHMP will be in operation throughout the life of the WWC including the Project Area. The aim of the revisions the existing ACHMP is to ensure WWC meet the requirements of the Project Approval.

12.3 Offset Measures

In their comments on the report (refer to **Appendix A**), the registered Aboriginal parties have made reference to offset measures:

- ADTOAC does not believe that offset measures for impacts that may occur to Palmers Creek Grinding Grooves 2, Palmers Creek Grinding Grooves 1 or Palmers Creek ST1 have been adequately addressed. It is felt that further consultation between the registered Aboriginal parties and WWC is required before the project is progressed further.

- ATOAC feel that this needs to be discussed further with WWC before anything can be said regarding offset measures as each of the registered Aboriginal parties suggestions and/or needs will be different.

WWC has indicated it notes the above comments from ADTOAC and is committed to ongoing consultation with the registered Aboriginal parties as part of the ongoing implementation of its mining operations. WWC has advised that it is committed to ensuring that impacts to Palmers Creek Grinding Grooves 1 and 2 are effectively mitigated by leaving a substantial barrier of coal under the area. OCAL notes that the resource that has been sterilised to protect these two grinding grooves is approximately 670,000 tonnes of run-of-mine coal. WWC considers that the detailed subsidence assessment completed for the Project which indicates a very low potential for impact as accurate and appropriate. WWC also notes that the potential for indirect impacts due to sediment mobilisation due to cracking can be effectively managed and is confident that with the controls currently in place this potential impact will not occur.

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APPENDIX A

Registered Aboriginal Party
Correspondence and Statements

Kerrie Hine

From: Amanda Reynolds
Sent: Wednesday, 18 September 2013 8:31 AM
To: kerrie@awabakal.com.au
Subject: RE: Response-Draft Report Lonwalls 51 and 52
Attachments: image001.jpg; image002.jpg

Hi Kerrie,

Thanks for getting back to me. I thought that that is what you might have meant, but just wanted to clarify.

We did do quite a bit about that as part of the EA in 2010, so you should have that information - it is quite interesting. That information was also collected and is also being used for the grinding groove sites located during the additionally survey.

Cheers,
Amanda

_____
From: kerrie@awabakal.com.au [kerrie@awabakal.com.au]
Sent: Tuesday, 17 September 2013 11:28 PM
To: Amanda Reynolds
Subject: RE: Response-Draft Report Lonwalls 51 and 52

Hi Amanda,

Sorry for the delayed response, and was thinking that there might be some research potential regarding the difference between axe grinding grooves, how they were used, what tools were sharpened, why were some used more than others, how tall were the people that used them, that sort of thing.

And I was talking with Jan the other week and she mentioned that Umwelt already had some interesting data regarding axe grinding grooves, so I guess the research has already been done, and that's basically it really.

Thanks Kerrie

[cid:image001.jpg@01CEB3FD.93C8C7F0]

_____
From: Amanda Reynolds [mailto:areynolds@umwelt.com.au]
Sent: Thursday, 12 September 2013 3:21 PM
To: kerrie@awabakal.com.au
Subject: RE: Response-Draft Report Lonwalls 51 and 52

Thanks Kerrie,

I am going through the word document that you sent through and I'm not entirely sure I know what you are asking on page 10.6.

Note: Are we sure that we could not benefit from researching or/the research potential regarding the axe grinding grooves within and outside the mining lease?

The sites located during the 2010 EA (including all of the Palmers Creek grinding groove sites) have been/ will be baseline recorded and impacts from mining on them observed and recorded to help inform impact assessments in the future. At the moment, research potential of grinding grooves is predominantly limited to the information we obtained from

measuring and interpreting the grooves. Areas of PAD where it is thought axe blanks may have been worked before or after grinding or the location of quarries may increase the research potential, but these are either not identified or in the case of Palmer's Creek Grinding Groove 2 unlikely to be affected by subsidence.

I'd appreciate it if you could clarify your meaning of the above note so that I can discuss it and explain it correctly in the report.

Thanks,
Amanda

Amanda Reynolds
Archaeologist

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From: Kerrie Brauer [mailto:klbrauer@bigpond.com] On Behalf Of kerrie@awabakal.com.au<mailto:kerrie@awabakal.com.au>
Sent: Monday, 2 September 2013 10:09 AM
To: Amanda Reynolds
Subject: FW: Response-Draft Report Lonwalls 51 and 52
Importance: High

Hi Amanda,

We have been given the opportunity to read the written Review and Response by Shane Frost from ADTOAC, and after careful consideration we support and agree with all the comments contained within his document.

Regards,
Kerrie Brauer

[cid:image001.jpg@01CEAADB.DE581F80]
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_____

From: Shane Frost [mailto:awabakal_to@bigpond.com]
Sent: Saturday, 31 August 2013 1:37 PM
To: Amanda Reynolds
Cc: Kerrie Brauer
Subject: Response-Draft Report Lonwalls 51 and 52
Importance: High

[cid:image002.jpg@01CEAADB.DE581F80]

ALLA Amanda,

Please find attached to this email our response to the Draft Report for Longwalls 51 and 52.

NGI NOA
Shane Frost
Managing Director: Awabakal Descendants Traditional Owners Aboriginal Corporation
Email:awabakal_to@bigpond.com Phone:49964362/49964362 Fax:49964325
Mobile:0428320671

_____

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_____

Kerrie Hine

From: cacatua@resetdsl.net.au
Sent: Tuesday, 17 September 2013 11:08 AM
To: Amanda Reynolds
Subject: RE: 3149 - updated draft report

Amanda,

Sorry for the delay.

Cacatua is in support of the modifications, however as always if Shane and Kerrie would like some changes then Cacatua will support these changes.

Thank you

Donna
Reports manager

> Hi Donna,
>
> The closing date for comment on the draft report for OCAL's
> modification was September 2. I haven't heard back from you yet. Could
> you please let me know if there are any comments on the report or any
> additions or other changes you would like to make.
>
> Cheers,
> Amanda
>
> Amanda Reynolds
> Archaeologist
>
> Umwelt (Australia) Pty Limited
> 75 York Street
> Teralba, NSW 2284
>
> Phone: (02) 4950 5322
> Mobile: 0447 770 134
>
> www.umwelt.com.au<http://www.umwelt.com.au>
>
> Inspired People | Dedicated Team | Quality Outcomes
>
> Newcastle ph. 02 4950 5322 | Perth ph. 08 6260 0700 | Canberra ph. 02
> 6262
> 9484
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>
> Please consider the environment before printing this email
> From: Amanda Reynolds

> Sent: Monday, 19 August 2013 3:19 PM
> To: 'Shane Frost'; 'Awabakal'; 'kerrie@awabakal.com.au';
> 'cacatua@resetdsl.net.au'
> Cc: Janice Wilson
> Subject: 3149 - updated draft report
>
> Hi all,
>
> Please find attached an updated version of the draft OCAL LW51 and 52
> Aboriginal Archaeological and Cultural Heritage Assessment report. The
> changes I have made are tracks, and I have also highlighted text
> changes where it is more than just an error.
>
> Please review these changes to make sure that you are comfortable with
> them, and with any of my wording. Add or remove anything that you like
> in any of the sections. If there is information you would like
> included to inform the assessment but don't want make public include
> it and also indentify that you would like it restricted and it will be.
>
> In terms of the concerns raised in the workshop over the grinding
> groove sites, the subsidence prediction done by DGS is saying that
> there is very low likelihood for the Palmers Creek 1 and 2 grooves to be impacted.
>
> Please voice your comments or any concerns, either directly into the
> report or in a separate email/letter. If you are happy with the report
> as it is and do not have anything further to add please let me know.
> Similarly, if there is anything you would like to see in place in the
> event the sites are impacted this is the opportunity to present them
> for OCAL to address.
>
> The closing date for comments is Monday 2 September, however if you
> could have you comments in sooner it would be appreciated.
>
> If you have any questions please feel free to contact me.
>
> Cheers,
> Amanda
>
> Amanda Reynolds
> Archaeologist
>
> Umwelt (Australia) Pty Limited
> 75 York Street
> Teralba, NSW 2284
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> www.umwelt.com.au<http://www.umwelt.com.au>
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Kerrie Hine

From: Awabakal [culture@awabakallalc.com.au]
Sent: Thursday, 12 September 2013 3:30 PM
To: Amanda Reynolds
Cc: CEO; Janice Wilson
Subject: draft report

Hi Amanda,

Sorry it has taken a while to get back to you with recommendations etc.

The work load over the last 6-12 months has been very demanding. I'm not just dealing with one project, I'm dealing with a whole range of Culture & Heritage works within the Awabakal Local Aboriginal Land Council boundary. And to be honest, I have not had the chance to read the whole draft report of 30 + pages. But I do have a number of major concerns which I will address below.

Concerns;
Recommendations;

- **The Awabakal Local Aboriginal Land Council are unhappy with how OCAL are implementing their remediation works within the WWC lease. The material (blue metal/road-base) that OCAL are using is not environmentally friendly and someone has dumped this material onto a number of Aboriginal Sites (ARTFEACT SCATTERS) in their existing lease of the Conservation area. They are still recorded sites even if the Artefacts have been collected !**

  IT IS IN THE LALCS BEST INTERESTS TO MAINTAIN ALL SITES. WITH ARTEFACT SCATTER SITES, THE LALC IS RECOMMENDING THAT OCAL USE A DIFFERENT METHOD AND MATERIAL FOR REMEDIATION WORKS. THE OTHER GROUPS AND I TALKED ABOUT LAYING GEO FABRIC DOWN AND THEN LAYING A RIVER ROCK TYPE STONE INSTEAD OF BLUE METAL/ROADBASE. I THINK THIS IS REALLY IMPORTANT, NOT JUST FOR OUR CULTURE & HERITAGE BUT FOR THE BENEFITS OF NATURE ITSELF.

- **We are also very annoyed that we are not involved in any vegetation clearing in which it clearly states in the ACHMP (Aboriginal Cultural Heritage Management Plan) that Aboriginal representatives are to be given the opportunity to monitor vegetation clearing in order for visibility of the grounds surface.**

  THE LALC IS RECOMMENDING, THAT OCAL STICK TO THE ACHMP AND GIVE ALL GROUPS THE OPPRTUNITY TO MONITOR ANY SUCH VEGETATION CLEARING AS IT STATES IN THE ACHMP.

- **It also clearly states in the ACHMP that all stakeholder groups are to be notified and given the opportunity to monitor any ground disturbance works. But that hasn't been happening either, only one representative from two groups have been given the opportunity.**

  THE LALC IS RECOMMENDING, THAT OCAL STICK TO THE ACHMP AND GIVE ALL GROUPS THE OPPORTUNITY TO MONITOR ANY SUCH GROUND DISTURBANCE WORKS WITHIN THE MINE LEASE AS IT STATES IN THE ACHMP.

- **Offset measures for Palmers Ck GG1- Palmers Ck GG2- Palmers Ck ST1**

  ON BEHALF OF THE LALC, I AM RECOMMENDING THAT 1-3-6-12-18 MONTH SUBSIDENCE MONITORING INTERVALS TAKE PLACE FOR ANY SUBSIDENCE INSPECTIONS WITHIN THE PROPOSED AREA. 1-3 MONTH SUBSIDENCE MONITORING INTERVALS ARE CLEARLY NOT ENOUGH, AS THERE IS A REAL NEED FOR ONGOING MONITORING AS PER THE SUBSIDENCE MEASURES THAT HAVE BEEN MADE PUBLIC IN THE LAST MONTH BY NEWSPAPERS ETC. BEST PRACTICES FOR BETTER OUTCOMES.

Again, sorry for any inconveniences that may have been caused

If you have any further enquiries please feel free to contact me.

Kind Regards
Pete

PETER TOWNSEND
Culture & Heritage Officer

Awabakal Local Aboriginal Land Council
Ph: 49654532
Fax: 49654531
E-mail: culture@awabakallalc.com.au

Yaamakara. I am a Wiradjuri/Weilwan man. I acknowledge the traditional people of this country, elders, children past and present.

Kerrie Hine

From: Kerrie Brauer [klbrauer@bigpond.com] on behalf of Kerrie Brauer [kerrie@awabakal.com.au]
Sent: Monday, 2 September 2013 10:09 AM
To: Amanda Reynolds
Subject: FW: Response-Draft Report Lonwalls 51 and 52
Attachments: Review and Response-Draft Report longwall 51&52.pdf

Importance: High

Hi Amanda,

We have been given the opportunity to read the written Review and Response by Shane Frost from ADTOAC, and after careful consideration we support and agree with all the comments contained within his document.

Regards,
Kerrie Brauer

ATOAC
Kerrie Brauer | Director | Administration | Awabakal Traditional Owners Aboriginal Corporation
M: 04 12 86 63 57 | E: kerrie@awabakal.com.au | www.awabakal.com.au
PO Box 253 Jesmond NSW 2299 Australia

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From: Shane Frost [mailto:awabakal_to@bigpond.com]
Sent: Saturday, 31 August 2013 1:37 PM
To: Amanda Reynolds
Cc: Kerrie Brauer
Subject: Response-Draft Report Lonwalls 51 and 52
Importance: High

"From the Mountains to the Sea"
AWABAKAL
Descendants Traditional Owners
Aboriginal Corporation
ICN:4500 ABN:20402046601

ALLA Amanda,

Please find attached to this email our response to the Draft Report for Longwalls 51 and 52.

NGI NOA
Shane Frost
Managing Director: Awabakal Descendants Traditional Owners Aboriginal Corporation
Email:awabakal_to@bigpond.com Phone:49964362/49964362 Fax:49964325 Mobile:0428320671

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Kerrie Hine

From: Shane Frost [awabakal_to@bigpond.com]
Sent: Saturday, 31 August 2013 1:37 PM
To: Amanda Reynolds
Cc: Kerrie Brauer
Subject: Response-Draft Report Lonwalls 51 and 52
Attachments: Review and Response-Draft Report longwall 51&52.pdf

Importance: High

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AWABAKAL
Descendants Traditional Owners
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ICN:4500 ABN:20402046601

ALLA Amanda,

Please find attached to this email our response to the Draft Report for Longwalls 51 and 52.

NGI NOA
Shane Frost
Managing Director: Awabakal Descendants Traditional Owners Aboriginal Corporation
Email:awabakal_to@bigpond.com Phone:49964362/49964362 Fax:49964325 Mobile:0428320671

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"From the Mountains to the Sea"
AWABAKAL
Descendants Traditional Owners
Aboriginal Corporation
ICN:4500 ABN:20402046601

PO BOX 86
CLARENCE TOWN
NSW 2321

Date: 29 August 2013

Attention: Amanda Reynolds
Umwelt (Australia) Pty Limited
PO Box 3024
TERALBA NSW 2283

Re: Review and Response-Draft Report- *ABORIGINAL ARCHAEOLOGICAL AND CULTURAL HERITAGE*

ASSESSMENT WEST WALLSEND COLLIERY PROPOSED LW 51 AND LW52

ALLA Amanda,

We have reviewed the document supplied to us by Umwelt (Australia) Pty Limited regarding the above proposed development and herein provide our response regarding any concerns we have with the draft report document.

Please see our response as set out below.

1. We do not agree to any disturbance or damage to our Cultural Heritage this includes **ALL** known and unknown Cultural Heritage sites within the project area.

2. This proposed project area takes in a ridgeline that is Culturally significant to us because it was used as a pathway by our People to access the southern end of Sugarloaf. It can be seen by the number of sites (AHIMS) associated with this ridgeline running right from the lake to the mountain that there was a high degree of usage of this particular area and that is why it is important to us that there is no disturbance in the area.

Subsidence and Direct and Indirect Impacts

1. We were told originally for the previous mine plan that two grinding groove sites in this area would not be impacted because they were of high Cultural value (see section 11.1.1). We have now been told (see section 10 of draft) that there is the possibility of indirect impact from sediment but no direct impact!

    a) What is the difference between indirect and direct impact? Isn't impact what it says it is whether direct or indirect!!

2. We have no problem with the meaning of the words 'direct' and 'indirect', the problem we have is with the word **'IMPACT'** and the context in which it is used. It is concerning that it is connected with the two (2) grinding groove sites that under the current mining approval and ACHMP they are considered as offsets for this mining operation and are not to be impacted in any way.

    As an example, if your car is damaged or smashed up and written off from an impact, does it matter if it is ultimately attributed to a direct impact or indirect impact? The end result is still the same no matter how we attribute the blame!!

    a) If one looks at the map we were provided at a recent workshop (Attachment A) you can see that there is a blue line running around the outer edge of Longwalls 51 and 52 which in the key says ***'20mm Predicted Subsidence Contour'***. As can be seen the line runs to the outside of Grinding Groove with PAD site 38-4-1279 which would suggest it puts inside the predicted subsidence impact zone and within the probability of not just 'indirect impacts' from sediment but also sustaining 'direct impacts' resulting in what can only be considered as **IMPACTS** from the proposed mining activity. Any impacts should then be considered as directly related to subsidence. If this is the case why is it that this report only mentions indirect impacts to this site??

3. As previously discussed within other responses to reports of this and other mining activities within our Traditional Country and the mining companies calculations of what degree of damage or disturbance will be created or expected due to subsidence, we will again say we have no faith in these calculations because we believe they are only educated guesses and assumptions that are based on very limited knowledge of what is really going on below the ground level. We must also say that due to previous experience and in light of recent revelations of the massive damage caused within the Sugarlaof State Conservation Area regarding unpredicted subsidence, this vindicates our opinion that there is no one who can accurately predict what the outcome of subsidence will be after undermining occurs. Therefore we again would reiterate that we **DO NOT** support mining within these areas or the destruction or disturbance of any of our Cultural Heritage sites. All these areas and sites are significant to us as they are considered to be a Cultural Landscape, one and the same and cannot be separated.

Management Options, Intergenerational Equity and Offsets

1. Consideration and discussion needs to be given priority regarding the fact of what offsets will be offered if these sites are damaged due to the proposed undermining (direct or indirect impact) (see section 11.1.3)? What about intergenerational equity? If these sites are damaged or destroyed what has been put in place to cover the Intergenerational Equity, the fact that we are supposed to be leaving something for future generations? In relation to (see section 12.3) it is our belief that this has not been adequately addressed in our opinion and needs further consultation between the mine and the Aboriginal Stakeholders so as to come to some mutual agreement before this mining extension for Longwalls 51 and 52 is approved and included in a revised ACHMP.

Significance of this area to Awabakal Traditional Descendants

This area is of ***HIGH*** significance to our People being part of our Traditional Country and is considered to be of great importance within our Cultural Heritage. This area has not just a physical presence within the Cultural Heritage of the Awabakal People but it is part of our oral history and a place of spiritual significance. Our apical Ancestor Mahrahkah, an Awabakal woman, and her two daughters, were recorded by Threlkeld and Warner as living in and around these areas which all formed part of their Traditional Country. This apart from everything else makes it a very important location for our family, knowing that Mahrahkah walked these areas before any white man was ever seen in the Newcastle and Lake Macquarie areas. She was intrinsically acquainted with her Land and she has left a legacy for us to carry on in this day and to pass onto our Descendants.

It is our desire to see this legacy continue in the protection and preservation of our Cultural Heritage, not its demise and destruction. That is why it makes it a very hard task for us to be part of the process of making decisions when developments are proposed as they nearly always involve the degradation and destruction of our Cultural Heritage. It is very difficult for us to see our Cultural Heritage compromised by *'development'* as it causes much heartache for our People knowing that due to *'progress'* our physical connection to the past is becoming more of a chasm than a gap in time. This is our Cultural Heritage that is being put on the line!! This is our physical link to our Ancestors that can be destroyed in the process!! Once it is disturbed or destroyed it is this way forever!! It may be easy for others to make what we consider to be dismissive and erroneous decisions with *good intentions* about what has been passed down to us from our Ancestors; but what most consider to be progression and advancement, is for us, what ultimately cuts us off a little bit more from our Ancestors and Cultural Heritage!!

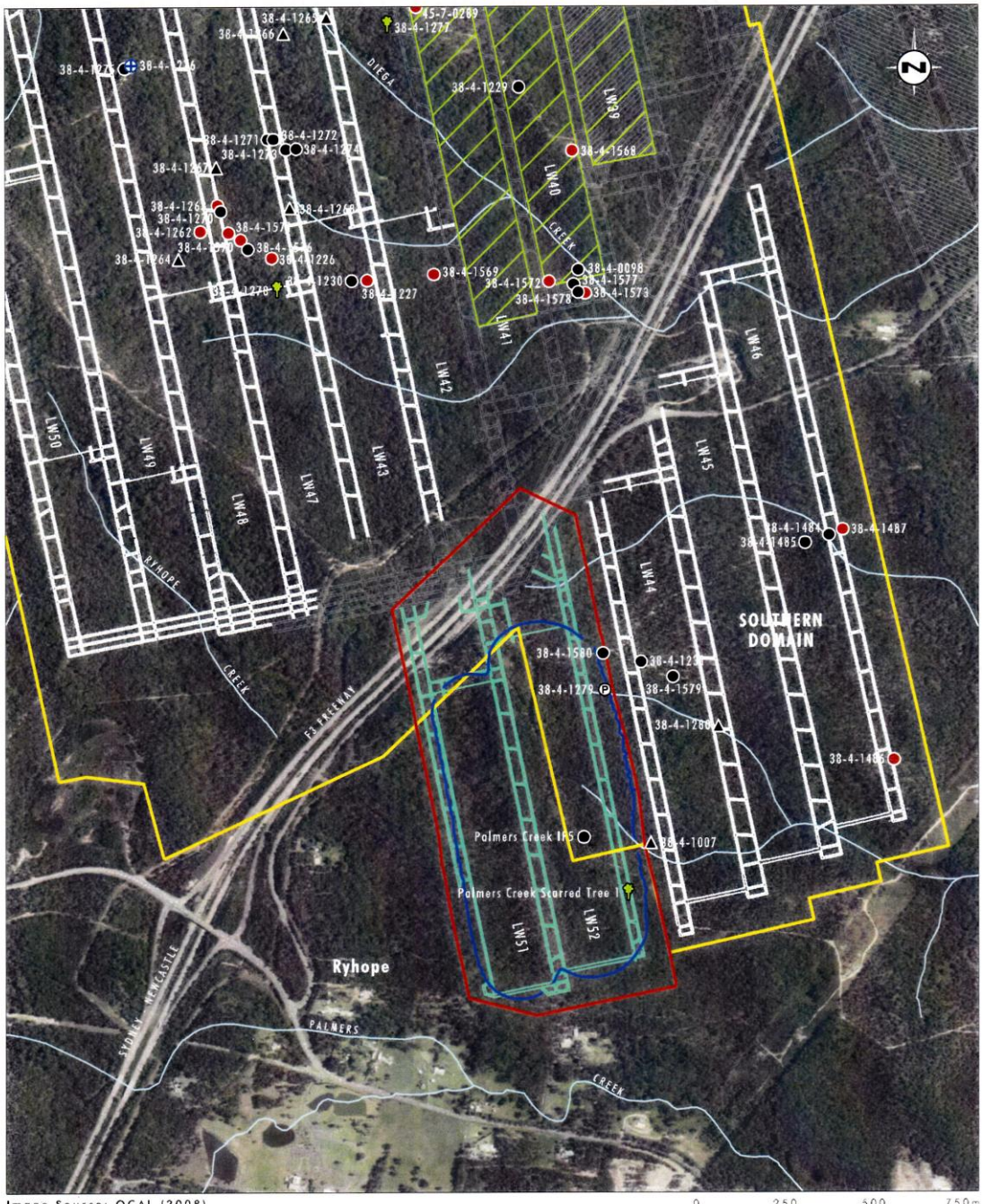
We hope that it has been shown here that this area is significant to us as Awabakal People and there is a great need to protect and preserve what is left of the Cultural Heritage of our People. We all need to regard the question of ***Intergenerational Equity*** as being of the utmost importance so that future generations are not disadvantaged in relation to what has or has not been left for them to appreciate and learn from. This again is why it is crucial to make sure appropriate decisions are made and a suitable management and mitigation process put in place so as to provide the protection and preservation that the Cultural Heritage of our People deserves.

Thank you Amanda for the opportunity to provide our comments for this draft report and we would ask for these comments to be added to the final report so that they can be considered in regard to their implementation to provide as much protection as possible to our Cultural Heritage sites that may be put at risk of impact within the proposed Longwalls 51 and 52 area. Looking forward to your reply and if you need further clarification regarding the information we have provided please don't hesitate to contact us at your earliest convenience. Our contact details are as follows.

NGI NOA
Shane Frost-Managing Director: Awabakal Descendants Traditional Owners Aboriginal Corporation
Email:shanefrost@bigpond.com Phone: 49964325 Fax: 49964325 Mobile: 0428320671

Cultural Heritage Sites - Physical reminders of our Ancestors; once they are gone, they are gone forever and impossible to bring back!! THINK first and make WISE decisions last!!

Attachment (A)



Kerrie Hine

From: kerrie@awabakal.com.au
Sent: Thursday, 29 August 2013 10:45 AM
To: Amanda Reynolds
Cc: amanda@awabakal.con.au
Subject: RE: 3149 - updated draft report
Attachments: OCAL 3149_R02_AACHA_V1_workshop.docx

Hi Amanda,

I have gone through the updated draft and am happy that our comments were captured in the workshop meeting, and have also attached the draft with our comments marked in Red on pages 9.1, 9.4, 10.6, 11.2, 11.3, 11.6, 12.4

Looking forward to your reply and also happy to discuss.

Kind regards,
Kerrie

ATOAC
Kerrie Brauer | Director | Administration | Awabakal Traditional Owners Aboriginal Corporation
M: 04 12 86 63 57 | E: kerrie@awabakal.com.au | www.awabakal.com.au
PO Box 253 Jesmond NSW 2299 Australia

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From: Amanda Reynolds [mailto:areynolds@umwelt.com.au]
Sent: Monday, 19 August 2013 3:19 PM
To: 'Shane Frost'; Awabakal; kerrie@awabakal.com.au; cacatua@resetdsl.net.au
Cc: Janice Wilson
Subject: 3149 - updated draft report

Hi all,

Please find attached an updated version of the draft OCAL LW51 and 52 Aboriginal Archaeological and Cultural Heritage Assessment report. The changes I have made are tracks, and I have also highlighted text changes where it is more than just an error.

Please review these changes to make sure that you are comfortable with them, and with any of my wording. Add or remove anything that you like in any of the sections. If there is information you would like included to inform the assessment but don't want make public include it and also indentify that you would like it restricted and it will be.

In terms of the concerns raised in the workshop over the grinding groove sites, the subsidence prediction done by DGS is saying that there is very low likelihood for the Palmers Creek 1 and 2 grooves to be impacted.

Please voice your comments or any concerns, either directly into the report or in a separate email/letter. If you are happy with the report as it is and do not have anything further to add please let me know. Similarly, if there is anything you would like to see in place in the event the sites are impacted this is the opportunity to present them for OCAL to address.

The closing date for comments is Monday 2 September, however if you could have you comments in sooner it would be appreciated.

If you have any questions please feel free to contact me.

Cheers,
Amanda

Amanda Reynolds
Archaeologist

Umwelt (Australia) Pty Limited
75 York Street
Teralba, NSW 2284

Phone: (02) 4950 5322
Mobile: 0447 770 134

www.umwelt.com.au

Inspired People | Dedicated Team | Quality Outcomes

Newcastle ph. 02 4950 5322 | **Perth** ph. 08 6260 0700 | **Canberra** ph. 02 6262 9484

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APPENDIX B

Search Results

National Native Title Tribunal

Operations East, Sydney Office
Level 16, Law Courts Building,
Queens Square
Sydney NSW 2000
GPO Box 9973
Sydney NSW 2000
Telephone (02) 9227 4000
Facsimile (02) 9227 4030

2 July 2013

Amanda Reynolds
Archaeologist
Umwelt Australia Pty Limited
75 York Street
TERALBA NSW 2284

Our Reference: 5545/13SJ
Your Reference: 3149

Dear Ms Reynolds

Native Title Search Results for Lake Macquarie Local Government Area

Thank you for your search request of 24 June 2013 in relation to the above area.

Search Results
The results provided are based on the information you supplied and are derived from a search of the following Tribunal databases:

Register Type	**NNTT Reference Numbers**
Schedule of Applications (unregistered claimant applications)	NN2007/003
Register of Native Title Claims	NC2012/003; NC2013/002
National Native Title Register	NND2003/001; NND2007/002; NND2007/003
Register of Indigenous Land Use Agreements	NIA2000/001
Notified Indigenous Land Use Agreements	Nil.

I have included relevant extracts for each of the above claims and determinations listed above, extract attachments and NNTT Registers fact sheet to help guide your understanding of the search result.

Please note that there may be a delay between a native title determination application being lodged in the Federal Court and its transfer to the Tribunal. As a result, some native title determination applications recently filed in the Federal Court may not appear on the Tribunal's databases.

The search results are based on analysis against external boundaries of applications only. Native title applications commonly contain exclusions clauses which remove areas from within the external boundary. To determine whether the areas described are in fact subject to claim, you need to refer to "Area covered by claim" section of the relevant Register Extract or Application Summary and any maps attached.

Search results and the existence of native title
Please note that the enclosed information from the Register of Native Title Claims and/or the Schedule of Applications is **not** confirmation of the existence of native title in this area. This cannot be confirmed until the Federal Court makes a determination that native title does or does not exist in relation to the area. Such determinations are registered on the National Native Title Register.

Tribunal accepts no liability for reliance placed on enclosed information
The enclosed information has been provided in good faith. Use of this information is at your sole risk. The National Native Title Tribunal makes no representative, either express or implied, as to the accuracy or suitability of the information enclosed for any particular purpose and accepts no liability for use of the information or reliance placed on it.

If you have any further queries, please contact me on 1800 640 501.

Yours sincerely

Sylvia Jagtman
Senior Case Management Assistant

Telephone (02) 9227 4013
Facsimile (02) 9227 4030
Email sylvia.jagtman@nntt.gov.au

Encl

Searching the NNTT Registers in New South Wales

Search service
On request the National Native Title Tribunal may search its public registers for you. A search may assist you in finding out whether any native title applications (claims), determinations or agreements exist over a particular area of land or water.

In New South Wales native title cannot exist on privately owned land including family homes or farms.

What information can a search provide?
A search can confirm whether any applications, agreements or determinations are registered in a local government area. Relevant information, including register extracts and application summaries, will be provided.

In NSW because we cannot search the registers in relation to individual parcels of land we search by local government area.

Most native title applications do not identify each parcel of land claimed. They have an external boundary and then identify the areas not claimed within the boundary by reference to types of land tenure e.g., freehold, agricultural leasehold, public works.

What if the search shows no current applications?
If there is no application covering the local government area this only indicates that at the time of the search either the Federal Court had not received any claims in relation to the local government area or the Tribunal had not yet been notified of any new native title claims.

It does not mean that native title does not exist in the area.

Native title may exist over an area of land or waters whether or not a claim for native title has been made.

Where the information is found
The information you are seeking is held in three registers and on an applications database.

National Native Title Register
The National Native Title Register contains determinations of native title by the High Court, Federal Court and other courts.

Register of Native Title Claims
The Register of Native Title Claims contains applications for native title that have passed a registration test.

Registered claims attract rights, including the right to negotiate about some types of proposed developments.

Register of Indigenous Land Use Agreements
The Register of Indigenous Land Use Agreements contains agreements made with people who hold or assert native title in an area.

The register identifies development activities that have been agreed by the parties.

Schedule of Native Title Claims
The Schedule of Native Title Claims contains a description of the location, content and status of a native title claim.

This information may be different to the information on the Register of Native Title Claims, e.g., because an amendment has not yet been tested.

How do I request a native title search?
Download the Search Request Form from the Tribunal's website at - http://www.nntt.gov.au/Applications-And-Determinations/Registers/Pages/Search-The-Tribunal-Registers.aspx

Email to: NSWEnquiries@nntt.gov.au
Post to: GPO Box 9973 Sydney NSW 2001
For additional enquiries: 02 9227 4000

ATTACHMENT "B"
AREA OF LAND AND WATERS COVERED BYTHE APPLICATION.

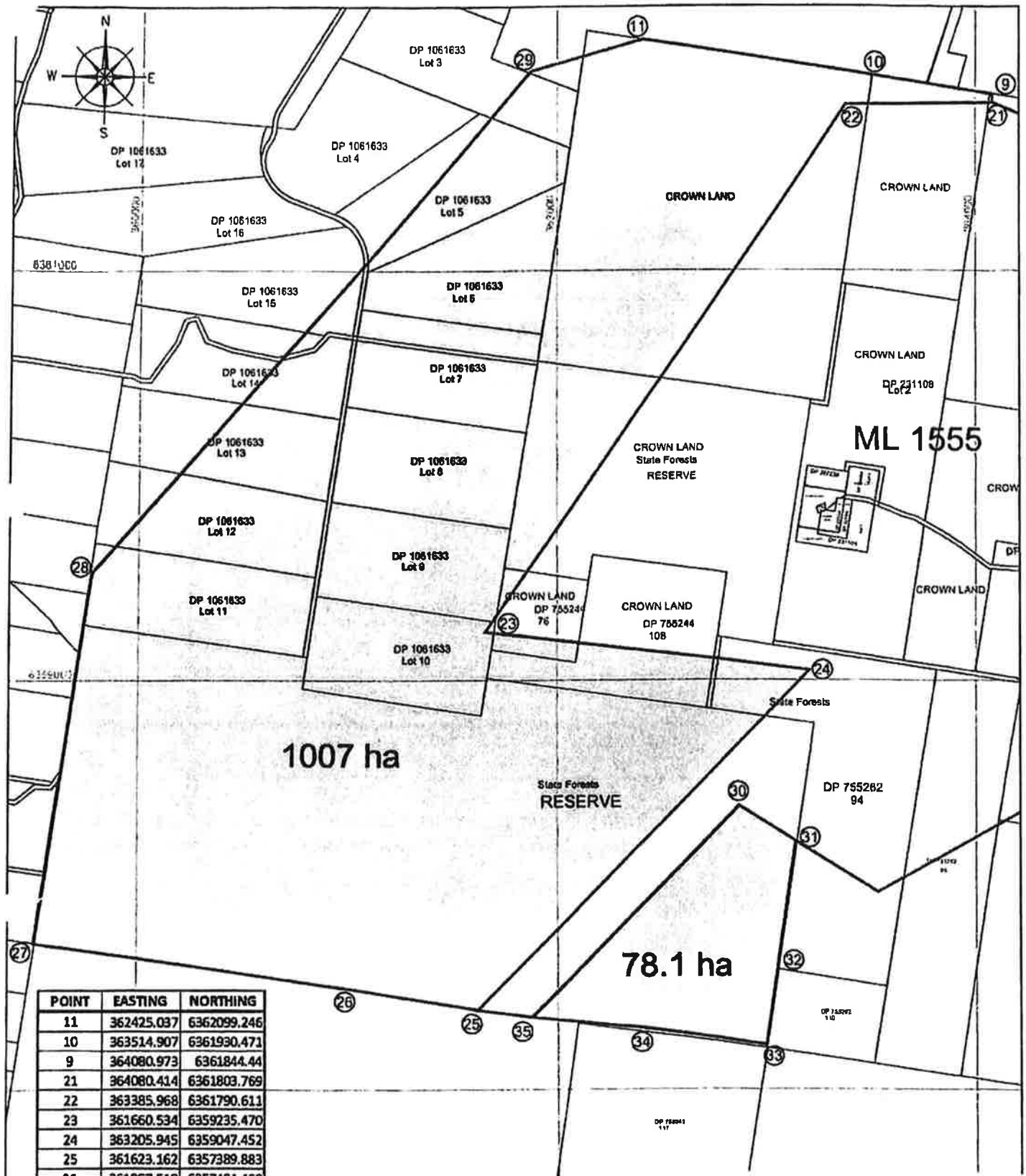
Awabakal People Native Title Claim Group

Description

The application area covers the lands and waters subject to Mining Lease Application 416; situated in the Cessnock and Lake Macquarie City Councils, New South Wales.

Data Reference and source

As set out in the table contained in the bottom left-hand corner of the attached map.



POINT	EASTING	NORTHING
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10	363514.907	6361930.471
9	364080.973	6361844.44
21	364080.414	6361803.769
22	363385.968	6361790.611
23	361660.534	6359235.470
24	363205.945	6359047.452
25	361623.162	6357389.883
26	361067.510	6357484.460
27	359509.743	6357716.381
28	359778.805	6359523.619
29	361874.487	6361950.030
30	362864.505	6358385.842
31	363135.951	6358214.996
32	363046.520	6357602.968
33	362990.202	6357217.553
34	362406.245	6357301.213
35	361879.918	6357354.731

Strata Sought
from 15m below the surface
to a depth of 900m

SCALE

0 250 500 1000

METRES

Application Summary Attachment:
NSD951/2012 (NC12/3)
A map showing the external boundaries of the claim area,
Attachment C of the Application, 1 page, A4, 4/07/2012

NATIVE TITLE DETERMINATION APPLICATION

Awabakal People Native Title Claim Group

National Native Title Tribunal

Claim Area

NOTE: To determine areas subject to claim within the external boundary, reference to the application description is necessary.
Application boundary data compiled by the NNTT from data sourced from NTSCORP Limited.
MLA416 boundary data compiled by the NNTT from data sourced from the Dept of Primary Industries (NSW) and DONALDSON COAL PTY LTD (June 2012).
Cadastral data sourced from Public Sector Mapping Agency (November 2010).

Map created by: Geospatial Services, National Native Title Tribunal (14/06/2012)
Map Ref: 20120614_Awabakal People Native Title Claim Group_Tenure_A3P.pdf

NORTH

0 1

KILOMETRES

Latitude and Longitude based on Geocentric Datum of Australia 1994
Non Projection

© Commonwealth of Australia 2012

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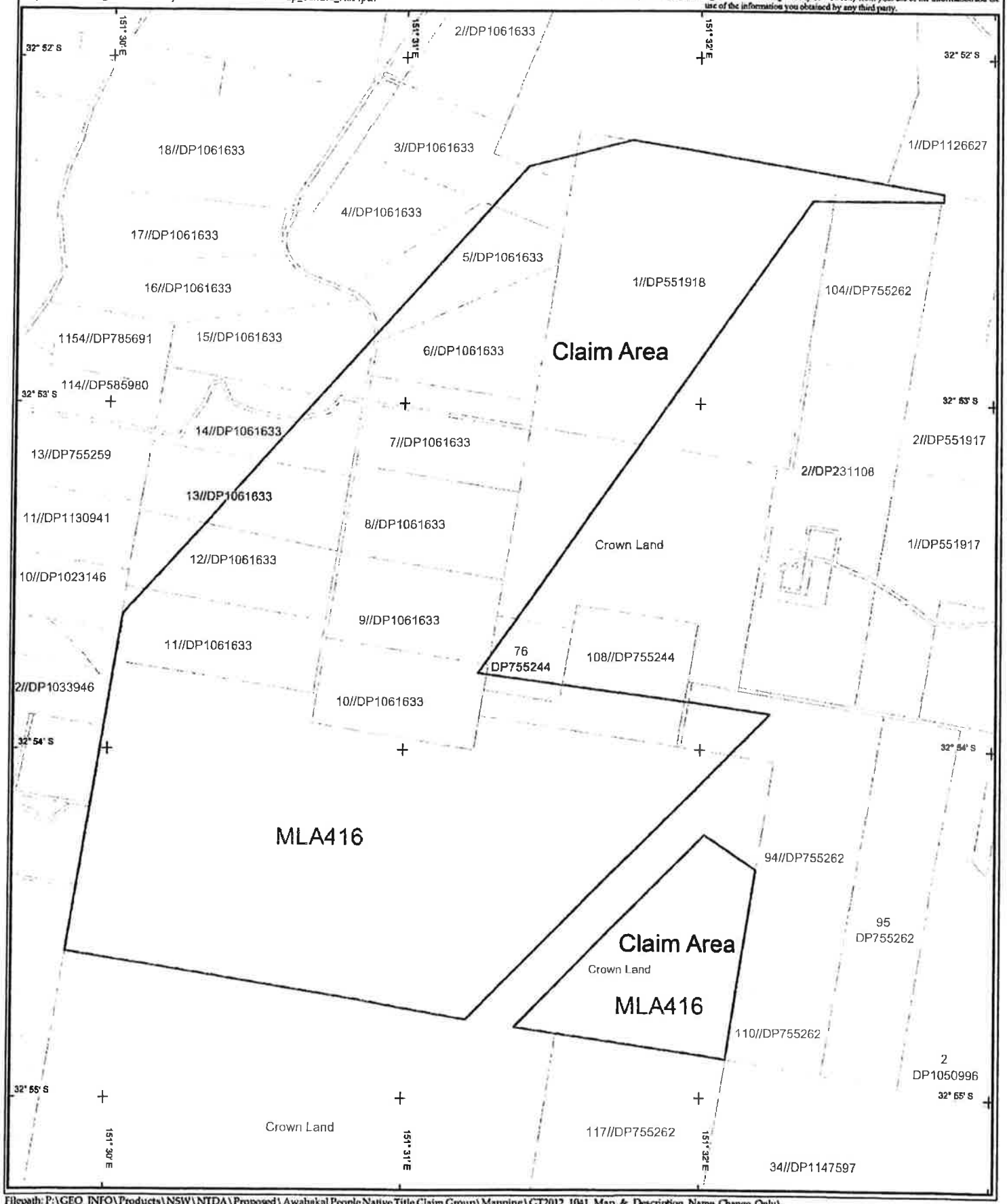

Filepath: P:\GEO_INFO\Products\NSW\NTDA\Proposed\Awabakal People Native Title Claim Group\Mapping\GT2012_1041_Map_&_Description_Name_Change_Only\
2020614_Awabakal People Native Title Claim Group_Tenure_A3P.wor

Awabakal and Guringai People

The application area covers all the lands and waters within the external boundary described below:

External Boundary Description

Commencing at the intersection of the northern bank of Broken Bay and the High Water Mark (HWM) of the South Pacific Ocean and extending generally south westerly across Broken Bay to the intersection of the southern bank of Broken Bay and the HWM of the South Pacific Ocean; then generally southerly along that HWM to Latitude 33.680820° South; then south westerly to the southernmost corner of Lot 104 on DP1066371; then north westerly along the southern boundary of that lot and southern boundary of Golf Avenue to the southern boundary of Barrenjoey Road; then generally south westerly along that road to its intersection with the southern boundary of Mona Vale Road; then generally westerly and generally south westerly along the southern boundary of that road to its intersection with the eastern boundary of the Pacific Highway; then generally north westerly along the eastern boundary of that highway to the southern boundary of Pennant Hills Road; then generally south westerly along the southern boundary of that road to its intersection with Castle Hill Road; then generally north easterly along northern boundaries of that road to its intersection with Old Northern Road; then generally northerly along the eastern boundaries of that road, Hastings Road, New Line Road and again Old Northern Road to its intersection with Canoelands Road; then generally easterly and generally north easterly along the southern boundary of that road to Longitude 151.073080° East; then northerly to the centreline of the Hawkesbury River at Longitude 151.072721° East; then generally northerly along the centreline of that river to Latitude 33.430521° South; the generally northerly passing through the following coordinate points:

Longitude ° East	Latitude ° South
151.047884	33.423592
151.057400	33.414590
151.071675	33.411148
151.071040	33.391551
151.066599	33.383076

Then northerly to the eastern boundary of Western Commission Track at Latitude 33.361380° South; then generally northerly along eastern boundaries of that track to its intersection with the Great Northern Road; then north to the western boundary of the Gosford City Council; then generally north easterly, generally northerly, again generally north easterly, generally south easterly and again generally north easterly along western and northern boundaries of that Local Government Authority boundary and north western boundaries of Wyong Shire Council boundary and Lake Macquarie City Council to Latitude 32.995389° South; then generally north westerly and generally northerly along eastern boundaries of Watagan Forest Road and eastern boundaries of Heaton Road to Sandy Creek Road; then generally westerly along the northern boundary of that road to its intersection with Quarrobolong Road; then generally northerly, generally north easterly and again generally northerly along eastern boundaries of that road, Vincent Street, Maitland Road, Old Maitland Road, Kings Road to the intersection with a unnamed road at Latitude 32.777000° South; then westerly along the northern boundary of that road to intersect an unnamed road at Longitude 151.393545° East; then generally northerly, generally north westerly and again generally northerly along eastern boundaries of that road to its intersection with Majors Lane; then generally westerly, generally northerly and generally north easterly along northern and eastern boundaries of that lane, Lovedale Road and Allandale Road to its intersection with the southern boundary of New England Highway; then generally easterly along the southern boundaries of that highway, High Street and Belmore Road to its intersection with the southern bank of the Hunter River; then generally easterly and generally north easterly along southern banks of that river to a northernmost corner of Lot 1 on DP 128319; then generally south easterly along northern boundaries of that lot and Lot 1 on DP 361407 to again the southern bank of the Hunter River; then generally south easterly, generally easterly, generally south westerly and again south easterly along the southern bank of that river, South Channel, southern boundaries of Lot 20 on DP262325, Lot 6 and Lot 5 DP1104199 and western and southern boundaries of 105 on DP1104195 to the HWM; then generally southerly along that HWM back to the commencement point.

Exclusions:

The application area does not include the land and waters within:

- Ash Island.
- Native Title Determination Application NSD951/2012 – Awabakal People (NC2012/003).
- Native Title Determinations

- NSD6001/98 - Metropolitan LALC (Duffy's Forest) as determined by the Federal Court on 31/03/1998.
- NSD6023/99 - Darkinjung LALC (2000) as determined by the Federal Court on 11/10/2000.
- NSD6010/00 - Darkinjung LALC (2001) as determined by the Federal Court on 10/08/2001.
- NSD6003/01 - Metropolitan LALC (Hornsby) as determined by the Federal Court on 12/04/2002.
- NSD6008/01 - Darkinjung LALC (2002) as determined by the Federal Court on 03/05/2002.
- NSD6022/02 - Bahtahbah LALC as determined by the Federal Court on 19/06/2003.
- NSD6003/03 - Darkinjung LALC (2003) as determined by the Federal Court on 17/12/2003.
- NSD1249/04 - Darkinjung LALC (2005) as determined by the Federal Court on 07/12/2005.
- NSD23/05 - Awabakal LALC as determined by the Federal Court on 06/12/2005.
- NSD986/06 - Bahtabah Local Aboriginal Land Council 1 as determined by the Federal Court on 20/03/2007.
- NSD987/06 - Bahtabah Local Aboriginal Land Council 2 as determined by the Federal Court on 20/03/2007.

Note:

Reference Datum

Geographical coordinates have been provided by the NNTT Geospatial Unit and are referenced to the Geocentric Datum of Australia (GDA94), in decimal degrees and are based on the spatial reference data acquired from the various custodians at the time.

Data Reference and source

- Agreement boundary data compiled by National Native Title Tribunal.
- Native Title Determination Application NSD951/2012 – Awabakal People (NC2012/003) as accepted for registration 02/08/2012
- Where possible roads and creeks are based on Cadastral data sourced from the LPM Authority, NSW (July 2001).
- Road, River and Creek data sources from Topographic vector data is © Commonwealth of Australia (Geoscience Australia) 2003.
- Mining Lease Application data sourced from Department of Primary Industries, NSW.

Use of Coordinates

Where coordinates are used within the description to represent cadastral or topographical boundaries or the intersection with such, they are intended as a guide only. As an outcome to the custodians of cadastral and topographic data continuously recalculating the geographic position of their data based on improved survey and data maintenance procedures, it is not possible to accurately define such a position other than by detailed ground survey.

Prepared by Geospatial Services, National Native Title Tribunal (28/05/2013).

ATTACHMENT "C"
A MAP SHOWING THE EXTERNAL BOUNDARIES OF THE CLAIM AREA.

See attached Map of Awabakal and Guringai Native Title Determination Application as Attachment C as prepared by Geospatial Services, National Native Title Tribunal 10 May 2013

FEDERAL COURT OF AUSTRALIA
AUSTRALIA
NEW SOUTH WALES
DISTRICT REGISTRY

NATIVE TITLE DETERMINATION APPLICATION

Awabakal and Guringai People

Register Extract Attachment: NSD780/2013 (NC2013/002)

Map of the claim area - Attachment C of the Application ●

National Native Title Tribunal

Claim Area

NOTE: To determine areas subject to claim within the external boundary, reference to the application description is necessary.

Application and Determination boundary data compiled by the NNTT from data sourced from DOL (NSW), Mining Lease Application data sourced from Department of Primary Industries, NSW.

Topographic image data is © Commonwealth of Australia and is used under licence from Geoscience Australia 2008

NOTE: Topographic images should be used as a guide only.

Map created by: Geospatial Services, National Native Title Tribunal (03/05/2013)
Map Ref: 20130509_Proposed_Awabakal_and_Guringai_People_Topo_A3P.pdf

0 10
KILOMETRES
Latitude and Longitude based on Geocentric Datum of Australia 1994
Non Projection

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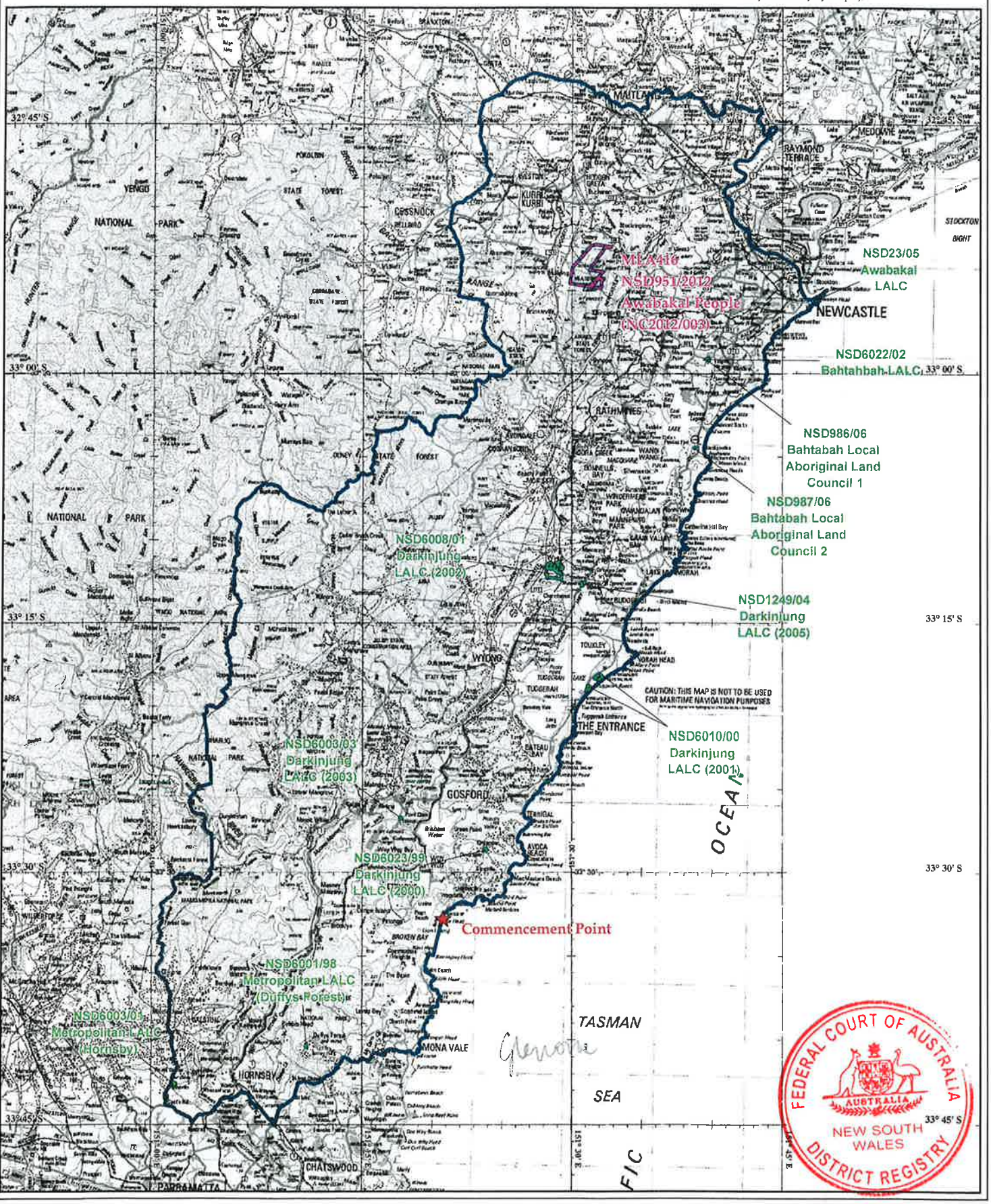
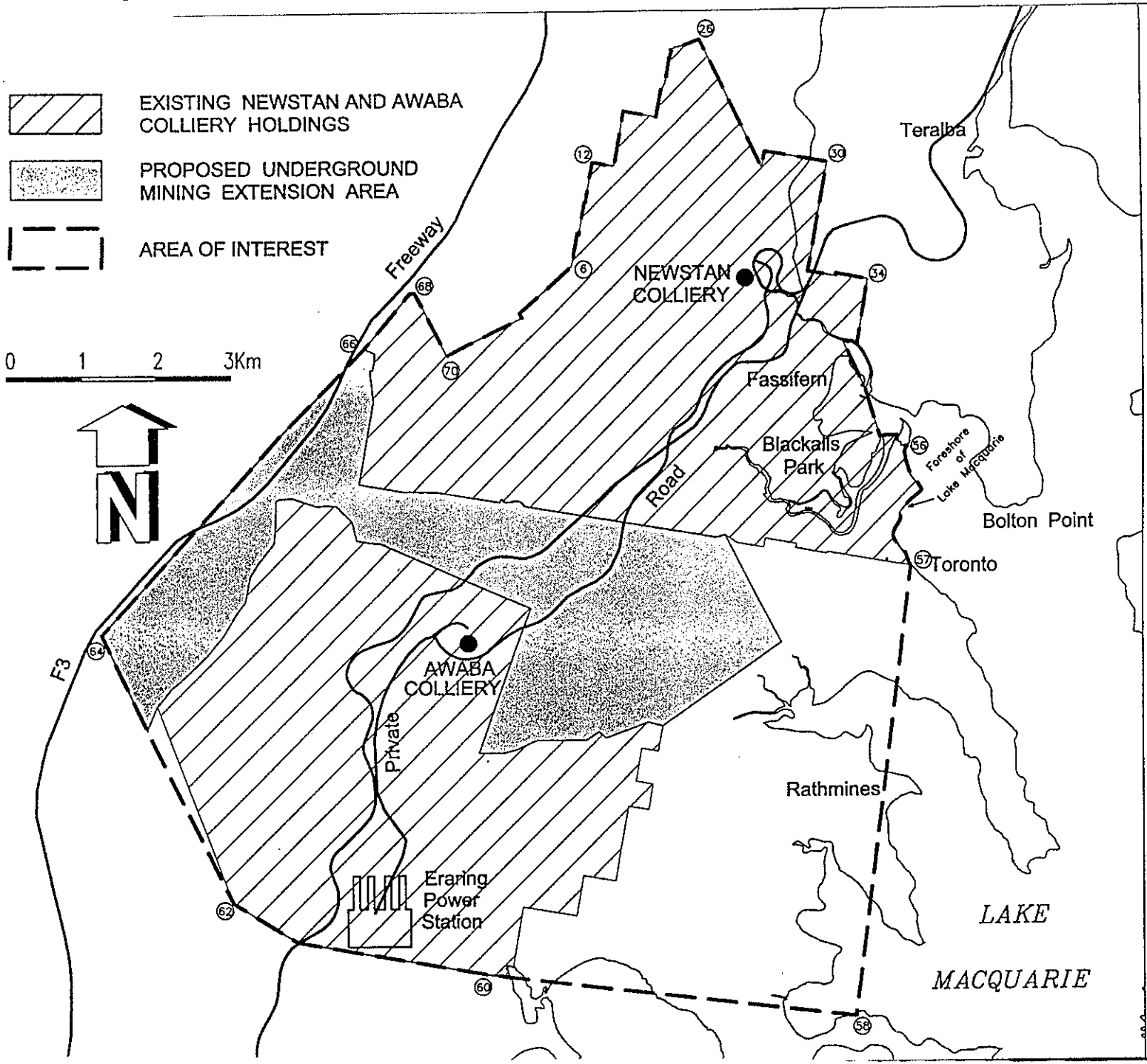


FEDERAL COURT OF AUSTRALIA
NEW SOUTH WALES DISTRICT REGISTRY

Filepath:P:\GEO_INFO\Products\NSW\NTDA\Proposed\Awabakal and Guringai People\Mapping\GT2013_0643_Map_&_Description\20130509_Awabakal_and_Guringai_Topo_A3P.wor

NIA2000/001 Powercoal Pty Lty, Victor Perry , Stephen Seiver & NSWALC Map of Area Attached to Register of Indigenous Land Use Agreements 29 August 2001



I.S.G. CO-ORDINATES
ZONE 56/1

Cnr	East	North	Cnr	East	North
1	350358	1348749	37	355045	1348490
2	350586	1348864	38	355023	1348505
3	350556	1348923	39	355005	1348513
4	350838	1349172	40	354991	1348517
5	351096	1349399	41	354976	1348520
6	351250	1349534	42	354945	1348516
7	351326	1349970	43	354913	1348520
8	351351	1349957	44	354878	1348527
9	351354	1349978	45	354875	1348527
10	351423	1350378	46	355170	1347921
11	351438	1350376	47	355369	1347287
12	351530	1350910	48	355598	1347300
13	351801	1350864	49	355607	1347288
14	351821	1350861	50	355590	1347261
15	351952	1351597	51	355596	1347228
16	352390	1351520	52	355613	1347213
17	352455	1351859	53	355637	1347204
18	352510	1351960	54	355652	1347206
19	352540	1352078	55	355645	1347162
20	352580	1352295	56	355734	1347147
21	352613	1352391	57	355789	1345582
22	352602	1352408	58	355044	1339589
23	352656	1352447	59	350369	1340145
24	352758	1352465	60	350173	1340169
25	352758	1352465	61	347590	1340629
26	352985	1352550	62	346744	1341156
27	353807	1350829	63	345606	1343469
28	353848	1351045	64	345000	1344750
29	354086	1351006	65	347365	1347344
30	354679	1350902	66	348476	1348454
31	354418	1349456	67	349085	1349193
32	354786	1349393	68	349145	1349193
33	354792	1349425	69	349262	1348992
34	355211	1349352	70	349582	1348358
35	355067	1348501	71	349747	1348441
36	355063	1348472	72	350156	1348647

Schedule 1

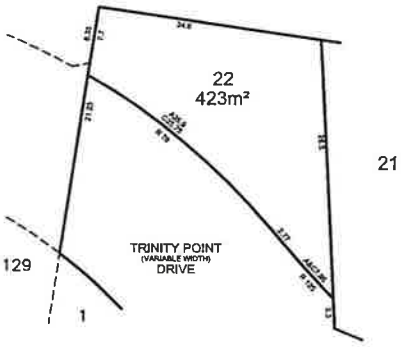
PC1243

NOTES:-

1. THE PROPOSED BOUNDARIES HAVE NOT BEEN INVESTIGATED NOR MARKED FOR THE PURPOSES OF THIS PROPOSED SUBDIVISION. THE BOUNDARY DIMENSIONS ARE COMPILED FROM THE RELEVANT DEPOSITED PLANS.
2. THIS DRAFT SUBDIVISION PLAN IS FOR THE EXPRESS PURPOSE OF GAINING SUBDIVISION APPROVAL ONLY.
3. FINAL DIMENSIONS MAY CHANGE SUBJECT TO LMC COUNCIL APPROVAL AND SHOULD NOT BE RELIED UPON.
4. THIS ELECTRONIC PLAN SHOULD NOT BE USED FOR CRITICAL DESIGN DIMENSIONS. ALL CRITICAL POSITIONS AND DIMENSIONS SHOULD BE VERIFIED ON REQUEST TO SURDEVEL PTY LTD.

NORTH POINT (MGA)

NSD729/07 (NN07/3)
Plan of Proposed Subdivision - Stage 1b
Attachment A of the Application
Page 1 of 1, A4, 01/05/2007

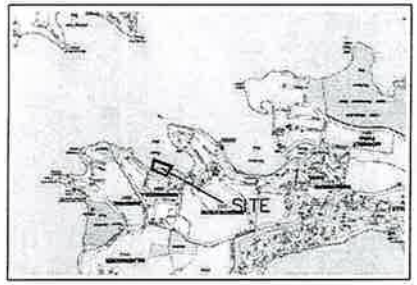


DIAGRAM

STEPHEN J. LAWLER B.SURV. M.I.S. AUST.
SURVEYOR REGISTERED UNDER THE
SURVEYING ACT 2002

SHEET 1 OF 1

CLIENT	JOHNSON PROPERTY GROUP PTY. LTD.	SCALE BAR 0 50 100 200m	PLAN OF: STAGE 1b: PROPOSED 2 LOT SUBDIVISION AND CREATION OF PUBLIC ROAD
CONSULTING SURVEYORS	SURDEVEL PTY. LTD.	PLAN OF PROPOSED SUBDIVISION - STAGE 1b 01-09-06	FILENAME: S:\Subs\Morisset Park\Final Layout\Stage 1b
		OF LOT 2 IN PROPOSED SUBDIVISION OF LOT 38 DP 1076099 (D, 136)	SCALE 1:1500 (A1)



LOCALITY PLAN

TRINITY POINT MARINA
LGA: LAKE MACQUARIE
SUBURB/LOCALITY: MORRISSET PARK
PARISH: MORISSET
COUNTY: NORTHUMBERLAND

NOTES

THIS PLAN HAS BEEN PREPARED FOR INFORMATION ONLY AND RETAINS ALL CONDITIONS DOCUMENTED ON THE ORIGINAL SURVEY.

THIS PLAN HAS BEEN PREPARED FOR THE EXPRESS PURPOSE OF GAINING APPROVAL. AND IS NOT APPROVED FOR USE FOR ANY OTHER PURPOSE.

DIMENSIONS ARE SUBJECT TO CHANGE THROUGH THE APPROVAL PROCESS AND THEREFORE SHOULD NOT BE RELIED UPON.

THE ELECTRONIC VERSION OF THIS PLAN SHOULD NOT BE USED FOR OBTAINING CRITICAL DESIGN DIMENSIONS. ALL CRITICAL DIMENSIONS SHOULD BE VERIFIED BY SURVEY.

NSD729/07 (NN07/3)
Proposed Plan of Subdivision Trinity Point Marina Development
Attachment B of the Application
Page 1 of 1, A4, 01/05/2007

'B'

DRG STATUS : PRELIMINARY, NOT FOR CONSTRUCTION

0 20 40 60 80 100m
1:1200 (A1) 1:2400 (A3)

Issue	Details of Issue	Des'd	Drn	Chk'd	Approved	Date
A	PRELIMINARY ISSUE	SA	NB	SA		

INITIALS SHOWN IN THE ADJACENT ISSUE RECORDS INDICATE THE STAGES UNDERTAKEN IN THE DRAWING APPROVAL PROCESS. DRAWINGS ARE ONLY TO BE USED WHEN APPROVED BY PATTERSON BRITTON & PARTNERS AND THEN ONLY AS NOTED FOR DRG STATUS. THE ORIGINAL SIGNATURES CAN BE FOUND ON THE REVERSE SIDE OF THE ORIGINAL OF THE DRG REGISTER/TRANSMITTAL FORM No.5.2.2. HELD BY PATTERSON BRITTON & PARTNERS

14 Telford Street
Newcastle East 2300
telephone (02) 4928 7777
facsimile (02) 4928 2111
mail@newcastle.pattbrit.com.au
A.C.N. 003 220 226

Patterson Britton & Partners Pty Ltd
consulting engineers

Client: JPG Property Group — Creating living communities

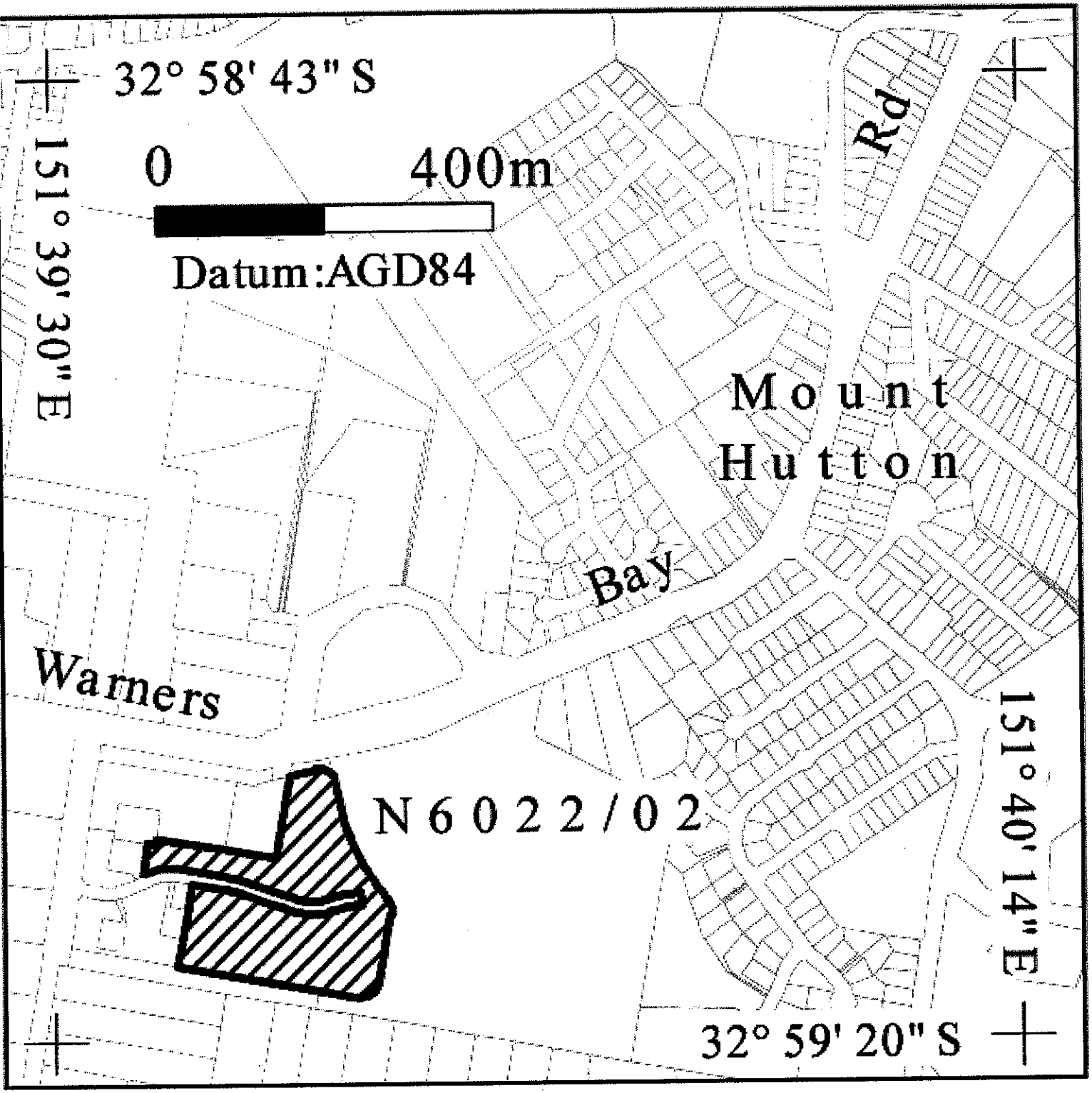
Project: TRINITY POINT MARINA

Title: PROPOSED PLAN OF SUBDIVISION
TRINITY POINT MARINA DEVELOPMENT

Drawing No.: PRELIM 1
Issue: A
Cad File No.:
Ref.(s):

A1

N:\Drafting Jobs\6791_01 Scarborough Gardens _lot layout and Da (nb)\Cad\PLAN OF SUBDIVISION\MARINA.dwg, 26/04/2007 3:59:01 PM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400m
Datum:AGD84
151° 39' 30" E
Rd
Mount
Hutton
Bay
Warners
N6022/02
151° 40' 14" E
32° 59' 20" S

B1

PLAN FORM 3 (APPROVED FORM 5) To be used in conjunction with Plan Form 2

WARNING: CREASING OR FOLDING WILL LEAD TO REJECTION

*OFFICE USE ONLY

DP 1075419

Registered 15-12-2004

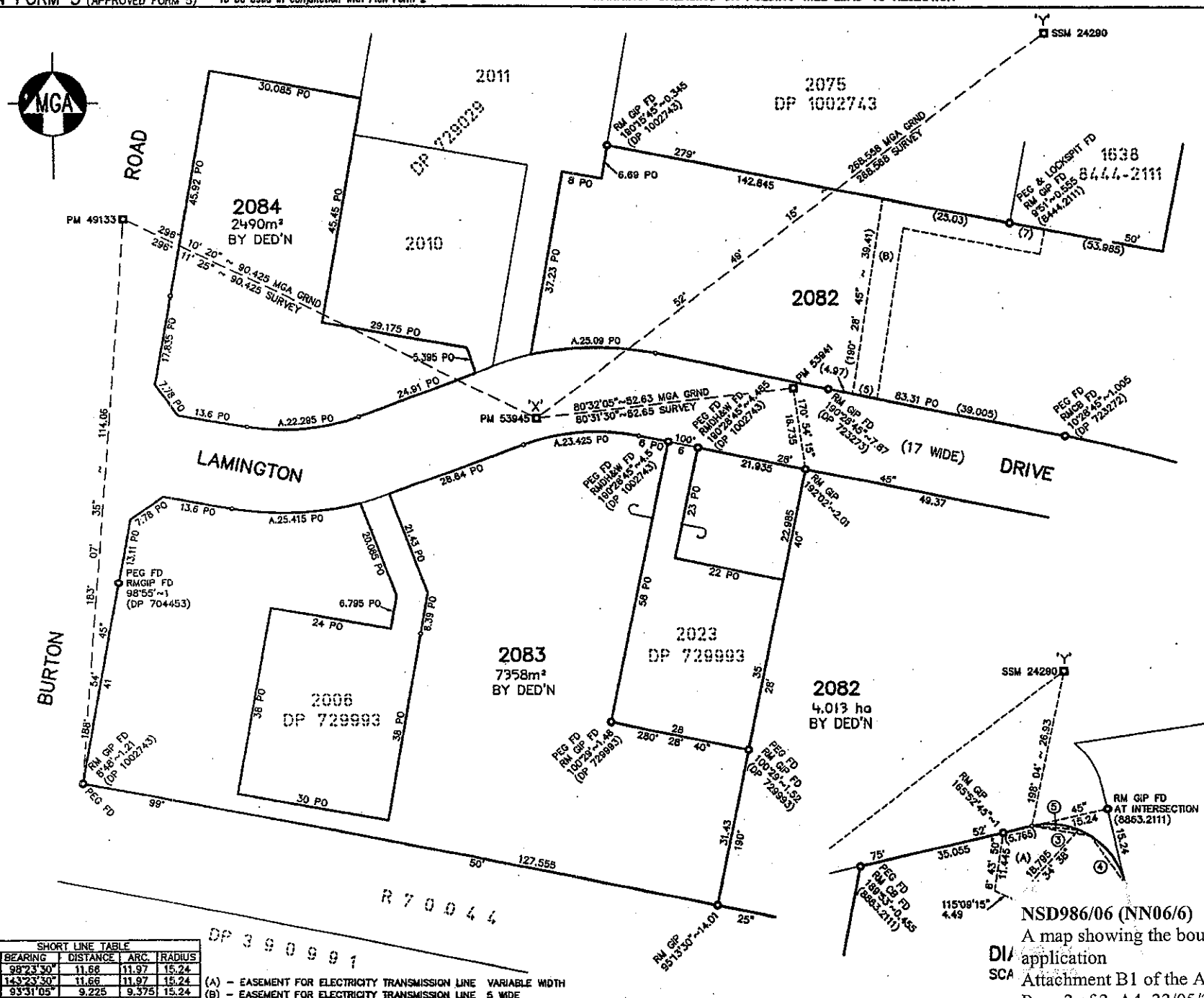
This is sheet 2 of my plan in 2 sheets dated 7TH AUGUST 2003

Surveyor registered under Surveying Act, 2002

This is sheet of my plan of sheets covered by Subdivision Certificate No. of

Authorised Person/General Manager/Accredited Certifier

For use where space is insufficient in any panel on Plan Form 2.



Plan Drawing only to appear in this space

Ref:Cityink & Legalities /Scr:P

Filename : 207510P_EASE.7.8.03.DWG

NSD986/06 (NN06/6)

A map showing the boundaries of the area covered by the application

Attachment B1 of the Application

Page 2 of 2, A4, 22/05/2006

Box : 173

B2

Department of Lands
Reliable from the ground up

Cadastral Records Enquiry Report

Requested Parcel : Lot 2084 DP 1075419

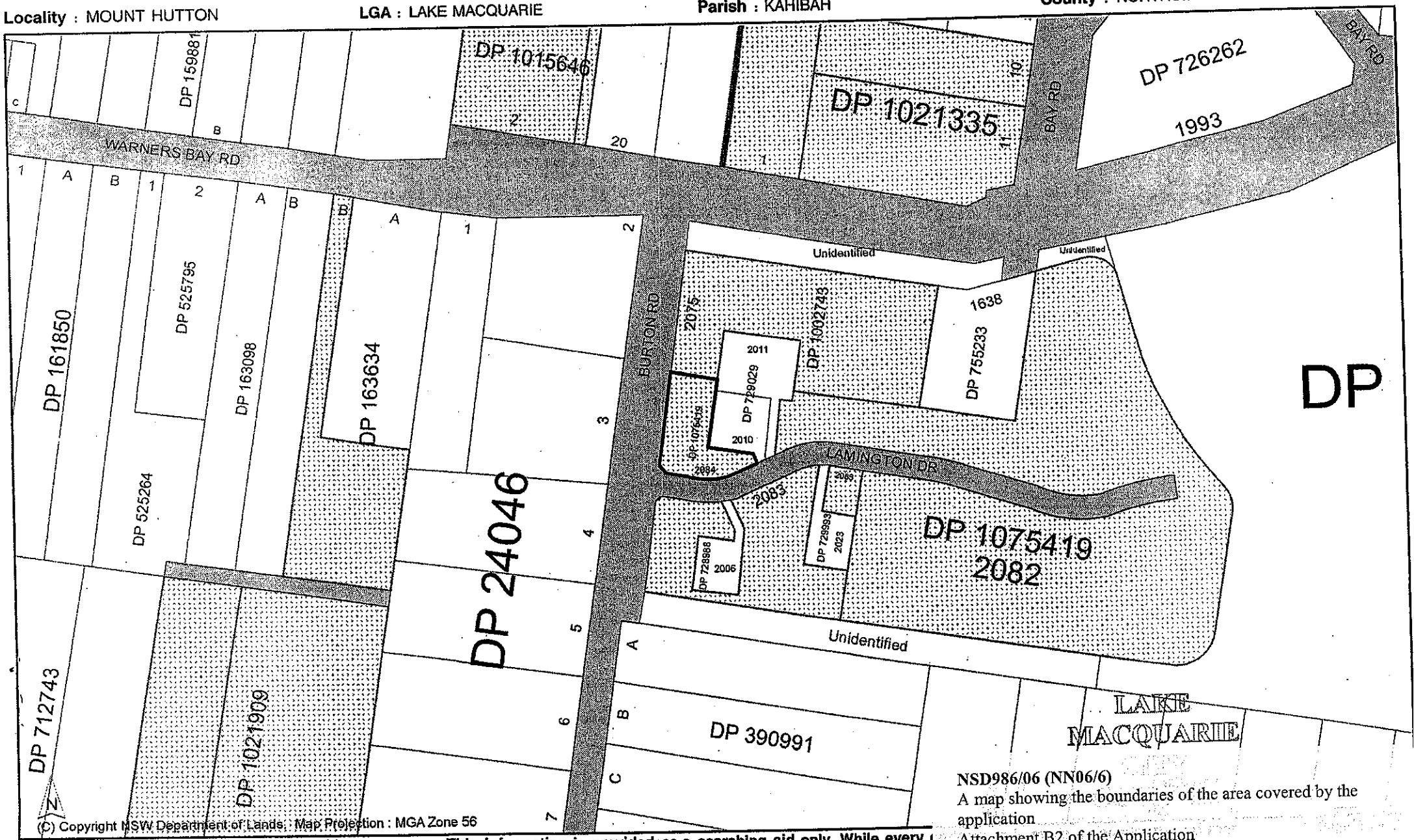
Identified Parcel : Lot 2084 DP 1075419

Locality : MOUNT HUTTON

LGA : LAKE MACQUARIE

Parish : KAHIBAH

County : NORTHUMBERLAND

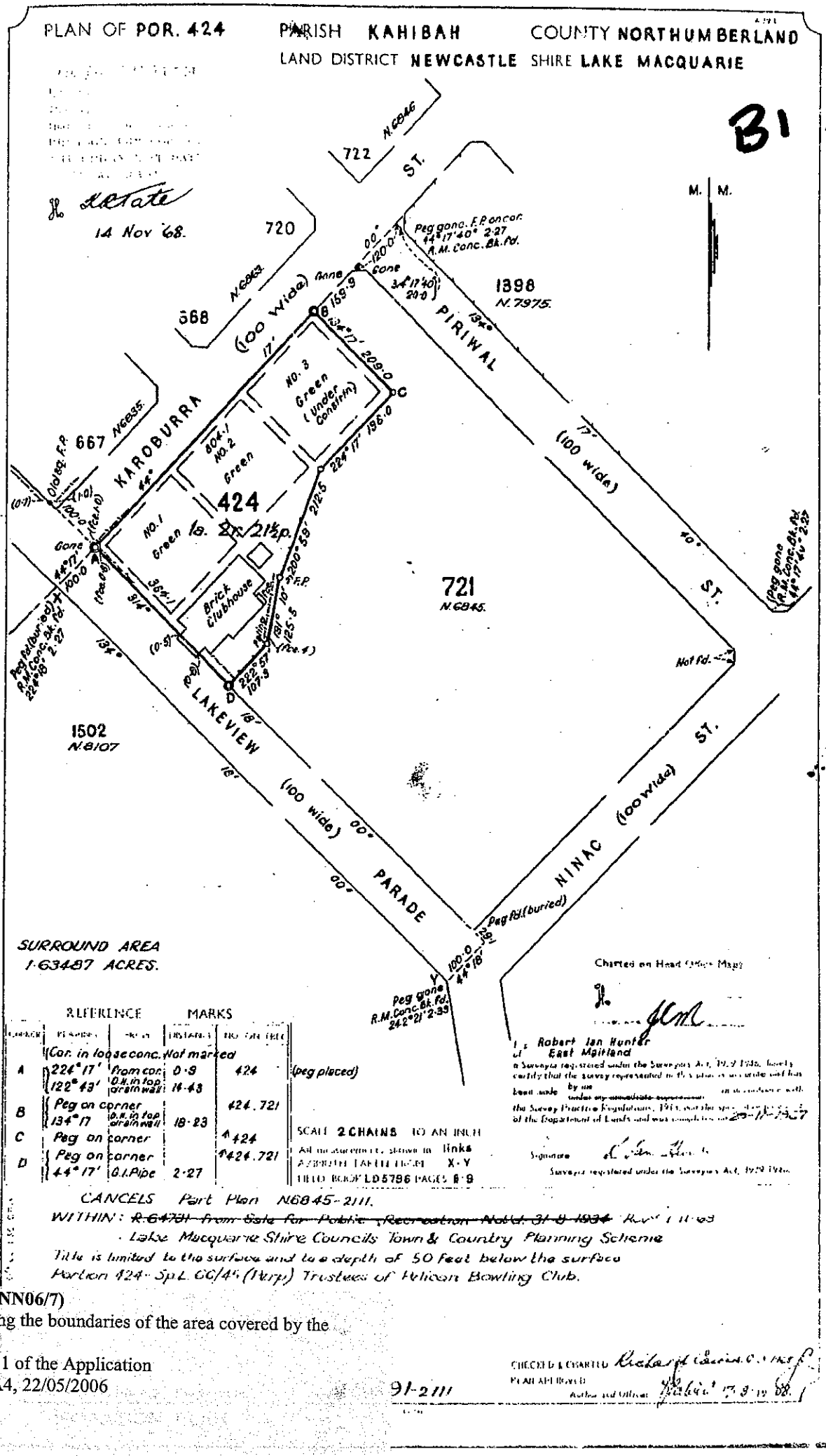


(C) Copyright MSW Department of Lands. Map Projection : MGA Zone 56

Report Generated 10:01:17 AM, 4 May, 2006

This information is provided as a searching aid only. While every c cadastral pattern is accurately reflected, the Registrar General car

NSD986/06 (NN06/6)
A map showing the boundaries of the area covered by the application
Attachment B2 of the Application
Page 1 of 1, A4, 22/05/2006



NSD987/06 (NN06/7)
A map showing the boundaries of the area covered by the application
Attachment B1 of the Application
Page 1 of 1, A4, 22/05/2006

Department of Lands
Reliable from the ground up

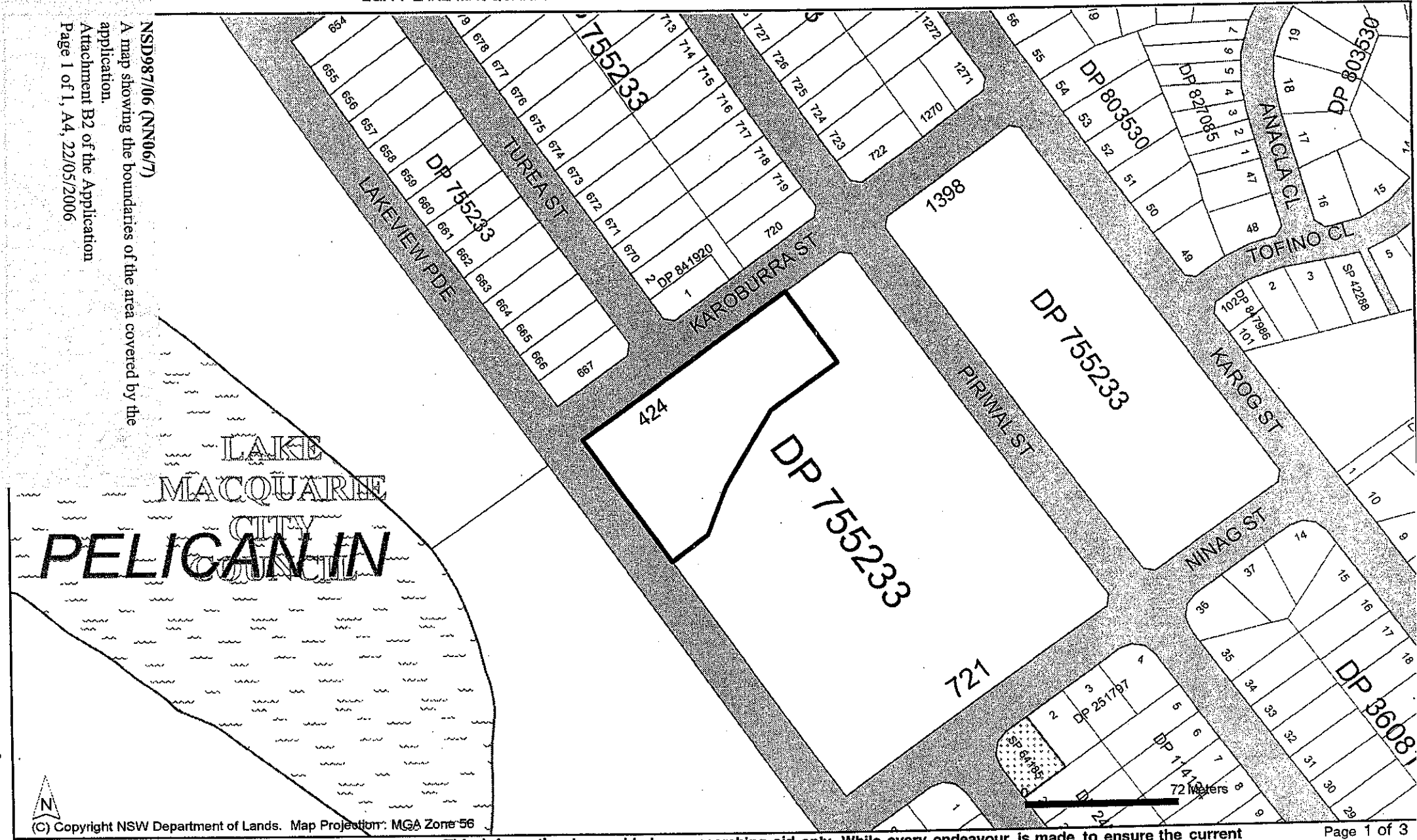
Cadastral Records Enquiry Report

Box : 173

Requested Parcel : Lot 424 DP 755233 **Identified Parcel** : Lot 424 DP 755233

Locality : PELICAN **LGA** : LAKE MACQUARIE **Parish** : KAHIBAH **County** : NORTHUMBERLAND

NSD987/06 (NN06/7)
A map showing the boundaries of the area covered by the application.
Attachment B2 of the Application
Page 1 of 1, A4, 22/05/2006



(C) Copyright NSW Department of Lands. Map Projection: MGA Zone 56

Report Generated 10:01:10 AM, 4 May, 2006

This information is provided as a searching aid only. While every endeavour is made to ensure the current cadastral pattern is accurately reflected, the Registrar General cannot guarantee the information provided

B2

National Native Title Tribunal

Extract from the Register of Native Title Claims

Application Information

Application Reference: **Federal Court number:** NSD951/2012

NNTT number: NC2012/003

Application name: Kerrie Brauer & Ors on behalf of the Awabakal People

Registration History: Registered from 02/08/2012

Register Extract (pursuant to s. 186 of the *Native Title Act 1993*)

Application filed with: Federal Court of Australia

Date application filed: 04/07/2012

Date claim entered on Register: 02/08/2012

Applicants: Ms Kerrie Brauer, Mr Wayne Saxby, Mr William Henry Saxby, Mr Trevor Phillip Powell, Mr Wayne Maurice Hawken, Mr Shane Michael Frost

Address for service: Just Us Lawyers
238 Kelvin Grove Road, KELVIN GROVE QLD 4059
PO Box 120
RED HILL QLD 4059
Phone: 07 3369 7145
Fax: 07 3315 2727

Additional Information:

Not Applicable

DESCRIPTION OF THE AREA COVERED BY THE CLAIM:

Information identifying the boundaries of:
a) the area covered by the application; and
b) any areas within those boundaries that are not covered by the application.

In relation to (a) above a description of the area of land and waters covered by the application is provided at Attachment "B".

Areas within the boundary identified in Attachment "B" that are not covered by the application are set out below:

1. The area covered by the application excludes any land or waters that is or has been covered by:

(a) Scheduled interest;
(b) a freehold estate;
(c) a commercial lease that is neither an agricultural lease nor a pastoral lease;
(d) an exclusive agricultural lease or an exclusive pastoral lease;
(e) a residential lease;
(f) a community purpose lease;
(g) a lease dissected from a mining lease and referred to in s.23B(2)(c)(vii) of the Native Title Act 1993 (Cth);
(h) any lease (other than a mining lease) that confers a right of exclusive possession over particular land or waters.

2. Subject to paragraphs 4 and 5, the area covered by the application excludes any land or waters covered by the valid construction or establishment of any public work, where the construction or establishment of the public work commences on or before 23 December 1996.

3. Subject to paragraphs 4 and 5, exclusive possession is not claimed over areas which are subject to valid previous non-exclusive possession acts done by the Commonwealth or State of New South Wales.

4. Subject to paragraph 6, where the act specified in paragraphs 1, 2 and 3 falls within the provisions of:
s.23B(9) - Exclusion of acts benefiting Aboriginal Peoples or Torres Strait Islanders;
s.23B(9A) - Establishment of a national park or state park;
s.23B(9B) - Acts where legislation provides for non-extinguishment;
s.23B(9C) - Exclusion of Crown to Crown grants; and
s.23B(10) - Exclusion by regulation.

the area covered by the act is not excluded from the application.

5. Where an act specified in paragraphs 1, 2 and 3 affects or affected land or waters referred to in:
s.47 - Pastoral leases etc. covered by claimant application
s.47A - Reserves etc. covered by claimant application
s.47B - Vacant Crown land covered by claimant application,

the area covered by the act is not excluded from the application.

6. The area covered by the application excludes land or waters where the native title rights and interests claimed have been otherwise extinguished.

PERSONS CLAIMING TO HOLD NATIVE TITLE:

The claim group are persons:

1. who are recognised by other members of the claim group as being descended (which may include by adoption) from a deceased person who they recognise as having been a member of the aboriginal landholding group for the application area depicted in Attachment "C" ("an apical ancestor"); and

2. who identifies himself or herself as being a descendant of an apical ancestor.

It is accepted that adoption may take place and where adoption has occurred it confers upon the adoptee the right to identify as a member of the claim group.

The following deceased persons are recognised as having been apical ancestors from whom claim group members are descended:

The Awabakal People:

- Margaret (Known as Queen Margaret/Old Margaret)

- Ned (Known as King Ned/King Molly/Black Ned/Old Ned)

- Flathead (Father of King Ned/Black Ned/Old Ned)

- Mahrahkah (Known as Molly/Molly Morgan/Maria Morgan)

- Charlotte Preston (Daughter of Molly/Molly Morgan/Maria Morgan)

REGISTERED NATIVE TITLE RIGHTS AND INTERESTS:

The following Native Title Rights & Interests were entered on the Register on 02/08/2012

1. Over areas where a claim to exclusive possession can be recognised (such as areas where there has been no prior extinguishment of native title or where s.238, ss.47, 47A or 47B apply), the claim group claims the right to possess, occupy, use and enjoy the lands and waters of the application area as against the whole world, pursuant to the traditional laws and customs of the claim group.

2. Over areas where a claim to exclusive possession cannot be recognised, the claim group claims the non-exclusive right to:

(a) live and be present on the application area;
(b) take, use, share and exchange traditional natural resources for personal, domestic and non-commercial, communal purposes;
(c) conduct burial rites;
(d) conduct ceremonies;
(e) teach on the area about the physical and spiritual attributes of the area;
(f) maintain places of importance and areas of significance to the native title holders under their traditional laws and customs and protect those places and areas from physical harm;
(g) light fires for domestic purposes including cooking but not for the purposes of hunting or clearing vegetation;
(h) be accompanied into the claim area by non claim group members being people required:

(1) by traditional law and custom for the performance of ceremonies or cultural activities; and
(2) to assist in observing and recording traditional activities on the claim area.

(i) in relation to water, take and use:
(1) traditional natural resources from the water for personal, domestic and non-commercial communal purposes; and
(2) for personal. domestic and non-commercial, communal purposes.

3. For the purposes of 2. above:

"Live" means to reside and for that purpose erect shelters and temporary structures but does not include a right to construct permanent structures.

"Traditional Natural Resource" means:

(1) "animals" as defined in the National Parks and Wildlife Act 1974 (NSW)
(2) "plants" as defined in the National Parks and Wildlife Act 1974 (NSW)
(3) charcoal, shells and resin; and
(4) clay, soil, sand, ochre, gravel or rock on or below the surface.

"Water" means water source as defined by the Water Management Act 2000 (NSW)

4. The native title rights and interests are subject to:
(a) The valid laws of the State of New South Wales and the Commonwealth of Australia; and
(b) The rights conferred under those laws.

REGISTER ATTACHMENTS:

1. 1. Written description and plan of application area, Attachment B of the Application, 2 pages - A4, 04/07/2012

2. 2. A map showing the external boundaries of the claim area., Attachment C of the Application, 1 page - A4, 04/07/2012

Note: The Register of Native Title Claims may, in accordance with s. 188 of the Native Title Act 1993, contain confidential information that will not appear on the Extract.

National Native Title Tribunal

Extract from the Register of Native Title Claims

Application Information

Application Reference: **Federal Court number:** NSD780/2013

NNTT number: NC2013/002

Application name: Kerrie Brauer & Ors on behalf of the Awabakal and Guringai People

Registration History: Registered from 13/06/2013

Register Extract (pursuant to s. 186 of the *Native Title Act 1993*)

Application filed with: Federal Court of Australia

Date application filed: 13/05/2013

Date claim entered on Register: 13/06/2013

Applicants: Kerrie Brauer, Trevor Powell, Wayne Hawken, Shane Frost, Peter Leven, Wayne Saxby, Tracey-Lee Howie, Trudy Smith, Laurie Bimson

Address for service:
Michael Owens
Michael Owens
Lawyer and Consultant
15 Cahill Street
Aitkenvale QLD 4814
Phone: 0418 181 004

Additional Information:

Not Applicable

DESCRIPTION OF THE AREA COVERED BY THE CLAIM:

Information identifying the boundaries of:

(a) the area covered by the application; and

(b) any areas within those boundaries that are not covered by the application.

In relation to (a) above a description of the area of land and waters covered by the application is provided at Attachment "B".

Areas within the boundary identified in Attachment "B" that are not covered by the application are set out below:

1. The area covered by the application excludes any land or waters that is or has been covered by:

(a) Scheduled interest;

(b) a freehold estate;

(c) commercial lease that is neither an agricultural lease nor a pastoral lease;

(d) an exclusive agricultural lease or an exclusive pastoral lease;

(e) a residential lease;

(f) a community purpose lease;

(g) a lease dissected from a mining lease and referred to in s. 23B(2)(c)(vii) of the Native Title Act 1993 (Cth);

(h) any lease (other than a mining lease) that confers a right of exclusive possession over particular land or waters.

2. Subject to paragraphs 4 and 5, the area covered by the application excludes any land or waters covered by the valid construction or establishment of any public work, where the construction or establishment of the public work commences on or before 23 December 1996.

3. Subject to paragraphs 4 and 5, exclusive possession is not claimed over areas which are subject to valid previous non-exclusive possession acts done by the Commonwealth or State of New South Wales.

4. Subject to paragraph 6, where the act specified in paragraphs 1, 2 and 3 falls within the provisions of:

s. 23B(9) - Exclusion of acts benefiting Aboriginal Peoples or Torres Strait Islanders;

s. 23B(9A) - Establishment of a national park or state park;

s. 23B(9B) - Acts where legislation provides of non-extinguishment;

s. 23B(9C) - Exclusion of Crown to Crown grants; and

s. 23B(10) - Exclusion by regulation

the area covered by the act is not excluded from the application.

5. Where an act specified in paragraphs 1, 2 and 3 affects or affected land or waters referred to in:

s. 47 - Pastoral leases etc covered by claimant application

s. 47A - Reserves etc covered by claimant application

s. 47B - Vacant Crown land covered by claimant application

the area covered by the act is not excluded from the application.

6. The area covered by the application excludes land or waters where the native title rights and interests have been otherwise extinguished.

The Applicant relies on section 2 and elsewhere in the Report of Mr. Nathan Woolford of 10 May 2013 in Annexure "F".

PERSONS CLAIMING TO HOLD NATIVE TITLE:

The claim group are persons:

1. who are recognised by other members of the claim group as being descended (which may include by adoption) from a deceased person who they recognise as having been a member of the aboriginal landholding group for the application area depicted in Attachment "C" ("an apical ancestor"); and

2. who identifies himself or herself as being a descendant of an apical ancestor.

It is accepted that adoption may take place and where adoption has occurred it confers upon the adoptee the right to identify as a member of the claim group.

The following deceased persons are recognised as having been apical ancestors from whom claim group members are descended:

The Awabakal People:

- Margaret (known as Queen Margaret/Old Margaret)
- Ned (known as King Ned/King Molly/Black Ned/Old Ned)
- Flathead (Father of King Ned/Black Ned/Old Ned)
- Mahrahkah (Known as Molly/Molly Morgan/Maria Morgan)
- Charlotte Preston (Daughter of Molly/Molly Morgan/Maria Morgan)

The Guringai Peoples:

- Bungaree (Known as King Bungaree)
- Bowen Bungaree
- Matora
- Gooseberry (Known as Cora)
- Charlotte Ashby
- Biddy Salamander

The Applicant relies on section 3 and elsewhere in the Report of Mr. Nathan Woolford dated 10 May 2013 in Attachment "F".

REGISTERED NATIVE TITLE RIGHTS AND INTERESTS:

The following Native Title Rights & Interests were entered on the Register on 13/06/2013

1. Over areas where a claim to exclusive possession can be recognised (such as areas where there has been no prior extinguishment of native title or where s. 238, ss. 47, 47A or 47B apply), the claim group claims the right to possess, occupy, use and enjoy the lands and waters of the application area as against the whole world, pursuant to the traditional laws and customs of the claim group.

2. Over areas where a claim to exclusive possession cannot be recognised, the claim group claims the non-exclusive right to:

(a) live and be present on the application area;

(b) take, use, share and exchange Traditional Natural Resources for personal, domestic and non-commercial, communal purposes;

(c) conduct burial rites;

(e) teach on the area about the physical and spiritual attributes of the area;

(f) maintain places of importance and areas of significance to the native title holders under their traditional laws and customs and protect those places and areas from physical harm;

(g) light fires for domestic purposes including cooking but not for the purposes of hunting or clearing vegetation;

(i) In relation to Water, take and use:

(1) Traditional Natural Resources from the Water for personal, domestic and non-commercial communal purposes; and

(2) for personal, domestic and non-commercial, communal purposes.

3. For the purposes of 2. above,

"Live" means to reside and for that purpose erect shelters and temporary structures but does not include a right to construct permanent structures;

"Traditional Natural Resource" means:

"animals" as defined in the National Parks and Wildlife Act 1974 (NSW), but also including fish.

"plants" as defined in the National Parks and Wildlife Act 1974 (NSW)

charcoal, shells and resin; and

clay, soil, sand; ochre; gravel or rock on or below the surface.

"fish" and "fishing".

"Water" means water source as defined by the Water Management Act 2000 (NSW).

REGISTER ATTACHMENTS:

1. Attachment B boundary description, 4 pages - A4, 07/06/2013
2. Attachment C Map, 2 pages - A4, 13/05/2013

Note: The Register of Native Title Claims may, in accordance with s. 188 of the Native Title Act 1993, contain confidential information that will not appear on the Extract.

National Native Title Tribunal

Extract from Register of Indigenous Land Use Agreements

NNTT Number	NIA2000/001
Short name	Powercoal Pty Ltd, Victor Perry, Stephen Seiver & NSW ALC ILUA A
ILUA Type	Area Agreement
Date Registered	29/08/2001
State/territory	New South Wales
Local government Region	Lake Macquarie City Council

Description of the area covered by the agreement

The area covered by the agreement is located about 20km south west of Newcastle and in the vicinity of Lake Macquarie and covers an area of about 87 square km. The map at Schedule 1 of the agreement is attached.

Parties to agreement

Applicant

Party name	Powercoal Pty Ltd
Contact address	c/- Clayton Utz Level 18 - 333 Collins Street Melbourne VIC 3000

Other Parties

Party name	Victor Perry on behalf of the Wonnarua People
Contact address	c/- NSW Aboriginal Land Council Level 9 - 33 Argyle Street PARRAMATTA NSW 2150

Party name	Stephen Seiver
Contact address	c/- NSW Aboriginal Land Council Level 9 - 33 Argyle Street PARRAMATtA NSW 2150

Party name	New South Wales Aboriginal Land Council
Contact address	Level 9 - 33 Argyle Street PARRAMATTA NSW 2150

Period in which the agreement will operate

Start date	28/05/1999
End date	28/05/2020

Statements of the kind mentioned in ss. 24EB(1) or 24EBA(1) or (4)

Consent to Future Acts provided for by the agreement:
1. Subject to the Deed and to the Master Deed, Victor Perry (on behalf of the Wonnarua People) and Stephen Seiver consent to the doing of the Future Acts.
2. Subdivision P of Division 3 of Part 2 of the NTA is not intended to apply and does not apply to the doing of any of the Future Acts.
3. The non-extinguishment principle applies to the doing of the Future Acts.

Future Act is defined as a future act as defined in the NTA which consists of:
(a) the grant of a Mining Tenement;
(b) the grant or renewal by a Government Authority of any other right in respect of the surface area of the area of interest for the purposes of the mining operations;
(c) Mining operations; and
(d) any other act done by Powercoal for the purposes of the mining operations.

Mining operations are defined as 'the underground coal mining operations to be carried out by or under the direction of Powercoal within the area of interest, including, without limiting the generality of the foregoing, exploration, developing, designing, constructing, extracting, handling and transporting of coal and other products won from the underground coal mining operations within the area of interest and any rehabilitation work within the area of interest.

Mining Tenement is defined as a tenement granted to Powercoal under the Mining Act 1912 (NSW) to carry out Mining Operations in the area of interest.

Assignment provided for by the agreement: Powercoal is able to assign all or part of its rights under the Deed to another party, provided that other party assumes the obligations of Powercoal under the Deed.

Attachments to the entry

NIA2000 001 Schedule 1 - Map.pdf

National Native Title Tribunal

Extract from Schedule of Native Title Applications

Application Reference:	Federal Court number: NSD729/2007 NNTT number: NN2007/003
Application Name:	Johnson Property Group Pty Ltd & Kendall Grange Properties Pty Ltd (Johnson and Kendall Grange)
Application Type:	Non-Claimant
Application filed with:	Federal Court of Australia
Date application filed:	27/04/2007

Current stage(s):	Notification complete

Applicants:	Johnson Property Group Pty Limited ACN 102 465 814 and
Address(es) for Service:	

Additional Information

Not applicable

Draft determination of native title sought:

That, with respect to the area shown in Attachments A and B, no native title claims or rights exist.

Application Area:

State/Territory: New South Wales
Brief Location: Lot Specific area in Morisset Park
Primary RATSIB Area: New South Wales
Approximate size: 0.214219 sq km
(Note: There may be areas within the external boundary of the application that are not claimed.)
Does Area Include Sea: No

Area covered by the claim (as detailed in the application):

That part of the land in lot 2 in DP 1107753 (formerly part of lot 38 in DP 1076099) as shown edged in pink on the plan attached as Attachment A.

All of the water and lake bottom comprised in that area of the waters of Lake Macquarie adjoining lot 2 in DP 1107753 as shown edged in green on the plan attached as Attachment B.

Attachments:

1. Plan of Application Area (land), Attachment A of the Application, 1 page - A4, 01/05/2007
2. Plan of Application Area (water), Attachment B of the Application, 1 page - A4, 01/05/2007

NNTT Contact Details

Address: Sydney Office
Level 16, Law Courts Building
Queens Square
SYDNEY NSW 2000

GPO Box 9973
SYDNEY NSW 2001

Telephone: (02) 9227 4000
Freecall: 1800 640 501
Fax: (02) 9227 4030
Web Page: www.nntt.gov.au

End of Extract

National Native Title Tribunal

Extract from the National Native Title Register

Determination Information:

Determination Reference:	Federal Court Number(s): NSD6022/2002 NNTT Number: NND2003/001
Determination Name:	Bahtahbah Local Aboriginal Land Council
Date(s) of Effect:	19/06/2003
Determining Outcome:	Native title does not exist

Register Extract (pursuant to s. 193 of the *Native Title Act 1993*)

Determination Date:	19/06/2003
Determining Body:	Federal Court of Australia

ADDITIONAL INFORMATION:

Not Applicable

MATTERS DETERMINED:

Native title does not exist over the subject land.

REGISTER ATTACHMENTS:

1. Attachment A - Map of External Application Boundary, 1 page - A4, 19/06/2003

Note: The National Native Title Register may, in accordance with s. 195 of the Native Title Act 1993, contain confidential information that will not appear on the Extract.

National Native Title Tribunal

Extract from the National Native Title Register

Determination Information:

Determination Reference:	Federal Court Number(s): NSD986/2006 NNTT Number: NND2007/002
Determination Name:	Bahtabah Local Aboriginal Land Council v New South Wales Native Title Services Limited
Date(s) of Effect:	20/03/2007
Determining Outcome:	Native title does not exist

Register Extract (pursuant to s. 193 of the *Native Title Act 1993*)

Determination Date:	20/03/2007
Determining Body:	Federal Court of Australia

ADDITIONAL INFORMATION:

Not Applicable

MATTERS DETERMINED:

No native title exists in the land described as all of Lot 2084 in Deposited Plan 1075419 at Mount Hutton, Parish of Kahibah, County of Northumberland.

Note: The National Native Title Register may, in accordance with s. 195 of the Native Title Act 1993, contain confidential information that will not appear on the Extract.

National Native Title Tribunal

Extract from the National Native Title Register

Determination Information:

Determination Reference:	Federal Court Number(s): NSD987/2006 NNTT Number: NND2007/003
Determination Name:	Bahtabah Local Aboriginal Land Council v New South Wales Native Title Services Limited
Date(s) of Effect:	20/03/2007
Determining Outcome:	Native title does not exist

Register Extract (pursuant to s. 193 of the *Native Title Act 1993*)

Determination Date:	20/03/2007
Determining Body:	Federal Court of Australia

ADDITIONAL INFORMATION:

Not Applicable

MATTERS DETERMINED:

Pursuant to s86G of the Native Title Act 1993 (Cth) there is no native title in the land described as all of Lot 424 in Deposited Plan 755233 at Pelican, Parish of Kahibah, County of Northumberland.

Note: The National Native Title Register may, in accordance with s. 195 of the Native Title Act 1993, contain confidential information that will not appear on the Extract.

APPENDIX C

Previous Archaeological Research

Appendix C – Previous Archaeological Research in and around the Sugarloaf Range

National Highway (F3 Freeway) – Lough 1981, Donlan and Brayshaw 1986

Lough (1981) surveyed the then proposed National Highway (F3 Freeway) from Wakefield (just north of the Project Area) to Minmi Road (approximately 12 kilometres north of the Project Area) and located fifteen Aboriginal archaeological sites. These included three sets of grinding grooves located on Flaggy Creek (#38-4-0091, #38-4-0092, #38-4-0093), and three artefact scatters on Burkes Creek (#38-4-0094, #38-4-0095, #38-4-0096), seven kilometres north of the current Project Area. As a result of Lough's study, the route of the National Highway was realigned to avoid impact to the sites. Donlan and Brayshaw (1986) undertook a survey of the altered route, and recorded an open campsite (#38-4-0137), 7.5 kilometres north-east of the Project Area. All of the sites recorded during the two studies appear to occur on or adjacent to creeklines.

Transgrid - Bowdler and Gollan and Bowdler and Happ 1982

Bowdler and Gollan (1982) surveyed a proposed transmission line route between Tomago and Eraring. One set of grinding grooves was recorded in the upper reaches of Cockle Creek (38-4-0118) on the eastern fall of the Sugarloaf range, five kilometres north-east of the Project Area. The site was recorded as containing five grooves on a boulder in the creekline. The site was not to be impacted by the construction of the transmission line. However, the site was later impacted by mine subsidence.

Bowdler and Happ (1982) recorded a set of grinding grooves (#38-4-0109) on Burnt Creek on the north-eastern fall of the Sugarloaf Range, ten kilometres north of the Project Area. This site was recorded during a survey for a proposed transmission line route between West Wallsend and Tomago.

Cameron Park - Steele 1993 and Mills 1999

Steele (1993) and Mills (1999) undertook Aboriginal heritage studies of a proposed residential development at Cameron Park, approximately eleven kilometres north-east of the Project Area. Three artefact scatters (#38-5-0182, #38-5-0187, #38-5-0188), eight isolated finds (including #38-5-0180, #38-5-0181, #38-5-0183, #38-5-0184, #38-5-0186, #38-5-0189), and six potential archaeological deposits were located during the two surveys. All of the sites were associated with Cocked Hat Creek, its terraces, and tributaries. The sites contained very low numbers (the open sites contained a maximum of four artefacts) of flakes and flaked pieces composed of silcrete and mudstone/chert, and were assessed as having low archaeological significance (n.b. During the preparation of the Assessment report for the WWCCOP ATOAC—requested that it be noted that this is an area that has high Aboriginal significance (Umwelt 2010)). The potential archaeological deposits were also associated with Cocked Hat Creek and were considered to have potentially high archaeological significance because the creekline contained landform units (creek beds with sandstone outcrops, creek terraces) which are known to contain archaeological evidence. It was not possible to examine these areas at the time of survey due to dense vegetation.

Hunter Expressway - Brayshaw 1994, 2001, Umwelt 2003a, 2003c, 2006c, 2006d, 2010b

This series of projects was discussed in some detail in the WWCCOP EA report (Umwelt 2010). At the time these were the only projects within the Sugarloaf Range area that incorporated information in relation to a broad range of site types and report on both surface survey and subsurface salvage.

Awabakal Local Aboriginal Land Council (ALALC), Mindaribba Local Aboriginal Land Council (MLALC), Black Creek Aboriginal Corporation (BCAC), Barkuma Neighbourhood Centre (BNC) and Lower Wonnarua Tribal Council (LWTC) were requested to provide their own reports on the values and significance of the landscape crossed by the road corridor. As demonstrated by the comments provided by the participating Aboriginal organisations, the Sugarloaf Range has high Aboriginal cultural values and significance for not only the traditional owners of the land, the Awabakal, but also for neighbouring inland groups.

For this discussion only the eastern four kilometre section of the road corridor, where it crosses the Sugarloaf Range (eleven kilometres north-east of the Survey Area) is relevant to the present discussion.

In relation to the location of Aboriginal archaeological sites, the initial assessment of the proposed road corridor was undertaken in 1994 by Brayshaw MacDonald for Connell Wagner. The initial survey located only one isolated find near Minmi Creek and one PAD (in a rockshelter) near Burnt Creek, a tributary of Blue Gum Creek within the north-eastern extent of the Sugarloaf Range area. While reported by Brayshaw (1994), these sites do not appear on the OEH/AHIMS site register. In 2001, at the request of OEH, Brayshaw (2001) resurveyed parts of the area, this time with both ALALC and MLALC. The 2001 survey did not result in further site locations.

Prior to the Brayshaw (1994, 2001) surveys, five sites were known in the area. All five were sets of grinding grooves that were located on sandstone benches outcropping in Blue Gum Creek (Blue Gum Creek Grinding Grooves #38-4-0235 and #38-4-0236), Minmi Creek (Seahampton 1 #38-4-0394, Seahampton 2 #38-4-0393) and a tributary of Minmi Creek (Seahampton 3 #38-4-0392) and all on the north-eastern fall of the Sugarloaf Range. Three of these sites were within 100 metres of the proposed road corridor; one was on an access track required by RTA for geotechnical testing and one was within 100 metres of the F3 Freeway/Newcastle Link Road Interchange.

In November 2003, Umwelt (2003c) was commissioned to undertake the inspection of the road corridor and associated areas of impact as part of the Additional Aboriginal Heritage Assessment required by DECCW (now OEH) for the project. The inspection was to focus on obtaining information related to the distribution of Aboriginal resources (e.g. water, food and medicinal plants, stone for tool manufacture, shelter, areas with expansive outlooks, areas suitable for camping etc) in the landscape and how this related to site distribution. The inspection was also to be used as an opportunity to collect data to formulate the detailed Research Design and Methodology required for the salvage of sites and subsurface testing of areas to be impacted by the project.

The inspection of the four kilometre section of the route within the Sugarloaf Range had been modified from that surveyed by Brayshaw in 1994 and 2001. The inspections found that the Sugarloaf Range area had a good resource base of seasonal plant foods and a large number of medicinal plants that were not available along the coast, in the coastal hinterland and further inland. The Sugarloaf Range also had many sandstone outcrops associated with creeklines that were suitable for grinding stone implements and clifflines and fallen boulders suitable for rockshelter formation (Umwelt 2003a, 2003c).

The inspections located seven previously unrecorded sites and two areas of high Aboriginal cultural heritage sensitivity (Umwelt 2003a). The two areas of high cultural sensitivity included an Aboriginal pathway that follows the present route of the Sugarloaf Range Road and Stockrington Road from Mt Sugarloaf to Pambalong and Hexham Swamps to the north and north-east. This pathway was intersected by the proposed Hunter Expressway road corridor. The second area was adjacent to Blue Gum Creek. This area had a large rockshelter (no floor deposit), a waterfall and plunge pool and an artefact scatter and PAD (Blue Gum Creek 4 Artefact Scatter and associated PAD #38-4-0763).

The remaining sites located within the Sugarloaf Range consisted of one isolated find (Blue Gum Creek 3 Isolated Find #38-4-0762), three artefact scatters (Sugarloaf 1 Artefact Scatter and associated PAD #38-4-0759; Blue Gum Creek 1 Artefact Scatter #38-4-0760; Blue Gum Creek 2 Artefact Scatter #38-4-0761); one set of grinding grooves (Blue Gum Creek 5 Grinding Grooves #38-4-0236) and two stone arrangement sites (incorporating three stone arrangements – Minmi Creek Stone Arrangement 1 #38-4-0819 and Minmi Creek Stone Arrangements 2 and 3 #38-4-0820).

Surface collection under Section 90 Consent #1940 was undertaken for the artefact scatter and isolated find sites within the road corridor. Subsurface investigations were undertaken under Section 90 Consent #1940 at Blue Gum Creek 4 Artefact Scatter and associated PAD #38-4-0763 and Sugarloaf 1 Artefact Scatter and associated PAD #38-4-0759).

Table 1 provides details of the contents of the isolated find and artefact scatter sites.

Table 1 – Sites in Sugarloaf Range Salvaged under Section 90 Consent #1940

Site Name	DECCW Site #	No. of Artefacts
Sugarloaf 1 Artefact Scatter and associated PAD	#38-4-0759	23 surface and 3 subsurface
Blue Gum Creek 1	#38-4-0760	2 surface
Blue Gum Creek 2	#38-4-0761	32 surface
Blue Gum Creek 3 IF	#38-4-0762	1 surface
Blue Gum Creek 4 Artefact Scatter and Associated PAD	#38-4-0763	8 surface and 2 subsurface

The Sugarloaf 1 Artefact Scatter and associated PAD (#38-4-0759) contained a total of 23 surface artefacts which were collected from an area at the intersection of two tracks on a low ridge crest between a tributary of Minmi Creek and the main channel of Minmi Creek. The artefacts were spread along the tracks over an area approximately 100 metres in length by 5 to 8 metres in width. The artefacts consisted of flakes, broken flakes, flaked pieces and a single core. The majority of the artefacts were manufactured from Nobbys tuff. There was one silcrete core and one silcrete flaked piece (probably broken off the core by impact with the dozer during road construction).

Four 1 x 1 metre squares were excavated in areas off the road on the crest of the low ridge. The areas chosen for excavation were those deemed to be the least disturbed by prior tree clearance and road construction and were located within close proximity of the surface artefacts. The soil consisted of remnant A2 horizon, less than 15 centimetres in depth. Square 1 contained three Nobbys tuff broken flakes, two in Spit 1 and one in Spit 3. Square 3 contained one silcrete broken flake in Spit 2.

Blue Gum Creek 4 Artefact Scatter and Associated PAD (#38-4-0763) contained a total of eight surface artefacts which were collected from an eroded foot/motor bike track (and from the surface of a conglomerate rock exposure on the south-eastern side of Blue Gum Creek. Artefact types included flakes and broken flakes manufactured from Nobbys tuff, basalt and quartz. The majority of the artefacts exhibited evidence of being exposed to uncontrolled heat from bushfire (burnt, crazed, shattered).

Four 1 x 1 metre squares were excavated on a heavily grassed, level bench, on the slope on the eastern side of the track. At the time of site recording it was proposed that this area had the potential to have retained some topsoil (which had been eroded from the remainder of the slope); however, the excavations found that the majority of the topsoil was also missing from this area with only an extremely gravelly, A2 horizon of 5 to 15 centimetres in depth

over the clay. One broken basalt flake was located in Spit 1 of Square 2 and one broken silcrete flake was located in Spit 1 of Square 4.

In both excavations substantial soil loss and subsurface disturbance was noted. This appeared to have been caused by logging activities (related to obtaining pit props) which had disturbed the topsoil and acted to destabilise the slopes. Only very low numbers of subsurface artefacts were located. This result reflected the surface scatters which also contained relatively low numbers of artefacts.

The surface artefacts collected from the remaining sites were flakes, broken flakes and flaked pieces manufactured predominantly from Nobbys tuff and with minor numbers of basalt and silcrete. The majority of the artefacts collected from Blue Gum Creek 2 (#38-4-0761) were very small portions of broken flakes and heat shattered flakes manufactured from Nobbys tuff. It is assessed that the 32 fragmentary artefacts in this site reflect, what was a much smaller assemblage, at the time of discard. The artefacts had been damaged and broken due to track construction/use in the area (most probably related to the construction of a tunnel for the Richmond Vale Railway which was adjacent to the site) and bushfire (heat shatter).

The sites remaining in association with the Hunter Expressway road corridor are managed in compliance with an Aboriginal Cultural Heritage Plan of Management (Umwelt 2010b) during the construction and maintenance phases of the project.

Tasman Underground Mine (Umwelt 2002)

Umwelt was commissioned to undertake an archaeological assessment of an eight hectare area to be impacted by surface infrastructure associated with the Tasman underground mine. The eight hectare surface infrastructure area, located within the larger project/mine lease boundary of approximately 60 hectares, is immediately west of George Booth Drive, approximately 1.5 kilometres west of the town of Seahampton and 2 kilometres east of Mount Sugarloaf (Umwelt 2002: 2). The southern boundary of the broader Tasman ML is approximately six kilometres north of the Project Area.

A pedestrian field survey was conducted and concentrated on vehicle tracks, transmission lines and other areas of enhanced ground surface visibility. The survey covered approximately 5% of the 60 hectare project/mine lease boundary. The focus of the survey effort was located on/near areas to be impacted by surface infrastructure as the underground mining was to be undertaken by the bord and pillar method which has no impact to the ground surface as it does not result in subsidence. No archaeological sites were located during the survey of the surface infrastructure area. It was recommended that no further archaeological works were required (Umwelt 2002: 13).

Western Domain within the Proposed Continued Underground Mining Area (Umwelt 2006a)

Umwelt was commissioned to conduct an archaeological assessment of five longwalls known as the 'Western Domain', located inside and roughly corresponding with the five eastern most longwalls proposed in the continued underground mining area. Prior to the assessment only one site (an isolated find comprised of '1 flake found in the roadway' was known to occur in the continued operations project area (Umwelt 2005:8).

The strategy for the field survey of the Western Domain conducted in April 2006 was to target creeklines, ridges, spurs and locations which afforded good ground surface visibility. Due to generally dense vegetation and leaf litter away from the creeklines, roads, animal and motorcycle tracks within the continued underground mining area were targeted for survey as they provided better ground surface visibility and covered topographic locations such as

ridges and spurs, which are known to have been used by Aboriginal people to negotiate the steeper areas of the sandstone country (Vinnicombe 1980, ALALC 2003) and which commonly have small artefact scatter sites resulting from this transient use. Creeklines were targeted for survey as one of the objectives of the survey was to locate any axe grinding grooves that may be present as these (sandstone) sites were considered to have the highest potential to be adversely impacted by subsidence following underground mining. Watercourses were targeted because it was observed that artefact scatter and isolated find sites have generally been located on lower slopes/footslopes adjacent to creeks. Creeklines were also assessed as likely to be impacted by mine subsidence through the need for remediation works to correct ponding (Umwelt 2006a:9).

Nine previously unrecorded sites were located during the Western Domain survey, five artefact scatters and four isolated finds. The raw materials used for implement manufacture included tuff, silcrete and basalt. All but one of the sites recorded was located in a disturbed context within an existing vehicle track, a vehicle track which had been previously graded, or in an area where vegetation had been mechanically cleared (Umwelt 2006a:10). The exception to this highly disturbed context was site Western Domain 5 (#38-4-0993) a small artefact scatter located on a sandstone rubble bank immediately adjacent to a small perched wetland which became known as the 'wet soak' (Umwelt 2007, Umwelt 2008:1).

In addition to the sites recorded during the survey, attempts were made to locate two previously recorded artefact scatter sites, one inside the Western Domain area, one just outside (#38-4-0097 and #38-4-0098). Attempts to find these sites were unsuccessful, in large part due to the dense vegetation cover present at each of the previously recorded site locations (Umwelt 2006a:12).

The majority of the nine sites recorded during the Western Domain survey were assessed as being typical of the artefact scatter and isolated find sites located throughout the Sugarloaf Range and the Lower Hunter Valley. Two sites recorded during the survey however were assessed as being unusual or unique within the previously recorded sites of the area. Western Domain 5 (#38-4-0993) was located in a unique landscape context, while Western Domain 8 (#38-4-1002) had a relatively large number of artefacts in its assemblage compared to other sites in the locality and also contained an implement type (a backed point or Bondi Point) rarely recorded in the Sugarloaf Range (Umwelt 2006a:12).

As the environmental context of Western Domain 5 (#38-4-0993) was assessed as rare/possibly unique and not well understood it was recommended that a geomorphic investigation in the form of auger testing be undertaken to determine the nature of the wet soak. It was assessed that only after obtaining further geomorphic information could the nature of the wet soak feature and the potential for subsidence to impact this feature be known and an appropriate management/mitigation outcome for the site considered (Umwelt 2006a: 27-28).

Northern Domain (Umwelt 2006e)

Following previous assessments the long wall layout of the Northern Domain was redesigned prior to approval being sought. The two western-most longwalls were extended by approximately 125 metres and 75 metres respectively. The extension of the western-most longwall (LW37) meant that previously recorded artefact scatter AHIMS #38-4-0766 was located within the subsidence impact area. Because the effect of subsidence was determined to be negligible to the artefact scatter it was assessed that there was no archaeological constraint to the Northern Domain project. It was further recommended that any mitigation works which may be conducted (such as those to correct creek ponding) be undertaken in consultation with the ALALC (Umwelt 2006e:10).

Proposed Easement, Tasman Lease, West Wallsend (Umwelt 2006b)

Umwelt was commissioned by Newcastle Coal to prepare an assessment for a proposed power easement running from the township of West Wallsend north-west and terminating approximately 2 kilometres east of Mt Sugarloaf near the township of Seahampton (Umwelt 2006b: 1.1). Due to the linear nature of the power easement and the localised nature of the impact from pole emplacement the entire easement inspected via a pedestrian survey (Umwelt 2006b: 5.1-5.2).

One artefact scatter comprised of two silcrete flakes and one tuff flake was recorded during the survey. Though the artefacts themselves were located adjacent to the easement and wholly outside the assessment area the landform in which the artefacts were found (ephemeral drainage line) was present in the proposed easement and the site area was defined as extending into the assessment area based on its landform context. This site was assessed as having a low archaeological and cultural significance due to its highly disturbed nature (Umwelt 2006b:5.2).

The artefact scatter site was thought to be typical of those known in the area as it was associated with a creekline, had a small number of artefacts manufactured from raw materials common to sites in the area.

The assessment concluded that no further archaeological or cultural heritage management works were required in relation to the project, providing that no ground disturbance (either from vegetation clearance or pole emplacement) impacted the site area (Umwelt 2006b: 7.2).

Geomorphic Investigation of the 'Wet Soak' Associated with Artefacts Scatter WD5, within the Proposed Continued Underground Mining Area (Umwelt 2008)

In accordance with Aboriginal Heritage Impact Permit (AHIP) #2789 a geomorphic investigation was conducted in May 2008 in relation to the perched wetland known as the 'wet soak' on whose banks artefact scatter Western Domain 5 (#38-4-0993) is located. The purpose of this investigation was to confirm whether the wet soak was a natural rather than anthropogenic feature and to determine the origin and persistence of the perched wetland (Umwelt 2008:1).

Five, 10 centimetre diameter auger holes were excavated to depths of between 35 centimetres and 70 centimetres at the edges and downstream of the wet soak. On-site analyses of sediment texture and fabric, colour and mottling, pH and field texture were conducted (Umwelt 2008:3). Results of the geomorphic testing showed that a sandy clay, intersected by four of the five auger holes, is the *in situ* material which seals the floor of the wet soak. This clay is distinct from the surrounding skeletal earthy fabric, sand textured soils (Umwelt 2008:5). It was therefore concluded that the wet soak is an entirely natural feature which persists because of the presence of minor claystone units in the locale geological strata (Umwelt 2008:6).

The Western Domain 5 site (#38-4-0993) was assessed as highly significant to the ADTOAC and the ATOAC and the Western Domain mine plan was modified to avoid impact to this site.

Due Diligence Archaeological Inspection of Proposed Geotechnical Boreholes at West Wallsend Colliery (Virtus Heritage 2010)

Virtus Heritage undertook due diligence inspections for the WWC 2010 exploration drilling program, with the report forming part of a Review of Environmental Factors required for the program. During the inspections four artefact scatters and four isolated finds were identified on access tracks in proximity of the borehole locations. These sites are all within the WWC

continued underground mining area, and therefore are required to be managed by WWC under the ACHMP.

Tasman Extension Project, Cessnock and Lake Macquarie Local Government Areas, Hunter Valley, New South Wales: Aboriginal Cultural Heritage Assessment (South East Archaeology 2012)

South East Archaeology undertook the survey and assessment for a proposed extension of the Tasman Underground Mine approximately six kilometres north of the Project Area. The Tasman Underground Mine uses the bord and pillar method of mining with the proposed extension predominantly to the west of the existing Tasman underground workings.

The assessment focused on the extent of the proposed underground workings and pit top infrastructure with survey covering 90% of the investigation area. The survey identified 38 artefact sites, 35 grinding groove sites, 26 rockshelters with PAD and one grinding groove and artefact scatter site. Nine sites that had been previously recorded could not be located.

The artefact sites identified were small and predominantly made up of tuff and silcrete broken artefacts. Eighteen of the artefact sites were isolated artefacts, 17 had ten or fewer artefacts with only three having greater numbers (19, 24 and 43 artefacts respectively). The analysis of the artefact sites by South East Archaeology identified that they were consistent with background discard of artefacts and that the evidence was insufficient to suggest activities were focused on a given area.

Of the 38 grinding groove sites identified, only three comprised single grooves. Fourteen of the sites had between 2 and 10 grooves, six between 11 and 20 and five had over 20 grooves. The larger sites were all previously identified sites with the largest site containing 92 grooves. These sites were all on the upper slopes on the western side of the main Sugarloaf Ridge line, directly south of Mount Sugarloaf. This area was identified as having high Aboriginal cultural value. Based on the experimental studies presented in Umwelt 2010, it was hypothesised that the grooves were created by the creation/ sharpening of hatchets and axes. A number of broad basin-like depressions which could have resulted from food, ochre or medicine preparation were also identified at these sites.

None of the 26 rockshelters with PAD had artefacts, grinding grooves or any other material evidence that they were utilised in the past by Aboriginal people. The shelters were still recorded, however, it was also noted that under the NPW Act definition the rockshelters with deposit are not technically ‘Aboriginal objects’. These shelters would be equivalent to the shelters recorded by Umwelt (2012) as cultural landscape features. One of the shelters was situated on a ridge crest, two were situated in a drainage depression and the remaining 23 were located on simple slopes.

The South East Archaeology assessment identified that 39 of the 57 sites identified may be impacted by the project, either through surface impacts by vehicles on access tracks or through subsidence. A large number of sites were identified as being ‘very unlikely’ (<5%) or ‘unlikely’ (5-10%) to be impacted by subsidence, though some sites were identified as suffering by ‘possible’ (10%-25%) subsidence impacts. The remaining sites were identified as being moderately likely to be impacted by subsidence, with the potential for minimisation. It was otherwise stated that no harm would come to the objects based on surface impacts and ‘probably’ no harm and no loss of cultural value to those sites that were unlikely to be impacted due to subsidence.

APPENDIX D

Site Cards for Newly Identified Sites

Aboriginal Site Recording Form

AHIMS Registrar
PO Box 1967, Hurstville NSW 2220

Office Use Only

Site Number | | | – | | – | | | | |

Date received / / Date entered into system / / Date catalogued / /

Entered by (I.D.)

Information Access

☐ Gender/male ☐ Gender/female ☐ Location restriction ☐ General restriction ☐ No access

Office Use Only

For Further Information Contact:

☐ **Nominated Trustee**

Title | Surname | First Name | Initials

Organisation

Address

Phone number | Fax

Client on system ☐

☐ **Knowledge Holder**

Title | Surname | First Name | Initials

Organisation

Address

Phone number | Fax

Client on system ☐

Aboriginal Heritage Unit or Cultural Heritage Division Contacts

Geographic Location

Site Name: Palmers Creek IF5

Easting: 362719 Northing: 6349367 AGD/GDA: GDA

Mapsheet: Wallsend 1:25000

Zone: 56 Location Method: Non-Differential GPS

Other Registration

Primary Recorder

Title | Surname: Reynolds | First Name: Amanda | Initials

Organisation: Umwelt (Australia) Pty Ltd

Address: 75 York St Teralba

Phone number: 02 4950 5322 Fax: 02 4950 5737

Date recorded: 21/03/2013

Client on system ☐

NPWS Aboriginal Site Recording Form - Site Information

OPEN/CLOSE SITE Open Site

Site Context

Landform

- [ ] Mountainous
- [ ] Plain
- [ ] Rolling hills
- [x] Steep hills
- [ ] Undulating plain

Landform Unit

- [ ] Beach
- [ ] Coastal rock platform
- [ ] Dune
- [ ] Intertidal flat
- [ ] Lagoon
- [ ] Tidal Creek
- [ ] Tidal Flat
- [ ] Cliff
- [x] Crest
- [ ] Flat
- [ ] Lower slope
- [ ] Mid slope
- [ ] Upper slope
- [ ] Plain
- [ ] Ridge
- [ ] Tor
- [ ] Valley flat
- [ ] Levy
- [ ] Stream bank
- [ ] Stream channel
- [ ] Swamp
- [ ] Terrace
- [ ] Terrace flat

Slope

2 degrees

Vegetation

- [ ] Closed forest
- [ ] Grasslands
- [ ] Isolated clumps of trees
- [ ] Open forest
- [x] Open woodland
- [ ] Scrub
- [ ] Woodland
- [ ] Cleared
- [ ] Revegetated
- [ ] N/A

Land use

- [ ] Conservation
- [ ] Established urban
- [ ] Farming-intensive
- [ ] Farming-low intensity
- [ ] Forestry
- [ ] Industrial
- [ ] Mining
- [ ] Pastoral/grazing
- [ ] Recreation
- [ ] Semi-rural
- [ ] Service corridor
- [x] Transport corridor
- [ ] Urban expansion
- [ ] Residential

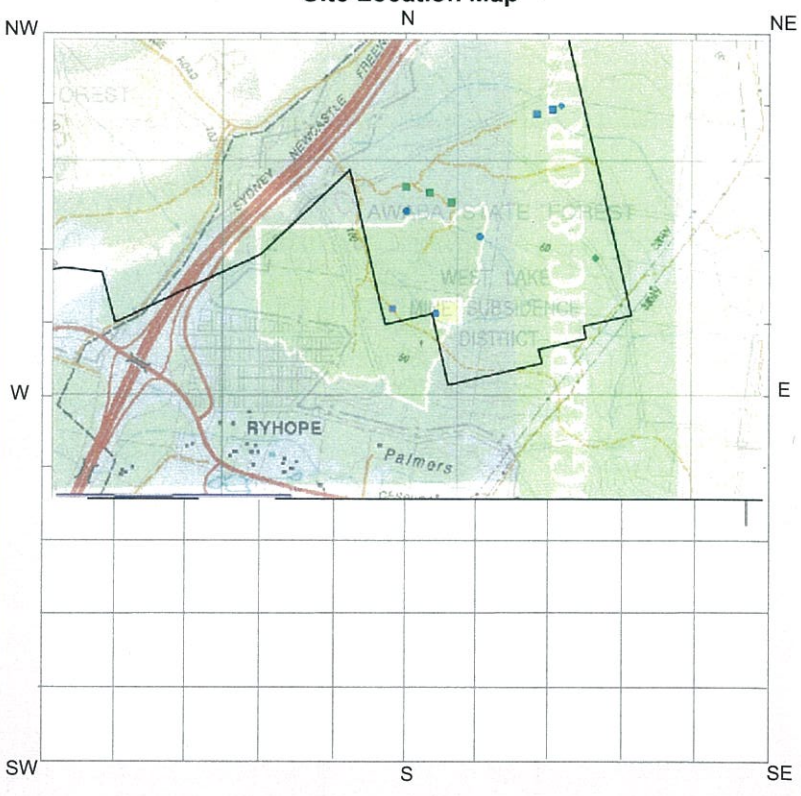
Water

Distance to permanent water source	metres
Distance to temporary water source	90 metres
Name of nearest permanent water source	
Name of nearest temporary water	1st order tributary

Directions for Relocation

The site is located on a four-wheel drive track off Wakefiled Road.

Site Location Map



Current Land Tenure

- [x] Public — National Park / other Government Dept.
- [ ] Private

Primary report **I.D.** (I.D. Office Use only)

General Site Information

Closed Site

Shelter/Cave Formation

- [ ] Boulder
- [ ] Wind erosion
- [ ] Water erosion
- [ ] Rock collapse

Rock Surface Condition

- [ ] Boulder
- [ ] Sandstone platform
- [ ] Silica gloss
- [ ] Tessellated
- [ ] Weathered
- [ ] Other platform

Condition of Ceiling

- [ ] Boulder
- [ ] Sandstone platform
- [ ] Silica gloss
- [ ] Tessellated
- [ ] Weathered
- [ ] Other platform

Shelter Aspect

- [ ] North
- [ ] North East
- [ ] East
- [ ] South East
- [ ] South
- [ ] South West
- [ ] West
- [ ] North West

Open Site

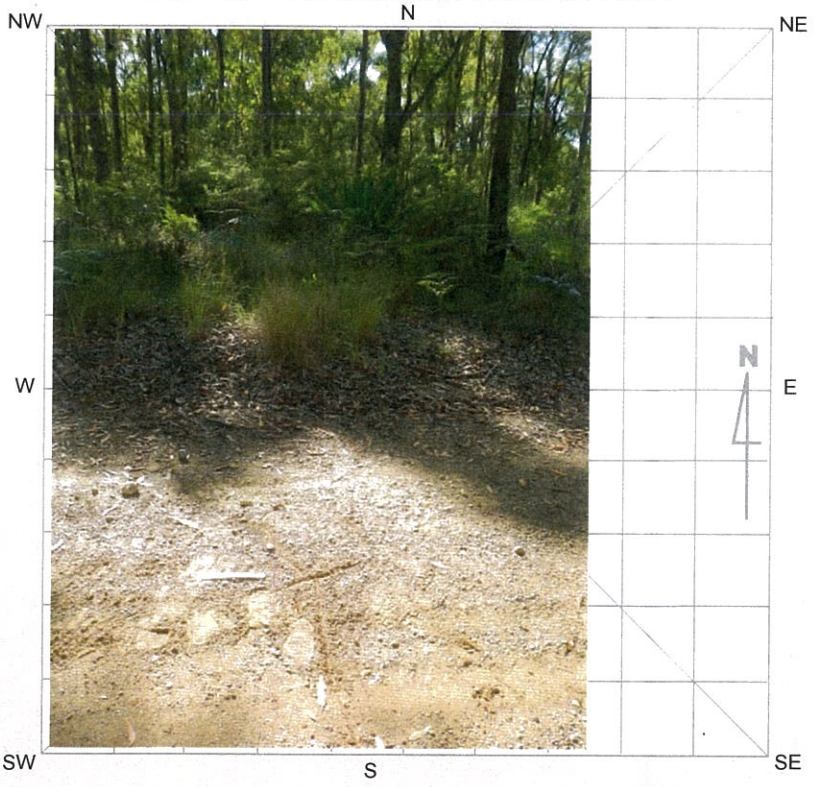
Site Orientation

- [ ] N-S
- [ ] NE-SW
- [ ] E-W
- [ ] SE-NW
- [x] N/A

Features

- [ ] 1. Aboriginal Ceremony & Dreaming
- [ ] 2. Aboriginal Resource & Gathering
- [ ] 3. Art
- [x] 4. Artefact
- [ ] 5. Burial
- [ ] 6. Ceremonial Ring
- [ ] 7. Conflict
- [ ] 8. Earth Mound
- [ ] 9. Fish Trap
- [ ] 10. Grinding Groove
- [ ] 11. Habitation Structure
- [ ] 12. Hearth
- [ ] 13. Non Human Bone & Organic Material
- [ ] 14. Ochre quarry
- [ ] 15. Potential Archaeological Deposit
- [ ] 16. Stone Quarry
- [ ] 17. Shell
- [ ] 18. Stone Arrangement
- [ ] 19. Modified Tree
- [ ] 20. Water Hole

Site Plan Indicate scale, boundaries of site, features



Site Dimensions

Closed Site Dimensions (m)

- [ ] Internal length
- [ ] Internal width
- [ ] Shelter height
- [ ] Shelter floor area

Open Site Dimensions (m)

- [1] Total length of visible site
- [1] Average width of visible site
- [1] Estimated area of visible site
- [1] Length of assessed site area

Aboriginal Community Interpretation and Management Recommendations

Peter Townsend (ALALC), Jodie Wilson (ATOAC) and Teagan McCormack (CCC) were involved in the inspection that identified this site. It is understood that the RAPs regard the Sugarloaf Range and it's landscape as having high cultural significance. Sites within the landscape also have a high cultural value (Umwelt 2010).

Preliminary Site Assessment

Site Cultural & Scientific Analysis and Preliminary Management Recommendations

The site is assessed as having low archaeological significance.

This section should only be filled in by the Endorsees

Endorsed by: ☐ Knowledge Holder ☐ Nominated Trustee ☐ Native Title Holder ☐ Community Consensus

Title	Surname	First Name	Initials

Organisation

Address

Phone number Fax

Attachments (No.)

- ☑ A4 location map
- ☐ B/W photographs
- ☑ Colour photographs
- ☐ Slides
- ☐ Aerial photographs
- ☐ Site plans, drawings
- ☐ Recording tables
- ☐ Other
- ☐ Feature inserts-No. ☐

Comments

The site consists of a silcrete broken flake on a mid slope in the centre of a four wheel drive track. The track is used by WWC, Ausgrid, NPWS and motor bikes. Recreation four wheel drive access is limited as there is a locked gate at the access point from Wakefield Road.

NPWS FEATURE RECORDING FORM - ARTEFACT

Site I.D.

Site Name: Palmers Creek IF5

First recorded date: 20/03/2013

Importance

No. of instances: 1

Recorded by

	Yes	No
Stone artefacts only	Yes	
Artefacts collected		No
Permit issued		No

Percentage of Non-stone Artefacts to Percentage of Stone Artefacts

0-9% | 10-19% | 20-29% | 30-39% | 40-49% | 50-59% | 60-69% | 70-79% | 80-89% | 90-100%

0-9%

Feature Context & Condition

Scatter No.

Easting: 362719

Northing: 6349367

Density (Artefact count per square metre)

Dimensions

Length (m): 1

Width (m): 1

Depth (m)

	Yes	No
In situ		No
Stratified		No

Feature Condition

- [ ] Very good
- [ ] Good
- [x] Poor

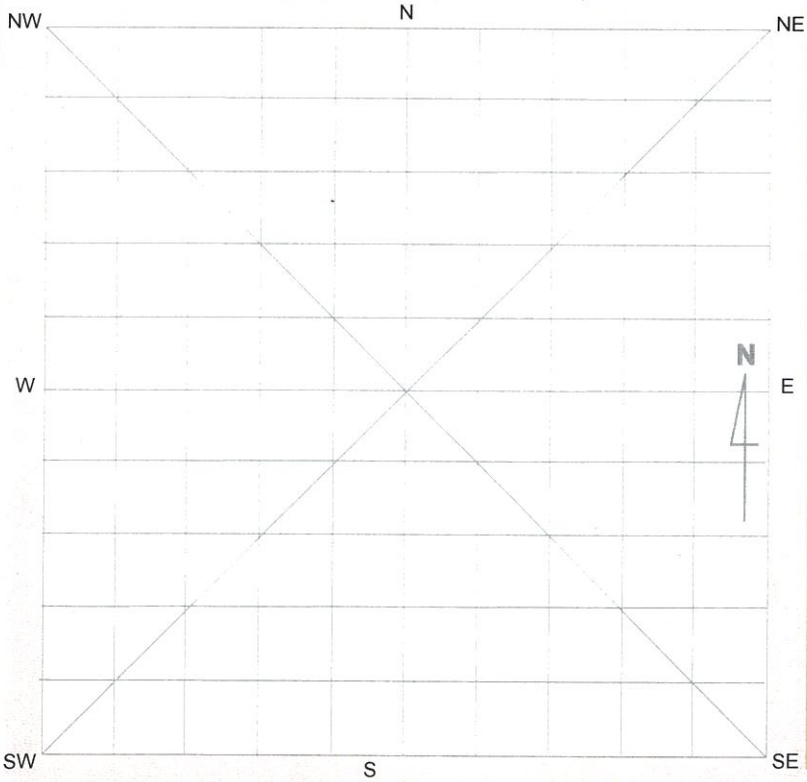
General Condition

- [ ] Weathered
- [x] Vehicle damage
- [ ] Surface water wash
- [ ] Fire damage
- [ ] Erosion
- [ ] Stock damage
- [x] Exposed archaeological material

Recommended Action

- [ ] Boardwalk
- [ ] Fencing
- [ ] Closure to public
- [ ] Continued inspection
- [ ] Fire hazard reduction
- [ ] Expert assessment
- [ ] Meeting with land manager
- [ ] Revegetation
- [ ] Signage
- [ ] Soil erosion control
- [ ] Track closure/re-routing
- [ ] Additional recording

Feature Plan (Indicate scale, location of instances)



Feature Environment

(Complete when *feature* environment differs to *site* environment, use attributes from cover card, p. 2)

- Land form
- Land form unit
- Slope
- Vegetation
- Land use

Water

Distance to permanent water source: metres

Distance to temporary water source: metres

Name of nearest permanent water source

Name of nearest temporary water

Stone Artefact

Instance No.	Recording Date	Artefact Material	Artefact Type	Platform Surface	Platform Type	Termination	Cross Section	Length (mm)	Width (mm)	Thickness (mm)
1	20/03/2013	Silcrete	Broken Flake							

Other Artefact Type

Instance No.	Recording Date	Artefact Material	Artefact Type	Description	Length (mm)	Width (mm)	Thickness (mm)

Material

Basalt
Chert
Fine grained siliceous
Granite
Quartz
Quartzite
Sandstone
Silcrete
Green glass
Amber glass
Amethyst glass
Clear glass
Ceramic
Porcelain
Tin can
Wire
Nail
Button
Shell
Bone
Wood
Resin

Artefact Description

Adze
Anvil
Axe
Backed blade
Blade
Core
Core tool
Cyclon
Distal fragment
Eloura
Flake
Flake tool
Flaked piece
Hammerstone
Manuport
Milling slab
Mortar
Muller
Nuclear tool
Pirri
Proximal fragment
Tula
Other diagnostic type
Modified
Unworked

Platform Surface

Cortex
Flake scar
More than one flake scar
Faceted
Ground
Indeterminate
Bipolar

Platform Type

Wide
Focal
Shattered
Indeterminate
Bipolar

Termination

Feather
Hinge
Step
Outrepasse
Bipolar

Cross Section

High/strong
High/weak
Low/weak
Irregular

Comments:

NPWS FEATURE RECORDING FORM - MODIFIED TREE

Site I.D. ☐ Site Name ☐

First recorded date ☐ **Importance** ☐ **Aboriginal Information Recorded?** ☐

No. of instances ☐

Recorded by ☐

Feature description

Easting ☐☐☐☐☐☐ Northing ☐☐☐☐☐☐☐

No. of scars ☐

No. of carved panels ☐

Feature Condition

- ☐ Very good
- ☐ Good
- ☐ Poor

Condition

- ☐ Weathered
- ☐ Ringbarked
- ☐ Fire damage
- ☐ Vehicle damage
- ☐ Insects/termites
- ☐ Rot
- ☐ Limb fall
- ☐ Stock damage

Recommended Action

- ☐ Fencing
- ☐ Closure to public
- ☐ Continued inspection
- ☐ Expert assessment
- ☐ Fire hazard reduction
- ☐ Insect removal
- ☐ Meeting with land manager
- ☐ Rubbish removal
- ☐ Signage
- ☐ Tree health assessment
- ☐ Track closure/re-routing
- ☐ Additional recording

Feature environment

(Complete when *feature* environment differs to *site* environment, use attributes from cover card, page 2)

- ☐ Land form
- ☐ Land form unit
- ☐ Slope
- ☐ Vegetation
- ☐ Land use

Water

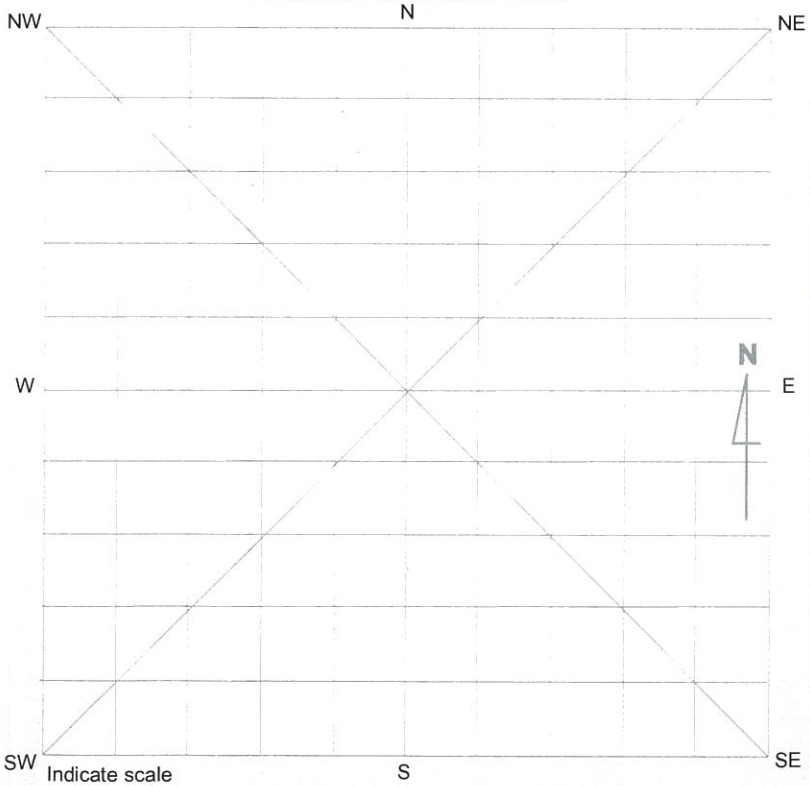
Distance to permanent water source ☐ metres

Distance to temporary water source ☐ metres

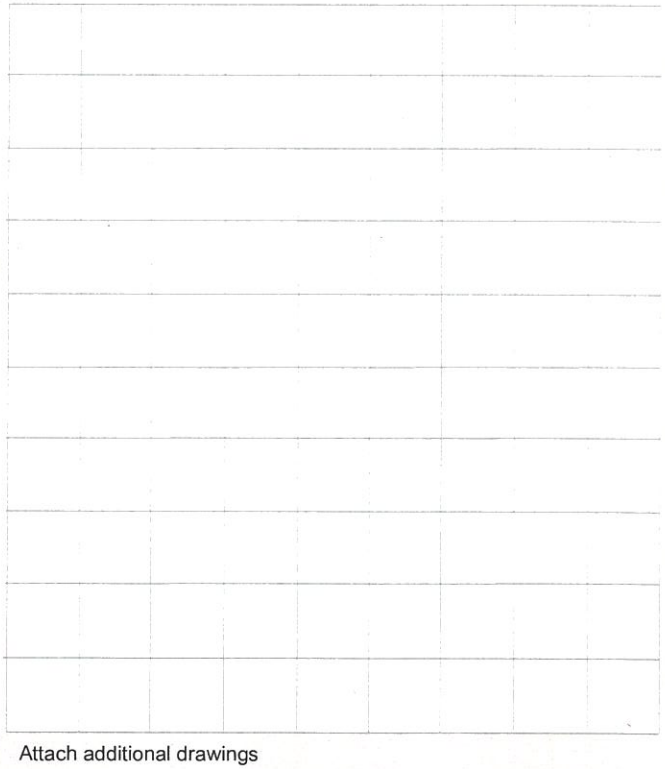
Name of nearest permanent water source ☐

Name of nearest temporary water ☐

Feature Location Plan



Scar/Carved Panel Drawing



Attach additional drawings

NPWS FEATURE RECORDING TABLE - MODIFIED TREE

Instance No.	Recording Date	Type	Species	Living Status	Tree Status	Regrowth	Length of Scar	Width of Scar	Depth	Height Above Ground	No. of Scars	Shape	No. of Carved Panels	Carving Type	Orientation	Axe Marks

Type of Tree	**Tree Species**	**Living Status**	**Tree Status**	**Regrowth**
Carved Tree	Eucalypt	Dead	Standing	Yes
Scarred Tree	Red Gum	Alive	Lying down	No
Carved/Scarred Tree	Angotha	Dying	Partially felled	
			Subject to salinity	
			Not *in situ*	

Scar Shape	**Carving Type**	**Axe Marks**	**Orientation**
Oval	Linear	Metal	North East
Rectangular	Geometric	Stone	East
Square	Pictorial	Indeterminate	South East
Round			South
Other			South West
			West
			North West
			North

Comments:

NPWS FEATURE RECORDING FORM - GROOVE

Site I.D. ____ Site Name ____

First recorded date ____/____/____ **Importance** ____ **Aboriginal Information Recorded?** ____

No. of instances ____

Recorded by ____

Feature Description

Type of Grinding Feature

- ☐ Broad
- ☐ Narrow/point
- ☐ Hollow
- ☐ Flat

Seed Species Present Recording date ____/____/____

Groove Function

Dimensions

Profile Shape

- ☐ 'U' shaped
- ☐ 'V' shaped
- ☐ Flat

Smallest	Largest	
Length (mm)	Length (mm)	Groove count
Width (mm)	Width (mm)	Cluster count
Depth (mm)	Depth (mm)	

Feature Context & Condition

Easting ____ Northing ____

Dimensions of Whole Feature ____ Length (m) ____ Width (m)

Feature Condition

- ☐ Very good
- ☐ Good
- ☐ Poor

General Condition

- ☐ Weathered
- ☐ Vandalised

General Condition ctd

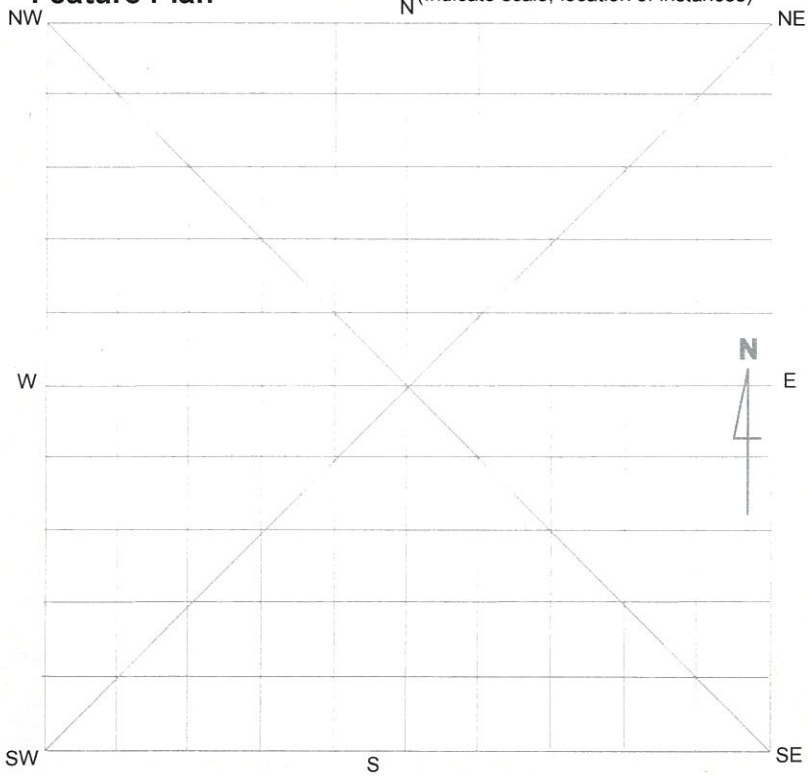
- ☐ Fire damage
- ☐ Surface water wash
- ☐ Graffiti
- ☐ Vehicle damage
- ☐ Erosion
- ☐ Stock damage

Recommended Action

- ☐ Boardwalk
- ☐ Cage/barrier/fencing
- ☐ Closure to public
- ☐ Continued inspection
- ☐ Expert assessment
- ☐ Graffiti removal
- ☐ Meeting with land manager
- ☐ Revegetation
- ☐ Rubbish removal
- ☐ Signage
- ☐ Erosion control
- ☐ Track closure/re-routing
- ☐ Additional recording

Feature Plan

N (Indicate scale, location of instances)



Feature Environment

(Complete when *feature* environment differs to *site* environment, use attributes from cover card, p. 2)

- ____ Land form
- ____ Land form unit
- ____ Slope
- ____ Vegetation
- ____ Land use

Water

Distance to permanent water source ____ metres

Distance to temporary water source ____ metres

Name of nearest permanent water source ____

Name of nearest temporary water ____

NPWS FEATURE RECORDING FORM - ART

Site I.D. ____ Site Name ____

First recorded date ____/____/____ **Importance** ____ **Aboriginal Information Recorded?** ____

No. of instances ____

Recorded by ____

Feature Context & Condition

Easting ____ Northing ____

Pigment ☐ Engraved ☐ Super-impositioning ☐

Artwork Condition

- ☐ Very good
- ☐ Good
- ☐ Poor

General Condition

- ☐ Weathered
- ☐ Vandalised
- ☐ Surface water wash
- ☐ Mineralisation
- ☐ Graffiti
- ☐ Fire damage
- ☐ Insects/termites
- ☐ Erosion
- ☐ Stock
- ☐ Unstable structure

Recommended Action

- ☐ Boardwalk
- ☐ Cage/barrier/fencing
- ☐ Closure to public
- ☐ Continued inspection
- ☐ Dripline
- ☐ Expert assessment
- ☐ Fire hazard removal
- ☐ Graffiti removal
- ☐ Insect/bird nest removal
- ☐ Meeting with land manager
- ☐ Rubbish removal
- ☐ Signage
- ☐ Erosion control
- ☐ Track closure/re-routing
- ☐ Additional recording

Feature Environment

(Complete when *feature* environment differs to *site* environment, use attributes from cover card, p. 2)

- ____ Land form
- ____ Land form unit
- ____ Slope
- ____ Vegetation
- ____ Land use

Water

- Distance to permanent water source ____ metres
- Distance to temporary water source ____ metres
- Name of nearest permanent water source ____
- Name of nearest temporary water ____

Art Sketch Plan

Sketch and number motif groups

NPWS FEATURE RECORDING TABLE - ART MOTIF

Instance	Recording Date	Motif	Application Technique	Form	Main Colour	Location	Condition

Motif

Anthropomorphic
Bird
Bird Track
Canoe
Circle
Contact material culture
Duck
Eel
Emu
Emu track
European figure
Female
Fish
Foot
Hand
Jellyfish
Kangaroo
Line
Lizard
Macropod
Macropod Track
Male
Marine-Other
Other
Pattern
Quadruped
Reptile
Rifle
Shield
Ship
Snake
Spear
Wallaby

Application Technique

Abraded
Drawn
Other
Painted
Pecked
Pigment & Engraved
Stencilled

Form

Fill
Line
Line+ Fill
Other
Pattern

Main Colour

Black
Mauve *
N/A
Orange *
Other
Red *
White *
Yellow *

Art Location

All over shelter surfaces
ceiling
Floor
Mostly near largest sheltered space
Mostly on out of the way surfaces
Other
Wall

Condition

Faded
Stained
Mineralisation Evident
V brant Colours
Unweathered
Weathered

Comments:

NPWS FEATURE RECORDING FORM - SHELL

Site I.D. ____ Site Name ____

First recorded date ../../.. **Importance** ____ **Aboriginal Information Recorded?** ____

No. of instances ____

Recorded by ____

Feature Context & Condition

Easting ____ Northing ____

Dimensions of Whole Feature

____ Length (m) ____ Width (m) ____ Depth (m)

Shell Distribution

- ☐ Surface scatter
- ☐ Stratified deposit
- ☐ Mounded

____ Distance to high water mark (m)

Feature Condition

- ☐ Very good
- ☐ Good
- ☐ Poor

General Condition

- ☐ Weathered
- ☐ Vandalised
- ☐ Surface water wash
- ☐ Mineralisation
- ☐ Graffiti

General Condition ctd

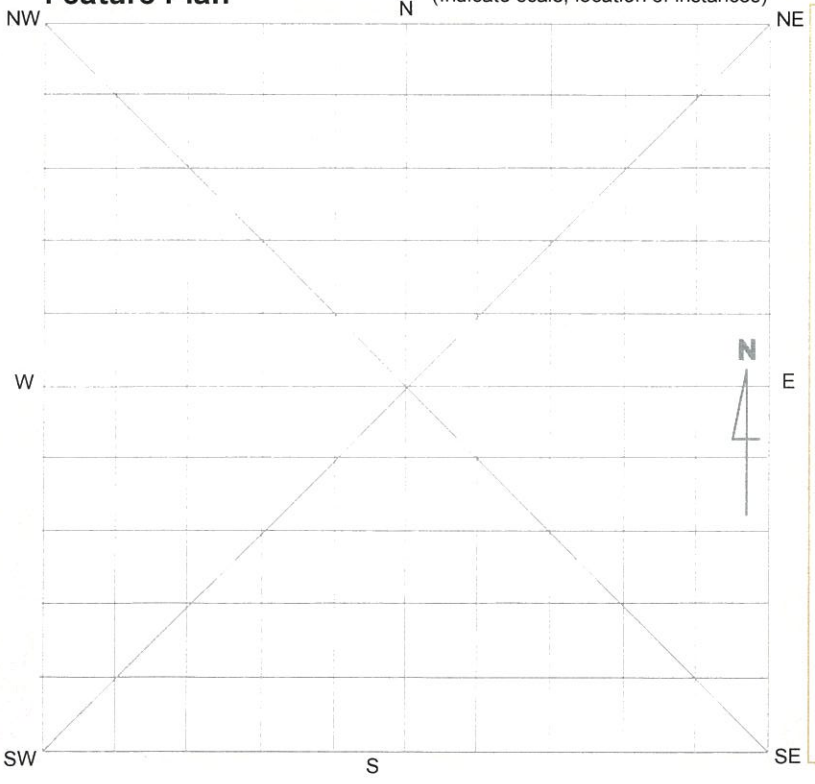
- ☐ Fire damage
- ☐ Vehicle damage
- ☐ Insects/termites
- ☐ Erosion
- ☐ Stock damage
- ☐ Unstable structure
- ☐ Exposed bone material
- ☐ Exposed archaeological material

Recommended Action

- ☐ Boardwalk
- ☐ Cage/barrier/fencing
- ☐ Closure to public
- ☐ Continued inspection
- ☐ Expert assessment
- ☐ Fire hazard removal
- ☐ Graffiti removal
- ☐ Meeting with land manager
- ☐ Insect/bird nest removal
- ☐ Revegetation
- ☐ Rubbish removal
- ☐ Signage
- ☐ Erosion control
- ☐ Track closure/re-routing
- ☐ Additional recording

Feature Plan

(Indicate scale, location of instances)



Feature Environment

(Complete when *feature* environment differs to *site* environment, use attributes from cover card, p. 2)

____ Land form

____ Land form unit

____ Slope

____ Vegetation

____ Land use

Water

Distance to permanent water source ____ metres

Distance to temporary water source ____ metres

Name of nearest permanent water source ____

Name of nearest temporary water ____

NPWS FEATURE RECORDING TABLE - SHELL

Instance No.	Recording Date	Shell Species	% of this species shell to % total of other shell

Species		Percentage of this Species Shell to Percentage Total of other Shell
Anadara	Nerita	0 – 9%
Bimbala	Ocean Snail	10 – 19%
Chiton	Periwinkle	20 – 29%
Cowrie	Pippi	30 – 39%
Dog Cockle	Ribbed Cockle	40 – 49%
Duck Bill	Rock Oyster	50 – 59%
Limpit	Thiad	60 – 69%
Mud oyster	Triton	70 – 79%
Mutton Fish	Turban (large)	80 – 89%
		90 – 100%

Comments:

Aboriginal Site Recording Form

AHIMS Registrar
PO Box 1967, Hurstville NSW 2220

Office Use Only

Site Number | | | - | | - | | | | |

Date received / / Date entered into system / / Date catalogued / /

Entered by (I.D.)

Information Access

☐ Gender/male ☐ Gender/female ☐ Location restriction ☐ General restriction ☐ No access

Office Use Only

For Further Information Contact:

☐ **Nominated Trustee**

Title | Surname | First Name | Initials

Organisation

Address

Phone number | Fax

Client on system ☐

☐ **Knowledge Holder**

Title | Surname | First Name | Initials

Organisation

Address

Phone number | Fax

Client on system ☐

Aboriginal Heritage Unit or Cultural Heritage Division Contacts

Geographic Location

Site Name: Palmers Creek Scarred Tree 1

Easting: 362845 Northing: 6349217 AGD/GDA: GDA

Mapsheet: Wallsend 1:25000

Zone: 56 Location Method: Non-Differential GPS

Other Registration

Primary Recorder

Title | Surname: Reynolds | First Name: Amanda | Initials

Organisation: Umwelt (Australia) Pty Ltd

Address: 75 York St Teralba

Phone number: 02 4950 5322 Fax: 02 4950 5737

Date recorded: 20/02/2013

Client on system ☐

NPWS Aboriginal Site Recording Form - Site Information

OPEN/CLOSE SITE: Open Site

Site Context

Landform

- [ ] Mountainous
- [ ] Plain
- [ ] Rolling hills
- [x] Steep hills
- [ ] Undulating plain

Landform Unit

- [ ] Beach
- [ ] Coastal rock platform
- [ ] Dune
- [ ] Intertidal flat
- [ ] Lagoon
- [ ] Tidal Creek
- [ ] Tidal Flat
- [ ] Cliff
- [ ] Crest
- [ ] Flat
- [ ] Lower slope
- [ ] Mid slope
- [x] Upper slope
- [ ] Plain
- [ ] Ridge
- [ ] Tor
- [ ] Valley flat
- [ ] Levy
- [ ] Stream bank
- [ ] Stream channel
- [ ] Swamp
- [ ] Terrace
- [ ] Terrace flat

Slope

2 degrees

Vegetation

- [ ] Closed forest
- [ ] Grasslands
- [ ] Isolated clumps of trees
- [ ] Open forest
- [x] Open woodland
- [ ] Scrub
- [ ] Woodland
- [ ] Cleared
- [ ] Revegetated
- [ ] N/A

Land use

- [x] Conservation
- [ ] Established urban
- [ ] Farming-intensive
- [ ] Farming-low intensity
- [ ] Forestry
- [ ] Industrial
- [ ] Mining
- [ ] Pastoral/grazing
- [x] Recreation
- [ ] Semi-rural
- [ ] Service corridor
- [ ] Transport corridor
- [ ] Urban expansion
- [ ] Residential

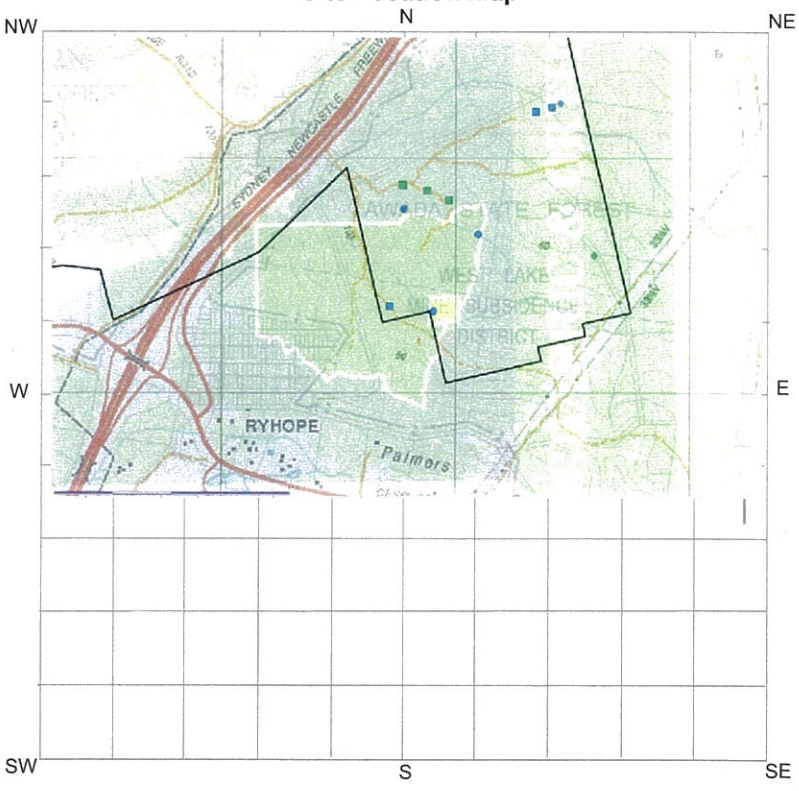
Water

Distance to permanent water source	1500 metres
Distance to temporary water source	130 metres
Name of nearest permanent water source	Palmers Creek
Name of nearest temporary water	1st order tributary

Directions for Relocation

The site is located south of a four-wheel drive track off Wakefiled Road.

Site Location Map



Current Land Tenure

- [x] Public — National Park / other Government Dept.
- [ ] Private

Primary report I.D. (I.D. Office Use only)

General Site Information

Closed Site

Shelter/Cave Formation

- ☐ Boulder
- ☐ Wind erosion
- ☐ Water erosion
- ☐ Rock collapse

Rock Surface Condition

- ☐ Boulder
- ☐ Sandstone platform
- ☐ Silica gloss
- ☐ Tessellated
- ☐ Weathered
- ☐ Other platform

Condition of Ceiling

- ☐ Boulder
- ☐ Sandstone platform
- ☐ Silica gloss
- ☐ Tessellated
- ☐ Weathered
- ☐ Other platform

Shelter Aspect

- ☐ North
- ☐ North East
- ☐ East
- ☐ South East
- ☐ South
- ☐ South West
- ☐ West
- ☐ North West

Open Site

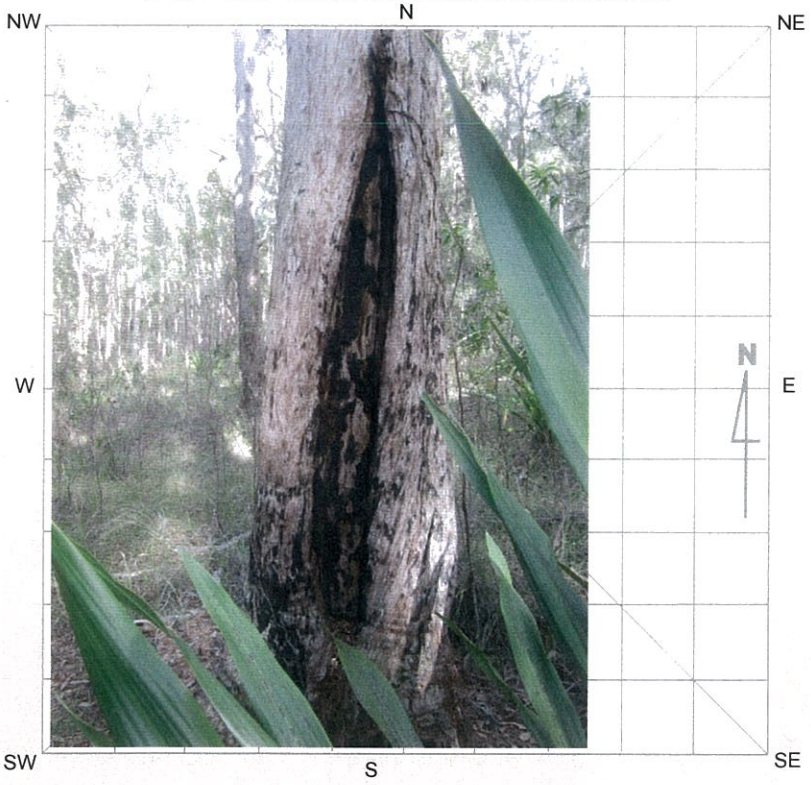
Site Orientation

- ☐ N-S
- ☐ NE-SW
- ☐ E-W
- ☐ SE-NW
- ☑ N/A

Features

- ☐ 1. Aboriginal Ceremony & Dreaming
- ☐ 2. Aboriginal Resource & Gathering
- ☐ 3. Art
- ☐ 4. Artefact
- ☐ 5. Burial
- ☐ 6. Ceremonial Ring
- ☐ 7. Conflict
- ☐ 8. Earth Mound
- ☐ 9. Fish Trap
- ☐ 10. Grinding Groove
- ☐ 11. Habitation Structure
- ☐ 12. Hearth
- ☐ 13. Non Human Bone & Organic Material
- ☐ 14. Ochre quarry
- ☐ 15. Potential Archaeological Deposit
- ☐ 16. Stone Quarry
- ☐ 17. Shell
- ☐ 18. Stone Arrangement
- ☑ 19. Modified Tree
- ☐ 20. Water Hole

Site Plan Indicate scale, boundaries of site, features



Site Dimensions

Closed Site Dimensions (m)

- ☐ Internal length
- ☐ Internal width
- ☐ Shelter height
- ☐ Shelter floor area

Open Site Dimensions (m)

- 1 Total length of visible site
- 1 Average width of visible site
- 1 Estimated area of visible site
- 1 Length of assessed site area

Aboriginal Community Interpretation and Management Recommendations

Peter Townsend (ALALC) and Adam Sampson (CCC) were involved in the inspection that identified this site. It is understood that the RAPs regard the Sugarloaf Range and its landscape as having high cultural significance. Sites within the landscape also have a high cultural value (Umwelt 2010).

Preliminary Site Assessment

Site Cultural & Scientific Analysis and Preliminary Management Recommendations

The site is assessed as having moderate archaeological significance.

This section should only be filled in by the Endorsees

Endorsed by: ☐ Knowledge Holder ☐ Nominated Trustee ☐ Native Title Holder ☐ Community Consensus

Title	Surname	First Name	Initials

Organisation

Address

Phone number Fax

Attachments (No.)

- ☑ A4 location map
- ☐ B/W photographs
- ☑ Colour photographs
- ☐ Slides
- ☐ Aerial photographs
- ☐ Site plans, drawings
- ☐ Recording tables
- ☐ Other
- ☐ Feature inserts-No. ☐

Comments

Palmers Creek ST1 is an oval scar on a living white mahogany (Eucalyptus acmenoides). The tree is in fair condition, with possible evidence of white ants. The tree is approximately 2.2 metres in circumference and has survived bushfire, as evidenced by burnt bark and outer layers of heartwood. The visible scar begins 40 centimetres from the ground, and is approximately 2.1 metres in height. The regrowth over the heartwood is 20 centimetres thick, leaving a maximum width of scar of 60 centimetres.

NPWS FEATURE RECORDING FORM - ARTEFACT

Site I.D. | Site Name | **Importance**

First recorded date

No. of instances

Recorded by

	Yes	No
Stone artefacts only		
Artefacts collected		
Permit issued		

Percentage of Non-stone Artefacts to Percentage of Stone Artefacts

0-9% | 10-19% | 20-29% | 30-39% | 40-49% | 50-59% | 60-69% | 70-79% | 80-89% | 90-100%

Feature Context & Condition

Scatter No. | Easting | Northing

Density (Artefact count per square metre)

Dimensions Length (m) | Width (m) | Depth (m)

	Yes	No
In situ		
Stratified		

Feature Condition

- Very good
- Good
- Poor

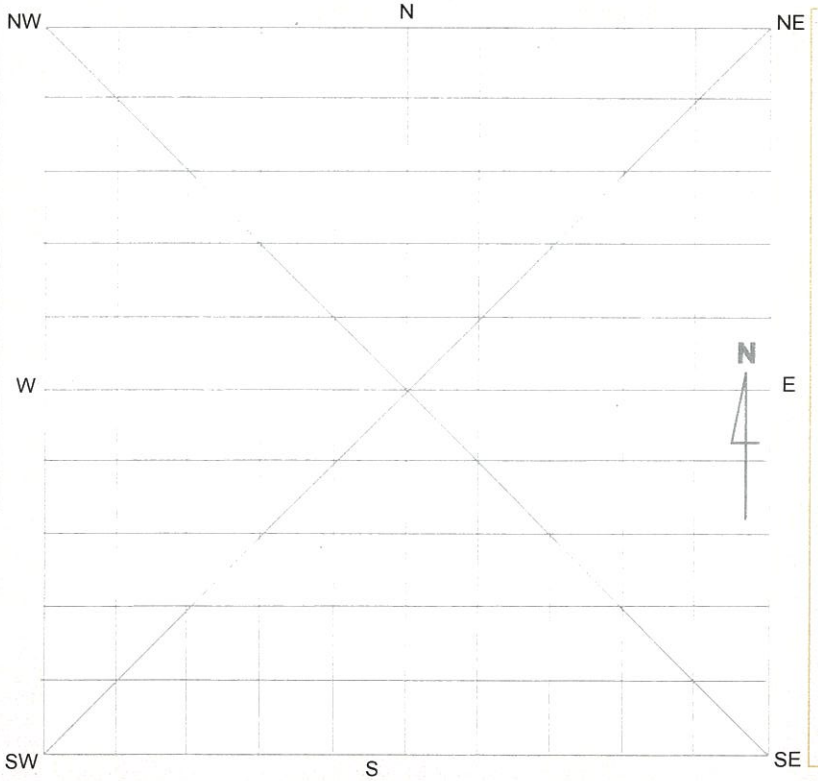
General Condition

- Weathered
- Vehicle damage
- Surface water wash
- Fire damage
- Erosion
- Stock damage
- Exposed archaeological material

Recommended Action

- Boardwalk
- Fencing
- Closure to public
- Continued inspection
- Fire hazard reduction
- Expert assessment
- Meeting with land manager
- Revegetation
- Signage
- Soil erosion control
- Track closure/re-routing
- Additional recording

Feature Plan (Indicate scale, location of instances)



Feature Environment

(Complete when *feature* environment differs to *site* environment, use attributes from cover card, p. 2)

- Land form
- Land form unit
- Slope
- Vegetation
- Land use

Water

Distance to permanent water source ____ metres

Distance to temporary water source ____ metres

Name of nearest permanent water source

Name of nearest temporary water

Stone Artefact

Instance No.	Recording Date	Artefact Material	Artefact Type	Platform Surface	Platform Type	Termination	Cross Section	Length (mm)	Width (mm)	Thickness (mm)

Other Artefact Type

Instance No.	Recording Date	Artefact Material	Artefact Type	Description	Length (mm)	Width (mm)	Thickness (mm)

Material

Basalt
Chert
Fine grained siliceous
Granite
Quartz
Quartzite
Sandstone
Silcrete
Green glass
Amber glass
Amethyst glass
Clear glass
Ceramic
Porcelain
Tin can
Wire
Nail
Button
Shell
Bone
Wood
Resin

Artefact Description

Adze
Anvil
Axe
Backed blade
Blade
Core
Core tool
Cyclon
Distal fragment
Eloura
Flake
Flake tool
Flaked piece
Hammerstone
Manuport
Milling slab
Mortar
Muller
Nuclear tool
Pirri
Proximal fragment
Tula
Other diagnostic type
Modified
Unworked

Platform Surface

Cortex
Flake scar
More than one flake scar
Faceted
Ground
Indeterminate
Bipolar

Platform Type

Wide
Focal
Shattered
Indeterminate
Bipolar

Termination

Feather
Hinge
Step
Outrepasse
Bipolar

Cross Section

High/strong
High/weak
Low/weak
Irregular

Comments:

NPWS FEATURE RECORDING FORM - MODIFIED TREE

Site I.D. ____ Site Name ____

First recorded date ____ **Importance** ____ **Aboriginal Information Recorded?** ____

No. of instances ____

Recorded by ____

Feature description

Easting ____ Northing ____

No. of scars ____

No. of carved panels ____

Feature Condition

- ☐ Very good
- ☐ Good
- ☐ Poor

Condition

- ☐ Weathered
- ☐ Ringbarked
- ☐ Fire damage
- ☐ Vehicle damage
- ☐ Insects/termites
- ☐ Rot
- ☐ Limb fall
- ☐ Stock damage

Recommended Action

- ☐ Fencing
- ☐ Closure to public
- ☐ Continued inspection
- ☐ Expert assessment
- ☐ Fire hazard reduction
- ☐ Insect removal
- ☐ Meeting with land manager
- ☐ Rubbish removal
- ☐ Signage
- ☐ Tree health assessment
- ☐ Track closure/re-routing
- ☐ Additional recording

Feature environment

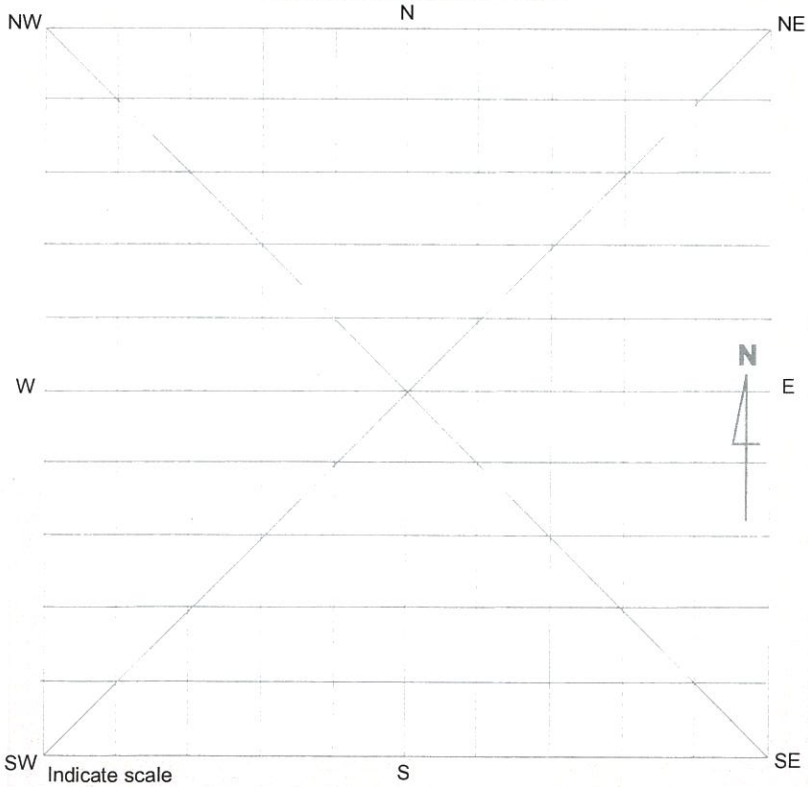
(Complete when *feature* environment differs to *site* environment, use attributes from cover card, page 2)

- ____ Land form
- ____ Land form unit
- ____ Slope
- ____ Vegetation
- ____ Land use

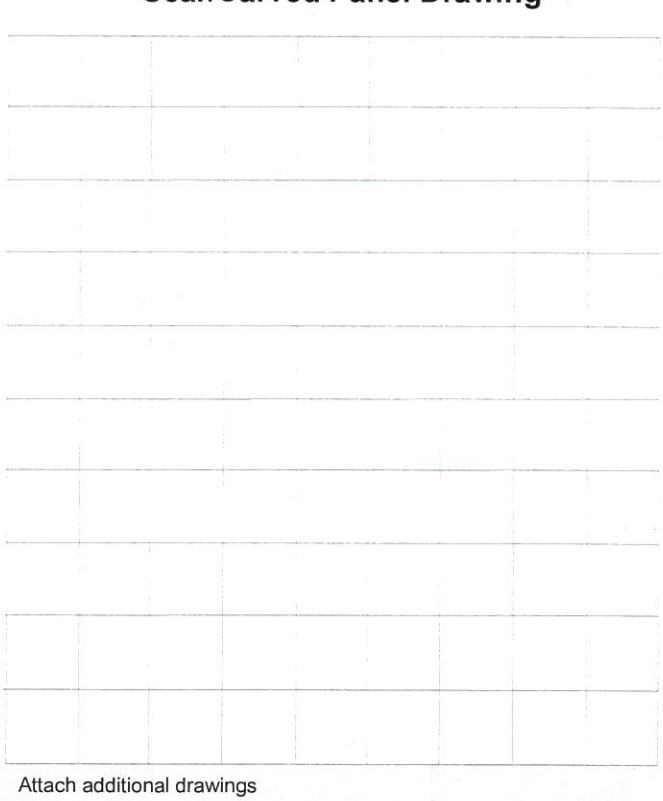
Water

- Distance to permanent water source ____ metres
- Distance to temporary water source ____ metres
- Name of nearest permanent water source ____
- Name of nearest temporary water ____

Feature Location Plan



Scar/Carved Panel Drawing



Attach additional drawings

NPWS FEATURE RECORDING TABLE - MODIFIED TREE

Instance No.	Recording Date	Type	Species	Living Status	Tree Status	Regrowth	Length of Scar	Width of Scar	Depth	Height Above Ground	No. of Scars	Shape	No. of Carved Panels	Carving Type	Orientation	Axe Marks
1	20/02/201	Scarred	Eucalypt	Alive	Standing	Yes	210	60	20	40	1	Oval			East	

Type of Tree	**Tree Species**	**Living Status**	**Tree Status**	**Regrowth**
Carved Tree	Eucalypt	Dead	Standing	Yes
Scarred Tree	Red Gum	Alive	Lying down	No
Carved/Scarred Tree	Angotha	Dying	Partially felled	
			Subject to salinity	
			Not *in situ*	

Scar Shape	**Carving Type**	**Axe Marks**	**Orientation**
Oval	Linear	Metal	North East
Rectangular	Geometric	Stone	East
Square	Pictorial	Indeterminate	South East
Round			South
Other			South West
			West
			North West
			North

Comments:

NPWS FEATURE RECORDING FORM - GROOVE

Site I.D. ____ Site Name ____

First recorded date ____/____/____ **Importance** ____ **Aboriginal Information Recorded?** ____

No. of instances ____

Recorded by ____

Feature Description

Type of Grinding Feature

- ☐ Broad
- ☐ Narrow/point
- ☐ Hollow
- ☐ Flat

Seed Species Present Recording date ____/____/____

Groove Function

Profile Shape

- ☐ 'U' shaped
- ☐ 'V' shaped
- ☐ Flat

Dimensions

Smallest	Largest	
Length (mm)	Length (mm)	Groove count
Width (mm)	Width (mm)	Cluster count
Depth (mm)	Depth (mm)	

Feature Context & Condition

Easting ____ Northing ____

Dimensions of Whole Feature ____ Length (m) ____ Width (m)

Feature Condition

- ☐ Very good
- ☐ Good
- ☐ Poor

General Condition

- ☐ Weathered
- ☐ Vandalised

General Condition ctd

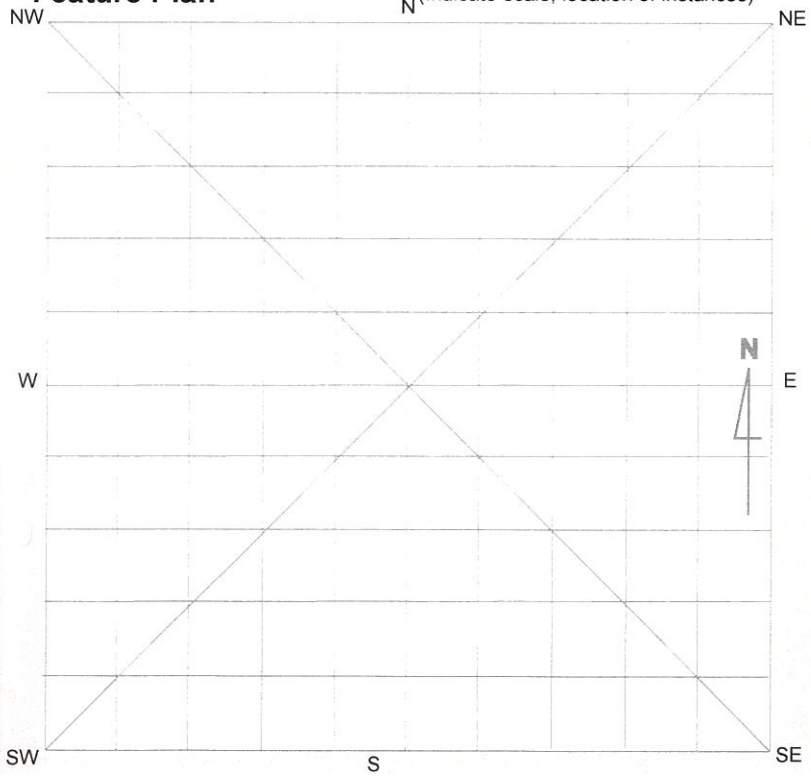
- ☐ Fire damage
- ☐ Surface water wash
- ☐ Graffiti
- ☐ Vehicle damage
- ☐ Erosion
- ☐ Stock damage

Recommended Action

- ☐ Boardwalk
- ☐ Cage/barrier/fencing
- ☐ Closure to public
- ☐ Continued inspection
- ☐ Expert assessment
- ☐ Graffiti removal
- ☐ Meeting with land manager
- ☐ Revegetation
- ☐ Rubbish removal
- ☐ Signage
- ☐ Erosion control
- ☐ Track closure/re-routing
- ☐ Additional recording

Feature Plan

N (Indicate scale, location of instances)



Feature Environment

(Complete when *feature* environment differs to *site* environment, use attributes from cover card, p. 2)

- ____ Land form
- ____ Land form unit
- ____ Slope
- ____ Vegetation
- ____ Land use

Water

Distance to permanent water source ____ metres

Distance to temporary water source ____ metres

Name of nearest permanent water source ____

Name of nearest temporary water ____

NPWS FEATURE RECORDING FORM - ART

Site I.D. ____ Site Name ____

First recorded date ____/____/____ **Importance** ____ **Aboriginal Information Recorded?** ____

No. of instances ____

Recorded by ____

Feature Context & Condition

Easting ____ Northing ____

Pigment ☐ Engraved ☐ Super-impositioning ☐

Artwork Condition

- ☐ Very good
- ☐ Good
- ☐ Poor

General Condition

- ☐ Weathered
- ☐ Vandalised
- ☐ Surface water wash
- ☐ Mineralisation
- ☐ Graffiti
- ☐ Fire damage
- ☐ Insects/termites
- ☐ Erosion
- ☐ Stock
- ☐ Unstable structure

Recommended Action

- ☐ Boardwalk
- ☐ Cage/barrier/fencing
- ☐ Closure to public
- ☐ Continued inspection
- ☐ Dripline
- ☐ Expert assessment
- ☐ Fire hazard removal
- ☐ Graffiti removal
- ☐ Insect/bird nest removal
- ☐ Meeting with land manager
- ☐ Rubbish removal
- ☐ Signage
- ☐ Erosion control
- ☐ Track closure/re-routing
- ☐ Additional recording

Feature Environment

(Complete when *feature* environment differs to *site* environment, use attributes from cover card, p. 2)

- ____ Land form
- ____ Land form unit
- ____ Slope
- ____ Vegetation
- ____ Land use

Water

- Distance to permanent water source ____ metres
- Distance to temporary water source ____ metres
- Name of nearest permanent water source ____
- Name of nearest temporary water ____

Art Sketch Plan

Sketch and number motif groups

NPWS FEATURE RECORDING TABLE - ART MOTIF

Instance	Recording Date	Motif	Application Technique	Form	Main Colour	Location	Condition

Motif

Anthropomorphic
Bird
Bird Track
Canoe
Circle
Contact material culture
Duck
Eel
Emu
Emu track
European figure
Female
Fish
Foot
Hand
Jellyfish
Kangaroo
Line
Lizard
Macropod
Macropod Track
Male
Marine-Other
Other
Pattern
Quadruped
Reptile
Rifle
Shield
Ship
Snake
Spear
Wallaby

Application Technique

Abraded
Drawn
Other
Painted
Pecked
Pigment & Engraved
Stencilled

Form

Fill
Line
Line+ Fill
Other
Pattern

Main Colour

Black
Mauve *
N/A
Orange *
Other
Red *
White *
Yellow *

Art Location

All over shelter surfaces
ceiling
Floor
Mostly near largest sheltered space
Mostly on out of the way surfaces
Other
Wall

Condition

Faded
Stained
Mineralisation Evident
V brant Colours
Unweathered
Weathered

Comments:

NPWS FEATURE RECORDING FORM - SHELL

Site I.D. ☐ Site Name ☐

First recorded date ☐/☐/☐ **Importance** ☐ **Aboriginal Information Recorded?** ☐

No. of instances ☐

Recorded by ☐

Feature Context & Condition

Easting ☐☐☐☐☐☐ Northing ☐☐☐☐☐☐☐

Dimensions of Whole Feature

☐ Length (m) ☐ Width (m) ☐ Depth (m)

Shell Distribution

☐ Surface scatter

☐ Stratified deposit

☐ Mounded

☐ Distance to high water mark (m)

Feature Condition

☐ Very good
☐ Good
☐ Poor

General Condition

☐ Weathered
☐ Vandalised
☐ Surface water wash
☐ Mineralisation
☐ Graffiti

General Condition ctd

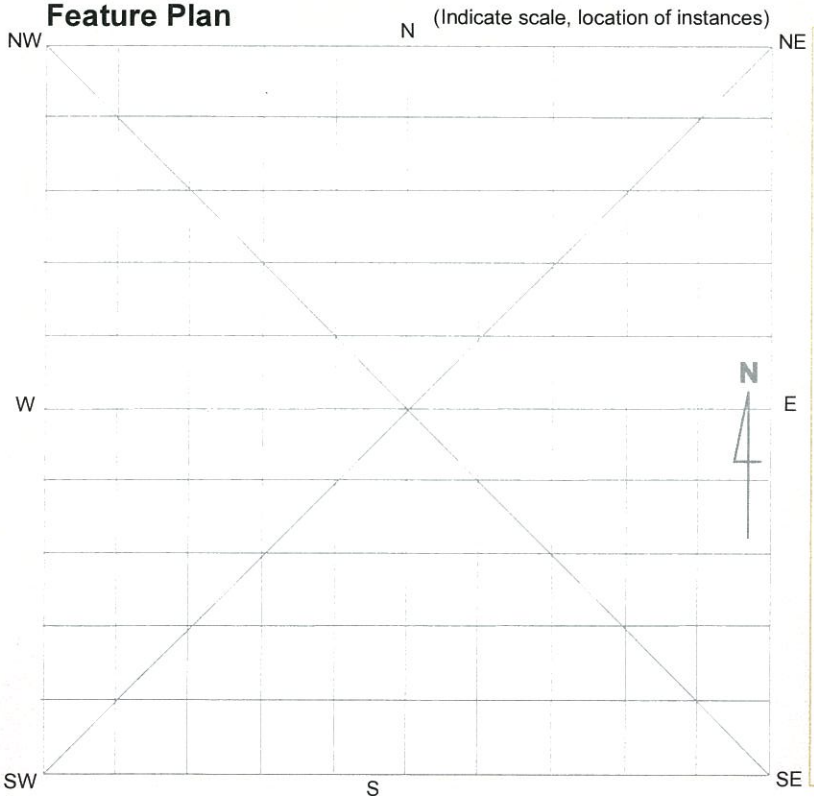
☐ Fire damage
☐ Vehicle damage
☐ Insects/termites
☐ Erosion
☐ Stock damage
☐ Unstable structure
☐ Exposed bone material
☐ Exposed archaeological material

Recommended Action

☐ Boardwalk
☐ Cage/barrier/fencing
☐ Closure to public
☐ Continued inspection
☐ Expert assessment
☐ Fire hazard removal
☐ Graffiti removal
☐ Meeting with land manager
☐ Insect/bird nest removal
☐ Revegetation
☐ Rubbish removal
☐ Signage
☐ Erosion control
☐ Track closure/re-routing
☐ Additional recording

Feature Plan

(Indicate scale, location of instances)



Feature Environment

(Complete when *feature* environment differs to *site* environment, use attributes from cover card, p. 2)

☐ Land form
☐ Land form unit
☐ Slope
☐ Vegetation
☐ Land use

Water

Distance to permanent water source ☐ metres

Distance to temporary water source ☐ metres

Name of nearest permanent water source ☐

Name of nearest temporary water ☐

NPWS FEATURE RECORDING TABLE - SHELL

Instance No.	Recording Date	Shell Species	% of this species shell to % total of other shell

Species

Anadara	Nerita
Bimbala	Ocean Snail
Chiton	Periwinkle
Cowrie	Pippi
Dog Cockle	Ribbed Cockle
Duck Bill	Rock Oyster
Limpit	Thiad
Mud oyster	Triton
Mutton Fish	Turban (large)

Percentage of this Species Shell to Percentage Total of other Shell

0 – 9%
10 – 19%
20 – 29%
30 – 39%
40 – 49%
50 – 59%
60 – 69%
70 – 79%
80 – 89%
90 – 100%

Comments:

APPENDIX 7

Groundwater Assessment

aurecon

Project: West Wallsend Colliery Longwalls 51 and 52

Groundwater Impact Assessment

Reference: 235471-02

Prepared for: Oceanic Coal

Revision: 3

17 December 2013

Leading. Vibrant. Global.
www.aurecongroup.com

Document Control Record

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Executive summary

Oceanic Coal Australia P/L (OCAL), which is wholly owned by Glencore (Australia) Pty Limited, is proposing to prepare an Environmental Assessment to accompany an application to DP&I for a minor modification to the West Wallsend Colliery Project Approval. This minor modification is for the extraction of LW 51 and 52, which will be located on the southern side of the lease area, to the west of longwalls 44 to 46, and adjacent to previously extracted longwall panels in the Newstan Colliery. As part of this process, an assessment has been made of the likely impact of the future proposed coal extraction in longwalls 51 and 52 on the local groundwater regime. This assessment utilized the results of several previous hydrogeological studies to evaluate the potential for any adverse impacts on the groundwater regime. The previous work showed that, there are three potential sources of groundwater in the region:

- alluvial aquifers;
- the near-surface weathered rock aquifer; and
- fractured rock aquifers (including coal seam aquifers).

Potentially, the most important of these sources is found in the alluvial sediments, which fill the broad valleys of the creeks that flow into Lake Macquarie. The West Wallsend Colliery mining lease (CCL 718, CCL725 and ML 1451) covers the catchment area of two of these creek systems. These are the Cockle Creek catchment (and its tributaries including Burkes Creek and Diega Creek) and the catchment of Palmers Creek (including Ryhope Creek and Central Creek). Longwalls 51 and 52 are located within the Palmers Creek catchment.

In the Palmers Creek catchment, a previous investigation was carried out in Ryhope Creek to examine the nature and extent of the alluvium. The results confirmed that the alluvium in Ryhope Creek is relatively thin and contains a series of water-bearing zones of sand, silty sand and clayey sand, with only minor gravelly bands, interbedded with less permeable clay and sandy clay layers. No single major aquifer was identified in the deposits, and hence, the alluvial groundwater resource in Ryhope Creek was considered to be of minor significance, due to its variable quality, and limited volume.

The previous investigation also examined the nature of the alluvium on the northern side the Palmers Creek alluvial plain. Towards the northern edge of the alluvium, the investigations found water bearing sand and gravel zones, which are probably fed from the main aquifer zone that is known to exist in the alluvium further to the south near the Palmers Creek channel in this area. The groundwater in the channel is exploited in a limited number of bores further downstream, and it is considered to be a viable water resource in the local area.

The weathered rock aquifer is generally widespread across the lease area, and includes all the near-surface permeable weathered rock. While the groundwater quality can be very good in this aquifer, its occurrence and distribution are very patchy. Fractured rock aquifers occur at depth in the coal measure strata. These include jointed coal seams and localised jointed or fractured zones, often

adjacent to major faults. Flows are mostly relatively small in these zones, and water quality is generally poor and suitable only for stock use. In the vicinity of longwalls 51 and 52, there is no evidence of any significant or widespread occurrence of either the weathered rock aquifer or any fractured rock aquifers. For this reason, and since there is no exploitation of the groundwater from either of these sources within this area, the risk to these aquifers was determined to be negligible and no detailed evaluation of these sources was made as part of the current study.

The investigations have indicated that the main hydrogeological risks associated with the proposed extraction of longwalls 51 and 52 at West Wallsend Colliery are:

1. There is the potential for mining-induced ground movements to alter the groundwater regime in the main Palmers Creek alluvial aquifer, resulting in limited drainage into the zone of interconnected fracturing above the mine, and impacting on the quantity and quality of water in the main aquifer; and
2. There is the potential for the interconnected fracturing zone above the mine to drain groundwater from the area around the Slattery property and impact on the water resource tapped by the domestic bore at the property.

The alluvium in Ryhope Creek is not considered in this analysis as there has been no major aquifer zone identified in this alluvium, and the main alluvial deposit is located more than 350 metres to the west of the nearest longwall panel, so that any impacts are predicted to be negligible and unmeasurable.

The potential impact of future mining depends on two factors;

- the distance between the mine and the base of the alluvium or the aquifer intersected by the bore; and
- the height of interconnected fracturing above the mine opening.

In order to determine the impact of the proposed future mining on the near surface aquifers, the height of the fractured zone above the proposed mine workings was established based on several years of previous experience, incorporating a qualitative evaluation of local geological and mining conditions. This was then compared with an assessment of recent piezometer data and previous piezometric testing. This assessment yielded an approximate fractured zone height of about 75 to 95 metres.

A further assessment by Ditton Geotechnical Services (DGS) compared to predictions of the heights of fracturing above longwalls 51 and 52 (estimated using three different prediction methods), with the results for the deep borehole extensometers and shallow piezometers above longwalls 39 to 41. The results indicate that the predicted mean and U95%CL values (i.e. Mean Value + 0.12H) of the Buckingham PI Term theory model and an effective strata unit thickness of t'=11 m best represents the measured sub-surface fracture data for West Wallsend Colliery. The optimum prediction method predicts that, at the average depth of cover, the zone of interconnected fracturing will extend to a height of 73 metres (at the shallowest depth of cover) to 87 metres (at the greatest depth of cover) above longwall 51 and 91 to 106 metres above longwall 52 over the full range of cover depths.

The proposed longwall 52 has a depth of cover ranging from 110 to 150 metres, while longwall 51 has a depth of cover ranging from 80 to 140 metres. Given the estimated heights of connected fracturing above the two panels by DGS, it is assessed that it is 'unlikely' to 'very unlikely' that surface cracking will intersect the A-Zone fractures above LW51 and 52, based on the predicted U95% CL values and the steep slope cracking depths

Longwall 52 is currently located so that its southern extent is about 180 metres from the edge of the Palmers Creek alluvium. Since the previous investigations (including augering) have indicated the main alluvial aquifer is located towards the centre of the alluvial channel, the effective distance to the main aquifer zone would be of the order of 280 metres. As a result, it is considered that there is very

low probability of any major drainage of groundwater from the aquifer due to the extraction of this panel.

Longwall 51 is located west of longwall 52, and its southern end lies approximately 80 to 150 metres from the alluvial boundary, and at least 170 to 220 metres from the aquifer in the centre of the alluvial channel. While the depth of cover in this vicinity is of the order of 90 metres, the cover depth to rockhead beneath the alluvium is approximately 70 metres. Since the longwall panel is not located directly beneath the alluvium, there will be no direct impacts from the mining, and certainly no catastrophic loss of alluvial groundwater. However, there is the potential for small quantities of groundwater to drain horizontally from the base of the aquifer into the goaf above the panel, given that the fractured zone above the seam may reach a height of 73 to 87 metres. It has been established that if a horizontal separation of at least 150 metres is maintained between the goaf and the alluvial aquifer, the probability of a hydraulic connection between the alluvium and the mine should be minimal. Given the fact that the main alluvial aquifer lies at a distance of at least 170 metres from the proposed longwall panel, this condition is met and it is likely that longwall 51 can be extracted with a VERY LOW probability of any adverse impacts on the normal flow rates in the alluvial aquifer.

The bore on the Slattery property is supplied largely by a local weathered rock aquifer, which is possibly connected to the alluvium in Palmers Creek. The proposed longwall panels 51 and 52 are located at 180 and 220 metres to the north respectively of this bore. Since the depth of cover to the collar of the bore is of the order of 95 m, the aquifer zone lies at a height of about 85 metres above the West Borehole seam. Because the height of fracturing above the West Borehole seam in longwall 51 is likely to be in the range of 73 to 87 metres, and the fractured zone is located more than 180 metres to the north, the extraction of the seam is not predicted to impact significantly on the aquifer that supplies the bore.

The field reconnaissance also indicated that, apart from the Palmers Creek alluvial aquifer, the occurrence of significant alluvial aquifers in this area is virtually unknown. Although the Palmers Creek alluvial aquifer is a relatively minor source of water within the Lake Macquarie Extraction Management Unit of the Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources, the assessment concluded that, since the aquifer contains good quality groundwater, the consequences of any impact on this aquifer are assessed as MODERATE. The assessment noted that any impact on the aquifer could have unknown impacts further downstream beyond the local area. While there is not a great deal of exploitation of this aquifer downstream, and the effects are likely to diminish with distance downstream, it could preclude any future expansion of groundwater use from this source.

The assessed consequences of an adverse impact on the flow to Slattery's bore are LOW, as the bore is not used all that often, any impact would be only local to this site, and the bore could be replaced, in the unlikely event that there were any adverse impacts.

The two main risk factors listed above were assessed using the Glencore risk matrix, taking into account the probabilities and consequences of an adverse outcome as discussed. Both risks were assessed as LOW. Although both of the assessed risks are considered to be LOW, which generally does not require any additional risk mitigation measures, the NSW Aquifer Interference Policy indicates that monitoring is required to demonstrate that the proposed mining does not exceed the minimal harm criteria for the identified groundwater source. A program of monitoring has therefore been recommended for both the Palmers Creek and Ryhope Creek alluvial plains, as well as continued monitoring of Slattery's bore.

A final review of the potential for any regional hydrogeological impacts from the proposed future mining was carried out and it was determined that there would be no regional impacts.

The compliance of the project with the NSW Aquifer Interference Policy was examined and it was determined that the minimal impact considerations will be met for the alluvial aquifer in Palmers Creek, and hence the impacts should be deemed acceptable by the Office of Water. Since there is a

negligible chance that the proposed mining will drain any groundwater from the Palmers Creek alluvium, no license will be required for this water source.

It is also evident from the study that any fractured rock aquifers in the overburden above longwalls 51 and 52 will be largely depressurised. However, since there are

- no high priority groundwater dependent ecosystems, or
- no high priority culturally significant sites listed in the schedule of the relevant water sharing plan, or
- no water supply works

in the zone that will be depressurised, the minimal impact criteria will not be exceeded, and the predicted impacts on the fractured rock aquifers should be acceptable to the Office of Water.

Since there is no evidence that the extraction of LW 51 and 52 will significantly increase the groundwater inflow from the coal measures over and above the normal increases that are experienced in a new longwall panel, the current license allocation will be sufficient to cover the additional inflows.

The applicability of the “Draft significant impact guidelines: Coal seam gas and large coal mining developments – impacts on water resources”, issued by the Australian Government Department of Sustainability, Environment, Water, Population and Communities was also examined and, based on the current assessment, the conclusion can be drawn that no assessment or referral would be necessary under the EPBC Act for the proposed extraction of longwalls 51 and 52.

1 Introduction

West Wallsend Colliery currently extracts coal from the West Borehole Seam, in CCL 718, CCL725 and ML 1451 south of Killingworth near Newcastle, New South Wales. The mine is operated by Oceanic Coal Australia Pty Ltd (OCAL) on behalf of the Macquarie Coal Joint Venture, and current underground operations in the mine utilise longwall mining techniques. OCAL is wholly owned by Glencore (Australia) Pty Limited.

The mine lease covers an extensive area roughly bounded by George Booth Drive in the north, the Sugarloaf Range in the west and, in the southeast, by the Newstan Colliery boundary, which lies east of the Wakefield Road. Most of the mining to date has been carried out in the northern, western and eastern parts of the lease, and has included some bord and pillar workings with pillar extraction and more than 40 longwall panels. The current longwall mining operations are located in the western domain on the western side of the Sydney-Newcastle F3 Freeway, which bisects the West Wallsend Colliery holding.

In 2004, OCAL produced a Subsidence Management Plan (SMP) for the northern and southern domains, to identify and characterise any surface and subsurface features in the lease area, and assess the likely impacts of the proposed mining on those features. As part of the SMP process, a detailed evaluation of the local hydrogeology in the two domains was carried out, and a report was prepared to summarise the findings of the investigations. Subsequently, additional mine planning activities resulted in a significant change to the mine layout in the former southern domain, and a reassessment of the likely impacts of the proposed extraction on the hydrogeology was undertaken. This study also included part of what is known as the western domain.

Once the life of mine plan for the colliery was finalised, OCAL made application for the continuation of mining activities under one approval which applies to all future mining operations. In accordance with statutory requirements Part 3A approval was obtained under the Environmental Planning and Assessment (EP&A) Act. The Continued Operations approval, amongst other aspects, included an assessment of the likely impact of all future proposed coal extraction on the local groundwater regime. Since longwalls 51 and 52 did not form part of that original approval, application must be made to add these two longwall panels to the existing West Wallsend Colliery Project Approval.

Oceanic Coal Australia P/L (OCAL) is proposing to prepare an Environmental Assessment to accompany an application to DP&I for a minor modification to the West Wallsend Colliery Project Approval. This minor modification is for the extraction of LW 51 and 52, which will be located on the southern side of the lease area, to the west of longwalls 44 to 46, and adjacent previously extracted longwall panels in the Newstan Colliery (Figure 1).

In order to assist in the preparation of the Environmental Assessment, Glencore requested that Aurecon provide an assessment of the likely impact of the proposed LW51/52 panels on the local hydrogeological regime in this area. This report presents the results of that assessment. It has been updated to address issues raised by the peer reviewer (Appendix C).

Figure 1 - Longwalls 51 and 52 location plan showing depth of cover and extent of alluvium

2 Scope

A preliminary constraints evaluation was carried out by Aurecon for this project, and this formed the basis of the current hydrogeological assessment, which expands on the issues highlighted in the initial evaluation.

The proposed methodology for preparing the hydrogeological assessment is as follows:

- Review all available hydrogeological reports and data from previous investigations at West Wallsend and nearby mining leases;
- Review of groundwater monitoring data from the West Wallsend lease area and adjacent lease areas;
- Review geological data from exploration drilling in the project area;
- Review available results of water pressure testing from the current exploration program and other sites in the local area;
- Determine the location of all registered groundwater bores and wells in the project area;
- Confirm the location, nature and extent of alluvium in the project area;
- Provide an overall assessment of the existing groundwater environment in the project area, including identification of the location and nature of any aquifer zones in the alluvium or overburden strata;
- Review the applicability of the NSW Aquifer Interference Policy to the project, and determine the compliance of the project with the Policy. Also comment on the relevance of the recently released Department of the Environment (DoE) policy contained in the “Draft significant impact guidelines: coal seam gas and large coal mining developments - impacts on water resources”;
- Determine the scope of monitoring to be conducted for the duration of the project; and
- Prepare a report suitable for inclusion Environmental Assessment Report.

3 Regional geology and hydrogeology

3.1 Geology

The near surface strata in the West Wallsend lease area belong to the Permian Age Newcastle Coal Measures. The major influencing structure in this region is the Macquarie Syncline, which trends in a NNW-SSE direction, and bisects the West Wallsend lease to the east of the underground mining area. In this area, the strata dip to the east at an angle of about 2° to 4°, consistent with their location on the western limb of the Macquarie Syncline.

The Newcastle Coal Measures are thickest in the east, and thin significantly towards the west, due largely to a decrease in the quantity of sediment. The maximum total thickness of these coal measures decreases from about 420 metres in the centre of the Macquarie Syncline to a minimum of about 50 metres in the west. In the longwall 51 and 52 mining area the total thickness of Newcastle Coal Measure strata is about 200 metres. The local stratigraphic sequence in the area is summarised in Table 1.

In the West Wallsend area, the Newcastle Coal Measures comprise four major formations (Moon Island Beach, Boolaroo, Adamstown, Lambton) separated by prominent tuff bands. The upper three formations (Moon Island Beach, Boolaroo and Adamstown) contain conglomerate and sandstone bands with interbedded shale, siltstone, tuffaceous claystone bands and high ash coal seams. The coal seam of particular relevance to this study is the West Borehole Seam, which belongs to the basal Lambton Formation, and will be extracted in longwalls 51 and 52. The Nobbys Tuff overlies the West Borehole Seam and forms a distinctive marker horizon over most of the Newcastle region, although in the northern part of the application area, the tuff thins to near-zero thickness.

The Adamstown Formation, which overlies the Nobbys Tuff, makes up the bulk of the overburden above the West Borehole Seam in the vicinity of longwalls 51 and 52, where it is up to 100 metres thick. This formation contains several coal seams (Australasian, Montrose, Wave Hill, Fern Valley and Victoria Tunnel) that are generally of poor quality. The lower part of the Adamstown formation over most of the application area comprises a thick, coarse-grained sedimentary sequence, in excess of 30 metres thick. The upper part of the Adamstown Formation is finer grained, and comprises interbedded sandstone, siltstone and shale. The coal seams also occur in this part of the Formation in this area. The majority of these seams converge to form two bands, 10 to 15 metres thick (containing dirty coal and carbonaceous mudstone, with interbedded tuff layers). The Warners Bay Tuff, which lies above the Adamstown Formation, is up to 7 metres thick.

The overlying Boolaroo Formation ranges from 35 to 70 metres thick, and is exposed on the flanks of the ridges. It comprises interbedded sandstone, siltstone and shale, with minor conglomerate bands and thin coal seams (mostly splits of the Pilot Seam). In the West Wallsend lease area, the overlying Awaba Tuff, and the uppermost formation, the Moon Island Beach Formation, both have a limited extent and crop out only on the ridge tops.

Several major dykes have been identified in the existing West Wallsend Colliery workings and in the Newstan Colliery workings to the south. These dykes are near-vertical and generally trend in a NNW-SSE direction. Since this structural trend direction is relatively consistent throughout the Newcastle Coalfield, any major dykes in the vicinity of longwalls 51 and 52 would most likely be intersected in longwalls 41 and 42, which are located to the NNW. Since no major dykes have been intersected in these panels, then it is likely that there will be none in longwalls 51 and 52. Occasional faults cross the West Wallsend Colliery lease and also trend approximately in a NNW-SSE direction similar to the dykes. A major NNW-SSE trending structural zone crosses the centre of the lease area and separates the northern and eastern domains from the western and southern domains. No major faults are known in the vicinity of longwalls 51 and 52.

Joints in the coarse-grained sediments are generally tight and widely spaced where the rock is exposed at the surface and underground. Jointing in the fine-grained sediments is closer spaced, although when the rock is fresh, these joints are normally tight and clean. Joints have a similar strike direction to the faults (NW-SE), and most tend to be near vertical or steeply dipping to the southwest.

There are several creek valleys that cross the West Wallsend lease area. These valleys range up to one hundred metres wide, and are filled with recent alluvial deposits comprising mostly sand, silt and clay. Two of these, Ryhope Creek and Palmers Creek are located near longwalls 51 and 52.

Table 1 - Stratigraphic Sequence*

GROUP	FORMATION	COAL SEAMS	THICKNESS
ALLUVIAL DEPOSITS		Sand, gravel	0 – 15 m
NEWCASTLE COAL MEASURES	MOON ISLAND BEACH	Vales Point Wallarah Great Northern	0 – 30 m
	AWABA TUFF		
	BOOLAROO	Fassifern Upper Pilot Lower Pilot Hartley Hill	60 - 75 m
	WARNERS BAY TUFF		up to 7 m
	ADAMSTOWN	Australasian Montrose Wave Hill Fern Valley Victoria Tunnel	65 - 100 m
	NOBBYS TUFF		0 – 3 m
Base of Coal Measures	LAMBTON	Nobbys, Dudley } Young Wallsend; Yard, Borehole } Borehole/Yard; } West Borehole Seam	4.5 m
	WARATAH SANDSTONE		

* Based on revised Newcastle Coal Measures stratigraphy ratified in June 1992 by the Standing Committee on Coalfield Geology of NSW (Hawley & Brunton, 1995).

3.2 Hydrogeology

An understanding of the local hydrogeological regime in the West Wallsend lease area is necessary in order to determine if there is likely to be any impact from the future extraction of longwalls 51 and 52. The hydrogeological regime in the West Wallsend lease area has been examined in several previous studies (Pacific Power International, 2002, Connell Wagner PPI, 2003 and Connell Wagner PPI, 2004, Connell Wagner PPI, 2005, Connell Wagner, 2006, Aurecon, 2010). The following assessment is based on the results of those investigations, and several other studies, which have examined the permeability and hydrogeological properties of the strata in the Newcastle Coalfield.

Previous experience has shown that, there are three potential sources of groundwater that have been located in the Lake Macquarie area:

- alluvial aquifers;
- the near-surface weathered rock aquifer; and
- fractured rock aquifers (including coal seam aquifers).

The occurrence and properties of these aquifers are summarised in this section.

3.2.1 Alluvial aquifers

Potentially, the most important groundwater resource in the Newcastle/Lake Macquarie area is found in the alluvial sediments, which cover the low-lying areas adjacent to the lake system, and fill the broad valleys of the creeks that flow into the lake. In the Lake Macquarie area, numerous bores and wells draw water from these sediments, which usually comprise a fine-grained surface layer underlain by sand and gravel deposits. Flows from these wells mostly range from 0.1 to 9 L/s, and water quality is generally reasonable (Hitchcock, 1995).

The West Wallsend lease covers two major catchment areas. These are the Cockle Creek catchment (and its tributaries including Burkes Creek and Diega Creek) and the catchment of Palmers Creek (including Ryhope Creek and Central Creek). The Cockle Creek catchment covers an area of about 8000 hectares and drains into the northern end of Lake Macquarie. To the east of the West Wallsend lease near Lake Macquarie, Cockle Creek is a perennial stream with a broad floodplain and significant alluvial aquifer. However, within the lease area, the upper reaches of Cockle Creek comprise a series of ephemeral channels, which only flow after consistent rainfall. Although stream flows in the lease area are intermittent, the creek beds are contained in broad, flat valleys, which are filled with alluvial deposits.

The Cockle Creek catchment is flanked to the south by the Palmers Creek catchment, which underlies a small portion of the lease area to the south, where longwalls 51 and 52 are located. The valley of Palmers Creek comprises a broad alluvial terrace which contains one major aquifer. The groundwater in this aquifer is exploited in several bores and is utilised for stock and domestic purposes. This aquifer is outside the West Wallsend lease area, although longwalls 51 and 52 lie immediately north of the aquifer, adjacent to the lease boundary. Since there is the potential for this aquifer to be impacted by the proposed mining, this area is the subject of a more detailed evaluation in Section 6 below. Two tributaries of Palmers Creek (Ryhope Creek and Central Creek) flow south into Palmers Creek, and cross the southern part of the lease area near longwalls 51 and 52.

3.2.2 Weathered rock aquifer

The lack of groundwater flow in the coal measure strata is due to the extremely low primary permeability of the rock material. As a result, most groundwater flow through the overburden strata is

due to secondary or fracture permeability (through interconnecting defects such as joints and bedding).

Fracture permeability is most common in the weathered zone and in near surface strata where joints and fractures are likely to be open. This can form a near surface unconfined aquifer, termed the **weathered rock aquifer**, which may be intersected above the bedrock throughout the area. The weathered rock layer is generally of the order of 10 metres deep throughout the region, and hence the aquifer, where it occurs, is limited to this zone. The permeability and groundwater quality in the aquifer are both variable, due primarily to the variable properties of the parent rock from which the weathered rock layer is derived. However, where conditions permit, the aquifer can be exploited in shallow wells of large diameter to increase yields. Generally however, the occurrence of an aquifer in the weathered rock layer is patchy.

Occasionally, flow from this aquifer is significant, and may emerge at the ground surface in the form of a spring. Groundwater flow rates from these springs are usually intermittent, and depend on the recent climatic conditions, while the water quality is poor to good. There are no known springs derived from the weathered rock layer in the vicinity of the longwalls 51 and 52, which confirms that the weathered rock aquifer is generally poorly developed in this area. There are also no known groundwater dependant ecosystems reliant on this aquifer as a water source.

In summary, the evidence indicates that, where the weathered rock aquifer exists in the region, it is of minimal importance, due to its poor yield and continuity. The available data also indicate that there is no evidence for the existence of a weathered rock aquifer above longwalls 51 and 52. As a result, the risk of any adverse impacts on this aquifer from the mining will be negligible, and does not require any further evaluation.

Although there is no significant weathered rock aquifer above longwalls 51 and 52, the well on the Slattery property, which is located about 180 metres south of LW 51, probably exploits a localised weathered rock aquifer that may be partially connected to the alluvium in Palmers Creek. Consequently, the potential impact on this well will be assessed.

3.2.3 Fractured rock aquifers

The groundwater resource in the underlying unweathered strata of the Newcastle Coal Measures is also of minimal importance on a regional scale. Previous geotechnical investigations have confirmed that the Newcastle Coal Measures do not normally contain any significant quantities of groundwater, and the permeability of these rocks is generally less than 10^{-7}m/s (Pacific Power International, 1997). Because of this, most underground mines in Newcastle Coalfield (apart from those mining at very shallow depths) are relatively dry, and rarely experience any major inflow problems. Significant groundwater inflows in underground mines usually only occur when shallow workings intersect faults or jointed zones, which drain water from the overlying weathered rock aquifer into the mine.

The few aquifers that do occur at depth in these strata, are usually **fractured rock aquifers**. These include jointed coal seams and localised jointed or fractured zones, often adjacent to major faults. Fractured rock aquifers occasionally have permeabilities up to two orders of magnitude greater than the surrounding strata, due to their interconnecting cleat and/or joint patterns (hence the term fractured rock aquifer).

These aquifers have the potential for higher flows than the weathered rock aquifer, since they are confined aquifers and are at a higher pressure. Nevertheless, flows are often relatively small in these zones, and water quality is generally poor and suitable only for stock use. They are normally exploited using pumped bores, to utilise the high head in these aquifers. Hitchcock (1995) concludes that the Newcastle Coal Measures “have a poor resource potential with low yielding aquifers of high salinity”. This explains why fewer users exploit this resource than other sources.

The existence of water bearing zones in coal seams at West Wallsend Colliery was confirmed by water pressure testing at two shaft sites (Robert Carr Associates, 1998 and Douglas & Partners, 1992). Of the twenty successful tests in the overburden strata in these bores, fifteen gave permeabilities of less than 1 lugeon (< 1 x 10^{-7} m/s). Of the remaining five, four measured permeabilities in coal seams that ranged from 1 to 14 lugeons. The other test measured a permeability of 2.5 lugeons in fractured rock forming the roof of the West Borehole Seam. These results indicate that, while the permeability in some of the coal seams is greater than in the surrounding rocks, there are no significant aquifer zones, as the maximum permeability of 14 lugeons is not sufficient to produce any significant groundwater flow. Testing of the salinity in the borehole at one of the shaft sites yielded an average TDS value of 1260 mg/L. Water of this quality is not suitable for human consumption, and is suitable only for stock use.

Normally, any groundwater bearing seam in the immediate overburden strata above a longwall panel will drain into the goaf during extraction of the seam. Since very few major groundwater inflows have been experienced in the existing West Wallsend workings to date (apart from areas with shallow depth of cover), this confirms that the water-bearing coal seams are an insignificant groundwater source in this area, and there are no major fractured rock aquifers in the overburden strata above the existing workings. Were there any significant aquifer zones in the near roof strata, water inflows to the mine would be common and widespread.

Based on previous mining experience at West Wallsend, as well as the results of recent exploratory boreholes carried out for the current project, the conditions in the longwall 51 and 52 mining area are likely to be similar to the rest of the workings, and there is no evidence of the existence of any significant fractured rock aquifers in the near-roof strata. Consequently, the risk of an adverse impact on any fractured rock aquifer is negligible, and requires no further evaluation.

3.2.4 Groundwater Dependent Ecosystems

Groundwater dependant ecosystems are biological communities that have their species composition and their natural ecological processes determined by the quantity and quality of groundwater. The NSW Groundwater Quantity Management Policy requires that all significant groundwater dependant ecosystems be identified and protected. In the vicinity of longwalls 51 and 52, no groundwater dependant ecosystems were identified in the field studies, so that no further consideration of this aspect is required.

4 Proposed future mining

At the time of preparation of this report, extraction in the West Borehole was being carried out in Longwall 44 in the southern domain. Subsequent extraction is to continue in the southern domain in longwall 45 . Extraction will then continue in longwalls 42 and 43 in the northern domain, before the extraction of longwalls 46, 51 and 52 in the southern domain. Extraction of longwalls 47 to 50 will occur in the northern domain, after longwalls 51 and 52 are extracted.

The location of longwalls 51 and 52 is shown on Figure 1.

Details of the proposed mining in the two longwall panels are summarised in Table 2 below:

Table 2 - Proposed Mining Details

FEATURE	LW 51	LW 52
Seam	West Borehole	West Borehole
Working thickness	4.1 to 4.4 metres	4.2 to 4.5 metres
Panel Width	178.8 metres	206.8 metres
Panel Length	876 metres	964 metres
Depth of Cover	80 – 140 metres	110 – 150 metres
Chain Pillar Width	30 metres	30 metres

It should be noted that the mining parameters detailed above, and the proposed mine layout may be altered at any stage prior to or during the future development of the mine due to unforeseen geological, planning or mining factors.

5 Risk assessment and evaluation

The Department of Primary Industries recommends that, in assessing the impacts of subsidence on surface and subsurface features, the risk of an adverse outcome should be assessed. This risk is essentially a product of the probability of an adverse outcome and the consequences of such an event.

One of the main principles of the NSW Groundwater Quality Protection Policy is that the scope of works which is required to demonstrate adequate groundwater protection, should be commensurate with the risk the development poses to a groundwater system and the value of the resource. The NSW Government's new Aquifer Interference Policy also calls for a risk-based approach. Since the weathered rock aquifer has a negligible importance in the continued underground mining area, and there are no known fractured rock aquifers of any significance (Section 3.2.3), the risk of any adverse impact on these aquifers has not been considered in the subsequent evaluation, and the assessment concentrates on the potential for impacts on the alluvial aquifers.

Based on the available knowledge of the local hydrogeological regime at the time of the study (summarised in Section 3), the major potential hydrogeological risk associated with the future proposed mining in longwalls 51 and 52 was determined to be:

> *Ground surface movements and/or the fracturing of the overburden strata associated with the extraction of the West Borehole Seam has the potential to drain any aquifers in the alluvial deposits, and impact on the amenity of any current or future users of these groundwater sources*.

In order to determine the likely adverse consequences of the proposed mining on the groundwater in the alluvium, the following activities were undertaken to assist in the assessment of the potential consequences of the proposed mining:

1. Data relating to the alluvium was gathered from previous field studies (Section 3.2.1);
2. A field reconnaissance program was carried out to confirm the location, extent and nature of the alluvial deposits in the vicinity of longwalls 51 and 52 (Section 6.1);
3. An evaluation was made of the current and future potential groundwater usage in and near the affected area (Section 6.3); and
4. A qualitative assessment was made of the potential worst case consequences due to mining (Section 8.3).

In order to determine the likelihood of any adverse consequences occurring, the following activities were undertaken:

1. An estimation was made of the likely height of fracturing above the extracted longwall panels (Section 7); and

2. Based on ongoing monitoring and data from other sites, a qualitative assessment was made of the likelihood that the proposed mining would have an adverse impact on the local aquifers (Section 8.2).

The results of these investigations were used to assess the risk of an adverse hydrogeological outcome in the vicinity of longwalls 51 and 52 (Section 8.4), following which, an assessment was made of the potential for any adverse impacts on a regional scale (Section 9). This assessment process is summarized in the following sections.

6 Characterisation of the alluvial aquifer

6.1 Local alluvial deposits

As indicated above, longwall panels 51 and 52 are located on the southern side of the lease area, and are bounded by Palmers Creek in the south and Ryhope Creek (a tributary of Palmers Creek) to the west (Figure 1). Central Creek (another tributary of Palmers Creek) lies to the east of these two panels, but it is sufficiently far removed that the impacts need not be considered in this assessment. During previous investigations at West Wallsend, a program of auger drilling was undertaken to determine the nature of the alluvial deposits in Palmers Creek and Ryhope Creek, and to establish whether any significant alluvial aquifers were present in the alluvium. Since this investigation is relevant to the current study, the results will be used in the following assessment of the hydrogeological conditions in the vicinity of longwalls 51 and 52.

In the Palmers Creek catchment, the investigation of the alluvium was carried out in an area that is adjacent to longwalls 51 and 52. The investigation included a series of nine shallow hand augered bores to a maximum depth of 5.3 metres. Two of these bores were located in the valley of Palmers Creek and seven in the alluvium in Ryhope Creek. The results confirmed that the alluvium in Ryhope Creek is relatively thin but is similar to that intersected in Cockle Creek in the northern part of the lease. It comprises mostly clayey sand and sandy clay with occasional gravelly bands. No single major aquifer was identified in the deposits, however the alluvium contains occasional water-bearing sand horizons, interbedded with less permeable clay lenses.

The investigation in Palmers Creek intersected thin alluvial material in one bore (P1) which was located on the northern edge of the alluvial deposits. In the other bore (P2) alluvial material was intersected to a depth of 5 metres, where refusal was reached in a gravelly band. While no major alluvial aquifer was located, water bearing sand and gravel zones were intersected in this bore, including the gravel layer at the base of the bore. These zones are probably fed from the major aquifer zone which is known to exist in the much thicker alluvial deposits, further to the south and closer to the main Palmers Creek channel at this location. The approximate limit of the extent of the alluvium and the interpreted northern limit of the main alluvial aquifer in Palmers Creek is shown on Figure 2.

The investigation bores were drilled in March 2005. All bores were drilled with a hydraulically powered hand auger to depths ranging from 2.15 to 5.3 metres. Two of these investigation bores (Q2 and R1) were converted to monitoring bores by installing slotted casing and automatic water level monitoring instruments. In addition to these initial investigation bores, another monitoring bore (R5) was installed in the Ryhope Creek alluvium, about 350 metres west of longwall 51, where a dam appears to be fed by alluvial groundwater. To supplement this data, one additional bore (P4) was drilled in the alluvium in Palmers Creek in August 2013, and a water level monitoring instrument installed. This bores intersects a layer of water-bearing sand and silty sand with gravel. All of the bore locations are shown on Figure 2, and details of the bores given in Table 3 below.

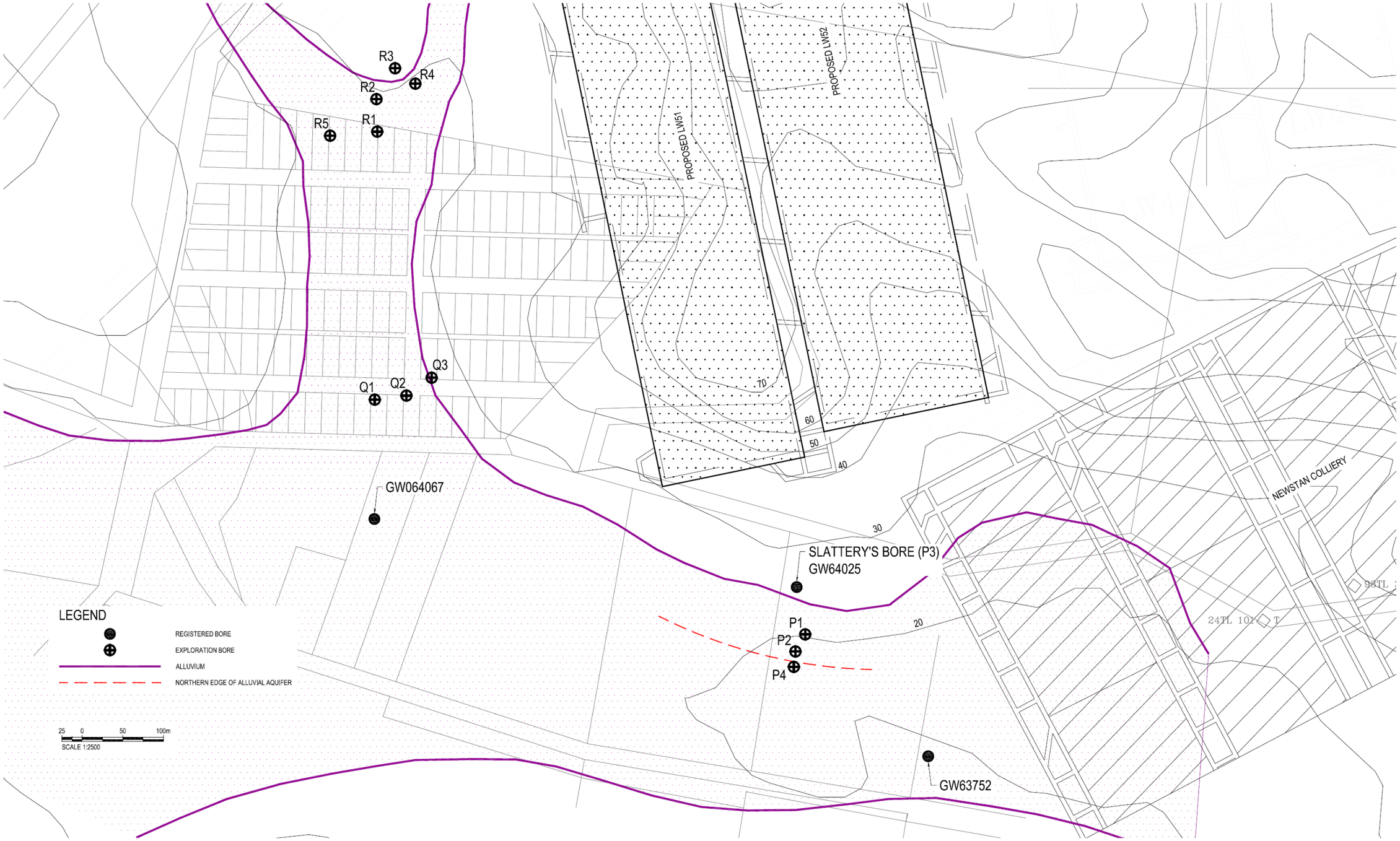

Figure 2 - Location of investigation bores and monitoring bores

Table 3 - Details of alluvial bores

Bore No.	Total Depth (m)	AHD Collar Elevation (m)	MGA Easting (m)	MGA Northing (m)	Depth to Groundwater Table (m)	Elevation of Groundwater Table (m)
P1	3.50	20.56	362641	6348733	2.00	18.56
P2	5.10	21.03	362629	6348712	3.30	17.73
Q1	5.30	24.80	362111	6349022	3.10	21.7
Q2	5.00	24.20	362150	6349027	2.00	22.2
Q3	3.10	25.36	362181	6349049	-	-
R1	3.60	28.02	362114	6349352	2.20	25.82
R2	4.00	31.42	362113	6349392	-	-
R3	2.15	32.65	362136	6349430	-	-
R4	2.80	29.18	362161	6349411	1.00	28.18
R5	3.0	26.5	362056	6349347	0.5	26.0
P4	5	~ 21	362627	6348693	3.2	17.8

The soil material intersected in the auger holes was logged at the time of drilling to determine the distribution and nature of the alluvium in the vicinity of the southern end of the longwall panels. A description of the soils in each bore is given in Table 4 below.

Table 4 - Alluvial bore logs

Bore No.	Depth (m)	Soil Description
P1	0 – 0.40	TOPSOIL – brown, dry, loose
	0.40 – 1.00	SILTY SAND – loose, brown dry (alluvial)
	1.00 – 2.60	SILTY CLAY – brown/orange, firm, moist, plastic at base (colluvial) GWL at 2.0 metres
	2.60 – 3.10	SILTY CLAY – grey, firm to stiff, moist, plastic (CW Siltstone)
	3.10 – 3.50	CW COAL - black
	Auger refusal in weathered coal at 3.50 m	
P2	0 – 0.55	TOPSOIL – brown, dry, loose
	0.55 – 1.60	CLAYEY SILTY SAND – yellow/brown, medium grained, dry, moist, loose (alluvial)
	1.60 – 2.30	SILTY SAND – grey/brown, loose, moist, medium grained (alluvial)

Bore No.	Depth (m)	Soil Description
	2.30 – 4.00	SILTY CLAY – some sand, grey, firm, moist, plastic (alluvial) GWL at 3.3 metres
	4.00 – 5.10	SANDY GRAVELLY CLAY – with sand and gravel bands, medium to coarse grained, dark grey, saturated, firm (alluvial)
	Auger refused in gravel band at base of bore at 5.10 m	
Q1	0 – 0.60	SILT – light brown, fine grained, dry, very loose (alluvial)
	0.60 – 1.30	SILTY CLAY – mottled brown/grey, firm, moist, plastic (alluvial)
	1.30 – 1.60	SANDY CLAY – grey/brown, medium grained, firm, moist (alluvial)
	1.60 – 3.30	SILTY CLAY – some sand, mottled grey/brown, firm to stiff, moist (alluvial) GWL at 3.1 metres
	3.30 – 3.80	SILTY CLAY – light grey, moist, stiff, plastic (alluvial)
	3.80 – 4.50	SANDY CLAY – mottled orange/grey, fine to medium grained, wet, firm (alluvial)
	4.50 – 4.80	SILTY CLAY – grey, moist, plastic, firm (alluvial)
	4.80 – 5.30	CLAYEY SAND – some gravel, grey, compact, water bearing, fine grained (alluvial)
	Auger refused in gravelly band at 5.30 m	
Q2	0 – 0.60	SILT – light brown, fine grained, dry, very loose (alluvial)
(instrument installed)	0.60 – 1.40	SILTY CLAY – mottled grey/brown, firm, moist, plastic (alluvial)
	1.40 – 1.80	SANDY CLAY – mid grey, medium to coarse grained, moist, firm to stiff, plastic (alluvial)
	1.80 – 3.10	CLAYEY SAND – some sandy clay layers, grey, medium to coarse grained, compact, saturated (alluvial) GWL at 2.0 metres
	3.10 – 4.60	SILTY CLAY – grey, soft, wet, plastic (alluvial)
	4.60 – 5.00	GRAVELLY CLAY – grey, stiff, some gravel lenses (alluvial)
	Auger refused on gravelly material at base of hole at 5.00 m	
Q3	0 – 0.90	SILTY CLAY – some fine sand, mottled grey/red, firm, moist (colluvial)
	0.90 – 2.00	SILTY CLAY – light grey, stiff, plastic, moist (colluvial)
	2.00 – 2.80	SILTY CLAY – some minor sandy and gravelly bands, light grey/brown mottled, stiff, moist, plastic (CW mudstone)
	2.80 – 3.10	SILTY CLAY – brown, moist (CW coal)
	Auger refusal in weathered coal material at 3.10 m	
R1	0 – 0.20	SILTY SAND – loose, brown, moist (alluvial)
(instrument installed)	0.20 – 0.60	SILTY CLAY – some organic content, dark brown/grey, moist/wet, soft (alluvial)
	0.60 – 1.80	SANDY CLAY – grey, medium grained, wet, soft (alluvial)

Bore No.	Depth (m)	Soil Description
	1.80 – 2.20	SANDY CLAY – grey/brown, wet, firm to stiff (alluvial) GWL at 2.2 metres
	2.20 – 2.80	SILTY CLAY – orange/grey, stiff, moist, plastic (alluvial)
	2.80 – 3.40	SAND – grey, medium grained, saturated, compact (alluvial)
	3.40 – 3.60	GRAVEL – some gravelly clay, grey, fine grained, saturated (alluvial)
	Auger refusal on gravel layer at 3.60 m	
R2	0 – 0.30	TOPSOIL – silty, grey/brown, loose
	0.30 – 1.50	SILTY CLAY – grey, firm, moist (colluvial)
	1.50 – 2.30	CLAYEY SILT – grey, firm, moist (colluvial)
	2.30 – 2.50	SILTY SAND – grey, fine grained, moist (colluvial)
	2.50 – 3.00	SANDY CLAY – mottled orange/grey, fine grained, moist, stiff (colluvial)
	3.00 – 3.50	SANDY SILT – grey, fine grained, friable (colluvial)
	3.50 – 4.00	SANDY CLAY – grey/brown, fine grained, firm, moist (residual)
	Auger refusal in residual material at 4.00 m	
R3	0 – 0.20	TOPSOIL – silty, grey/brown, loose
	0.20 – 0.50	SILTY CLAY – grey, dry, firm (colluvial)
	0.50 – 1.00	CLAYEY SAND – mottled brown/grey, medium to fine grained, compact, moist (colluvial)
	1.00 – 2.00	SANDY CLAY – some clayey sand, mottled grey/brown, medium grained, moist, stiff (residual)
	2.00 – 2.15	CW SANDSTONE – mottled grey/brown
	Auger refusal in CW Sandstone at 2.15 m	
R4	0 – 1.00	SANDY SILT – organic, dark brown/grey, soft, wet (alluvial)
	1.00 – 2.30	SILTY SAND – grey, medium grained, loose, saturated (alluvial) GWL at 1.0 metres
	2.30 – 2.80	SILTY CLAY – some clayey sand, mottled brown/grey, medium grained, stiff moist (alluvial)
	Auger refusal in very stiff clay at 2.80 m	
R5	0 – 0.7	TOPSOIL – silty, grey/brown, loose
(instrument installed)	0.7 – 1.8	SILTY SAND - mottled grey and orange, fine grained, moist, friable, compact (alluvial)
	1.8 – 3.0	SAND - grey, loose, saturated, medium grained, some silty bands (alluvial)
	Hole stopped due to caving	
P4	0 – 0.2	TOPSOIL – silty sand, dark brown, loose
(instrument	0.2 – 0.5	SILTY SAND – fine grained, grey/brown
installed)	0.5 – 0.8	SANDY CLAY – fine to medium grained, grey mottled orange/brown,

Bore No.	Depth (m)	Soil Description
	0.8 – 1.0	SAND – fine to medium grained, orange/brown
	1.0 – 2.0	SILTY CLAY – medium plasticity, grey with coarse grained sand
	2.0 – 3.2	SILTY SAND – fine to coarse grained, grey, some sub-angular gravel
	3.2 – 4.6	SILTY CLAY – medium plasticity, grey
	4.6 – 5.0	SAND – fine to medium grained, grey

In addition to the investigation boreholes, reference was made to the groundwater database of the NSW Office of Water (NoW), to determine the location of any registered bores in the vicinity. This database lists details of all registered bores and wells in New South Wales. While it is recognised that many existing bores are not registered, the database does give an indication of the extent of groundwater usage in the area.

The database lists three registered bores in the nearby area. All three of these bores are located at the southern edge of the lease area in the valley of Palmers Creek. The details of these bores from the NoW database are given in Table 5 below, and their location is shown on Figure 2. Summary logs of the bores are shown in Table 6, and copies of the Groundwater Works Summary sheets are given in Appendix A.

Table 5 - Details of Registered Bores in Palmers Creek

Reg. No.	Location	GWL (m bgl)	Depth (m)	Water-Bearing Strata	Flow Rate (L/s)	Salinity (mg/L)
64067	Palmers Creek	4	12.8	Sand, gravel	0.4	2000
64025 (P3)	Palmers Creek (Slattery)	6	12.19	Sandstone, coal	0.9	60
63752	Palmers Creek (Spruce)	6	12.2	Sand, gravel	0.46	20

Table 6 - Logs of registered bores

Bore No.	Depth (m)	Soil Description
GW064025	0 – 3.0	CLAY
(monitoring bore P3,	3,0 – 6.0	SANDSTONE – soft
instrument installed)	6.0 – 9.6	SANDSTONE SHALE – water supply
	9.6 – 10.6	COAL
	10.6 – 12.19	SANDSTONE - hard
	Open hole fully cased to 12.19 m with slotted PVC	
GW064067	0 – 3.0	CLAY, some SAND
	3,0 – 6.0	SAND
	6.0 – 12.8	GRAVEL – water supply
	Screened from 6.0 to 12.8 m	
GW063752	0 – 3.0	SAND, GRAVEL
(new monitoring bore	3,0 – 9.0	SAND, GRAVEL – water supply, some COAL

Bore No.	Depth (m)	Soil Description
instrument installed)	9.0 – 11.0	SAND, COAL, GRAVEL
	11.0 – 12.2	SAND, COAL
	Screened from 6.0 to 12.2 m	

Bores 64067 and 63752 both appear to exploit the alluvial aquifer in the valley of Palmers Creek, while bore 64025, which is located on the flank of the creek valley, taps a weathered sandstone aquifer that is possibly connected to the alluvium. The water quality in the two bores furthest downstream (64025 and 63752) is very good, and suitable for human consumption. Even though the recorded flow rates from these bores are low, this water represents an important groundwater resource. The water in the remaining upstream bore is of a lesser quality, and suitable only for stock use. The groundwater level has been monitored in GW064025 since February 2009, and the bore renamed P3 for monitoring purposes. A new water level monitoring instrument was installed in GW063752 in August 2013.

It is unlikely that there are additional, unregistered bores in this area, due to the limited groundwater resources available. The reconnaissance in the area did not discover any additional bores, other than those noted above. While most farm dams in the area collect surface run-off, some dams which have been excavated into the alluvial deposits, can rely on groundwater for their water supplies. Only one such dam was located during the field reconnaissance, and this dam has been dug into the alluvium on the west side of Ryhope Creek, about 350 metres west of longwall 51. Discussions with the dam owner confirm that it is likely that at least part of the water flowing to the dam is from the alluvial water source.

The reconnaissance was also unable to identify any springs, soaks or other signs of shallow groundwater occurrence.

6.2 Groundwater monitoring data

The established monitoring bores have four years of groundwater level data available from early 2009. The data are plotted in Figure 3.

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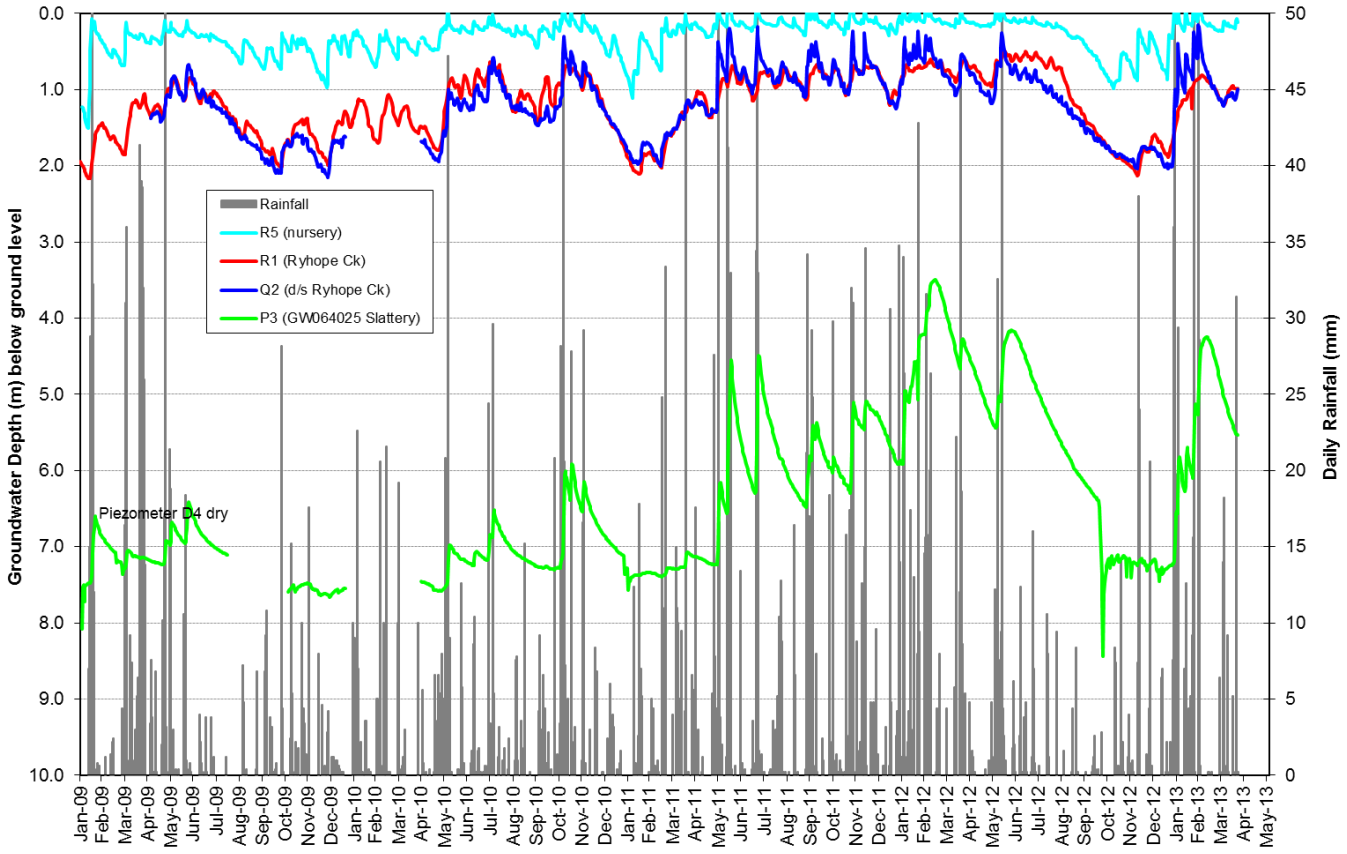
Figure 3 - Groundwater level data



The groundwater level data from the three bores in the alluvium show a typical water level pattern for the alluvium in this area. Typically, the groundwater level ranges between the ground surface and a depth of about 2 metres, and responds to the prevailing climatic conditions. Rapid rises in level are evident after significant rainfall events, with periods of slow decline in level during periods of low rainfall.

The groundwater level in Slattery's bore shows a much greater range in water level than the other monitoring bores (generally 3.5 to 7.5 metres below the ground surface), which is typical for a weathered rock aquifer. It too shows a rapid rise in level following major rainfall events followed by a slow decline in dry periods. The record also indicates that there have been very few pumping events in the three years since the level has been recorded. The most obvious pumping event was in October 2012 during a period of very dry weather. This reduced the level to 7.5 metres below the ground surface for a period of about two months, before significant rains in January 2013 returned the groundwater level to more normal levels.

6.3 Groundwater usage

As part of the current study, it was necessary to determine the current groundwater usage and assess the potential for future usage of the groundwater resources in the vicinity of longwalls 51 and 52.

The results of this assessment have indicated that:

- The current usage of groundwater within the study area is minimal, and is limited to a bore located to the south of longwall 51 (Slattery's bore - GW064025). The other water bore in the near vicinity (GW063752 on the Spruce property) is not used as a water supply;
- While the groundwater in the alluvium is potentially the most important groundwater resource, most of the alluvium in the vicinity of longwalls 51 and 52 contains no aquifer zones that would provide a significant groundwater source, with the exception of the alluvial aquifer in Palmers Creek (which is located well south of the lease area); and
- The potential for future usage of weathered rock aquifers and fractured rock aquifers is considered to be negligible, due to their generally poor yield, quality and continuity.

While it is theoretically possible that there may be additional utilisation of the groundwater in the alluvium in or near the proposed mining area in the future (over and above the current utilisation), the probability of this could be considered to be very low since:

- Most of the water-bearing zones in the alluvium near longwalls 51 and 52 are contained in discontinuous lenses;
- The flow rates from most of the aquifer zones in the alluvium are unlikely to be economic; and
- Other sources of water are available (surface water and rainwater).

As indicated above, the only water resource considered to be significant is located in the alluvium in Palmers Creek, which lies beyond the southern fringe of the proposed mining area, and outside the subsidence-affected area. Future usage of this water resource downstream of the West Wallsend lease area is likely due to its good quality and ready availability.

7 Estimation of height of fracturing

In order to determine the impact of the proposed future mining on the groundwater regime in the alluvium, the height of the fractured zone above the proposed mine workings needs to be estimated. The fractured zone is defined as the height of interconnected fracturing that could transmit water from the strata to the mine opening. Since there is no quantitative method of estimating this height, it must be established based on previous experience in the local area, incorporating empirical methodology along with a qualitative evaluation of local geological and mining conditions. This is not a simple task; since the height of the fractured zone is dependent on many variables including seam thickness, rock type, rock strength and deformation properties, jointing and bedding, geological structures and depth of cover.

7.1 Predictions

Previous studies in this region (ECNSW, 1987, Forster & Enever, 1992) have suggested that interconnected fracturing may extend to a height of between 20 and 33 times the coal extraction thickness above supercritical extraction areas. Since the strength properties of the rocks throughout this region are relatively uniform, it should be expected that the height of the significant fracturing in the continued underground mining area would be similar to elsewhere in the region. However, estimating the height of fracturing is not merely a process of determining the working seam thickness and then multiplying by a suitable factor. The exercise requires a full evaluation of all the relevant factors, to determine their influence on the degree of fracturing.

The factor that most influences the height of the fractured zone in this region is the seam extraction height, which is why deformation zone thicknesses are often expressed as a factor of this variable. In the continued underground mining area, the maximum extraction height is 4.5 metres, which is greater than for most other coal seam extraction in this region. Because of this, the height of the fractured zone in this area will be potentially greater than that measured above other mines at a similar depth. However, in order to refine the estimate of the extent of the fractured zone, the evaluation must include an assessment of all the influencing factors.

Next to the extraction height, the most important factor is the rock type and strength of strata in the overburden. Above the proposed mining area, the strata comprise a good mix of interbedded fine and coarse-grained rocks. This is important, since different rock types behave differently when exposed to changes in stress, which occur as the underlying coal seam is extracted. Coarse-grained rocks, which are generally massive or poorly bedded in this area, re-distribute the imposed stresses above the mine by forming vertical fractures, whereas fine-grained rocks tend to be more thinly bedded, and deform by bending and slippage along bedding planes. Consequently, the rocks in the vicinity of longwalls 51 and 52, by virtue of their variable nature, will tend to inhibit the vertical extension of the zone of interconnected fracturing in the overburden above the mine.

Since the Adamstown Formation, which forms the immediate roof of the seam, has a relatively uniform thickness in the lease area, the height of interconnected fracturing will most likely be reasonably consistent. As a result, it should rise to the same stratigraphic horizon in different parts of the lease area, for similar depths of cover. Based on the analysis of geological data from previous studies in the area (Pacific Power International, 2002), it is evident that the high strength of the strata in the Adamstown Formation will have a significant influence on the height of the fractured zone. These strong strata in the upper part of the formation will act as a beam resting on the caved and fractured material below and serve to limit the subsidence. Since the degree of fracturing in the overburden is directly linked to the degree of subsidence, the height of the fractured zone will be similarly limited. Assuming the subsidence predictions prove reasonably accurate, the fractured zone height will be roughly similar to that above other seams that have produced subsidence of a similar magnitude at a similar depth of cover in this area.

It is therefore assessed that, due primarily to the strength of the strata in the Adamstown Formation, it is highly unlikely that continuous vertical fractures will form through the entire thickness of this unit, except perhaps where it thins to the west. Consequently, the fractured zone will most likely be wholly within the Adamstown Formation.

The exact level of the top of this zone will most likely depend on the position of the numerous tuff layers located in the upper part of the formation. Previous analyses of bore cores (Pacific Power International, 2002) indicated that there are up to 100 separate tuff or tuffaceous claystone horizons ranging from 1 mm to more than 3 metres thick in the overburden. Any cracks which penetrate the entire thickness of coarse-grained material in the lower section of the formation should be sealed when they reach the tuff layers, due to plastic deformation or swelling of the reactive clays contained in them. This is even more likely if the cracking results in some groundwater movement. Any one of these tuff layers therefore could form a relatively impermeable horizon that would present a barrier to vertical groundwater movement in the overburden strata, provided that it is located higher than about 65 metres above the roof of the seam.

Because of the variable lithology in the upper part of the Adamstown Formation, predicting the exact height of fracturing is not possible with any certainty. Nevertheless, the fractured zone will most likely extend somewhere into the upper part of the formation. This height is likely to be between 75 and 95 metres above the roof of the seam, depending on the vertical distribution of tuff layers and the extraction height. This is at the lower end of the fractured zone height measured in other areas (20 to 33 times the extraction thickness), but this is due to the presence of the high strength strata above the seam.

The height of fracturing will also vary slightly with depth of cover, since the additional overburden load at greater cover depths may result in greater fracturing in the massive sandstone/conglomerate layer. It is therefore expected that in the vicinity of longwall 51, where the depth of cover is shallowest, the height of fracturing will be at the lower end of the estimated range (ie. about 75 m). Above longwall 52, where the depth of cover is greatest, the height of fracturing will be at the upper end of the range (ie. about 95 m). In addition, the height of interconnected fracturing may be restricted where the tuffaceous claystone bands in the strata above the mine are thicker. It is also possible that the height of fracturing in the vicinity of any major faults may be higher than that predicted, due to the influence of the fault structure.

Ditton Geotechnical Services Pty Ltd (DgS, 2013) has reviewed the results for the deep borehole extensometers and shallow piezometers above longwalls 39 to 41 for the purposes of estimating the heights of continuous sub-surface fracturing above LWs 42 to 52 in the Western and Southern Domains of West Wallsend Colliery. This assessment indicated that continuous fractures (named the A-Zone) have developed to heights ranging from 68 m to 80 m in the overburden above LWs 39 to 40 and represents 17.4 to 21.1 times the seam thickness.

The results of this assessment have compared to predictions of the heights of fracturing above longwalls 51 and 52, which were estimated using three different prediction methods. The results indicate that the predicted mean and U95%CL values (i.e. Mean Value + 0.12H) of the Buckingham PI Term theory model and an effective strata unit thickness of t'=11 m best represents the measured sub-surface fracture data for West Wallsend Colliery.

The optimum prediction method predicts that, at the average depth of cover, the A Zone will extend to a height of 73 to 87 metres above longwall 51 and 91 to 106 metres above longwall 52. These predictions are in line with the predictions based on the initial qualitative assessment using Forster and Enever, 2002.

7.2 Previous experience and monitoring

Previous experience of mining beneath surface water bodies at Wyee Colliery has confirmed the limited extent of interconnected fracturing in the overburden, in conditions similar to those at West Wallsend. At Wyee, several 240 metre wide panels were extracted in the Fassifern Seam beneath the Mannering Creek Ash Dam, in an area where the overlying Great Northern Seam had been previously extracted. The depth of solid rock cover ranged from 140 to 150 metres, and the effective seam thickness was of the order of 4.5 metres. Monitoring showed that there was no indication of any groundwater or surface water inflows to the mine. The conditions at Wyee are similar to those in the workings at West Wallsend, and the degree of subsidence at Wyee was significantly greater than that which is expected in the this area (taking into account the subsidence due to both extracted seams). This indicates that the height of fracturing was also greater than that at West Wallsend.

The data from Wyee indicate conclusively that there is a zone of competent, relatively unfractured rock (aquiclude zone) in the overburden between the Great Northern goaf and the bottom of the ash dam, which prevents drainage of surface water into the mine. This experience was used in assessing the potential for inrush in several panels that were extracted from beneath Lake Macquarie in Wyee Colliery at similar depth of cover. All panels were extracted in dry conditions with no evidence of any lake water entering the workings.

The extensive subaqueous mining experience at Wyee, along with an intensive monitoring program, has provided valuable data which is relevant to other mining in the region. The data gathered was used to predict that there was unlikely to be any impact from the extraction of longwalls 27, 28 and 31 at West Wallsend on the Cockle Creek alluvium. The extraction of these panels was approved subject to an intensive investigation and monitoring program, incorporating seven groundwater observation bores.

Monitoring of these groundwater observation bores in the Cockle Creek alluvium during the extraction of the longwalls confirmed the existence of an aquiclude zone above the fractured zone at West Wallsend. Although the total depth of cover over these longwall panels is as low as 135 metres (and 120 m to rockhead), there was no indication from the observation bores of any connection between the mine and the alluvium, and the predictions were confirmed. The results of the monitoring are discussed in full in a previous study (Aurecon, 2010).

In addition to longwalls 27, 28 and 31, there have been numerous longwall panels extracted beneath alluvial deposits at the West Wallsend Colliery to date, with no long-term adverse impacts evident on the groundwater regime. This gives a good indication that the likely height of fracturing above these workings is within the predicted range. In particular, there have been at least ten panels extracted from beneath the Cockle Creek alluvium and ten panels from beneath Diega Creek. In both of these creek valleys there have been minor temporary hydrogeological impacts observed, but the long-term hydrogeological regime in the alluvium in both creeks appears to be unaffected (despite media reports to the contrary which have focussed on Diega Creek).

In addition to this mining, Newstan Colliery has extracted longwall panels beneath the alluvium in Palmers Creek adjacent to the West Wallsend lease area, with no apparent impacts on the important aquifer in this alluvium. The minimum depth of cover to these panels was of the order of 105 metres (95 metres to rockhead). Monitoring during and after mining in the bore on the Spruce property has shown that the groundwater depth in this area is of the order of 2 to 3 metres, and has not changed over the period since the mining (as evidenced by recent water level readings from GW63752).

More recently, six nested Casagrande piezometer borehole installations, which contain between one and three piezometers tips each, have been constructed to measure piezometric pressures in the overburden above the longwall panels in the western and southern domains. These bores were installed to verify and calibrate the fracturing model devised for the overburden above the longwall panels (DgS, 2013). The mode estimated that interconnected fracturing that provides a continuous path for water (designated as the A-Zone) can be expected up to a height of 68 to 80 m above the workings (Section 7.1).

The results of the monitoring to date are presented in full in Aurecon, 2013, and are summarised in Table 7 below. While the results have been impacted by damage to many of the installations during mining, the results that are available confirm the predictions of the A-Zone height presented in DgS, 2013.

Table 7 - Results of Overburden Monitoring

Longwall panel	Borehole numbers	Installation	Results
LW39	CC1	2 nested piezometers in coal measures	There are insufficient data from this bore to determine with any certainty the height of continuous mining induced fracturing, although it appears likely that fracturing does not extend up to piezometer CC1-1, where the depth of cover is 87.3m. (ie A-Zone height is less than 87 m high)
LW40	CC2	2 nested piezometers in coal measures	These two piezometers have always been dry, indicating that the groundwater table is below the top of the predicted A-Zone height.
LW41	D6, D7 and D8	3 nested piezometers in D6 and D8 in coal measures One piezometer in D7 in alluvium	The data from D6 and D7 suggests that continuous mining induced fracturing has not reached the base of either of these bores. The depth of cover to the base of these two bores is 72.0 and 86.7 m respectively. Due to the damage caused to D8 by the mine subsidence, there are no available data that can be used to assess the height of fracturing at the location of this bore.
LW44	C1	3 nested piezometers in coal measures	Due to damage caused to C1 by mine subsidence, there is no available data that can be used to assess the height of fracturing at this location.
LW45	C2	2 nested piezometers in coal measures	There is no evidence of any mining–related impacts to piezometers in C2 so far, but they are yet to be undermined by longwall 45.

In summary, the previous mining experience in the region, as well as the results of available monitoring, support the predictions of the likely height of the zone of interconnected fracturing above the mine.

7.3 Assessment

The proposed longwall 52 has a depth of cover ranging from 110 to 150 metres, while longwall 51 has a depth of cover ranging from 80 to 140 metres (see Figure 1). Given the estimated heights of connected fracturing above the two panels, it is assessed that it is 'unlikely' to 'very unlikely' that surface cracking will intersect the A-Zone fractures above LW51 and 52, based on the predicted U95% CL values and the steep slope cracking depths (DGS, 2013).

The preliminary constraints analysis for longwalls 51 and 52 identified an opportunity to extend this panel to the south to maximise recovery. The analysis confirmed that if the panel were extended into the possible Newstan Lease extension area, the depth of cover would not decrease significantly and would not fall below 80 metres in this area, and connection to the surface would be unlikely. However, were the longwall to extend further to the south beneath the alluvium, the depth of cover would include up to 13 metres of alluvial material, so that the depth to rockhead would be of the order of 67 metres. At this depth, it was considered likely that hydraulic interconnection would occur with the alluvium. In addition, the analysis confirmed that any southerly extension of the longwall panel could impact on flow from Slattery's bore.

The constraints analysis concluded that the optimum length for the panel was to maintain a distance of at least 150 metres between the end of the panel and Slattery's bore. The current layout fulfils that requirement. In addition, at this location, the panel is at least 170 metres from the alluvial aquifer in Palmers Creek. At this distance, the likelihood of any interaction between the fractured zone above the mine and the alluvial aquifer is negligible.

8 Assessment of local impacts of mining

Although the past mining experience at West Wallsend Colliery provides very good evidence that there will be no future impacts on the local hydrogeology in the vicinity of longwalls 51 and 52, an assessment of the potential risk of an adverse outcome has been made for completeness and to satisfy the statutory requirements.

The risk to the groundwater regime is essentially a product of the probability of an adverse outcome and the consequences of such an event. These aspects are examined in detail in the subsections below.

8.1 Risk factors

The investigations have indicated that the main hydrogeological risks associated with the proposed extraction of longwalls 51 and 52 at West Wallsend Colliery are:

- There is the potential for mining-induced ground movements to alter the groundwater regime in the main Palmers Creek alluvial aquifer, resulting in limited drainage of groundwater into the zone of interconnected fracturing above the mine, and impacting on the quantity and quality of water in the main aquifer; and
- There is the potential for the interconnected fracturing zone above the mine to drain groundwater from the area around the Slattery property and impact on the water resource tapped by the domestic bore at the property.

The alluvium in Ryhope Creek is not considered in this analysis as there has been no major aquifer zone identified in this alluvium, and the main part of the alluvium is located more than 300 metres to the west of the nearest longwall panel, so that any impacts should be negligible and unmeasurable.

8.2 Probability of an adverse outcome

The probability that future mining will have an adverse impact, on Slatterys bore or drain or partially drain the aquifer in the Palmers Creek alluvial deposits, depends on two factors;

- the distance between the mine and the base of the alluvium or the aquifer intersected by the bore; and
- the height of interconnected fracturing above the mine opening.

Contours showing the depth of cover over the two longwall panels are shown in Figure 1. This Figure indicates that there is a large range in the depth of cover over the area. The depth of cover is summarised in Table 8 below, and the probability of any impact discussed in the following subsections.

Table 8 - Depth of cover

Longwall panel	Catchment	Range in Depth of Cover*	Depth of Cover beneath Alluvial Areas
LW 51	Palmers Creek	80 to 140 metres	No alluvium undermined, 70 to 80 m to seam
LW 52	Palmers Creek	110 to 150 metres	No alluvium undermined, 80 to 90 m to seam

* represents depth of cover to the ground surface

8.2.1 Alluvial aquifer

Since the Palmers Creek alluvium contains viable aquifer, there is the concern that water may be drained from the aquifer into the goaf above longwalls 51 and 52 if the panels approach too close to the alluvium. This would be undesirable from both a mining and an environmental point of view.

Longwall 52 is currently located so that its southern extent is about 180 metres from the edge of the Palmers Creek alluvium. Since the alluvial aquifer is located towards the centre of the alluvial channel, the effective distance to the aquifer zone would be of the order of 280 metres. The depth of cover in this vicinity is of the order of 100 metres (see Figure 1), so that a significant hydraulic connection would be unlikely, as the fractured zone will not reach the level of the base of the alluvium. As a result, it is considered that there is very low probability of any major drainage of groundwater from the aquifer due to the extraction of this panel.

Longwall 51 is located west of longwall 52, and its southern end lies approximately 80 to 150 metres from the alluvial boundary, and possibly 170 to 220 metres from the aquifer in the centre of the alluvial channel (Figure 4). While the depth of cover in this vicinity is less than for LW 52, and is of the order of 90 metres, the cover depth to rockhead beneath the alluvium is approximately 70 metres (see above). Since the longwall panel is not located directly beneath the alluvium, there will be no direct impacts from the mining, and certainly no catastrophic loss of alluvial groundwater. However, there is the potential for small quantities of groundwater to drain horizontally from the aquifer into the goaf above the panel, given that the fractured zone above the seam may reach a height of 73 to 87 metres. It will therefore be necessary to establish a minimum horizontal distance from the alluvial aquifer zone to the longwall goaf to prevent any drainage of the alluvial groundwater.

It is worth noting that the nearest longwall panel in the adjacent Newstan Colliery workings has been extracted at a depth of cover of about 105 metres beneath Palmers Creek. This equates to a cover to rockhead beneath the alluvium of about 90 metres. Assuming a nominal minimum fractured zone height of 75 to 80 metres, this leaves a maximum vertical distance of approximately 10 to 15 metres between the fractured zone and the aquifer. This extraction was carried out with no apparent adverse impacts on the alluvial aquifer, although groundwater monitoring data is sparse in this area. One bore located on the Spruce property adjacent to the Slattery land confirms a groundwater table in the alluvium (after mining) at a depth of 2 metres (measured 1 August 2013) at a distance of less than 100 metres from the longwall panels (Section 7.2). This groundwater depth is similar to groundwater levels measured in 1998 (Centennial Coal, 1999), before mining, and is similar to groundwater depths in the alluvium in unmined areas. It indicates conclusively that there have been no adverse impacts from that mining.

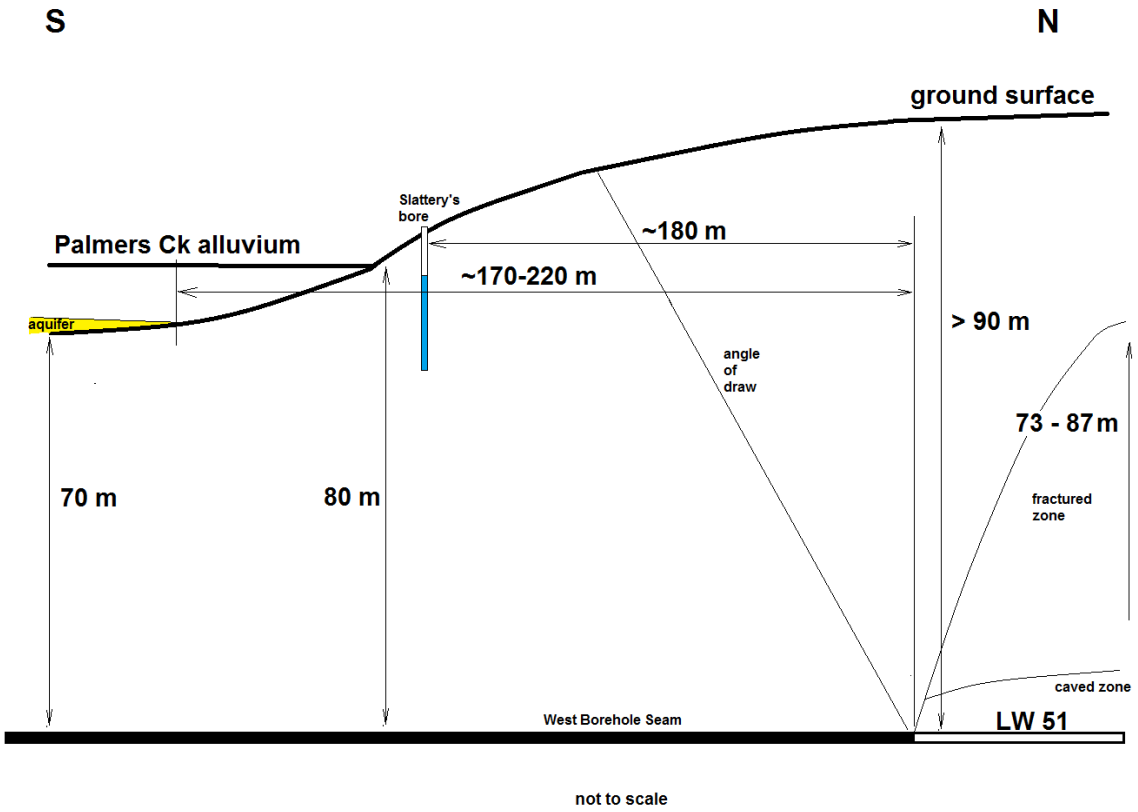
Since the horizontal permeability of the strata can be at least an order of magnitude greater than the vertical permeability, a much greater horizontal distance would be required to guarantee a similar level of protection from horizontal drainage out of the aquifer. It follows therefore that if a horizontal

separation of at least 150 metres is maintained between the goaf and the alluvial aquifer, the chance of a significant hydraulic connection between the alluvium and the mine should be minimal. This is an especially conservative separation, as it assumes that there would be a permeable zone precisely at the base of the alluvium, and that it extends over a distance of more than 150 metres in the direction of the goaf (including over the goaf edge, where the horizontal permeability is often reduced).

Given the fact that the alluvial aquifer lies at a distance of at least 170 metres from the proposed longwall panel, this conservative condition is met and it is likely that longwall 51 can be extracted with a very low probability of any adverse impact on normal flow rates in the alluvial aquifer.

Any changes in water quality would be normally caused by mining induced cracking which could result in contamination of the aquifer by surface groundwater or by oxidation of fresh rock in the cracks. The potential for any cracking to occur is considered to be negligible, as the alluvial aquifer is well outside the angle of draw which defines the zone of ground movements. Consequently, the likelihood of any impacts on the groundwater quality in the aquifer is considered to be negligible.

Figure 4 - Longwall 51 north-south cross section at south end



8.2.2 Slattery's bore

There is an active water bore on the Slattery property beyond the southern end of longwall 51 (Figure 1). This bore provides stock and domestic water for the property. It is believed that this bore is Registered Bore No. 64025, although the co-ordinates given for this bore appear to be slightly in error, as there is no bore at the stated co-ordinates, and there is no other record of a bore at the location of Slattery's bore. Reference to the groundwater works summary for the Registered Bore No. 64025

(Appendix A) indicates that the bore intersects an aquifer zone (Sandstone Shale Water Supply) between 6 and 9.6 m depth. This zone is just above a shallow coal seam, and although it does not represent an alluvial aquifer (and is probably a weathered rock aquifer), it is possible that it derives some of its water from the adjacent alluvial source. The total depth of the bore is 12.2 m. The proposed longwall panels 51 and 52 are located at 180 and 220 metres to the north respectively.

Since the depth of cover to the collar of the bore is of the order of 95 m, the coal seam intersected in the bore is most likely part of the lower Pilot Seam, and the aquifer zone lies at a height of about 85 metres above the West Borehole seam. Because the height of fracturing above the West Borehole seam in longwall 51 is likely to be in the range of 73 to 87 metres, and the fractured zone is located more than 150 metres to the north, the extraction of the seam should not impact significantly on the aquifer that supplies the bore. This has already been demonstrated by the existing mining in Newstan Colliery, where a longwall panel has been extracted only 200 metres to the east of the Slattery bore, with no apparent impacts on the groundwater flow.

Since the strata dip to the east, it is also likely that the aquifer zone dips in the same direction. It seems likely therefore, the aquifer zone in the bore is fed from the west, and is possibly partially replenished from the Palmers Creek alluvium. Consequently, it is apparent that as long as the aquifer zones to the west of the bore (both alluvial and weathered rock) remain unaffected by mining, then the probability that the groundwater flow to the bore will be impacted is low.

Nevertheless, given the proximity of the bore to the longwall panel there very small possibility that there may be some reduction in flow, if the aquifer is continuous in a northerly direction and is breached in the goaf above the panel (although this is not expected). This could lead to changes in the local groundwater gradient and possible changes to the existing flow rates at the bore. Since the flow rate to the bore currently appears to be more than adequate to meet the needs of the landholder, any such reduction in flow, may not be noticeable.

8.3 Consequences

The current study has shown that the probability of adverse impacts on the Palmers Creek alluvial aquifer and Slattery's bore from the extraction of the two longwall panels is considered to be low to very low. Nevertheless, the magnitude of the risk will depend on the consequences of the adverse outcome. Determining these consequences generally requires a detailed assessment of the groundwater regime (usually including a drilling program) in the affected area to determine the importance of the groundwater resource. While this has not been undertaken to date, the field reconnaissance in the vicinity of the longwall panels did give a broad indication of the likely importance of the aquifers systems. In addition, the installation of the groundwater monitoring bores has confirmed the nature of the near-surface alluvial material. This has provided sufficient detail for the current assessment.

The field reconnaissance also indicated that, apart from the Palmers Creek alluvial aquifer, the occurrence of significant alluvial aquifers in this area is virtually unknown. As a result, a more detailed investigation of the nature of the alluvium in the vicinity is unwarranted, as experience indicates that the likelihood of a significant aquifer in these deposits is negligible.

In determining the potential consequences of mining under this area, several aspects were identified as being significant, including the following:

- previous investigations (including the installation of groundwater monitoring bores) have shown that most of the alluvium in the vicinity of longwalls 51 and 52 consists of clayey sand and sandy clay with occasional clean sand and gravelly bands, with no major aquifer zones;
- the investigations have also confirmed the existence of an important alluvial aquifer located in the Palmers Creek alluvium at least 170 metres to the south of the proposed longwall panels;

- there are no known users of the alluvial groundwater over most of this area, and no significant likelihood that there will be any future utilisation of the alluvial groundwater in the area, apart from the aquifer in the Palmers Creek alluvium, which is tapped by at least three bores;
- the contribution of the alluvial groundwater in the area adjacent to longwalls 51 and 52 to the groundwater flow in the alluvial aquifers further downstream is negligible; and
- the closest registered bore to longwalls 51 and 52 is GW0640025 (Slattery's bore), which is 180 metres away and provides a good quality domestic water source to the property (although the water source is only utilised during periods of dry weather).

The assessment concluded that, since the aquifer in the Palmers Creek alluvium is considered to be a viable local aquifer, which contains good quality groundwater, the consequences of any impact on this aquifer are assessed as MODERATE. The assessment noted that any impact on the aquifer could have unknown impacts further downstream beyond the local area. While there is not a great deal of exploitation of this aquifer downstream, and the effects are likely to diminish with distance downstream, it could preclude any future expansion of groundwater use from this source. This assessment takes account of the fact that any impacts would most likely be difficult to remediate.

The assessed consequences of an adverse impact on the flow to Slattery's bore are LOW, as this is a local impact only, and the bore could be replaced.

8.4 Risk assessment

The two main risk factors listed above in Section 8.1 have been assessed using the Glencore risk matrix, and taking into account the probabilities and consequences of an adverse outcome discussed in Sections 8.2 and 8.3. A copy of the Glencore risk matrix is included in Appendix A, and the results of the assessment are presented in Table 9 below.

Table 9 - Results of risk assessment

Risk Factor	Probability	Consequence	Risk	Controls?
Palmers Creek alluvial aquifer	Rare (E)	Moderate (3)	LOW (20)	none
Slattery's bore	Unlikely (D)	Minor (4)	LOW (21)	none

Although both of the assessed risks are considered to be LOW, which generally does not require any additional risk mitigation measures, the NSW Aquifer Interference Policy indicates that monitoring is required to demonstrate that the proposed mining does not exceed the minimal harm criteria for the identified groundwater source. The application of the Aquifer Interference Policy to the proposed mining is discussed in Section 10.1 and proposed monitoring in Section 11.

9 Assessment of regional impact

Although the risk assessment process has concluded that the risk of any adverse impacts to the local hydrogeological regime in the vicinity of longwalls 51 and 52 is LOW, for completeness, it is also necessary to examine the risks on a regional scale. Therefore, the results of the study were used to determine any potential risks to the regional hydrogeologic regime. The two regional risk factors identified during this process are as follows:

- Any mining-related loss of groundwater from aquifers in the near-surface alluvial deposits may impact on the groundwater supplies and users of this resource further downstream.
- Any mining-related loss of groundwater from coal seam aquifers in the overburden above the West Borehole Seam may impact on the groundwater supplies in the coal seams and users of this resource in other parts of the basin.

Only a brief assessment was required to determine that both of these risks are LOW. The factors that support this assessment are set out below.

Alluvial aquifers

The regional risk to the alluvial aquifers is deemed to be LOW since:

- No alluvial areas will be undermined by either longwall panel;
- No major aquifer zones were identified in the alluvial areas that are adjacent to areas to be undermined in longwalls 51 and 52;
- The probability of any adverse impacts on the alluvial aquifer in Palmers Creek was determined to be LOW;
- The total area of alluvium in the potentially impacted area relative to the total area of alluvium in the Palmers Creek catchment is very small; and
- The volume of groundwater in the Palmers Creek alluvium relative to the total alluvial groundwater volume in the region is minimal.

Coal seam (fractured rock) aquifers:

The regional risk to the coal seam aquifers is deemed to be LOW since:

- Coal seam aquifers in this region do not provide an important source of groundwater due to their poor quality and yield, and are only utilised intermittently;
- No significant coal seam aquifers have been identified in the overburden above the West Borehole Seam in the vicinity of longwalls 51 and 52;
- There has already been significant coal extraction in the West Borehole Seam in this region, which would have depleted any groundwater resource in that seam and the overlying coal seams if any resource existed in the first place;
- The affected seams subcrop immediately to the west of the continued underground mining area so that there is minimal for drainage of groundwater resources up-dip; and

- The longwall 51 and 52 mining area covers a relatively small area when compared to the total coal basin, so that any additional regional impact would be negligible.

10 Other regulatory requirements

10.1 Compliance with NSW Aquifer Interference Policy

10.1.1 Background

The NSW Aquifer Interference Policy ('the Policy') was finalised in September 2012 after the initial draft policy was rewritten following industry consultation. The aim of the Policy is to explain the role and requirements of the Minister administering the *Water Management Act 2000* in the water licensing and assessment processes for aquifer interference activities under *the Water Management Act 2000* and other relevant legislative frameworks.

The definition of an aquifer is a contentious issue and the policy document contains three definitions:

- Under the *Water Management Act 2000* an aquifer is a geological structure or formation, or an artificial landfill, that is permeated with water or is capable of being permeated with water.
- More generally, the term 'aquifer' is commonly understood to mean a groundwater system that is sufficiently permeable to allow water to move within it, and which can yield productive volumes of groundwater.
- For the purposes of the Policy, the term 'aquifer' has the same meaning as groundwater system (above) and includes low yielding and saline systems. A groundwater system is any type of saturated geological formation that can yield anywhere from low to high volumes of water.

The third definition, which has been adopted in the policy is the broadest possible definition of an aquifer, as almost all geological formations contain groundwater, and while a small percentage will yield high volumes of water (and would fit the normal definition of an aquifer) the vast majority would be low yielding. This latter group would not normally be classed as aquifers but must be considered under this policy, which is effectively a groundwater interference policy, not just an aquifer interference policy

The *Water Management Act 2000* defines an aquifer interference activity as that which involves any of the following:

- the penetration of an aquifer,
- the interference with water in an aquifer,
- the obstruction of the flow of water in an aquifer,
- the taking of water from an aquifer in the course of carrying out mining or any other activity prescribed by the regulations, and
- the disposal of water taken from an aquifer in the course of carrying out mining or any other activity prescribed by the regulations.

Given the broad definition of an aquifer, the proposed extraction of longwalls 51 and 52 will involve all of the above activities. In fact the Policy specifically states that it has been developed in particular to

address several high risk activities, including “mining activities such as open cut voids, underground mine workings and the disposal of water taken from an aquifer including water taken as part of coal seam gas extraction”.

Although in Section 3.2 above it was concluded that the fractured rock aquifers and weathered rock aquifers are of negligible importance in the local area, any water drained from these sources is covered by the Policy and will need to be accounted for and licensed.

10.1.2 Water licensing

The main reason for the implementation of the Policy is that specified activities (including coal mining) may interfere with regulated groundwater (and connected surface water) sources. The main concern is that many of these water sources are at or near full commitment and have extraction limits set by water sharing plans. If there is unaccounted take, less water is available for the environment and other users who have a legal right to access water in the aquifer or connected water sources. To comply with extraction limits set by water sharing plans the Policy asserts that it is important that the volumetric take of water by aquifer interference activities is appropriately licensed and accounted for.

The local water sharing plan for this region is the Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources, 2009 (NSW Government, 2009). The West Wallsend lease area is located within the Lake Macquarie Extraction Management Unit (Figure 5), where the local water sharing plan is for the North Lake Macquarie Water Source, which is one of about 40 water sources specifically listed in the Water sharing Plan. The Lake Macquarie Extraction Management Unit makes up only about 5% of the total area of the Hunter Unregulated and Alluvial Water Sources area, and the North Lake Macquarie Water Source covers only 30% of the Lake Macquarie Extraction Management Unit. Within the North Lake Macquarie Water Source, the main water source is Cockle Creek, which has access rules set based on flows at the causeway on the Weir Road at Barnsley. Palmers Creek, which is not mentioned specifically in the water sharing plan, represents a relatively minor water source from a regional perspective. As a result, any activity in the vicinity of Palmers Creek (and its connected alluvial aquifer) can impact on only a very small percentage of the potentially available water sources in the Hunter Region.

The volume of water taken from any water source as a result of an activity needs to be predicted prior to project approval and then measured and reported in annual returns or environmental management reports. This is to ensure that appropriate water licences are held for all water sources that are impacted. Aquifer interference activities may induce flow from adjacent groundwater sources or flow from connected surface water sources to compensate for the water taken from the aquifer in which the activity is occurring or to fill the void created in the aquifer. Flows induced from other water sources also constitute take of water. In all cases, separate access licences are required to account for the take from all individual water sources.

What this means is, if the fracturing of the overburden strata above the mine induces flow from an adjacent alluvial aquifer, such as the Palmers Creek connected alluvial aquifer, then an access licence with a share component which specifies the surface water source (Palmers Creek) is required. Since the current study has found that there is a negligible chance that the proposed mining will drain groundwater from the Palmers Creek alluvium, then no license will be required for this water source. In theory however, there may be a miniscule reduction of groundwater flow in the alluvium, although this will be so small as to be indistinguishable from the normal variation in groundwater flow in the aquifer.

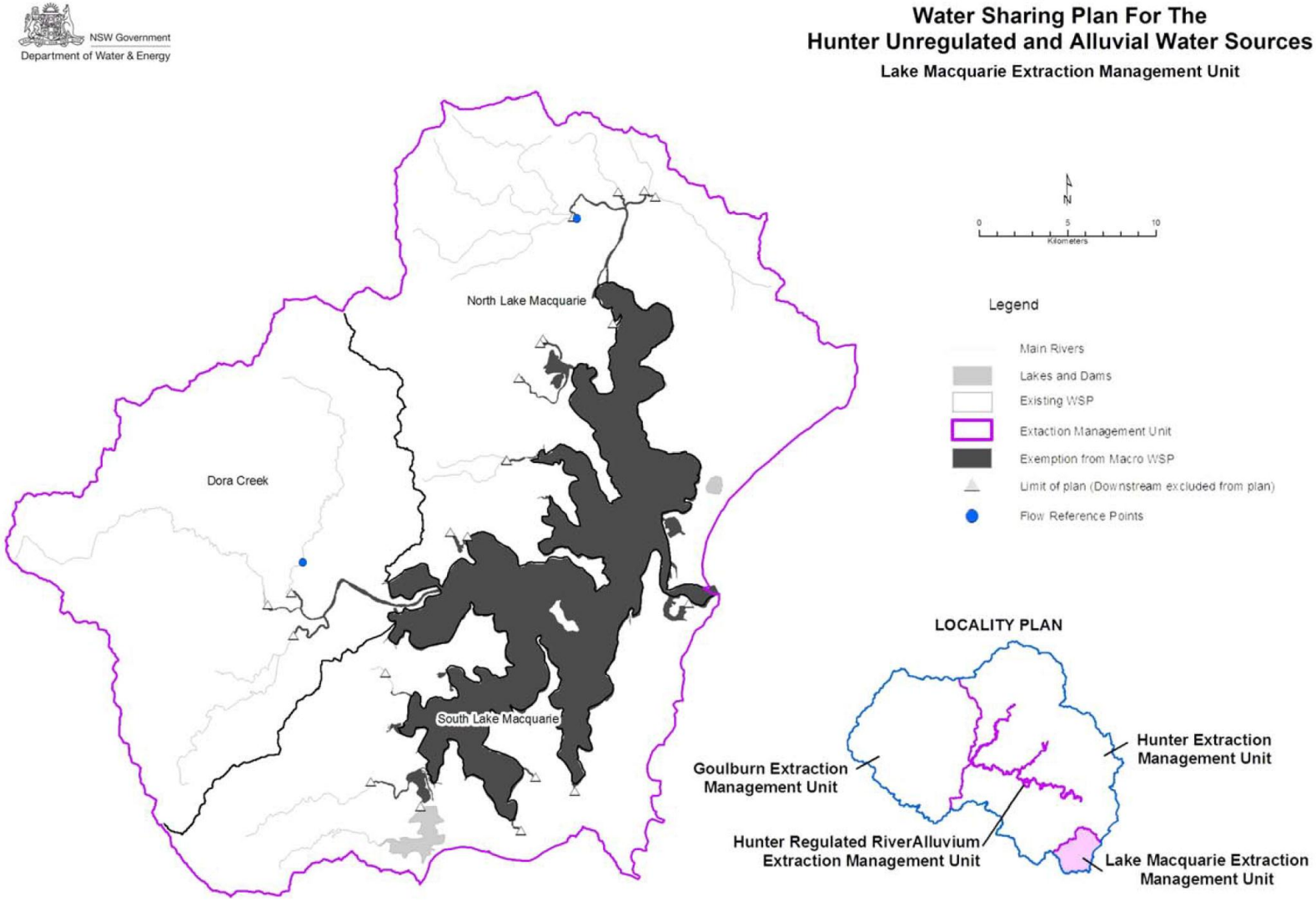


Figure 5 - Hunter Unregulated and Alluvial Groundwater Sources – Lake Macquarie Extraction Management Unit

Any groundwater within the coal measure strata that will be impacted by the mining does not normally contribute significantly to the alluvial water source, so is not subject to water access rules in the water sharing plan. However, under the Policy, any of this groundwater that is drained into the mine and subsequently discharged must still be licensed. Therefore, estimates of groundwater inflows to the mine must be made so that the appropriate volumes can be licensed. The water currently discharged from the mine is licensed and is almost entirely comprised of groundwater from the coal measure strata. At the end of June 2012, the total discharge from the mine averaged nearly 3 ML/day (Porteous, 2012), most of which was coal measure groundwater. The Water Management Plan predicts that this could rise to as much as 5 ML/day in the future, and recommends that licenses be acquired to accommodate any increase in discharge. An application has been made for this additional allocation.

Any expected increase in the current discharge due to groundwater inflows from LW 51 and 52 would normally need to be estimated, and the volume added to the license. However, since the predicted increase in flow includes inflows from LW 51 and 52, the recommended increase in the licensed discharge should cover the additional inflows. This should be adequate, as there is no evidence that the extraction of LW 51 and 52 will significantly increase the groundwater inflow from the coal measures over and above the normal increases that are experienced in a new longwall panel. This being the case, then the current license will be sufficient to cover the additional inflows.

10.1.3 Assessment process

The assessment of aquifer interference activities seeking approval under the EP&A Act is made on a case by case basis for each particular project in accordance with the Policy. This assessment will examine impacts on water sources and water dependent ecosystems based on an “account for, mitigate, avoid/ prevent, and remediate” approach. Consequently, the assessment will take into account the proponent’s:

- ability to demonstrate that they have the ability to obtain the necessary licences
- ability to demonstrate that the proposal has been designed so as to prevent the take of water
- ability to demonstrate that adequate arrangements will be in place to ensure that the minimal impact considerations are met
- proposed remedial actions are available for impacts greater than those that were predicted as part of the relevant approval

The Policy establishes and objectively defines minimal impact considerations as they relate to water-dependent assets (Table 1 of the Policy). The NSW Office of Water’s assessment will determine the potential level of impact relative to the considerations in Table 1 of the Policy and will identify where further mitigation, prevention or avoidance measures would be necessary to meet the Level 1 minimal impact considerations or, under the Level 2 minimal impact considerations, what further studies are necessary to assess whether the project will not prevent the long-term viability of a relevant dependent ecosystem or significant site.

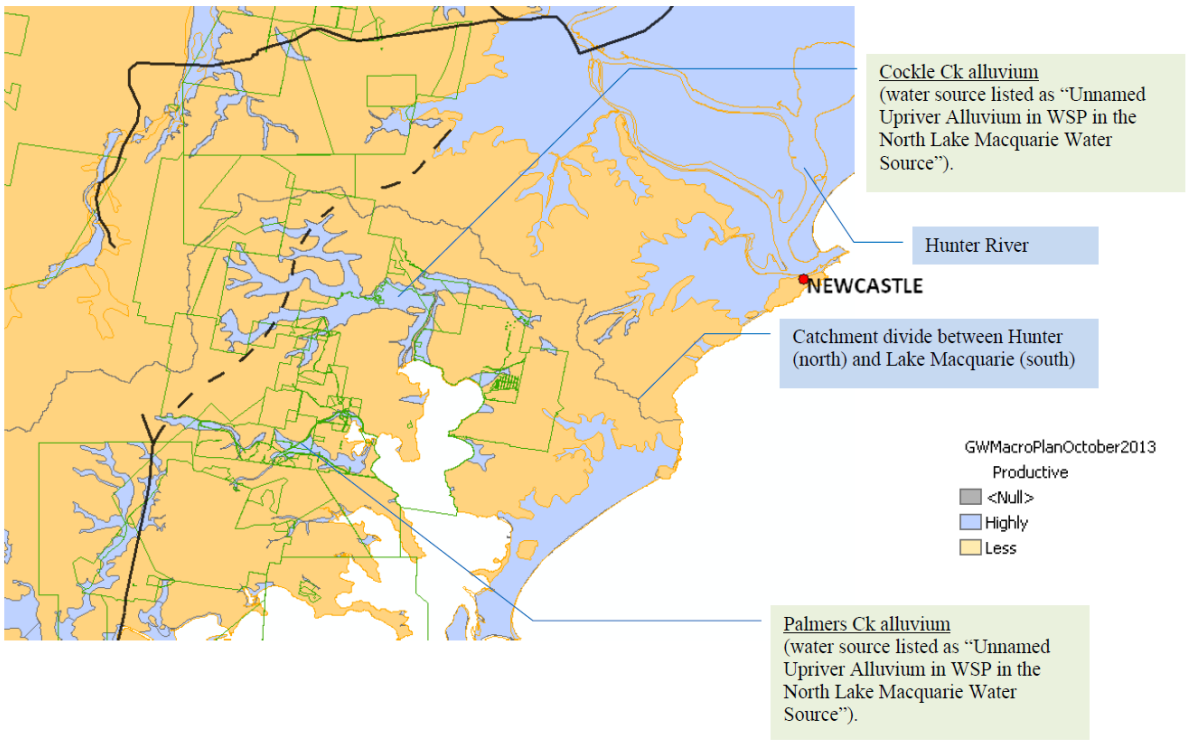
The NSW Office of Water will also assess the potential impacts of the aquifer interference activity against any specific rules in a relevant water sharing plan, based on the information provided in the proponent’s Environmental Assessment. Where the predicted impacts are greater than the Level 1 minimal impact considerations, then the assessment will need to involve additional studies to fully assess these predicted impacts. If this assessment shows that the predicted impacts do not prevent the long-term viability of the relevant water-dependent asset, as defined in Table 1, then the impacts will be considered to be acceptable.

Groundwater sources have been divided into “highly productive” and “less productive”. The Office of Water has apparently classified the Palmer’s Creek alluvium as "highly productive" because it is included as an 'Unnamed Upriver Alluvium in WSP in the North Lake Macquarie Water Source'

(Figure 6). However, based on the water quality and the yields from the existing wells in the aquifer in the upper section of the Palmers Creek alluvium, this aquifer is deemed to be in the “less productive” category. This is of no real consequence, as the minimal harm drawdown criteria are the same for both classifications. The categories of less productive groundwater sources are:

1. Alluvial;
2. Porous rock;
3. Fractured rock.

Figure 6 - North Lake Macquarie Water Source, Groundwater Productivity Classification



The current study has indicated that there are both alluvial and fractured rock aquifers in the vicinity of longwalls 51 and 52. The minimal impact considerations for less productive and highly productive groundwater sources given in Table 1 of the Policy are reproduced below in Table 10.

The current study has indicated that there will be no measurable impacts on the groundwater level, flow or water quality in the Palmers Creek alluvial aquifer from the extraction of longwalls 51 and 52, due to the separation distance of the aquifer from the proposed extraction. Consequently, the minimal impact considerations will be met for the alluvial aquifer in Palmers Creek, and hence the impacts should be deemed acceptable by the Office of Water.

It is also evident from the study that any fractured rock aquifers in the overburden above longwalls 51 and 52 will be largely depressurised. However, since there are

- no high priority groundwater dependent ecosystems, or
- no high priority culturally significant sites listed in the schedule of the relevant water sharing plan, or
- no water supply works

in the zone that will be depressurised, the minimal impact criteria will not be exceeded, and the predicted impacts on the fractured rock aquifers should be acceptable to the Office of Water.

Table 10 - Minimal impact considerations for aquifer interference activities (from NSW Aquifer Interference Policy)

	Water Table	Water Pressure	Water Quality
Alluvial Water Sources	1. Less than or equal to 10% cumulative variation in the water table, allowing for typical climatic "post-water sharing plan"(2) variations, 40m from any: (a) high priority groundwater dependent ecosystem; or (b) high priority culturally significant site; listed in the schedule of the relevant water sharing plan; or A maximum of a 2m decline cumulatively at any water supply work unless make good provisions should apply. 2. If more than 10% cumulative variation in the water table, allowing for typical climatic "post-water sharing plan" variations, 40m from any: (a) high priority groundwater dependent ecosystem; or (b) high priority culturally significant site; listed in the schedule of the relevant water sharing plan then appropriate studies(5) will need to demonstrate to the Minister's satisfaction that the variation will not prevent the long-term viability of the dependent ecosystem or significant site. If more than 2m decline cumulatively at any water supply work then make good provisions should apply.	1. A cumulative pressure head decline of not more than 40% of the "post-water sharing plan"(2) pressure head above the base of the water source to a maximum of a 2m decline, at any water supply work. 2. If the predicted pressure head decline is greater than requirement 1. above, then appropriate studies are required to demonstrate to the Minister's satisfaction that the decline will not prevent the long-term viability of the affected water supply works unless make good provisions apply.	1. (a) Any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40m from the activity; and (b) No increase of more than 1% per activity in long-term average salinity in a highly connected surface water source at the nearest point to the activity. Redesign of a highly connected(3) surface water source that is defined as a "reliable water supply"(4) is not an appropriate mitigation measure to meet considerations 1.(a) and 1.(b) above. (c) No mining activity to be below the natural ground surface within 200m laterally from the top of high bank or 100m vertically beneath (or the three dimensional extent of the alluvial material - whichever is the lesser distance) of a highly connected surface water source that is defined as a "reliable water supply". 2. If condition 1.(a) is not met then appropriate studies will need to demonstrate to the Minister's satisfaction that the change in groundwater quality will not prevent the long-term viability of the dependent ecosystem, significant site or affected water supply works. If condition 1.(b) is not met then appropriate studies are required to demonstrate to the Minister's satisfaction that the River Condition Index category of the highly connected surface water source will not be reduced at the nearest point to the activity. If condition 1.(c) is not met, then appropriate studies are required to demonstrate to the Minister's satisfaction that: - there will be negligible river bank or high wall instability risks; - during the activity's operation and post-closure, levee banks and landform design should prevent the Probable Maximum Flood from entering the activity's site; and - low-permeability barriers between the site and the highly connected surface water source will be appropriately designed, installed and maintained to ensure their long-term effectiveness at minimising interaction between saline groundwater and the highly connected surface water supply;

	Water Table	Water Pressure	Water Quality
Porous and Fractured Rock Water Sources	1. Less than or equal to 10% cumulative variation in the water table, allowing for typical climatic "post-water sharing plan" variations, 40m from any: (a) high priority groundwater dependent ecosystem; or (b) high priority culturally significant site; listed in the schedule of the relevant water sharing plan. A maximum of a 2m decline cumulatively at any water supply work . 2. If more than 10% cumulative variation in the water table, allowing for typical climatic "post-water sharing plan" variations, 40m from any: (a) high priority groundwater dependent ecosystem; or (b) high priority culturally significant site; listed in the schedule of the relevant water sharing plan if appropriate studies demonstrate to the Minister's satisfaction that the variation will not prevent the long-term viability of the dependent ecosystem or significant site. If more than a 2m decline cumulatively at any water supply work then make good provisions should apply.	1. A cumulative pressure head decline of not more than a 2m decline, at any water supply work. 2. If the predicted pressure head decline is greater than requirement 1. above, then appropriate studies are required to demonstrate to the Minister's satisfaction that the decline will not prevent the long-term viability of the affected water supply works unless make good provisions apply.	1. Any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40m from the activity. 2. If condition 1 is not met then appropriate studies will need to demonstrate to the Minister's satisfaction that the change in groundwater quality will not prevent the long-term viability of the dependent ecosystem, significant site or affected water supply works.

NOTES:
(1) All predicted volumes and aquifer impacts are to be determined using data and modelling as described in section 3.2.3;
(2) "post-water sharing plan" – refers to the period after the commencement of the first water sharing plan in the water source, including the highest pressure head (allowing for typical climatic variations) within the first year after commencement of the first water sharing plan;
(3) "Highly connected" surface water sources are identified in the Regulations;
(4) "Reliable water supply" is as defined in the SRLUP;
(5) "Appropriate studies" on the potential impacts of water table changes greater than 10% are to include an identification of the extent and location of the asset, the predicted range of water table changes at the asset due to the activity, the groundwater interaction processes that affect the asset, the reliance of the asset on groundwater, the condition and resilience of the asset in relation to water table changes and the long-term state of the asset due to these changes;
(6) Consideration of modelling accuracy is described in Section 3.2.1.
(7) All cumulative impacts are to be based on the combined impacts of all "post-water sharing plan" activities within the water source.

It has also been assessed that the resulting changes in the hydrological regime will not prevent the long-term viability of the affected water supply. This is largely because the pre-mining viability of this water source is minimal due to the low yield and generally poor quality of the groundwater in the coal measure aquifers, which is why there is no exploitation of this water source in the lease area. In the long-term, after mine closure, the coal measure aquifers will re-pressurise as the mine fills with groundwater to near its pre-mining level.

10.1.4 Investigation requirements

The Policy states that a "risk management approach to assessing the potential impacts of aquifer interference activities will be adopted, where the level of detail required to be provided by the proponent is proportional to a combination of the likelihood of impacts occurring on water sources, users and dependent ecosystems and the potential consequences of these impacts." The Policy indicates that the following aspects need to be addressed to allow an assessment of the aquifer interference activity (the current assessments and activities that address these aspects are shown in brackets):

- establishment of baseline groundwater conditions including groundwater depth, quality and flow based on sampling of all existing bores in the area potentially affected by the activity (monitoring bores have been established since 2009, and several years of background data are already available; two new monitoring bores have recently been installed in the Palmers Creek alluvial aquifer (P4 and GW063752) and at least two years data will be available prior to the commencement of mining. Some historic groundwater level data is available for GW063752 from 1998 and 1999, but nothing more recent. The water level in Slatterys bore has been monitored since February 2009);
- a strategy for complying with any water access rules applying to relevant categories of water access licences, as specified in relevant water sharing plans (there are no specific access rules for Palmers Creek; no impact is expected on the Palmers Creek alluvial aquifer, so there will be no need to comply with any access rules if they are implemented; there are no rules for access to strata water from the coal seam aquifers in the overburden);
- details of potential water level, quality or pressure drawdown impacts on nearby water users who are exercising their right to take water under a basic landholder right (no impact is expected on local water sources that are used by landholders);
- details of potential water level, quality or pressure drawdown impacts on nearby licensed water users in connected groundwater and surface water sources (no impact is expected on nearby Slatterys bore due to the distance from the mine, but any impact should be less than the minimal impact limits, no impact on GW063752 which is much further away);
- details of potential water level, quality or pressure drawdown impacts on groundwater dependent ecosystems (there are no known groundwater-dependent ecosystems in the vicinity);
- details of potential for increased saline or contaminated water inflows to aquifers and highly connected river systems (no change is expected to the groundwater quality in the Palmers Creek alluvial aquifer or connected surface water, as it is well outside the zone of subsidence impacts);
- details of the potential to cause or enhance hydraulic connection between aquifers (no enhanced connection is expected between the alluvial aquifer and the fractured rock aquifers in the overburden due to the separation distance between the two aquifers, and the lack of any mining-induced fracturing in the intervening strata that could link the two sources);
- details of the potential for river bank instability, or high wall instability or failure to occur (there is considered to be no chance of river bank instability, as the alluvial plain is outside the subsidence angle of draw, and therefore outside the zone of any surface subsidence impacts);
- details of the method for disposing of extracted water (in the case of coal seam gas activities) (not applicable).

Proponents of any project that may be defined as an aquifer interference activity under the *Water Management Act 2000* will also be required to provide estimates of all quantities of water that are likely to be taken from any water source during and following cessation of the activity and all predicted impacts associated with the activity.

If a development consent under Part 4, Division 4.1 of the EP&A Act applies to the activity, then all quantities of water that are likely to be taken from any water source must be estimated using a "complex modelling platform". For other cases, these quantities of water that can be estimated based on a desk-top analysis that is:

- developed using the available baseline data that has been collected at an appropriate frequency and scale; and
- determined to be fit-for-purpose to the satisfaction of the Minister.

The future water makes in the mine have been estimated by analysing historical water inflows, and probably represents a more credible estimate than could be produced by "complex modelling" (Porteous, 2012). The estimate produced by this methodology includes the increase in groundwater flows due to the extraction of longwalls 51 and 52. Since the proposed mining represents a variation to a consent under Part 3A of the EP&A Act, and does not represent a major new development, this approach is consistent with the nature of the variation (ie. is "fit-for-purpose"), and should be acceptable to the Minister.

10.2 Required assessment under the EPBC Act

The Australian Government Department of Sustainability, Environment, Water, Population and Communities (now DoE) recently released its "Draft significant impact guidelines: Coal seam gas and large coal mining developments – impacts on water resources" (Australian Government, 2013) to assist any person who proposes to take an action which involves a coal seam gas (CSG) development or a large coal mining development to decide whether the action has, or is likely to have a significant impact on a water resource**.** These guidelines will therefore assist in determining whether or not a proponent should submit a referral to DoE for a decision by the Australian Government Environment Minister (the Minister) on whether assessment and approval is required under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Since these guidelines are currently in draft form, there is no necessity to comply, however, a brief review has been carried out to check if the proposed extraction complies with the guidelines and determine of any referral and approval would be required. Under the EPBC Act, an action which involves a CSG development or a large coal mining development will require approval from the Minister if the action will have, or is likely to have, a significant impact on a water resource.

A 'significant impact' is an impact which is "important, notable, or of consequence, having regard to its context or intensity". Whether or not an action is likely to have a significant impact is "independent of the size of the water resource, and depends upon the sensitivity, value, and quality of the water resource which is impacted, and upon the intensity, duration, magnitude and geographic extent of the impacts". To be 'likely', it is not necessary for a significant impact to have a greater than 50 per cent chance of happening; it is sufficient if a significant impact on a water resource is a real or not remote chance or possibility. This definition of significant impact is less conservative than that defined under the State legislation discussed above, which is applied to all groundwater and surface water sources, and does not take into account the "sensitivity, value, and quality of the water resource which is impacted".

While, the much of the groundwater in the coal measures will be drained into the mine, this water resource is not significant due to its low value, based on the limited quantity and variable quality of the resource. The only significant groundwater resource in the area is in the Palmers Creek alluvial

aquifer, and it has been determined that there is unlikely to be any impact on this resource (ie the likelihood of any impact is remote). Consequently, based on the current assessment, the conclusion can be drawn that no assessment or referral would be necessary under the EPBC Act.

11 Monitoring and mitigation measures

Although both of the assessed groundwater-related risks relating to this project are considered to be LOW (Section 8.4), the NSW Aquifer Interference Policy indicates that monitoring is required to demonstrate that the proposed mining does not exceed the minimal harm criteria for the identified groundwater sources. Consequently, the following monitoring is recommended to be carried out to monitor the impacts (if any) of the extraction of longwalls 51 and 52.

Ryhope Creek

The alluvium in Ryhope Creek will not be undermined by any longwall panels, and it contains no major aquifer of significance. Nevertheless, it is deemed to be worthy of consideration for future monitoring, since:

- it flows into Palmers Creek, which contains a major alluvial aquifer;
- there is a slight possibility that the flow in the creek may be impacted by mining at shallow depths of cover in the western domain further upstream;
- a local nursery utilizes groundwater from the alluvium in the creek.

Although it is considered highly unlikely that there will be any significant impacts on the groundwater in the alluvium due to the extraction of longwalls 51 and 52, the factors noted above dictate that some monitoring should continue to be undertaken as a precaution. Consequently, three monitoring bores that were installed in the lower section of the creek in 2009 to monitor the groundwater in the alluvium (R1, R5 and Q2) should continue to be monitored until the extraction has been completed. One of these (R5) has been established near the groundwater-fed dam utilised by the Ryhope Nursery. The locations of the monitoring bores are shown in Figure 2.

Palmers Creek

Like Ryhope Creek, Palmers Creek will not be undermined by any future longwall panels, the nearest of which will be located more than 80 metres to the north, and about 170 metres from the alluvial aquifer. Nevertheless, because of the importance of the alluvial aquifer in the creek and the shallow depth of cover, two new monitoring bores (P4 and GW063752) have been established in the main aquifer zone to confirm that any changes in groundwater level or quality are less than the minimal impact considerations for connected alluvial water sources. These should be monitored for groundwater level and water quality for the duration of the project.

Slattery's bore

Slattery's bore is the registered bore that is closest to the proposed mine workings (No. 64025), being located about 180 metres to the south of the longwall panels. The location of the monitoring bore (labelled P3) is shown in Figure 2. The groundwater level in this bore has been monitored since 2009, and monitoring should be continued into the future until extraction of longwalls 51 and 52 is completed. This monitoring should detect any impacts from the mining and confirm whether they are less than the minimal impact considerations for affected water supply works.

A TARP should be established for the monitoring bores (including Slattery's Bore) to ensure that any changes in groundwater level are detected at an early stage before the minimum impact levels are reached. Trigger levels should be set for the groundwater level in each bore and the TARP should react to groundwater level changes outside the trigger levels. Although adverse impacts are not expected, the TARP should include proposed mitigation measures in the event that mining impacts are detected. The mitigation measures for Slattery's bore may include actions such as lowering the suction/pump down the existing borehole or providing a new borehole.

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Appendix A
Groundwater Works Summary sheets for registered bores

Groundwater Works Summary

Work Requested -- GW063752

Works Details

GROUNDWATER NUMBER	GW063752
LIC-NUM	20BL135419
AUTHORISED-PURPOSES	DOMESTIC STOCK
INTENDED-PURPOSES	DOMESTIC STOCK
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	Rotary Air
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	1986-11-01
FINAL-DEPTH (metres)	12.20
DRILLED-DEPTH (metres)	12.20
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	N/A
GWMA	-
GW-ZONE	-
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details

REGION	20 - HUNTER
RIVER-BASIN	211 - MACQUARIE - TUGGERAH LAKES
AREA-DISTRICT	
CMA-MAP	9232-3S
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	(Unknown)
NORTHING	6348578.00
EASTING	362871.00
LATITUDE	32 59' 33"
LONGITUDE	151 31' 56"
GS-MAP	0053C4
AMG-ZONE	56
COORD-SOURCE	GD.,ACC.MAP
REMARK	

Form-A

COUNTY	NORTHUMBERLAND
PARISH	AWABA
PORTION-LOT-DP	L127 DP503374 (127)

Licensed

COUNTY	NORTHUMBERLAND
PARISH	AWABA
PORTION-LOT-DP	2 503374

Construction

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1	1	Casing	P.V.C.	0.00	6.00	150			Seated
1	1	Opening	Screen	6.00	12.20	150		1	Johnson; Stainless Steel; SL: 0mm; A: .4mm

Water Bearing Zones

FROM-DEPTH (metres)	TO-DEPTH (metres)	THICKNESS (metres)	ROCK-CAT-DESC	S-W-L	D-D-L	YIELD	TEST-HOLE-DEPTH (metres)	DURATION	SALINITY
6.00	8.50	2.50	Unconsolidated	6.00		0.46			0-500 ppm

Drillers Log

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	3.00	3.00	Sand Gravel		
3.00	9.00	6.00	Sand Gravel Some Coal Water Supply		
9.00	11.00	2.00	Sandstone Coal Gravel		
11.00	12.20	1.20	Sand Coal		

Groundwater Works Summary
Work Requested -- GW064025
1 Works Details

GROUNDWATER NUMBER	GW064025
LIC-NUM	20BL135308
AUTHORISED-PURPOSES	DOMESTIC STOCK
INTENDED-PURPOSES	DOMESTIC STOCK
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	Rotary Air
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	1986-10-01
FINAL-DEPTH (metres)	12.20
DRILLED-DEPTH (metres)	12.20
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	N/A
GWMA	-
GW-ZONE	-
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

2 Site Details

REGION	20 - HUNTER
RIVER-BASIN	211 - MACQUARIE - TUGGERAH LAKES
AREA-DISTRICT	
CMA-MAP	9232-3S
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	(Unknown)
NORTHING	6348700.00
EASTING	362740.00
LATITUDE	32 59' 29"
LONGITUDE	151 31' 51"
GS-MAP	0053C4
AMG-ZONE	56
COORD-SOURCE	GD.,ACC.MAP
REMARK	

1 Form-A

COUNTY	NORTHUMBERLAND
PARISH	AWABA
PORTION-LOT-DP	LA DP341342 (69)

2 Licensed

COUNTY	NORTHUMBERLAND
PARISH	AWABA
PORTION-LOT-DP	A 341342

3 Construction

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1	1	Casing	P.V.C.	0.00	12.20	150			Seated on Bottom
1	1	Opening	Slots - Vertical	0.00	12.20	150		1	Plastic; SL: 0mm; A: 0mm

4 Water Bearing Zones

FROM-DEPTH (metres)	TO-DEPTH (metres)	THICKNESS (metres)	ROCK-CAT-DESC	S-W-L	D-D-L	YIELD	TEST-HOLE-DEPTH (metres)	DURATION	SALINITY
6.00	9.00	3.00	(Unknown)	6.00		0.90			0-500 ppm

5 Drillers Log

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	3.00	3.00	Clay		
3.00	6.00	3.00	Sandstone Soft		
6.00	9.60	3.60	Sandstone Shale Water Supply		
9.60	10.60	1.00	Coal		
10.60	12.19	1.59	Sandstone Hard		

Groundwater Works Summary
Work Requested -- GW064067
1 Works Details

GROUNDWATER NUMBER	GW064067
LIC-NUM	20BL135980
AUTHORISED-PURPOSES	DOMESTIC STOCK
INTENDED-PURPOSES	DOMESTIC STOCK
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	Rotary Air
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	1987-02-01
FINAL-DEPTH (metres)	12.10
DRILLED-DEPTH (metres)	12.80
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	N/A
GWMA	-
GW-ZONE	-
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

2 Site Details

REGION	20 - HUNTER
RIVER-BASIN	211 - MACQUARIE - TUGGERAH LAKES
AREA-DISTRICT	
CMA-MAP	9232-3S
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	(Unknown)
NORTHING	6348845.00
EASTING	362141.00
LATITUDE	32 59' 24"
LONGITUDE	151 31' 28"
GS-MAP	0053C4
AMG-ZONE	56
COORD-SOURCE	GD.,ACC.MAP
REMARK	

1 Form-A

COUNTY	NORTHUMBERLAND
PARISH	AWABA
PORTION-LOT-DP	L1 DP534295 (70)

2 Licensed

COUNTY	NORTHUMBERLAND
PARISH	AWABA
PORTION-LOT-DP	92 812541

3 Construction

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1	1	Casing	P.V.C.	0.00	6.00	150			Seated on Bottom
1	1	Opening	Screen	6.00	12.10	160		1	Johnson; Stainless Steel; SL: 0mm; A: .5mm

4 Water Bearing Zones

FROM-DEPTH (metres)	TO-DEPTH (metres)	THICKNESS (metres)	ROCK-CAT-DESC	S-W-L	D-D-L	YIELD	TEST-HOLE-DEPTH (metres)	DURATION	SALINITY
6.00	12.10	6.10	Unconsolidated	4.00		0.40			1001-3000 ppm

5 Drillers Log

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	3.00	3.00	Clay Some Sand		
3.00	6.00	3.00	Sand		
6.00	12.80	6.80	Gravel Water Supply		

Appendix B
Glencore Risk Matrix

Xstrata Risk Matrix

Risk Matrix		Probability				
		A	B	C	D	E
Max Reasonable Consequence	1	1	2	4	7	11
	2	3	5	8	12	16
	3	6	9	13	17	20
	4	10	14	18	21	23
	5	15	19	22	24	25

Risk Groups

1-10 High
11-19 Medium
20-25 Low

Probability

A – Almost certain to happen (Everyday/ weekly event)
B – Likely to happen at some point (Once a month)
C – Possible, head of so it might happen (Yearly)
D – Unlikely, not likely to happen (Once every five years)
E – Rare, practically impossible (Once every twenty-five years)

Maximum Reasonable Consequence

	People	Property	Environmental	Community
1	Multiple fatalities. Major permanent negative health impacts on a large number of people	> $10M	Disastrous environmental impact, with long term effect, requiring major remediation, regulatory intervention or premature closure of the operation.	Public international condemnation. Major breakdown of social order in affected community
2	Single fatality. Severe irreversible disability or impairment (PDI)	$1M - $10M	Serious environmental impact with medium-term effect, requiring significant remediation or resulting in prosecution.	Loss of community's economic viability. Significant damage to reputation of the operations
3	Major injury to one or more people. Severe health impacts on a number of people	$100K - $1M	Moderate reversible environmental impact with short term effect, requiring moderate remediation such as a reportable incident not likely to result in prosecution (e.g. minor water discharge)	Significant public criticism (e.g. community complaints) NGO or Media "taking up the issue" Major negative impact on economic viability
4	Significant reportable injury (MTI or less than 5 days of RWI or LTI). Impact on health of several people	$10K - $100K	Minor, reversible environmental impact, requiring minor remediation such as non reportable environmental incident (eg. minor oil spill)	Flare up of issues in affected communities. Media criticism
5	Minor Injury. Slight negative impact on individual health.	< $10K	Negligible, reversible environmental impact, requiring very little remediation	Slight negative impact on individuals in local community

Appendix C
Response to Peer Review

This report was peer reviewed by Dr Noel Merrick of HydroAlgorithmics P/L, and the results of the review are summarised in HydroAlgorithmics (2013). Dr Merrick's main conclusion is as follows:

"This review finds that the groundwater assessment has been performed competently, and the findings are well substantiated. In the absence of numerical modelling, effort has focused on risk assessment and this has been performed satisfactorily in the opinion of the reviewer."

The peer review did however identify several shortcomings, which are listed below along with Aurecon's response. The response also notes where changes have been made to the main report as a result of these comments.

The listed shortcomings are as follows:

1. The groundwater monitoring network proximal to Longwalls 51 and 52 is limited in extent and depth; 13 monitoring bores are mentioned, of which six are datalogged. However, there is a broader network in the West Wallsend Colliery Water Management Plan which is not cited by Aurecon (2013);

   Response:
   Most of the monitoring bores no cited are in alluvial valleys to the north where the data is not relevant to the current study. There are six bores that have been drilled into the coal measure strata over active longwall panels in the southern and western areas. The monitoring data from these bores is relevant, but most data were not available when the first draft of this report was prepared. These results (up to October 2013) have now been included in Section 7.2.

2. The key monitoring bore (P4) in the Palmers Creek alluvium has insufficient depth (5 m) and appears to be often dry. Its hydrograph is not presented.

   Response:
   P4 was only established in August 2013 and although it is only 5 m deep, the groundwater level is at a depth of about 3 m. It has never been dry. It is likely that Dr Merrick confused this bore with D4 (in Diega Creek) which is often dry.

3. The monitoring of deep groundwater levels is limited to weathered rock to a maximum depth of 58 m over Longwall 44. There is mention of six sites in the Water Management Plan for the evaluation of the height of fracturing, but the information gained at these sites is not mentioned by Aurecon (2013);

   Response:
   See Response 1 above. These results are now included in Section 7.2.

4. There is no monitoring of groundwater responses in the coal measures;

   Response:
   See Response 1 above. These results are now included in Section 7.2.

5. The desktop assessment is not able to address the quantitative elements of the Aquifer Interference Policy, namely: estimates of licensable takes, drawdown magnitude and extent, and in particular drawdown at private bores;

Response:
This is true. In order for the quantitative elements to be estimated, a full hydrogeological model would be required using a 'complex modelling platform'. In order to establish such a model, detailed water level and permeability data would be required to provide a reasonably accurate estimate of drawdown in the groundwater table and in particular in the private bore. Since there is very little groundwater level and permeability data in the coal measure strata, establishing a detailed model is not considered to be a worthwhile exercise. This is not an unreasonable approach, given the predicted negligible impacts on the bore and the relatively low probability of an adverse outcome.

6. There is no indication of the magnitude of current "take" from the porous rock groundwater source, other than that the mine is "relatively dry", or whether licences are on hand to cover any additional inflow to Longwalls 51 and 52;

   Response:
   Section 10.1.2 has been amended to address this issue.

7. Aurecon (2013) considers that the alluvial aquifer associated with Palmers Creek is "in the less productive category". However, it appears that the Office of Water has classified this source as "highly productive" because it seems to be included as 'Unnamed Upriver Alluvium in WSP in the North Lake Macquarie Water Source' (see Figure 1). To be highly productive, an aquifer should have yields in excess of 5 L/s and salinity less than 1,500 mg/L. It is likely that at least some of the Palmers Creek alluvium would satisfy these criteria. However, the Office of Water has a conservative policy of blanket classification of water sources. This is of no real consequence, as the minimal harm drawdown criteria are the same for both classifications.

   Response:
   While the Office of Water have classified the water source as 'highly productive', the data available from two bores in the alluvium suggest it is in the 'less productive' category. As Dr Merrick has pointed out, this is immaterial as the minimal impact criteria are identical for both the 'highly productive' and the 'less productive' water sources. Changes have been made to the text in Section 10.1.3 to clarify this.

The peer review also provides an exhaustive analysis of the methodology used to estimate the height of interconnected fracturing, and compares it with another methodology proposed by Tammetta. No comment is made on this review, as it was beyond the scope of this report to evaluate these two different methodologies. This report uses the predictions produced by DgS, 2013, when assessing the potential impacts of mining. However, it is worth noting that, where monitoring data is available, it appears to support the DgS predictions.

Dr Merrick also concludes that the DgS assessment is satisfactory. He states: "The reviewer has conducted a comparative assessment using an alternative model [Tammetta] and has investigated the senstivity of the height of the fractured zone to mining height, panel width and cover depth. The reviewer is of the opinion that the Ditton model [DgS] provides the best estimate, and concurs with the recommendation for reduction in mining height where the cover depth is 90 m or less at Longwall 51 in order to minimise the risk of intersecting surficial and deep fracturing.

It is this author's opinion that the Tammetta methodology has two major flaws;

- It is based on local data as well as international data from areas where there is a significant difference in the geological conditions to those found in NSW. This will produce spurious results.
- Some of the Tammetta data does not differentiate between interconnected fracturing and discontinuous fracturing, so that height of the zone of interconnected fracturing is overestimated.

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