APPENDIX E

ECOLOGICAL IMPACT
RESPONSE TO PAC REVIEW REPORT

ECOLOGICAL ASSESSMENT FOR THE COALPAC CONSILDATION PROJECT - CONTRACTED PROJECT

Response to the PAC Review Report

For:

Hansen Bailey

March 2013

Final

PO Box 2474

Carlingford Court 2118

Report No. **13007RP1**

The preparation of this report has been in accordance with the brief provided by the Client and has relied upon the data and results collected at or under the times and conditions specified in the report. All findings, conclusions or recommendations contained within the report are based only on the aforementioned circumstances. The report has been prepared for use by the Client and no responsibility for its use by other parties is accepted by Cumberland Ecology.

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Approved by: David Robertson
Position:
Signed: David Robertson
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Executive Summary

S1 Purpose

This document has been prepared by Dr David John Robertson, with the assistance of other staff of Cumberland Ecology Pty Ltd, PO Box 2474, Carlingford Court, 2118.

The purpose of this document is to provide a detailed response to biodiversity issues that were raised in Section 6 of the Coalpac Consolidation Project Review Report dated 14 December 2012 (PAC Report) of the proposed Coalpac Consolidation Project ("the Exhibited Project") by the Planning Assessment Commission (PAC). The Project entails consolidation and extension of existing Coalpac coal mines and will include open cut and highwall mining operations.

S2 Background

The PAC Review report raised a number of ecological and geological concerns about the Exhibited Project that can be summarised and grouped into the following:

- Pagodas and Pagoda country:-
  - Pagodas and Pagoda country were of international conservation significance and their values had not been adequately acknowledged or dealt with by the Environment Assessment;
  - Pagodas and Pagoda country would be significantly and detrimentally impacted by the proposed mining, particularly highwall mining;
  - Flora and fauna associated with the Pagoda country would be detrimentally impacted;
  - A suite of species of conservation concern (mostly associated with Pagoda habitats) had not been considered by the Environmental Assessment;
  - Buffers that could be considered to protect pagoda landforms (requested by PAC & provided by OEH); and
  - Selected threatened species including the Broad-headed Snake.
- Unique Permian Sediment/Vegetation:
  - The conservation values of vegetation (forests and woodlands) on soils derived from Permian sediments had not been adequately considered and such vegetation was not adequately conserved.

- Offsets are inadequate:
  - Offsetting proposed is inadequate to deal with the likely impacts of the Project.
- Ecology Assessment:
  - There are a number of issues with the accuracy of the Proponent's vegetation community descriptions (a new issue raised by OEH); and
  - The EIA had a lack of calculated edge effects; and
  - There are only generalised proposals to mitigate the impacts of edge effects.
  - Independent remapping of the vegetation within the Project Boundary; and
  - An assessment of the conservation values of vegetation within the Project Boundary.
- Incompatibility with Gardens of Stone Expansion

Some of the key reasons for the PAC's recommended refusal were related to conservation values, including both geological conservation values related to pagodas and ecological values, which mostly related to the flora and fauna said to occur on and around the pagoda areas.

Therefore the overarching issue for the PAC was their view that there was a fundamental incompatibility of the Project with the private proposal for the Gardens of Stone Expansion.

The PAC's concerns have all been discussed in detail in this report, and summarised here.

S3 Pagoda Issues

Pagoda landforms, including areas of cliffs and caves were recognised in the EIA (in the Exhibited EA) as important habitats especially for threatened species (e.g. Brush-tailed Rock Wallaby, Broad-headed Snake and a variety of plant species).

These areas would not be impacted by mining and were clearly excised from the open cut. Highwall mining was proposed to go under such habitats, with negligible subsidence impacts. A minimum buffer of 50 metres existed between open cut mining and pagodas, cliffs and caves, which were located upslope from the proposed mining.

The assessment concluded that steep, rocky habitats for flora and fauna were not to be impacted directly. A successful rehabilitation track record at these existing mines meant the indirect impacts of mining would, in the long term, be ameliorated by regrowth of rehabilitation.

The PAC's view was that the area downslope of the pagoda landforms was an area that required protection from mining. They sought advice from OEH who mitigated the perceived

and poorly-justified impacts via a >300m buffer or standoff zone, and removed large areas of the open cut.

Due to the PAC Review recommending additional protection of the *pagoda landforms*, their formation, definition, and significance in the landscape in relation to the Project has been assessed.

The pagoda shaped rock outcrops and cliff lines in and adjacent to the Project area are formed as the result of preferential and differential weathering of sedimentary rocks of the Triassic Narrabeen Formation, which overlies the Permian sedimentary rocks that form the coal measures targeted by the Project. In some places, **where the Triassic sediments are of sufficient thickness**[1], they have been deeply incised (forming gorges and gullies), preferentially along joint and fault planes, thus splitting and isolating sections of the sandstone caps and mesas and through differential weathering of weaker and stronger horizontal sedimentary beds, to form towers of rock, known locally as pagodas.

Together these features create a landform of special significance that has been recognised and defined in this report as a Significant Pagoda Landform (SPL).

The development of this definition permits identification and more accurate mapping than the work relied upon by the PAC in its review. The SPL mapped within the Project Boundary is confined to an area in the southeast of the Invincible mining area, and intersects some small areas where open cut mining was proposed in the Exhibited Project; some highwall mining panels were also proposed under the SPL area.

Geotechnical studies have shown that highwall mining will have a negligible impact upon such features. Notwithstanding that, the mine plan has been contracted away from the SPL within the Project Boundary (the Contracted Project). The Contracted Project mine plan has reduced the open cut mining footprint, and has restricted highwall mining so that no pagodas or cliffs within the SPL will be undermined.

The Contracted Project therefore recognises and values the significance of these pagoda landforms (through definition, mapping and re-planning) and improves their conservation outcomes. The PAC's perceived impacts, including "*Flora and fauna associated with the Pagoda Lands"* and "*a suite of species of conservation concern (mostly associated with Pagoda habitats)"* have been substantially eliminated by the Contracted Project.

The PAC and OEH recommend buffers or standoff zones from the pagoda landforms to*:*

- *(a) "Protect pagoda landforms and*
- *(b) Selected threatened species including the Broad-headed Snake*."

[1] Where the Triassic Narrabeen sediments are of insufficient thickness, they typically form outcrops of sandstone that are a discontinuous landform with individual continuous outcrop areas of less than 10 hectares, and >0.1 ha.. These outcrops may exhibit geomorphological features such as cliffs, caves, rock towers and isolated pagodas that do not form an aggregate or have deeply dissected wet gullies.

With regards to (a) highwall mining has been removed in the Contracted Project from beneath the pagodas and cliffs of the SPL. Elsewhere highwall mining will be designed to ensure negligible impacts with subsidence <20mm, and therefore no impacts to the surface. Open cut highwalls will be designed and managed to maintain stability (Geotek Solutions, 2013) and blasting will be carried out with negligible impacts (Terrock 2013).

In terms of (b) buffers for selected threatened species has been evaluated based on the three fauna species contained within the PAC report, including the Broad-headed Snake,, Cave Roosting Bats (Eastern Bentwing-bat and Large-eared Pied Bat), and Brush-tailed Rock Wallaby.

The effects on these species were found to be negligible, due to the absence of the Broad-headed Snake and Brush-tailed Rock Wallaby in the Project Boundary, and habitat for Cave Roosting Bats is being preserved within the Project area.

In addition, analyses show that both bat species are widespread across the Blue Mountains, and in the case of the Eastern Bentwing-bat, across other landscapes further east extending to the coast. The vegetation types that support both bat species are well represented to the east of the site and within various National Parks, including the Gardens of Stone National Park and the Blue Mountains National Park.

The prescription of buffers or standoff zones will serve only to harm the Contracted Project without achieving meaningful preservation outcomes for these species.

Analysis of "*pagoda-dependent*" flora and fauna (as suggested by the PAC) has shown that most such species are not restricted to pagoda landform habitats and occur much more widely in NSW. Those that do have a more restricted distribution are generally found outside the areas proposed for mining and are unlikely to be significantly impacted.

S4 Permian sediments

The assertion in the PAC review was that some of the forest and woodland communities on the lower slopes occur on soils derived from Permian sediments that contain higher levels of nutrients than soils derived from overlying Narrabeen Sandstone. This has been offered as having "*implications for the conservation value of the Project Area*".

Increased fertility does mean that vegetation can produce more food, and so support more insect prey for bats and other fauna, than areas of lower fertility such as sandstone-dominant plateaus to the east of the Project Boundary. However these Permian sediments are by no means unique to the Project Area.

There is total area of almost 44,000 ha of Permian sediments that outcrop from north of Rylstone to Lithgow with a high proportion of this already in conservation reserves (e.g. National Parks). The Contracted Project Disturbance Boundary amounts to 1.46% of this large area, and has already been contracted to preserve the more poorly represented vegetation communities. A comprehensive biodiversity offset package will provide further preservation of these communities as well as greater preservation of lands that contain Permian sediments.

S5 Offsets are inadequate

The Biodiversity Offset Package BOP as presented in the EA was considered by the PAC to be inadequate to deal with the likely impacts of the Project.

The offset package for the Contracted Project has been carefully considered and the current inclusions within it are appropriate to offset the residual impacts of the Contracted Project to a considerable extent. Furthermore, it is proposed that additional offsets will be sought and that these will combine to form an offset package that compensates for residual impacts at a minimum ratio of 4:1, not including mine rehabilitation. Additional offset properties are available in the region and can be acquired in consultation with OEH. An overall ratio of 4:1 is comparable with other recently approved mining projects in NSW.

S6 Ecology Assessment Issues

This report comprehensively responds to the issues raised by the PAC (via correspondence with OEH and SIGs) in relation to: differences of opinion in vegetation mapping and vegetation community identification and differentiation (Cumberland Ecology has adopted the higher value in this case); a lack of calculated edge effects and mitigation of such; and assessment of the conservation values of all vegetation within the Project Boundary (not just threatened species). The outcomes of this report satisfy the queries made by the PAC in relation to these issues.

S7 Incompatibility with Gardens of Stone Expansion (GOS2)

Some of the key reasons for the recommended refusal of the Project were related to conservation values, including both geological conservation values of SPL, and ecological values, which mostly concerning the flora and fauna said to occur on and around the pagoda areas.

Additionally, two non-Government proposals for reservation of the Ben Bullen State Forest (BBSF) had been presented to the PAC for consideration in their review. While the PAC did not assess the merits of these proposals, the Review report acknowledged that the over-arching issue for the PAC was to consider the Project in light of the areas' potential for conservation and future reservation into the Crown Estate.

It is critical for this Project to note that, as at the date of this report, no NSW Government policy or decision has been made to conserve the Ben Bullen State Forest as either a State Conservation Area or a National Park. The PAC was not directed by the Minister for Planning to consider the future reservation of the BBSF in the assessment of this Project.

In addition, there are other perspectives that should have been considered:

- There is precedent experience that clearly shows that both historic and recently rehabilitated mines can co-exist with reservation (as discussed in this report), and;
- Legislation permits mining in a State Conservation Area, the reservation instrument proposed for GOS2.

The PAC was "also of the view that significant scarring of the landscape (from open cut mining) will remain for decades, if not permanently", in spite of independent assessment of the high quality of rehabilitation at both mines.

There are many examples of old coal mining areas that are now within National Parks and which support considerable biodiversity, including old and established forest and woodland, and threatened species habitats. The results of Cullen Valley Mine rehabilitation to date, combined with inferences about unaided regeneration of vegetation on heavily mined areas from the old gold fields, indicates that if the Project continues to rehabilitate land as undertaken in the Cullen Valley Mine, then the landform and a high proportion of the biodiversity is likely to be restored in the longer term.

The PAC conclusions that the Project and reservation of GOS2 are incompatible if reservation is intended to include Ben Bullen State Forest, either now or in the foreseeable future" appears incorrect. Similarly, the conclusion by the PAC "that significant scarring of the landscape will remain for decades, if not permanently" does not seem warranted and is the complete opposite to comments made by PAC members whilst inspecting rehabilitation areas at the Coalpac mines.

In order to address the primary ecological issue of the PAC, the Contracted Project has further preserved the high conservation value of the Significant Pagoda Landforms and has improved the conservation outcomes across the Contracted Project area.

There has been a substantial 196 ha reduction in the open cut mining footprint, lessening the proximity to, and potential for indirect impacts upon, SPL and their gully habitats.

The reduced disturbance footprint centres on habitats around the SPLs in the south-east of the Project Boundary, a high conservation value plant species (*Persoonia marginata*) in the north of the Project, and completely avoids open cut mining on Hillcroft to the west of the railway line.

- By reducing the Contracted Project Disturbance Boundary to 762 ha, a number of changes have been made to the Project as assessed in the EIA, resulting in key biodiversity savings. These changes include:
    - Reduced footprint of open cut mining from SPL and gully habitats;:
    - Preservation of up to 240 m wide sections of gully habitats adjacent to the Ben Bullen SPL;
    - Avoidance of an additional 11.9 ha of gully habitat, 9 ha occurring in gullies areas adjacent the Ben Bullen State Forest SPL;
- No mining on Hillcroft (avoids 109 ha of native vegetation, including a substantial 74 ha Capertee Stringybark population); and
- Avoidance of all *Persoonia marginata* in the Contracted Project Boundary.

The reduction in impacts to threatened biodiversity (compared to the Exhibited Project) is:

- A reduction of approximately 7% of the impacts to Box Gum Woodland and Derived Native Grassland, listed under the TSC Act and the EPBC Act;
- A reduction of approximately 27% of the impacts predicted to *Eucalyptus cannonii* habitat, constituting an estimated 15,428 individuals;
- A reduction of approximately 20% of the impacts to native forest, woodland and grasslands, habitat for various fauna species known to occur or considered to potentially occur; and
- Approximately 1.96 ha of Box Gum Woodland Derived Native Grassland listed under the TSC Act only.
- A reduction in edge effects adjacent to the Ben Bullen State Forest SPL through a reducing the open cut highwall perimeter by 25%.

The Contracted Project addresses all of the PAC's valid concerns and significantly reduces the environmental impacts.

S8 Conclusion

The Exhibited Project mine plan as described in the Exhibited Environmental Assessment dated March 2012 and its associated ecological impacts have been reassessed in view of the PAC conclusions and recommendations, and the information upon which the PAC formed such opinions. Subsequently, the Contracted Project mine plan has been assessed and has been found to have reduced ecological impacts. A detailed assessment of potential impacts to SPLs and flora and fauna said to be dependent upon them has been conducted. It is concluded that the Contracted Project, would have a negligible impact upon SPLs and no significant impact on the flora and fauna associated with them. It should be noted that this is consistent with the findings of the ecological assessment for the original mine plan.

Based upon the work within this report, it is now affirmed that the ecological recommendations of the PAC have been addressed, either by accepting them, or in the case of several of the recommendations, through assessment of the Contract Project.

Chapter 1

Introduction

1.1 Purpose & Objectives

This document has been prepared by Dr David John Robertson, with the assistance of other staff of Cumberland Ecology Pty Ltd, PO Box 2474, Carlingford Court, 2118. My relevant experience is summarised in **Section 1.3** of this report and within my CV in **Appendix A**.

The purpose of this document is to provide a detailed response to biodiversity issues that were raised in Section 6 of the Coalpac Consolidation Project Review Report dated 14 December 2012 (PAC Report) of the proposed Coalpac Consolidation Project ("the Exhibited Project") by the Planning Assessment Commission (PAC). The Project entails consolidation and extension of existing Coalpac coal mines and will include open cut and highwall mining operations.

The objectives of this report are:

- To provide a detailed explanation of the key assumptions that underpinned the ecological assessments of the Exhibited Project mine plan;
- To provide a detailed analysis of the information relied upon, and the assumptions made by the PAC when making recommendations that pertain to biodiversity and conservation values;
- To explain how the mine plan has been revised to reduce ecological impacts and so respond to PAC recommendations;
- To provide an updated impact assessment of the Contracted Project mine plan; and
- To assess the offsets proposed for the Contracted Project mine plan.

In order to prepare this report I have read the PAC Report, relevant recommendations from which are reproduced in Section 1.2 and assessed in subsequent chapters.

1.2 Background

1.2.1 Environmental Assessment

Hansen Bailey was commissioned to prepare an Environmental Assessment (EA) for the Coalpac Consolidation Project under Part 3A of the *Environmental Planning and Assessment Act 1979*. Cumberland Ecology was engaged by Hansen Bailey and prepared the Ecological Impact Assessment (EIA) of the Project (Appendix J of the Exhibited EA).

The Director General of Planning issued 'environmental assessment requirements' (DGRs) on 16 December 2010 for the environmental assessment (EA) of the Project. The Project was also referred to the Department of Sustainability, Environment, Water, Population and Communities (SEWPAC) and was declared a controlled action by the Commonwealth Minister for the Environment due to its potential to impact threatened and migratory species. SEWPAC wrote to the NSW Department of Planning and Infrastructure (DP&I) and issued its requirements for assessment. Subsequently, a supplement to the DGRs was prepared and sent to Hansen Bailey on 19th of April 2011.

The DGRs (including the supplement with SEWPAC requirements) guided the biodiversity assessment of the Project and Cumberland Ecology prepared the Ecological Impact Assessment to address all ecological requirements within them.

The DGRs relating to the biodiversity assessment are:

- *"Measures taken to avoid, reduce or mitigate impacts on biodiversity;*
- *Accurate estimates of proposed vegetation clearing;*
- *A detailed assessment of the potential impacts of the Project on any:*
  - *Terrestrial or aquatic threatened species or population and their habitats, endangered ecological communities and water dependent ecosystems, and*
  - *Regionally significant remnant vegetation, or vegetation corridors, and*
- *A comprehensive offset strategy to ensure the Project maintains or improves the terrestrial and aquatic biodiversity values of the region in the medium to long term (in accordance with NSW and commonwealth policies), and considers offsets or compensation in relation to forestry production."*

The DGRs also contain the following requirements for rehabilitation:

"A detailed description of the proposed rehabilitation strategy for the Project area having regard to the key principles in the Strategic Framework for Mine Closure, including:

- *Rehabilitation objectives, methodology programs, performance standards and proposed completion criteria, and*

- *The potential for integrating this strategy with any other offset and rehabilitation strategies in the area*."

1.2.2 Ecological Issues Raised Before the PAC

The approvals path for the Project will entail two separate PAC processes. The first PAC included public hearings and a review of the EA and Response to Submissions (RTS) made following the exhibition period for the EA. Stakeholders were given the opportunity to provide responses about the merits of the Project at the public hearings that were chaired by Dr Neil Shepherd, the Chair of the first PAC.

Special Interest Groups (SIGs) opposed to the Project, including the Colong Foundation, Colo Committee, Lithgow Environment Group and the Blue Mountains Conservation Society, made submissions to the PAC to outline their case against the Project as proposed. They criticised the EIA by Cumberland Ecology, stating that the ecological values within and adjacent to the Project Boundary had been understated and that potential impacts to a number of species of conservation value had not been assessed. Amongst the concerns raised by the SIGs was that:

- Pagodas and Pagoda country were of international conservation significance and their values had not been adequately acknowledged or dealt with by the Environment Assessment;
- Pagodas and Pagoda lands would be significantly and detrimentally impacted by the proposed mining, particularly highwall mining;
- Flora and fauna associated with the Pagoda Lands would be detrimentally impacted; and
- A suite of species of conservation concern (mostly associated with Pagoda habitats) had not been considered by the Environmental Assessment;
- The conservation values of vegetation (forests and woodlands) on soils derived from Permian sediments had not been adequately considered and such vegetation was not adequately conserved;
- Offsetting proposed is inadequate to deal with the likely impacts of the Project.

The Office of Environment and Heritage (OEH) also raised concerns about the likely impacts of the Project, stating that:

- There are a number of issues with the accuracy of the Proponent's vegetation community descriptions; and
- The EIA had a lack of calculated edge effects; and
- There are only generalised proposals to mitigate the impacts of edge effects.

Pagodas and Pagoda lands were therefore the key issues raised at the public hearing. For the purposes of this report, the definition of pagodas is the same as that used by the Colong Foundation and the PAC. The definition comes from Washington & Wray, (2011), page 132 as follows:

> *"Pagodas are conical rock formations formed by differential weathering and erosion of the local sandstones. They come in two forms. Smooth pagodas have relatively regular conical-shapes (without terraces), while platy pagodas are stepped and terraced cones that resemble Asian pagodas, ziggurats or step-pyramids. On platy pagodas, erosionally resistant ironstone bands from 1 to several cm thick project from the surface and form the hard surfaces of the terraces. …Pagoda complexes are part of wonderfully intricate, ruinlike, landforms that resemble lost cities and temples, and are also often associated with slot canyons and weathering caves.*
>
> *Pagodas are generally large and prominent rock formations with associated cliff faces and small valley between. Where vegetation can occur on them, it is often stunted heath. However, between the pagodas themselves soil can accumulate and trees occur, giving rise to strips of woodland and open forest in the valleys amid pagodas".*

i. Additional Information Supplied by OEH

In addition to the submission OEH made to the PAC, the Commission also requested other information be provided so as to assist the PAC to review biodiversity matters.

The PAC requested additional information from OEH in letters dated 25th September (NSW Planning Assessment Commission (PAC) 2012c) and 11th October 2012 (NSW Planning Assessment Commission (PAC) 2012d) on the following issues:

- Selected threatened species including the Broad-headed Snake
- Buffers that could be considered to protect pagoda landforms;
- Independent remapping of the vegetation within the Project Boundary; and
- An assessment of the conservation values of vegetation within the Project Boundary.

OEH supplied maps of vegetation and maps of proposed buffers of various distances around what it considered to be significant pagoda landforms within and adjacent to the Project Boundary.

The additional information provided by OEH was relied upon by the PAC to make some of its ecological recommendations for the Project (see below). Neither the proponent nor Cumberland Ecology was given the opportunity to review the additional OEH materials prior to completion of the PAC report and the ecological recommendations therein.

1.2.3 PAC Review Conclusion and Recommendations

The PAC Report recommended refusal of the Exhibited Project mine plan and some of the key reasons for the recommended refusal were related to conservation values, including both geological conservation values and ecological values. The geological conservation values are related to significant pagoda landforms (SPLs). The ecological values were largely but not exclusively related to the flora and fauna said to occur on and around the pagoda areas.

In particular, this report has been prepared to respond to Recommendations 45-55 made by the PAC under the heading of "*Biodiversity*" (Section 6) within the PAC Report. The PAC biodiversity recommendations are:

> ***"Recommendation 45**: The Commission [PAC] recommends that the pagodas and the associated escarpments be considered natural features of special significance and that they be fully protected from any mine-induced impacts.*
>
> ***Recommendation 46**: The Commission recommends that highwall mining not be permitted under the pagodas or escarpments in the Project area.*
>
> ***Recommendation 47**: The Commission recommends that to provide adequate protection for threatened species and other fauna that use the pagoda landform, a minimum setback distance of 300m be maintained from the open-cut highwall to the pagodas and the escarpments.*
>
> ***Recommendation 48**: The Commission recommends that, given the significance and sensitivity of the pagodas and the pagoda landform environment, before the Project is submitted for determination the uncertainties in the Proponent's supporting information identified in section 6.2 [of the PAC Report] are resolved and the caveats and qualifications on the various commitments are removed so that the Determining Authority has an unequivocal understanding of what the outcomes will be and the risks associated with them.*
>
> ***Recommendation 49**: The Commission recommends that concerns about the adequacy of the flora assessment and identification of the vegetation associations present in the Project area be resolved to the satisfaction of OEH prior to approval of any extension to open-cut mining in the Project area and prior to any assessment of adequacy or otherwise of the biodiversity offset package.*
>
> ***Recommendation 50**: The Commission recommends that, given the acknowledged high quality and species richness of the native vegetation present in the Project area, the assessment focus should be on the overall quality of the habitat under threat and its biodiversity value rather than just on the threatened species component which is the focus of the EA.*

***Recommendation 51**: The Commission recommends that calculation of edge effects be required to the satisfaction of OEH before the Project is submitted for determination.*

***Recommendation 52**: The Commission recommends that the cumulative impacts on the biodiversity values of Ben Bullen State Forest and the region of this Project, together with the proposed Pine Dale Stage 2 Extension, be considered before any assessment of this Project is finalised.*

***Recommendation 53**: The Commission recommends that the following three principles be accepted as underpinning assessment of biodiversity impacts for this Project:*

- *Rehabilitation cannot restore the existing vegetation associations or ecological balance of the area;*

- *Rehabilitation to mature woodland is unproven for open cut mines in NSW; and*

- *The impacts on biodiversity from this Project are incompatible with reservation proposals for Gardens of Stone Stage II.*

***Recommendation 54**: The Commission recommends that, given the considerable uncertainties concerning the likelihood of rehabilitation on this Project area being capable of delivering a satisfactory biodiversity outcome, rehabilitation not be given credence as a mitigation strategy in the assessment.*

***Recommendation 55**: The Commission recommends that, until the baseline biodiversity characteristics of the site have been resolved to the satisfaction of OEH [Office of Environment and Heritage], assessment of the adequacy or otherwise of the revised offset package should not proceed. The Commission also recommends that particular attention be given in the assessment to the essential nature of the trade-off being proposed, i.e. it is a proposal designed to exchange a number of fragmented areas that generally require extensive rehabilitation work and are currently not considered suitable for reservation, for a single area of high quality habitat that adjoins other areas of high quality habitat and is already proposed for reservation."*

Each of these recommendations is considered and responses are provided within **Chapter 10** of this report.

1.3 Scope of Works & Report Structure

The remaining chapters of this document are set out as follows:

Chapter 2: Methods: This sets out the methods for preparation of this report, including the methods for researching the PAC recommendations, assessing the additional materials provided by OEH to the PAC, the methods for redesigning the mine plan and the impact assessment and offsetting of the Contracted Mine Plan;

Chapter 3: Rationale for Exhibited Project Biodiversity Assessment. This chapter explains the rationale for, and assumptions underpinning, the assessments for the Exhibited Project mine plan considered by the PAC;

Chapter 4: Analysis of Pagodas and Significant Pagoda Landforms. This Chapter provides an analysis of assumptions and information relied upon by the PAC and analysis of the ecological recommendations of PAC;

Chapter 5: Analysis of OEH Information Supplied to the PAC. This chapter reviews materials provided by OEH that have been relied upon by the PAC to formulate recommendations 45-55

Chapter 6: Compatibility with Gardens of Stone Stage 2 Proposal. This chapter reviews the compatibility of mining with the Gardens of Stone Stage 2 Proposal and the history of mining in relation to conservation reserves.

Chapter 7: Revision of the Exhibited Project mine plan. This chapter explains how the mine plan has been revised to respond to the PAC recommendations 45-55.

Chapter 8: Impact Assessment of the Contracted Mine Plan. This chapter revises the ecological impact assessment to take account of the proposed revision of the mine plan.

Chapter 9: Mitigation and Offsetting of the Contracted Mine Plan. This chapter revises the proposed mitigation and offsetting to take account of the proposed revision of the mine plan.

Chapter 10: Conclusion. This chapter provides a conclusion to the overall report.

Terminology used in this report is summarised in the glossary provided in **Section 1.5**.

1.4 Authorship

1.4.1 Primary Authorship

I, Dr David Robertson, Director of Cumberland Ecology, am the senior author of this report. A copy of my full Curriculum Vitae (CV) is provided in **Appendix A**.

I have been given a copy of Division 2 "*Provisions applicable to expert evidence generally*" of Part 31 of the Uniform Civil Procedure Rules (2005) and have read and understood this

document and its Schedule 7, "*Expert witness code of conduct*". I understand that I have an overriding duty to assist the Court impartially on matters relevant to my area of expertise, and that my paramount duty is to the Court and not to the Company retaining me. The evidence that I provide to the within this document will be in compliance with this Practice Direction.

1.4.2 General Qualifications and Experience

My ecological career has spanned 27 years since completion of a PhD on woodland ecology at Melbourne University in 1985. I am an ecologist with expertise in both botany and zoology and have worked as an ecological consultant since 1995.

During part of my career, I have also been a lecturer in plant taxonomy, plant ecology and freshwater ecology at Charles Sturt University and Australian Catholic University (1987-1994). This has developed my capability to work in both aquatic and terrestrial flora and fauna inventory, management of threatened species, ecological risk assessment, wetland rehabilitation and management, and ecological research for environmental impact assessment.

Throughout my career, I have worked on a wide variety of ecological projects. This includes ecological projects across Australia, including New South Wales, Queensland, ACT, Victoria, Tasmania and Western Australia. I have also gained international experience as the senior ecologist involved with consultancies in Hong Kong, Sri Lanka and the Philippines.

Since the inception of Cumberland Ecology Pty Ltd in 2003, I have worked with my team of ecologists at Cumberland Ecology on ecological investigations throughout NSW, averaging 60-80 projects per year. We have worked extensively within the Hunter Valley, Gunnedah Basin, Sydney Region, on coastal projects and in the Western Blue Mountains.

I have had, and continue to have, direct involvement in many large-scale vegetation mapping and flora and fauna impact assessment projects. Cumberland Ecology has also worked on many projects that entail biodiversity offsets, large and small. I have worked on a range of offsetting projects in NSW, Queensland, Hong Kong and the Philippines. My work on offsets has included work for private companies to develop offsets, working as a peer reviewer for the Department of Planning and Infrastructure (DP&I) to review offset proposals, and also, to provide advice directly to DP&I about a policy for the development and assessment of offsets for Major Projects.

i. Blue Mountains and Sandstone Landscape Experience

I have a good understanding of the ecology of the Blue Mountains landscape, and about the ecology of other sandstone landscapes within the Sydney Bioregion.

Prior to my work on the Coalpac Consolidation Project I have worked on many projects within and around the Blue Mountains. Examples include:

- Assessment of the impacts of urban development upon biodiversity within the Blue Mountains (Australian Museum 1995/96);

- Assessment of ecological responses to environmental flows within the Cox's River (Australian Museum 1995/96);
- Assessment of the ecological impacts of the Emirates Wolgan Valley Resort and preparation of a biodiversity management plan for part of the Resort land; and
- Numerous smaller environmental impact assessments for varied development proposals in the Blue Mountains area.

I have also worked as a peer reviewer for Department of Planning and Infrastructure for the Ulan Coal Mine extension and for Moolarben Stage 2 Coal Mine extension.

With regard to the Coalpac Consolidation Project, I have directed the Project and taken part in the fieldwork for many of the ecological assessments from 2009 to the present date.

ii. Offsetting Experience

I have worked on many projects that entail the preparation of ecological offsets and Cumberland Ecology has been engaged to monitor such offsets. Cumberland Ecology has helped to formulate offsets for many mining projects in NSW, and also for mines in north Queensland and in Mindanao, Philippines. Under my direction, an array of monitoring work has been and is being conducted at sites in the Hunter Valley, Gunnedah, Coffs Harbour and Western Sydney.

In 2010 the Department of Planning and Infrastructure engaged me to prepare a document outlining options for assessment of offsets for state significant projects.

I am an accredited BioBanking Assessor and my company routinely conducts BioBanking assessments for a wide variety of projects.

1.4.3 Cumberland Ecology Assistance

This report was prepared with the help of some of my staff. Such work included the compilation and review of literature, field work, data input and statistics and the preparation of GIS maps and figures. The staff who contributed includes:

- Tim Playford, Senior Project Manager/Ecologist
  - Tasks: drafting of Chapters 3 and 4 and assistance with editing report.
  - Qualifications: Bachelor of Science (Ecology) (Hons). University of Adelaide, 2003
- Sam Holliday, Senior Project Manager/ Ecologist
  - Task: assistance with collation and review of literature;
  - Qualifications: Bachelor of Science (First Class Hons) Environmental Management. Manchester University, UK, 1993;

- Master of Science (Distinction). The University of Wales, UK, 2004.

➢ Ryan Sims, Project Manager/ Ecologist

- Tasks: project management, collation and review of literature, fieldwork drafting and editing report.
- Qualifications: Bachelor of Environmental Science. University of Sunshine Coast, 2005;

➢ Michelle Frolich, GIS Specialist/ Ecologist

- Tasks: production of GIS maps and aerial photographs; analysis of areas of selected GIS maps.
- Qualifications: Bachelor of Science (Marine Science) (Hons). University of Sydney, 2007

1.5 Glossary

BHS: Broad-headed Snake.

Box Gum Woodland: White Box Yellow Box Blakely's Red Gum Grassy Woodland listed under the EPBC Act and TSC Act.

BVT: Broad vegetation type.

Contracted Project: The modified project described in Chapter 7 of this report.

Contracted Project Disturbance Boundary: includes all lands to potentially be disturbed as part of the Contracted Project within the Project Boundary. This has been modified to address concerns raised in the PAC Report.

DECCW: NSW Department of Environment Climate Change and Water (the previous name for OEH, see below).

EIA: Ecological Impact Assessment.

Exhibited Project: the Exhibited Coalpac Consolidation Project that was publically exhibited.

Exhibited Project Disturbance Boundary: includes all lands to potentially be disturbed as part of the Exhibited Project within the Project Boundary.

EEC: Endangered Ecological Community.

CEEC: Critically Endangered Ecological Community.

C/EEC: Critically Endangered Ecological Community and Endangered Ecological Community.

Current Survey: refers to the survey work by Cumberland Ecology conducted in 2009, 2010 and 2011 for the Exhibited Project.

EP&A Act: NSW Environmental Planning and Assessment Act 1979.

EPBC Act: Commonwealth Environment Protection and Biodiversity Conservation Act 1999.

KTP: Key Threatening Process, listed under the TSC and EPBC Act as a process that threatens, or could threaten, the survival or evolutionary development of species, populations or ecological communities.

LGA: Local Government Area.

Locality: is the area within a 10 km radius of the Project Boundary.

Mining Lease: means the land within the Coalpac mining tenements.

OEH: Office of Environment and Heritage, formerly DECCW.

Pagoda: (excerpt from Washington & Wray, 2011). *Pagodas are conical rock formations formed by differential weathering and erosion of the local sandstones. They come in two forms. Smooth pagodas have relatively regular conical-shapes (without terraces), while platy pagodas are stepped and terraced cones that resemble Asian pagodas, ziggurats or step-pyramids.*

Previous Surveys: refer to all previous flora and/or fauna surveys conducted within the Project Boundary and reviewed by Cumberland Ecology.

Project Boundary: refers to Project Boundary (all land subject to this EA).

ROTAP: refers to "rare or threatened Australian plants", which are not listed as threatened by either State or Commonwealth legislation. Rather these species appear in a 2005 publication by Briggs and Leigh on Rare or Threatened Australian Plants. The book predates both the TSC Act and EPBC Act.

Sandstone Outcrops: Outcrops of sandstone that are *in situ* and form a discontinuous landform with individual continuous outcrop areas of less than 10 hectares but occupy an area greater than 0.1 hectare. These outcrops may exhibit geomorphological features such as cliffs, caves, rock towers and isolated pagodas that do not form an aggregate or have deeply dissected wet gullies (SPL). Sandstone Outcrops do not exhibit the characteristics of SPLs, i.e. they do not exhibit clusters of pagodas or have deeply dissected wet gullies. Although rare, isolated rocks and boulders less than 0.1 ha located within the Contracted Project Disturbance Boundary are afforded no special significance.

SEWPaC: Commonwealth Department of Sustainability, Environment, Water, Population and Communities.

Significant Pagoda Landforms (SPLs):

- A complex that creates a continuous landform over a substantial area (typically greater than 10 hectares), comprising (as a minimum):

    - Large, substantial in height (typically up to 60m but may be higher), towering pagodas (either platy or smooth), that are generally prominent rock formations with associated cliff faces and deeply dissected gullies, characterised by banded ironstone and associated rock structures containing numerous overhangs and crevices, with;

    - Associated deeply dissected wet gullies between the pagoda formations that contain a complex of habitat types for both flora and fauna, some species of which are rarely found elsewhere (e.g. Pagoda Daisy).

Threatened flora and fauna: refers to communities, populations and species listed as threatened under the EPBC Act, the TSC Act and the Fisheries Management Act 1994; and

TSC Act: NSW Threatened Species Conservation Act 1995.

Chapter 2

Methods

This Chapter sets out the methods for the preparation of this report and explains the origin of information upon which I have based my expert opinions.

My staff and I have previously conducted field surveys of the Project area in 2009 and Cumberland Ecology prepared EIA for the EA. For this reason I am familiar with the land in question and general landscape of the region.

This document and the opinions expressed therein are based upon the following broad methods:

- Literature review of various documents;
- Database analysis of species records;
- Mapping Significant Pagoda Landforms;
- Testing the assertions made by the PAC and OEH;
- Site Inspections; and
- Consultation with experts on the Broad-headed Snake and peer review of Significant Pagoda Landforms mapping;

These are further explained below:

2.1 Literature Review

I have reviewed a wide range of literature to form a basis for the opinions expressed within this document.

- PAC Report, including the Main Report (NSW Planning Assessment Commission (PAC) 2012b) and Appendices (NSW Planning Assessment Commission (PAC) 2012a);
- Pagoda Landform Literature, including a paper referenced in the PAC Report by Washington and Wray (2011);

- Pagoda Flora and Fauna Species Literature, including key maps and reports relevant to understanding its distribution and habitat requirements
- Coalpac Consolidation Project Review Main Report dated 14 December 2012, prepared by the NSW Planning Assessment Commission (NSW Planning Assessment Commission (PAC) 2012b);
- Coalpac Consolidation Project Review Appendices A to E dated 14 December 2012, prepared by the NSW Planning Assessment Commission (NSW Planning Assessment Commission (PAC) 2012a);
- Coalpac Consolidation Project Ecological Impact Assessment, prepared for Coalpac Pty. Ltd. (Cumberland Ecology 2012);
- OEH threatened species profiles (various) – see References;
- Broad-headed Snake (BHS) Literature, including key maps and reports relevant to understanding its distribution, habitat requirements and habitat restoration; and
- NSW Wildlife Atlas (OEH 2013a) records for threatened species in the areas surrounding the Project and pagoda country identified by Washington and Wray (2011).

A complete reference list is provided in the References section after **Chapter 10.**

2.2 Database Analysis

Records were obtained from the Atlas of NSW Wildlife database (OEH 2013a) on flora and fauna species mentioned to be either 'restricted' or closely associated with pagoda landforms in the PAC Report and supporting literature by Washington and Wray (2011).

The list of species associated with pagodas habitats as mentioned in the PAC Report and Washington and Wray (2011) are as follows.

- Flora Species
  - *Leucochrysum graminifolia* (Pagoda Rock Daisy);
  - *Prostanthera hindii;*
  - *Leionema scopulinum;*
  - *Pseudanthus divaricatissimus*;
  - *Banksia pencillata* (Old-man Banksia);
  - *Acacia asparagoides;*

- *Epacris muelleri;*
- *Philotheca obovalis*;
- *Eucalyptus oreades* (Blue Mountains Ash); and
- *Leionema lamprophyllum ssp. orbiculare.*

➢ Fauna Species

- Broad-headed Snake (*Hoplocephalus bungaroides*);
- Large-eared Pied Bat (*Chalinolobus dwyeri*);
- Eastern Bentwing Bat (*Miniopterus schreibersii oceanensis*);
- Glossy Black Cockatoo (*Calyptorhynchus lathami*);
- Brush-tailed Rock Wallaby *(Petrogale penicillata);* and
- Superb Lyrebird *(Menura novaehollandiae*).

2.3 Mapping Significant Pagoda Landforms

2.3.1 Pagoda Country Map from Washington and Wray (2011)

In order to undertake further analysis of the distribution and extent of pagodas and ultimately assess their conservation significance, "*Figure 1 Map of main distribution of the pagoda country in relation to Sydney, NSW"* from Washington and Wray (2011) was digitised.

This proved challenging as the only material to work with was a PDF file extracted from the paper which had minimal points of interest at a large scale (see below). Nevertheless, it provides an indicative extent of the pagoda country in a digital format to allow further analysis of extent. This digitisation was undertaken conservatively to ensure that all areas mapped by Washington and Wray were incorporated into the Cumberland Ecology mapping.

The Pagoda Country was digitised using the PDF of Washington and Wray (2011) combined with the boundaries of the National Parks and Conservation Reserves, State Forests and woodland areas identified from aerial photographs. This provided an approximate boundary for the pagoda country, consistent with that shown in **Figure 4.1**.

2.3.2 Pagoda Landforms Mapping

In addition to digitising the "*pagoda country*" identified by Washington and Wray (2011), additional areas containing Significant Pagoda Landforms were identified. These areas were identified by using topographic maps, aerial photography and local knowledge in some areas of Wollemi National Park and Buddawang National Park.

i. Classification of Significant Pagoda Landforms

Prior to mapping Significant Pagoda Landforms (SPLs) in the Project Boundary and surrounding region, it was important to first define these features. This enabled SPLs to be subsequently mapped. This was based on the descriptions of pagoda country from Washington and Wray (2011), Muir (2005) and the PAC Report; these are provided below.

The pagoda landform was described in the PAC Report (p.75) as (and presented here in dot point form):-

- *"A complex of habitat types for both flora and fauna, some species of which are rarely found elsewhere (e.g. Pagoda Daisy);*
- *A number of fauna species, including species listed under the NSW Threatened Species Act and/or the Commonwealth Environment Protection and Biodiversity Conservation Act, utilise multiple parts of this habitat arrangement either seasonally (e.g. the Broad-headed Snake) or for daily living requirements (e.g. Brush-tailed Rock Wallaby and Eastern Bent-wing Bat)*
- *A complex arrangement of habitats characterized by a convoluted line of towering rock faces containing numerous overhangs and crevices giving way to steep slopes (talus slopes). At the bottom of these slopes there are deeply dissected wet gullies between the pagoda formations".*

Importantly, the PAC recognised (p.76) that *"the pagodas cannot be considered as structures in isolation*" (emphasis added).

Where sandstone outcrops and pagodas occur in isolation (and therefore do not form a complex of a continuous nature), they have been defined as Sandstone Outcrops (see **Section 1.5** for definitions).

Based on the description of pagoda landforms provided and used by Washington and Wray (2011) and the PAC, SPLs in the region surrounding the Project Boundary were identified. It is important that SPLs are defined and identified in order that they can be afforded special significance, compared to (Sandstone Outcrops) that offer a discontinuous association with each other; the latter would not create 'a complex arrangement of habitats' as defined by the PAC in the dot points above.

Therefore SPLs are described as the following.

- A complex that creates a continuous landform over a substantial area (typically greater than 10 hectares), comprising (as a minimum):
    - Large, substantial in height (typically up to 60m but may be higher), towering pagodas (either platy or smooth), that are generally prominent rock formations with associated cliff faces and deeply dissected gullies, characterised by banded ironstone and associated rock structures containing numerous overhangs and crevices, with;
    - Associated deeply dissected wet gullies between the pagoda formations that contain a complex of habitat types for both flora and fauna, some species of which are rarely found elsewhere (e.g. Pagoda Daisy).

The two photographs below are examples of a pagoda complex classified as a SPL adjacent Invincible Colliery (**Photograph 2.1**) and Sandstone Outcrops near the Cullen Valley Mine (**Photograph 2.2**).

Photograph 2.1 An example of a SPL in the Project Boundary taken from NW corner of the Ben Bullen SPL in Project Boundary and looking SE

Photograph 2.2 Isolated rock towers not classified as SPLs around Cullen Valley Mine in the north of the Project Boundary. These are defined as Sandstone Outcrops.

ii. Mapping SPLs

Once SPLs were defined, they were then mapped in the Project Boundary and wider region using Aerial Photographic Interpretation (API) of Google Earth, Version 6.1.0.5001 (**Figure 4.3**). SPL mapping in the Project Boundary was aided by a series of high resolution digital photographs taken during a helicopter flight of the Project Boundary, which focused on the escarpment to east of the Invincible open cut mining area, and valleys below.

The regional Mapping undertaken by Cumberland Ecology also used geo-referenced photographs available in Google Earth to confirm the presence of pagoda formations identified during API. The mapping of SPLs outside the Project Boundary was also aided through the review of literature and existing maps provided in management plans of nearby national parks. In particular the Gardens of Stone Plan of Management (DECC 2009) provided a map of the park which identified pagoda landforms that occur outside the pagoda country in Washington and Wray (2011). This was digitised and incorporated in the mapping of SPLs of the region.

Appendix E provides a series of photographs taken from a helicopter of the SPL in the Project Boundary. The location and view of each photograph is provided in **Figure 4.4**.

2.4 Testing the PACs Assertions on Pagoda Species

A test of the PAC's assertions was conducted for each species identified to be associated with SPLs. Each species was assessed on an individual basis. Species records were plotted on an aerial photograph together with the "*pagoda country*" map by Washington and Wray (2011) and boundaries of all National Parks and Conservation Reserves in the region. This allowed a comparative view of known species occurrences and their location in relation to the mapped "*pagoda country*", SPLs and nearby reserve systems.

2.5 Consultation with other Experts

Table 2.1 below lists the experts consulted for the preparation of this document. I consulted with Dr Jonathon Webb about his extensive knowledge and experience on the Broad-headed Snake. Dr Arthur White also conducted habitat assessment for the Broad-headed Snake in the Project Boundary (see below). In addition, I consulted with Dr Steven Bell on Cumberland Ecology's analysis of the flora and fauna associated with pagoda landforms. A summary of my discussions with the above experts is provided in **Section 2.5.1, Section 2.5.2** and **Section 2.5.3**.

A resume of each expert is provided in **Appendix G**.

Table 2.1 Specialist Consultation

Expert	Area
Dr. Jonathon Webb; Lecturer of Environmental Scientist at University of Technology (UTS), Sydney	BSc (Hons), PhD (University of Sydney) Broad-headed Snake Expert
Dr Arthur White; Director of Biosphere Environmental Consultants Pty. Ltd.	BSc (Hons), PhD (University of NSW) Herpetologist
Dr Stephen Bell; Director of East Coast Flora Surveys Pty. Ltd	BSc (Hons); PhD (University of Newcastle) Stephen is a consultant botanist with extensive knowledge of sandstone habitats
Dr Andy Markham; Director of Hydrobiology Pty. Ltd.	BSc (Hons) in Environmental Science, University of East Anglia; PhD in Geography, Queen Mary, University of London. Andrew is a fluvial geomorphologist, surface water hydrologist and Chartered Environmental Scientist.

2.5.1 Broad-headed Snake Peer Review

A series of questions on the BHS were sent to Dr Jonathon Webb and Dr Arthur White for them to answer. The questions sent were as follows:

- Where is the recovery plan work up to for the BHS?
- What is the latest information about key habitats for the BHS?
- Is the BHS likely to occur in the western Blue Mountains around Lithgow, or is it much more likely to occur to the east?
- What kind of work needs to be done to mitigate impacts on BHS habitat?
- Can BHS habitat be restored or improved if bush rock is replaced in significant quantities and large hollow bearing trees are retained below winter habitat?
- Are there any current/recent publications we can review?
- Are there any research programs underway that could be funded as an indirect offset by a mining project?

Arthur White's BHS review is provided in **Appendix B**.

2.5.2 Pagoda Landscapes Ecology Review

Dr Stephen Bell was consulted on Cumberland Ecology's analysis of flora and fauna of pagoda landforms.

Dr Bell supported the majority of the ecological analysis of the draft report; however Dr Bell raised three key points during discussions that have been considered in the preparation of the final report. Dr Bell's suggestions included:

- The classification of SPLs excludes areas containing pagoda landforms less than 10ha (see **Section 4.3.2** for discussion);
- Dr Bell suggested the use of recent mapping of vegetation communities by DEC (NSW) (2006) and (OEH 2012f) that are associated with pagoda landforms to aid in the mapping of SPLs regionally (see **Section 4.3.2** for discussion); and
- The assessment of OEH Atlas records of pagoda landform flora species does not account for the possibility of data entry error or misidentification (see **Section 2.7** for discussion).

2.5.3 SPL Geomorphological Review

Dr Andy Markham peer reviewed Chapter 2 and 4 of the draft report and prepared a letter report on 26th February 2013. This is provided in **Appendix J**.

Dr Andy Markham paid particular attention to the definition and descriptions of the pagodas and the appropriateness of the approach used in discussion of pagoda landforms. Dr Markham concluded that the SPL classification used in the Project Boundary is reasonable from a geomorphological perspective.

2.6 Broad-headed Snake Site Inspection

On 6th of February 2013, Dr Arthur White from Biosphere Environmental Consultants P.L. and Mr Ryan Sims from Cumberland Ecology P.L. surveyed the sandstone escarpment areas close to or within the mining lease boundary to determine where habitat for the Broad-headed snake was present and whether habitat areas were likely to be impacted by the proposed extensions to the mine.

Aerial survey maps of the mining leases areas and immediate surrounds were examined to determine the extent of sandstone escarpment areas and to determine access to each area. Sandstone exposures were deemed to contain potential habitat for the Broad-headed snake if they also contained:

- Medium to tall forest within 250 m of the sandstone outcrop;
- Loose, exfoliated pieces of sandstone that were not underlain by organic matter or on soil, that could be used as refuge habitat by either the Broad-headed snake or their prey; and
- Deep fissures or cracks that could be used as shelter habitat by either the Broad-headed snake or their prey.

Having located all potential habitat areas, the sites were visited on the 6th of February 2013 so that each area could be “ground-truthed” to validate or refute the presence of habitat for the Broad-headed Snake in each area.

2.7 Limitations

The quality of the aerial imagery used in some areas within the Wollemi National Park did not allow for adequate identification of SPL’s, and there is a possibility for more occurrences of the SPL’s to occur than that mapped in the region. Areas of currently mapped SPL’s do not specifically delineate the boundary of the landform, but give an indicative view.

That notwithstanding, a conservative approach was taken to mapping and it is considered that the vast majority of the SPLs have been accurately identified.

For the purposes of this report, the distribution of various flora and fauna species that were described as being reliant upon or which occur in pagoda habitat were analysed by plotting OEH Atlas records on geographic information system mapping. It is noted that the reliability of individual records varies, with some reliable and accurate, while others may be erroneous. It is acknowledged here that some erroneous records of plants may have influence the findings of the mapping analysis somewhat, as has been pointed out during discussions with Dr Stephen Bell. Notwithstanding this, the point of the analysis was to examine the degree of reliance of various plants and animals on pagoda landscapes and to find out which species were largely confined to these areas. For the majority of species assessed, there are a large number of records and the occurrence or spread of records clearly exceeds the area where pagodas are likely to occur. For this reason, it is highly unlikely that erroneous records have made a significant difference to the conclusions drawn in this report about "*pagoda species*".

Chapter 3

Rationale for Exhibited Project Biodiversity Assessment

The purpose of this Chapter is to summarise the approach taken in the EA Ecological Impact Assessment and the subsequent Response to Submissions and to outline the rationale for the biodiversity assessments for the Exhibited Project mine plan that was exhibited and subsequently considered by the PAC.

From the outset of the Project I recognised that the Project Boundary was biodiverse and contained significant landscape features such as pagodas that were valuable for a range of threatened species. Accordingly, we devised an assessment strategy to accurately record the biodiversity present and make informed judgements regarding the expected impact of the Project on these biodiversity values. The strategy consisted of the following main components:

- Database analysis of existing records of threatened species in the Project Boundary and the Lithgow Local Government Area (LGA);
- Literature review to understand the habitat requirements of threatened species;
- Detailed field surveys to identify the biodiversity present in the Project Boundary, and to identify the habitat features present.

My staff and I conducted extensive field surveys of the Project Boundary from 2009 to 2012 to provide flora and fauna baseline data for the Project. The field surveys were comprehensive and were conducted in compliance with the OEH guidelines for flora and fauna survey (DEC (NSW), 2005).

Full details of the field methodology employed are provided in Chapter 2 of Appendix J of the EA.

3.1 Vegetation Communities

The vegetation community mapping was conducted based on detailed field survey of the Project Boundary. It made due reference to previous mapping such as Benson and Keith (1990) and the DEC (NSW) (2006) mapping, however it differed from the other mapping based on the extensive ground-truthing that was conducted over three years. Large scale mapping projects such as those mentioned above are by nature generalisations of reality, and it is impossible for the authors of such mapping to ground-truth each area mapped in the same level of detail as Cumberland Ecology employed during the field surveys.

Accordingly, we have confidence in our mapping and we have recorded significant areas of ecologically significant vegetation, comprising Box Gum Woodland and Derived Native Grassland, which is listed as an EEC under the TSC Act and as a CEEC under the EPBC Act. The field survey methodology was designed to meet SEWPaC (formerly the Department of the Environment, Water, Heritage and the Arts) guidelines for identifying Box Gum Woodland as listed under the EPBC Act (DEH 2006). This vegetation community was not recorded on the DEC (2006) Vegetation Map Sheet, however despite the significant ramifications on the Project of the discovery of this vegetation community, it was included in the vegetation map prepared by Cumberland Ecology.

It is inevitable that there will be some disagreement regarding the identification of map units and vegetation community boundaries, and this is evidenced by the many different formal community descriptions for a single community. For example, Capertee Rough-barked Apple Red Gum Yellow Box Grassy Woodland is known by four different community names (see Section 4 of the Ecological Impact Assessment). This community corresponds to the description of Box Gum Woodland and Derived Native Grassland. This community was recognised as being of very high conservation significance, and was the basis of a Referral that was submitted to SEWPaC. Subsequent to discussions with SEWPaC, and on the basis of this mapping, the Project was declared as a controlled action. We note that SEWPaC never challenged the vegetation mapping we presented during all consultation to date.

As a result of the very high conservation value of this community, large areas were excised from the mine plan to reduce the impacts on this community (see **Section 3.4** below).

3.2 Significant Habitats: Pagodas, Cliffs and Caves

Pagoda landforms, cliffs and caves were recognised at the outset by Cumberland Ecology to be important habitats and it was also understood that these habitats could furnish important habitat for threatened species including the Brush-tailed Rock Wallaby, Broad-headed Snake and a variety of plant species (see discussion below).

Such habitat areas were not proposed to be directly impacted by mining and had been clearly excised from any open cut proposal. Furthermore, although highwall mining was proposed to go under such habitats, the subsidence assessment indicated that the mining could be achieved with negligible impacts to the structures (GEONET 2011).

We were also told to assume that a buffer of 50 metres minimum was to be left between any open cut mining and pagodas, cliffs and caves. As such, we assumed that steep, rocky habitats for flora and fauna were not to be impacted directly.

We did consider the potential or indirect impacts to pagodas, cliffs and caves from having mining nearby. However, we also recognised that in all cases, the pagodas, cliffs and caves were located upslope from the proposed mining. This meant that runoff and erosion were not likely to be significant issues that could indirectly impact upon such rocky landforms.

As explained below, we were also aware that the existing mining had entailed rehabilitation of forest and woodland species and that a number of locations have successfully re-established a broad range of native forest and woodland plants on mine rehabilitation (Ecobiological 2010, 2012). Hence in the long term, it was assumed that forest and woodland communities that were likely to be suitable for a range of flora and fauna could be re-established on the proposed mining areas. We assumed that as rehabilitation occurred, the indirect impacts of mining would, in the long term, be ameliorated by regrowth of rehabilitation.

Note that in the Exhibited Project EIA, the geological features of the pagoda landforms were not mapped in detail, and the complexity of rock outcrops was not analysed. The location and complexity of pagoda landforms was a key issue for special interest groups at the public hearing and within written submissions.

Cumberland Ecology did not map and analyse the pagoda landforms in the Exhibited Project EIA because it was considered that these landscapes were all excluded from the areas to be impacted by open cut mining, and also because they were effectively upslope from the open cut mining limits. As such they would also be protected from runoff and erosion.

Due to the PAC Review recommending additional protection of the *pagoda landforms*, this report has now mapped and considered the SPLs in detail within Chapter 4, and the mine plan has been modified to provide further buffers to these landscape features and to reduce potential biodiversity impacts, as outlined in Chapter 7 and 9.

3.3 Flora and Fauna Species

Although as demonstrated in the EA, the field surveys were adequate to detect the majority of species occurring in the Project Boundary, there are always additional species that will be detected with further survey effort. I recognised this during the planning of the Project and therefore we relied upon database records to identify threatened species that may occur in the Project Boundary. Where a threatened species was recorded in the locality and suitable habitat was found to occur in the Project Boundary, the species was considered to occur and assessed as such in the impact assessment. This is a very conservative approach that ensures that all species with potential to occur are appropriately considered.

The surveys and impact assessment focussed on threatened species as this was what was required by the DGRs:

- *"A detailed assessment of the potential impacts of the Project on any:*
  - *Terrestrial or aquatic threatened species or population and their habitats, endangered ecological communities and water dependent ecosystems."*

I note that there was no focus in the DGRs for ROTAP plant species or other species other than formally listed threatened species under the TSC Act and EPBC Act.

The Exhibited Project Ecological Impact Assessment (EIA) acknowledged that the proposed mining area was almost entirely forested with native vegetation and that it supported a relatively high biodiversity of flora and fauna species. The PAC Report noted that the Ecological Impact Assessment was focussed on the impacts to threatened species listed by the TSC Act and EPBC Act, which is correct and reflected by the DGRs as cited above. The PAC report also noted that species of conservation significance were prominent within the species assemblages and that a number of species used both the pagoda landforms and the nearby valleys. The Ecological Impact Assessment did not go into detail about this element of the biodiversity, although it was acknowledged in the report, and in the Response to Submissions that a suite of threatened species had potential to occur in and around the pagodas and cliffs, including Brush-tailed Rock Wallaby, Large-eared Pied Bat and Broad-headed Snake. Chapter 4 of this report now addresses the values of the pagoda landforms as habitats for such species and provides further evaluation of the relationship between pagoda landforms and species of conservation significance.

3.3.1 Flora Species

More than 400 plant species were recorded in the Project Boundary, with a high proportion being native. Three threatened flora species were recorded within the Project Boundary:

- *Eucalyptus cannonii* (Capertee Stringybark);
- *Persoonia marginata* (Clandulla Geebung); and
- *Eucalyptus aggregata* (Black Gum).

These species are listed as Vulnerable under the TSC Act and EPBC Act.

As demonstrated in Chapter 2 of Appendix J of the Exhibited Project EA, extensive field surveys have been conducted for threatened flora surveys in the Project Boundary, focussing on areas that were to be impacted. Cumberland Ecology did not undertake exhaustive studies of threatened plants on and at the back (east) of the pagodas because these areas are outside the mine plan and would not be impacted by the Project. As plants are sedentary we did not search extensively for plant species of conservation interest in areas outside of the proposed Disturbance Boundary as it was assumed that these would remain and would generally occur upslope from the disturbance.

As discussed previously, we took a highly conservative approach and other threatened flora species not recorded from the Project Boundary, but considered to have potential to occur, were assessed. This assessment included the following:

- *Eucalyptus pulverulenta;*
- *Grevillea evansiana;*
- *Grevillea obtusiflora ssp. obtusiflora;*
- *Grevillea obtusiflora ssp. fecunda;*

- *Prostanthera cryptandroides subsp. cryptandroides*; and
- *Derwentia blakelyi.*

No other threatened species of flora were considered likely to occur and no others were therefore assessed in the EA.

The focus of the field surveys was on threatened flora species, and although all species observed were recorded, no particular focus was placed on ROTAP species. This is because this classification has been superseded by threatened species legislation. Until 1998, three distinct lists existed for threatened flora at a national level:

- Schedules to the *Commonwealth's Endangered Species Protection Act 1992*;
- The ANZECC lists of threatened fauna and flora; and
- The Rare or Threatened Australian Plants (ROTAP) list developed by the CSIRO. This system is based on a coding system which provides a means of ranking the plants according to the level of risk they face in the wild.

On 16 July 2000, the Commonwealth Government introduced the EPBC Act. This act superseded the *Endangered Species Protection Act 1992* (and several other Acts). In conjunction with the introduction of the EPBC Act, the aim is to now have a single list of threatened flora which will be reflected in Schedules to that Act (ANPS 2013a). (ANPS 2013b) Although the ROTAP coding system is still seen in some scientific and general publications, the Schedules of the EPBC Act are more commonly used to determine a species' conservation status.

3.3.2 Fauna Species

As indicated in Chapter 2 of Appendix J of the Exhibited Project EA, Cumberland Ecology has conducted extensive fauna surveys according to recognised guidelines and standards. From the outset we recognised pagodas and cliffs as significant and distinctive landscape features and searched them for threatened species known to occur in three kinds of environments such as cave dependent bat species; Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*) and Large-eared Pied Bat (*Chanilobus dwyeri*); the Brush-tailed Rock Wallaby (*Petrogale penicillata*) and the Broad Headed Snake (*Hoplocephalus bungaroides*).

Fauna survey was not limited to the pagoda areas however, and extensive surveys were conducted for fauna species throughout the Project Boundary as we recognised that such fauna could reside partly on the pagodas and forage in the proposed mining area.

These surveys resulted in the recording of a wide diversity of species, including 10 threatened fauna species. These included the following:

- Gang-gang Cockatoo (*Callocephalon fimbriatum*);

- Brown Treecreeper (*Climacteris picumnus*);
- Scarlet Robin (*Petroica boodang*);
- Speckled Warbler (*Chthonicola sagittata*);
- Square-tailed Kite (*Lophoictinia isura);*
- Powerful Owl (*Ninox strenua*);
- Varied Sittella (*Daphoenositta chrysoptera*)
- Squirrel Glider (*Petaurus norfolcensis*);
- Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*); and
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*).

To provide certainty that all species had been appropriately surveyed, a detailed habitat assessment was conducted during all surveys to provides an indication of the likelihood of occurrence of threatened species within the Project Boundary. This was undertaken for all threatened species listed in database records within the LGA. A highly conservative approach was taken to assessing threatened species. Where threatened species were considered to have potential to occur but were not recorded, they were assessed as if they occurred. For example, the Broad-headed Snake was not recorded, but due to the presence of suitable habitat it was considered as being likely to occur and was included in the assessment.

Threatened fauna species not recorded but with potential to occur in the Project Boundary and which were therefore included in the impact assessment include the following species;

- Bathurst Copper Butterfly (*Paralucia spinifera*);
- Rosenberg's Goanna (*Varanus rosenbergi*);
- Broad-headed Snake (*Hoplocephalus bungaroides*);
- Regent Honeyeater (*Anthochaera phrygia*);
- Swift Parrot (*Lathamus discolor*);
- Grey-crowned Babbler (*Pomatostomus temporalis*);
- Turquoise Parrot (*Neophema pulchella*);
- Hooded Robin (Melanodryas cucullata);
- Scarlet Robin (*Petroica boodang*);
- Diamond Firetail (*Stagonopleura guttata*).

- Glossy Black Cockatoo (*Calyptorhynchus lathami*);
- Masked Owl (*Tyto novaehollandiae*);
- Barking Owl (*Ninox connivens*);
- Little Lorikeet (*Glossopsitta pusilla*);
- Black-chinned Honeyeater (*Melithreptus gularis*);
- Painted Honeyeater (*Grantiella picta*);
- Koala (*Phascolarctos cinereus*);
- Spotted-tail Quoll (*Dasyurus maculatus*);
- Brush-tailed Rock-wallaby (*Petrogale penicillata*);
- The Eastern Pygmy-possum (*Cercartetus nanus*);
- Greater Glider (*Petauroides volans*);
- Yellow-bellied Glider (*Petaurus australis*);
- Greater Broad-nosed Bat (*Scoteanax rueppellii*);
- Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*); and
- Eastern Freetail-bat (Mormopterus norfolkensis)

3.4 Impact Assessment

The field surveys, database analysis and habitat assessment provided a comprehensive baseline of information on all the species that occurred or have potential to occur in the Project Boundary. Using this data, we conducted an assessment of the likely impacts of the Exhibited Project, focussing on threatened species as these would be most at risk from the Project. The impact assessment took into consideration the extent of the proposed Project, the specific habitat requirements for each species that would be affected, and the amount of habitat that would be affected, either directly or indirectly.

The following is a summary of the impact of the Project on threatened biodiversity within the Project Disturbance Boundary:

- Approximately 16.21 ha of Box Gum Woodland and 0.27 ha of Derived Native Grassland, listed under the EPBC Act and the TSC Act. Approximately 29.97 ha of Box Gum Woodland shall remain undisturbed within the Project Boundary;
- Approximately 1.96 ha of Box Gum Woodland Derived Native Grassland listed under the TSC Act only;

- 278 ha of known and potential *Eucalyptus cannonii* habitat constituting an estimated 19,219 individuals. Approximately 630 ha of known and potential *E. cannonii* habitat or an estimated 18,382 individuals shall remain undisturbed within the Project Boundary;

- 3.28 ha of *Persoonia marginata* habitat constituting an estimated 321 individuals. Approximately 13.1 ha of *Persoonia marginata* habitat remains within the Project Boundary, or an estimated 4,457 individuals; and

- 835 ha of native forest and woodland, habitat for various fauna species known to occur or considered to potentially occur will be removed (787 ha shall remain).

The Exhibited Project would have removed approximately 835 ha of woodland and forest providing suitable foraging, shelter and breeding habitat for the threatened species recorded from the Project Boundary and those with potential to occur (see Section 4 of the EIA).

In assessing the impacts of the Project, I assumed that the Project was a state significant development and therefore the benefits of the Project could justify some impact upon threatened species within reason. For example it was considered reasonable that some widespread species such as birds and bats would lose habitat, but that this could be addressed by the offsets and rehabilitation. Such an approach represents best practice and is consistent with the approaches taken for other recent mining developments in NSW.

In assessing the potential impacts, we took into consideration the benefits of the proposed offsets strategy which entails acquisition of offset properties for the permanent conservation of flora and fauna, including threatened flora and fauna predicted to be impacted by the Project. The protection of native vegetation occurring on these properties will contribute to increasing and improving the amount of forest and woodland under conservation tenure within the locality, and will complement other proposed offsetting arrangements by other local mining projects. In addition, onsite rehabilitation will be undertaken over 835 ha that will be disturbed by the Exhibited Project.

Although few examples are available of where mines have been successfully rehabilitated to functioning natural vegetation communities, this does not mean that it cannot occur. The lack of good examples of this kind of rehabilitation does not mean that it cannot occur, but is a function of most mining rehabilitation to date having been focussed on restoring land stability and agricultural values, with little regard for biodiversity. This means that there are few areas of mature rehabilitated vegetation to compare to. It is considered reasonable that with appropriate effort and with a focus on biodiversity, that high quality rehabilitation can be achieved. Although it cannot be guaranteed that the exact ecosystem values will be replaced, it is highly likely that the main habitat components will be able to be restored and that these will be able to provide habitat for native species in the future as it matures. In assessing the merit of the offsets strategy we considered rehabilitation that had occurred for Coalpac already and noted that which had occurred to date had good floral diversity and was growing well. This has been verified by monitoring reports conducted by Ecobiological (Ecobiological 2010, 2012) .

3.5 Conclusion

The Exhibited Project EIA concluded that impacts to flora and fauna were manageable, provided that the various mitigation and offsetting measures proposed were implemented.

Cumberland Ecology did not map and analyse the pagoda landforms in detail in the Exhibited Project EIA because these landscapes were all excluded from the areas to be open cut mine or directly impacted, and also because they were effectively upslope from the proposed mining. As such they would also be protected from runoff and erosion.

This report has now mapped and considered the significance of pagoda landforms in detail within **Chapter 4**, and the mine plan has been modified to provide further buffers to these landscape features, as outlined in **Chapter 7.**

The Exhibited Project EIA acknowledged that the proposed mining area was almost entirely forested with native vegetation and that it supported a relatively high biodiversity of flora and fauna species. The PAC report noted that the Ecological Impact Assessment was focussed on the impacts to threatened species listed by the TSC Act and EPBC Act, which is correct and reflected the DGRs as cited above.

The PAC report also noted that species of conservation significance were prominent within the species assemblages and that a number of species used both the pagoda landforms and the nearby valleys. The Exhibited Project EIA did not go into detail about this element of the biodiversity, although it was acknowledged in that report and in the Response to Submissions that a suite of threatened species had potential to occur in and around the pagoda landforms, including Brush-tailed Rock Wallaby, Large-eared Pied Bat and Broad-headed Snake. **Chapter 4** of this report now addresses the values of the pagoda landforms as habitats for such species and provides further evaluation of the relationship between pagoda landforms and species of conservation significance.

Analysis of Pagoda Landforms and Significant Pagoda Landforms

This Chapter provides an analysis of pagodas and SPLs and considers assumptions and information about them that were relied upon by the PAC to formulate recommendations for protection of these geological features.

4.1 Background

A central issue for the PAC in its review decision was to determine the conservation value of the pagoda landform. It is critical for this Approval to note that, as at the date of this report, no NSW Government policy or decision has been made to conserve the Ben Bullen State Forest as either a State Conservation Area or a National Park.

After a review of a technical paper (Washington & Wray 2011), and public submissions from the Blue Mountains Conservation Society and the Colong Foundation (and supported by other NGOs), the PAC Report for the Project (p.76) states:

> "*Based on the scientific literature, the international significance of the pagoda structures, the importance of the habitat, multiple submissions on the EA and at the public hearings, and the Commission's own observations during both aerial and ground inspections, the Commission concludes that the significance of the pagoda landform is at the top of the scale and thus the pagoda landform should be afforded special significance status and the highest possible level of protection*."

Washington and Wray (2011) is the primary reference used in the PAC Report to ascribe scientific significance to the pagoda landforms. Dr Washington is an environmental scientist who is a current Director of the Colong Foundation for Wilderness, and also Secretary of the Colo Committee and associated with the Blue Mountains Conservation Society NGO. These three NGOs have been campaigning since the early 1990s for the reservation of the majority of public land (such as the Ben Bullen State Forest and the Newnes Forest, as two local examples) on the western side of the Wollemi and Blue Mountains National Parks. Dr Wray is a Principal Fellow at the University of Wollongong's School of Earth and Environmental Sciences, and his research is focussed on the geomorphology of sandstones. The paper describes the pagoda landforms, discusses possible digenetic hypotheses, and then attempts to convince the reader as to why they should be conserved.

In addition to this, the PAC Report referred to the Colong Foundation's Mr Keith Muir and the conservation work done by him. Muir (2005) also wrote a paper, supported by the three SIGs

associated with Dr Washington describing the pagoda formations and their significance. Mr Muir has Bachelor of Natural Resources (Hons.).

The remainder of this chapter uses excerpts from these papers and other sources to:

- Define and explain the characteristics of pagoda landforms;
- Map pagoda landforms and SPLs;
- Discuss the reservation status of pagodas;
- Assess pagoda ecology;
- Discuss the existing stability of pagodas in relation to the mine plan.

4.2 Definition & Characteristics of Pagodas

For the purposes of this report, we have adopted the definition for pagodas used by Washington & Wray, 2011, from Page 132 as follows:

> *"Pagodas are conical rock formations formed by differential weathering and erosion of the local sandstones. They come in two forms. Smooth pagodas have relatively regular conical-shapes (without terraces), while platy pagodas are stepped and terraced cones that resemble Asian pagodas, ziggurats or step-pyramids. On platy pagodas, erosionally resistant ironstone bands from 1 to several cm thick project from the surface and form the hard surfaces of the terraces. …Pagoda complexes are part of wonderfully intricate, ruinlike, landforms that resemble lost cities and temples, and are also often associated with slot canyons and weathering caves*."

And from Page 134:

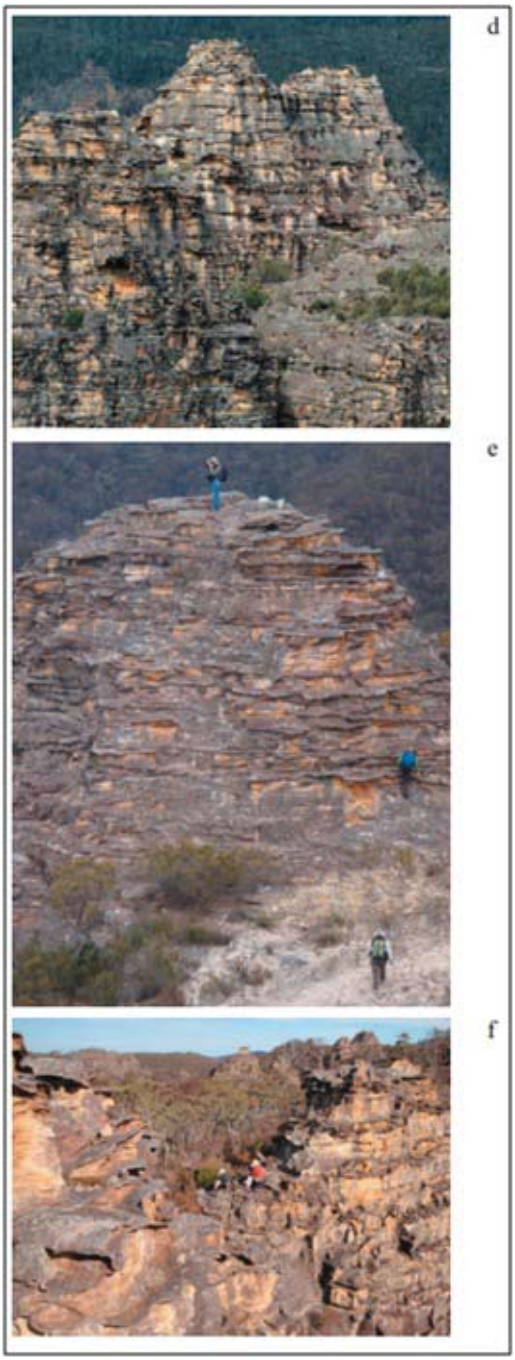
> *"Platy pagodas (Figures 2 d, e, f -* inserted*) however commonly have regular ironstone banding every 20 cm to a metre that can extend up to 60 metres in height. This banding is generally 2-5 cm in thickness and can, because of erosion of the surrounding friable sandstone, often project 20-40 cm from the sandstone (and in exceptional cases can project up to a metre). This ironstone plays a major protective role, and smooth pagodas appear to be eroding far more quickly than platy pagodas (we estimate at least 10 times faster, though this needs further research)."*

Muir, 2005 Page 13, 14 describes the Pagodas:

> *"The presence of ironstone and softer bands in the sandstones of the Gardens of Stone area permit differential weathering that is responsible for the beehives, domes and plates in the rock outcrops, locally called 'pagodas'. Ferruginised sandstone shelves project up to 0.5 m from pagoda flanks. By analogy with tors in deep weathered granite landscapes, the pagodas may be relict cores of more resistant rock, inherited from an earlier period of deep weathering of the Blue Mountain*

sandstones. Pagoda distribution matches that of steep, rocky spurs above drainage lines and escarpments."

Figure 4.1 **Reproduction of Figures from Washington and Wray (2011), showing typical pagodas. Note the bushwalkers (for scale) in the photos, and the substantial size and predominant nature (in the landscape) of these rock formations.**



4.2.1 Pagoda Formation

The pagoda shaped rock outcrops and cliff lines in and adjacent to the Project area are formed as the result of preferential and differential weathering of sedimentary rocks of the Triassic Narrabeen Formation.

The Narrabeen Formation lies unconformably over the Permian Illawarra Coal Measures. The Permian coal measures (that contain the coal seams proposed to be mined) have weathered to form the shallower, undulating slopes (i.e. generally <25 degrees). The Triassic Narrabeen Group (predominantly comprised of quartz lithic sandstone) overlies the coal measures, and forms a resistant 'cap' to weathering, facilitating the development of mesas (elevated areas of land with a flat top and sides that are usually steep), and further east large plateaus, above the coal measures.

In many places the Triassic sediments have been deeply incised (particularly where they are greater in thickness), preferentially along joint and fault planes, thus splitting and isolating sections of the sandstone caps and mesas and through differential weathering of weaker and stronger horizontal sedimentary beds, form towers of rock.

These deep incisions through the Triassic sediments typically form gorges and gullies that cut down through into the Illawarra Coal Measures, where the landform is then more typified by shallow slopes formed by the runoff of surface meteoric water over the more weathering-resistant rocks of the interburden formations between the coal seams. Where the coal seams outcrop, flatter benches have formed in the topography, where the seams themselves and the sediments below the seams have created greater resistance to erosion over time.

The geology of this landform has been documented in Yoo, E.K., 1998, Western Coalfield Regional Geology (northern part) 1:100,000, 1st edition. Geological Survey of New South Wales, Sydney. An extract is provided below:

> *The Narrabeen Group of the Sydney Basin has been well documented in the Blue Mountains by Goldbery (1972) and Bembrick (1980). Rocks of the Narrabeen Group form characteristic morphological features in the Western Coalfield (Photographs 24a to d). Near-continuous and mesa-like plateaus are most common over the greater part of the coalfield except when the Group is along the western edge. Outlying remnants of the Narrabeen Group Rocks weather to form pagodas (Photograph 24d). The Group is 656 m thick in the Kurrajong Heights No. 1 bore, 150 m at Mount Victoria and shows a moderate rate of thinning westwards (Goldbery 1972). It overlies the Illawarra Coal Measures (Photographs 14a, b, c), and underlies the Hawkesbury Sandstone in the southeastern part of the Western Coalfield.*

In summary, the Triassic sandstones that overly the Permian sediments of the Sydney Basin, have been differentially weathered as a result of near-vertical geological structures (planes of weakness such as joints and faults), and also horizontal features, principally due to differing sedimentary rocks (stronger, resistant quartz rich units such as sandstone versus softer clay rich units such as siltstones and mudstones).

There are also horizontal features whereby groundwater enrichment of iron within more porous units (typically sandstone) has formed highly resistant layers, above and below which weathering (in the recent past this has predominantly been from wind erosion) has worn away the weaker sediments.

The towers of rock isolated by vertical planes of weakness take on a step-like appearance as a result of the differential weathering of iron rich layers that to some observers (Washington & Wray 2011) have been likened to the pagodas or tiered towers of Asia.

4.2.2 Unique Pagoda Landform Unit

Washington & Wray, 2011 recognise that where pagodas predominate, they form significant and unique landscape units. This is stated on Page 134 of their report:

> *Platy pagodas are in our view distinct and significant features, as we are not aware of any other rock formations in Australia or overseas that mimic the geomorphology of platy pagodas. While there are many other rock pinnacles and beehives around the world, and while ironstone formations are found in other places, the regular stepped-cone shape of platy pagodas is a distinct geomorphic feature. The ironstone banding of the platy pagodas is thus significant in degree, not in nature, as ironstone is found throughout the Sydney Basin. However, the development of banding in platy pagodas forms a distinct geomorphic landscape unit.*

The fact that the pagoda landform is a highly significant landscape unit has not been disputed by Coalpac or Cumberland Ecology and as such the mine plan has been specifically designed to avoid damage to these unique landscape units.

4.3 Significant Pagoda Landform Locations

4.3.1 NSW Pagoda Locations

Washington and Wray (2011) attempted to map the locations of pagoda lands and Cumberland Ecology has digitised the map and reproduced it within **Figure 4.2** below. The locations of Pagodas in NSW identified in Washington & Wray, (2011) are discussed on page 132 of their report as follows:

> *"The 'pagodas' are a local name for distinctive sandstone formations in the north-western Blue Mountains region of NSW…These rocky cones are found in parts of three reserves of the Greater Blue Mountains World Heritage Area; the northern parts of the Blue Mountains NP, along the western edge of Wollemi NP, and in the Gardens of Stone NP. However much of the pagoda heartland is still found outside of reserves, principally on Newnes Plateau, Genowlan and Airly mesas in the Capertee Valley (Note – since publishing of the paper, this area has been reserved as the Mugii Murum-ban State Conservation Area), and in Ben Bullen State Forest. The main concentration of the pagoda country covers around 600 km2 (i.e. 60,000Ha)."*

Note that the Washington and Wray (2011) paper neglects to mention pagodas in the Wolgan State Forest (covering Baal Bone Mine) and Newnes State Forest (covering Angus Place Mine and Springvale Colliery).

4.3.2 Extent and Distribution of SPLs in NSW

Washington and Wray (2011) mapped significant areas within and in the vicinity of the Project Boundary as "*pagoda country"* (**Figure 4.2**). According to calculations conducted by Cumberland Ecology on digitisation of that mapping (see **Section 2.3**), approximately 51,000 ha of "*pagoda country*" occurs in the region. It should be noted that Washington and Wray mapping is relatively broad-scale and does not focus specifically on the pagoda landforms themselves, but rather indicates the areas (or "country") in which they occur. It appears to overtly follow the boundaries of un-reserved public land, in order to justify reservation and future conservation of this (predominantly) public land. As such, it includes substantial areas that do not contain pagodas or SPLs.

As discussed in **Section 2.3**, and drawing from the definitions and explanations in **Section 4.2**, and from regional mapping, Coalpac has defined and identified SPLs as:

- A complex that creates a continuous landform over a substantial area (typically greater than 10 hectares), comprising (as a minimum):
    - Large, substantial in height (typically up to 60m but may be higher), towering pagodas (either platy or smooth), that are generally large and prominent rock formations with associated cliff faces and deeply dissected gullies, characterised by banded ironstone and associated rock structures containing numerous overhangs and crevices, with;
    - Associated deeply dissected wet gullies between the pagoda formations that contain a complex of habitat types for both flora and fauna, some species of which are rarely found elsewhere.

During consultation Dr Bell raised some concern on the classification of SPLs as it would exclude areas containing pagoda landforms less than 10ha.

I discussed this point at length with Dr Bell, explaining that the definition for SPLs that was used in regional analysis used 10 ha as a cut off to identify and map major areas of such habitat across the region. This was done to verify how much of such habitat existed. I agreed that smaller occurrences of pagoda habitats could and do occur, but also explained that the Project Boundary had been mapped and analysed at a very fine scale that entailed looking at all pagodas and all sandstone rock outcrops, irrespective of size.

I also explained that the SPL definition was formulated based upon geological, aesthetic and ecological criteria. The use of "*typically greater than 10 ha*" areas was included in the definition based upon the assumption that generally such larger areas occur where the Narrabeen Sandstones are thicker, and as a result would have a complex array of pagodas and pagoda clusters, and intervening deeply incised valleys and ravines that have aesthetic value (for their scenic grandeur), scientific value (for the geological complexity of weathered

sandstone outcrops), and ecological value (for the juxtaposition of large, exposed rocky landforms and small sheltered valleys). Dr Bell accepted this explanation and noted that his brief was solely to look at ecology.

Both Dr Bell and myself agreed that smaller areas where isolated rock towers and singular pagoda features (i.e. within intervening lands that contain Sandstone Outcrops) could support some habitat for the "pagoda species" such as the aforementioned Pagoda Daisies that have been analysed in this report. However, I also explained that the Exhibited Project mine plan would not have cleared any significant habitat for such species, as cliffs, sandstone outcrops or pagodas were excluded from mining by the Exhibited Project mine plan. Moreover, the Contracted Project mine plan had been reduced to further protect what has been acknowledged as an SPL on the south eastern margins of the Project Boundary. Pagoda landscapes large and small were excluded from the Exhibited and Contracted Project mine plans and would be protected. Dr Bell accepted this explanation.

In order to gain an appreciation of the distribution of SPLs in the region, the distribution and boundaries of SPLs were mapped using Aerial Photographic Interpretation (API) and through the review of literature and existing maps provided in management plans of nearby National Parks. This mapping focussed on the actual landforms considered to comprise SPLs and did not include adjacent lands. As such it is at a substantially finer scale resolution than the indicative mapping of Washington and Wray (2011). **Figure 4.2** shows the extent of SPLs in the region.

During consultation Dr Bell suggested the use of recent mapping of vegetation communities by DEC (NSW) (2006) and (OEH 2012f) that are associated with pagoda landforms to aid in the mapping of SPLs regionally. The vegetation communities suggested by Dr Bell included:

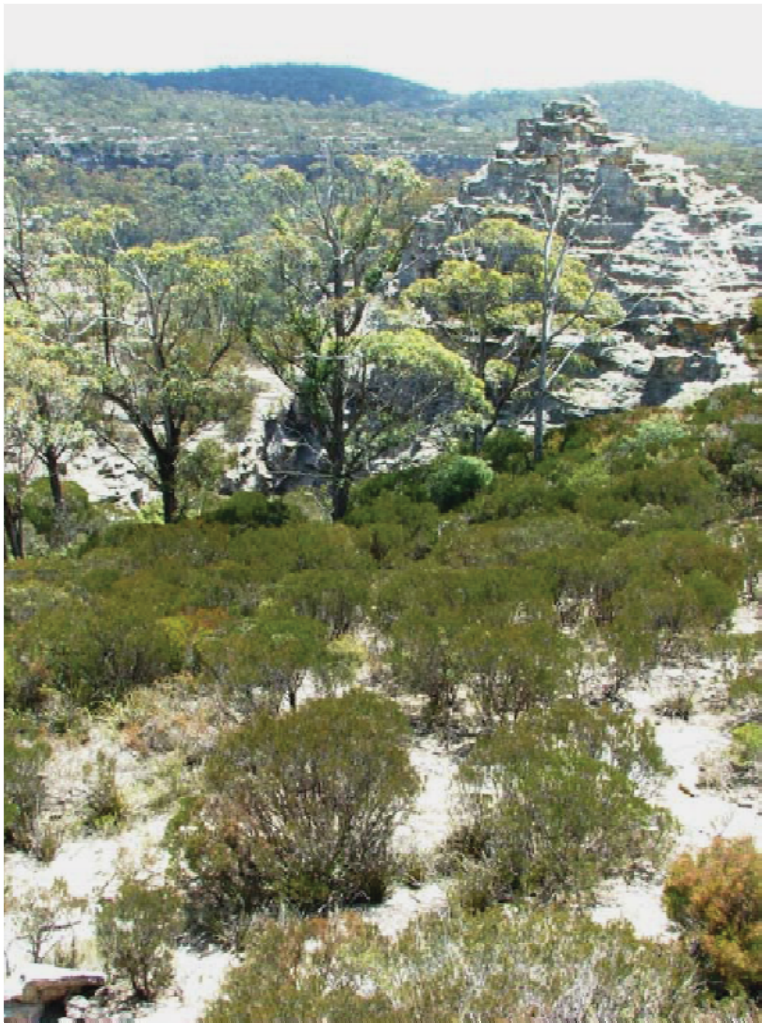
- "*Pagoda Rock Sparse Shrubland*" by DEC (NSW) (2006);
- "*Western Blue Mountains Pagoda Shrubland*" by OEH (2012f); and
- "*Western Blue Mountains Pagoda Woodland*" by (OEH 2012f).

After reviewing the aforementioned vegetation communities, I discussed with Dr Bell the vegetation units used as the basis for this mapping work were not confined to pagodas and in fact the shrublands occur on plateaus and rocky areas around pagodas quite extensively. For this reason, the occurrence of such plant communities in any given area could not be used as verification that pagodas or SPLs occurred. Although the OEH (2012f) mapping uses 3-dimensional digital technology to delineate rock and pagoda outcrops, the photographic description of each community shows that OEH's reference to pagodas in the name of each community is inconsistent with the definition used by Washington and Wray (2011) and is therefore considerably different to the definitions used for SPLs in this report.

The photographs supplied by DEC (NSW) (2006) show an example of "*Pagoda Rock Sparse Shrubland*", where the shrubland occurs on relatively flat land in the foreground of the photograph while an actual pagoda is seen in the background without any vegetation (see **Photograph 4.1**). Similarly, "*Western Blue Mountains Pagoda Shrubland*" by OEH (2012f) appears to occur on expansive plateaus and rock shelves in the vicinity of pagodas,

generally upslope from them, and sometimes well away from them (see **Photograph 4.2**). The third community, a pagoda woodland community "*Western Blue Mountains Pagoda Woodland*" (OEH 2012f) shows woodland occurring between large rock boulders and rocky outcrops that are outside the definition of SPLs and possibly Sandstone Outcrops, if isolated and smaller than 0.1 ha in size (see **Photograph 4.3**). Dr Bell agreed that the vegetation units did not always occur on pagodas.

I also explained that none of the pagoda vegetation communities, including "*Pagoda Rock Sparse Shrubland*" were proposed for clearing within either the Exhibited or Contracted Project mine plans.



Photograph 4.1 Pagoda Rock Sparse Shrubland (DEC (NSW) 2006). Location unknown. Note the expansive areas of shrubland occurring on plateaus.

Photograph 4.2 Western Blue Mountains Pagoda Shrubland (OEH 2012f). Location unknown. Note the expansive areas of shrubland occurring on plateaus.

Photograph 4.3 Western Blue Mountains Pagoda Woodland (OEH 2012f). Location unknown. Note the rock boulder, possibly isolated and smaller than 0.1 ha in size.

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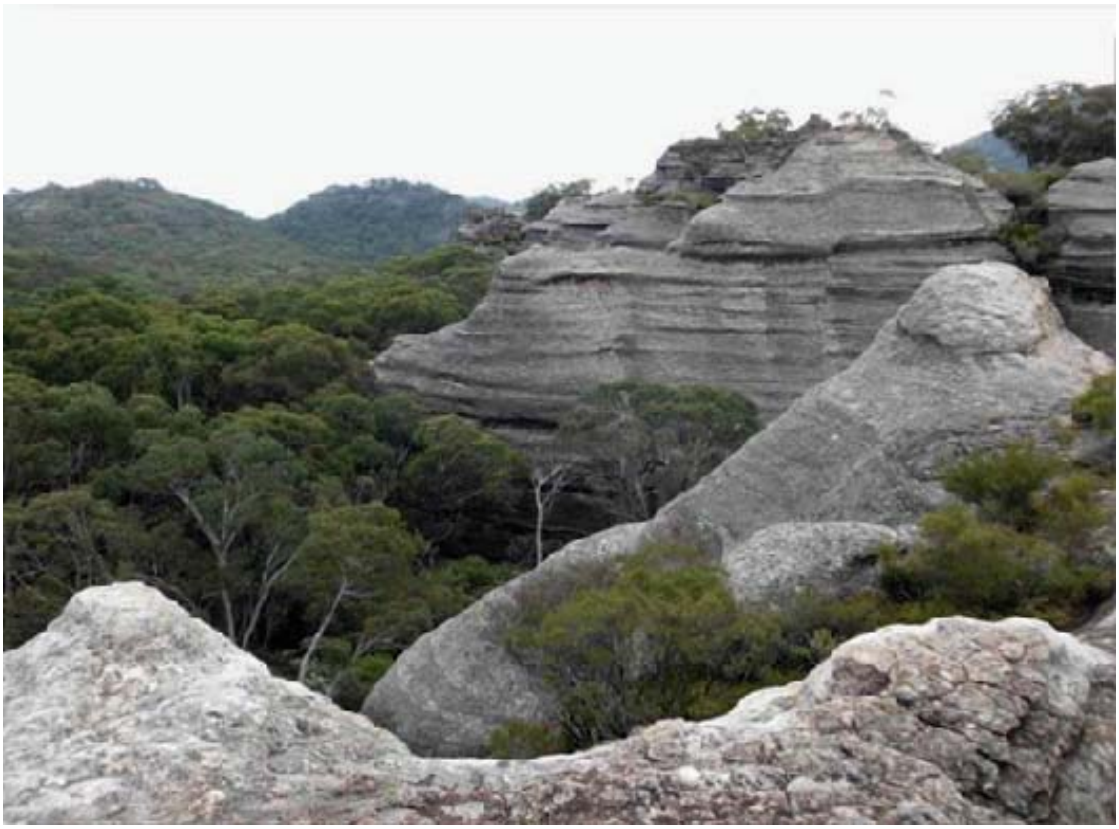
According to Cumberland Ecology's mapping approximately 25,893 ha of SPL has been mapped as occurring in the region, including approximately 113 ha (i.e. 0.4%) within the Project Boundary. As can be seen in **Figure 4.3**, SPLs occur over a wide area, including large areas outside of the region identified as "pagoda country" by Washington and Wray (2011), including areas such as Dunns Swamp and Morton National Park (**Photograph 4.4** and **Photograph 4.5**).



Photograph 4.4 Pagoda rock formations that are within a Significant Pagoda Landform at Dunns Swamp, in Wollemi National Park, north (outside) the Washington & Wray map of pagoda country

Photograph 4.5 Pagoda rock formations that are within a Significant Pagoda Landform at the Buddawang National Park, south (outside) the Washington & Wray map of pagoda country

Although large areas of SPLs have been mapped outside the pagoda country mapped by Washington and Wray (2011), the overall area of SPL is significantly less than the total area of "pagoda country" (see **Figure 4.2**). This is a function of the scale of the mapping, and the higher resolution of the Cumberland Ecology mapping that has focussed only on the SPLs and has not included the intervening landscape.

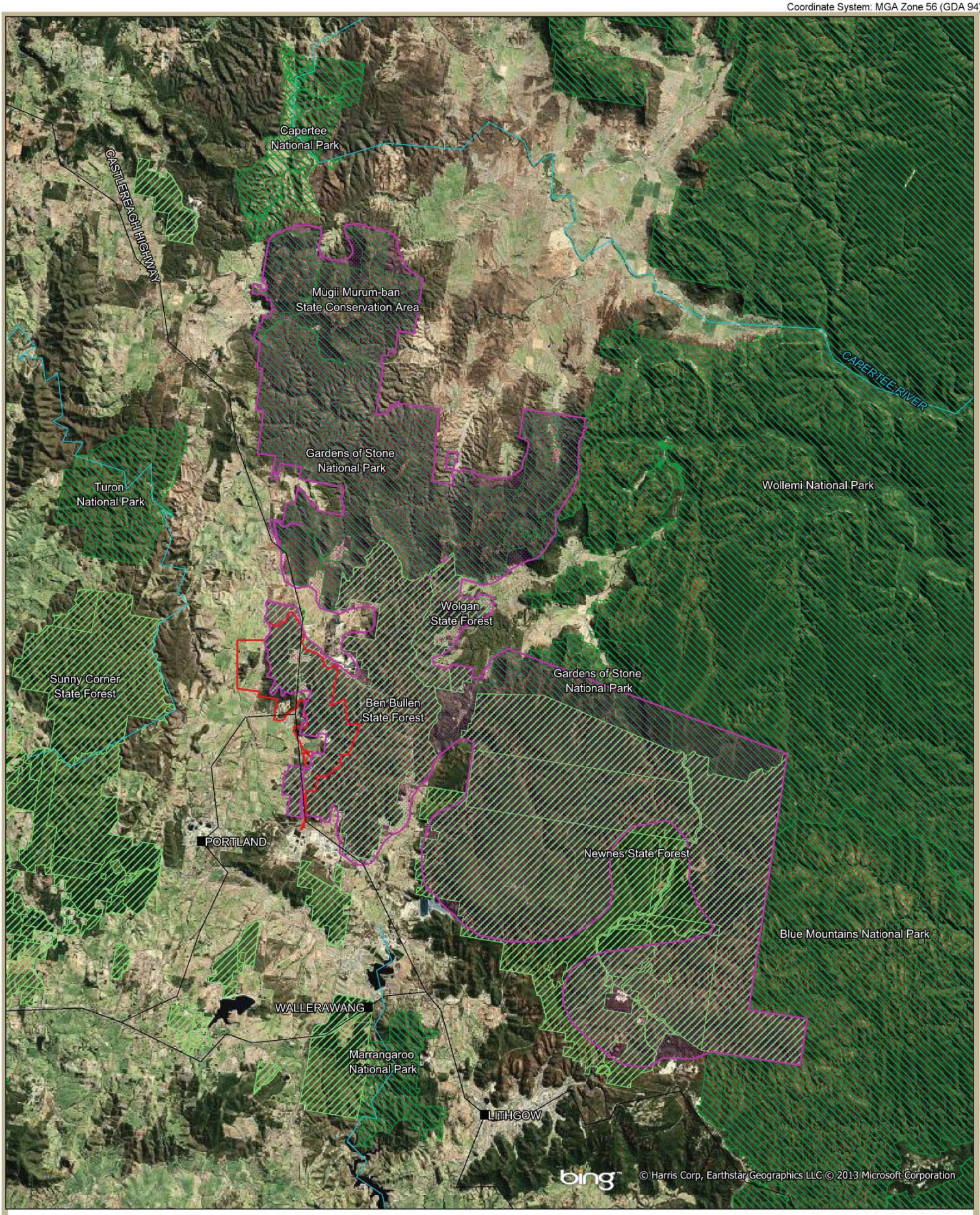


Figure 4.2. Pagoda Country Mapping from Washington and Wray (2011)

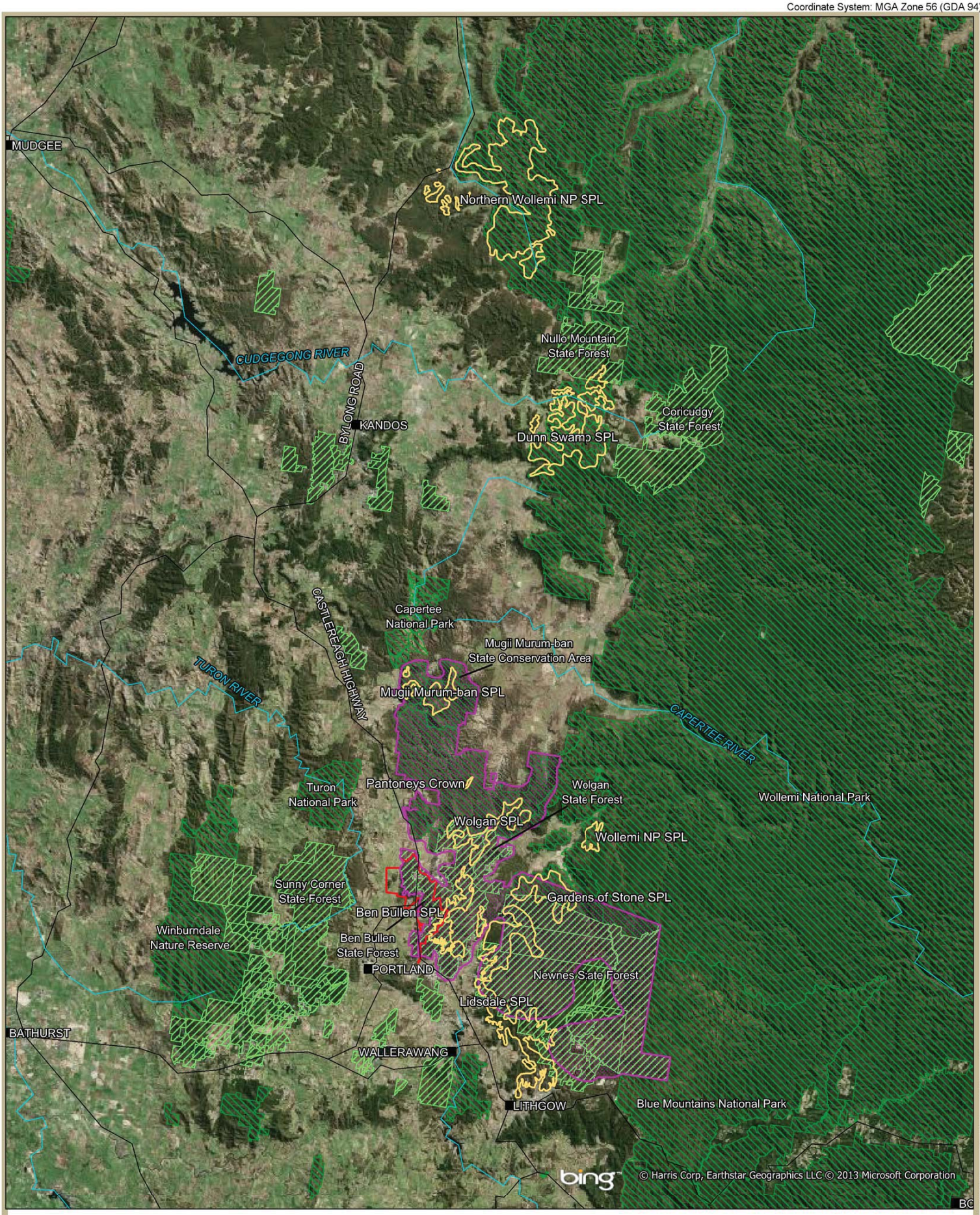


Figure 4.3. Regional Perspective of Significant Pagoda Landforms

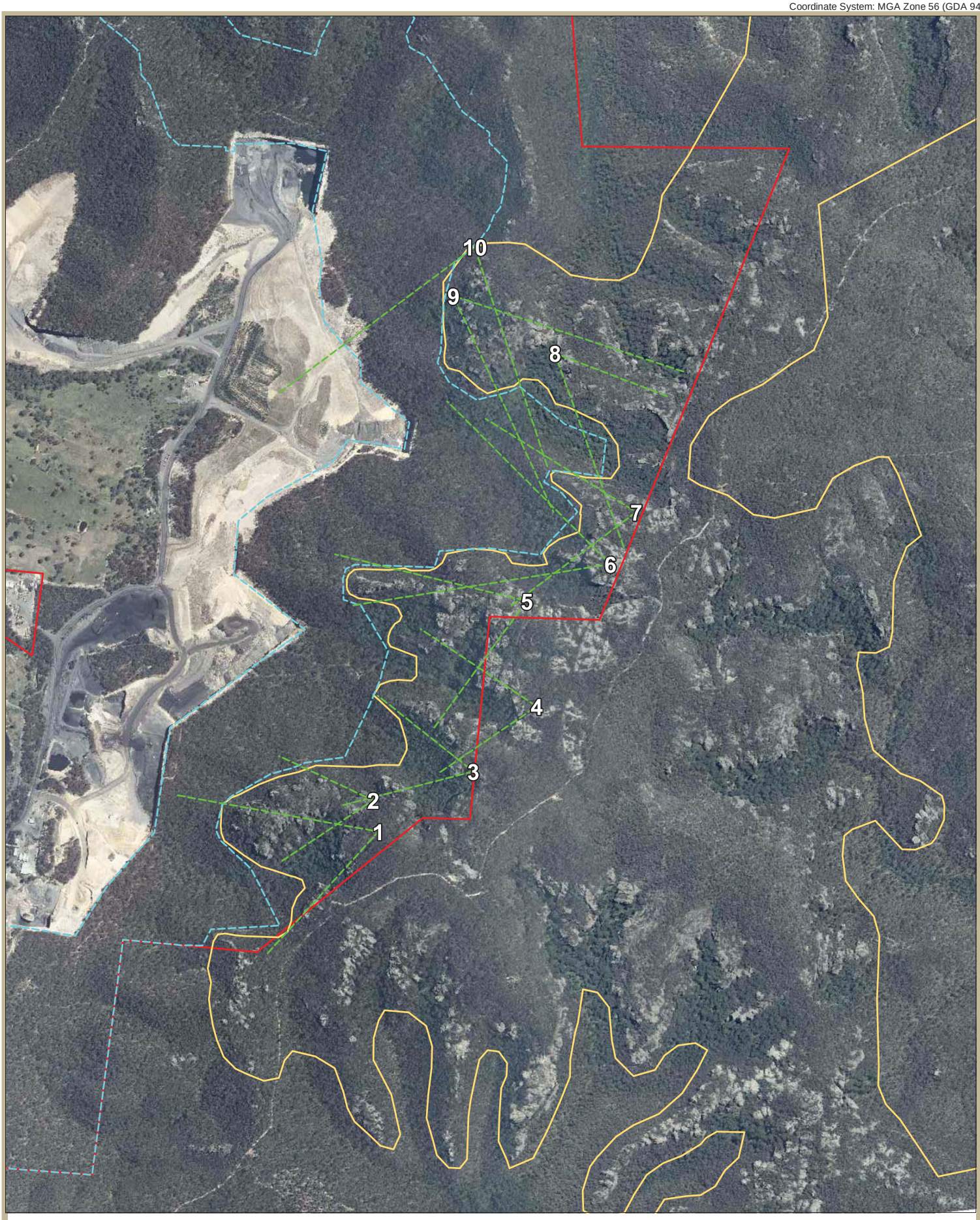


Figure 4.4. Significant Pagoda Landform Mapping of the Project Boundary

4.3.3 Reservation of Pagodas and relationship to coal mining

Washington & Wray, 2011, from Page 133:

> *While Gardens of Stone National Park was proposed in 1985, a park by that name was not created till 1994, and covered … 15,080 Ha. The Park gazetted was the area of the pagoda country that did not overlie mineable coal (due to the thinning of the coal seams and 'bad roof' due to jointing). While some pagodas are found in the nearby Wollemi and Blue Mountains National Parks, and others are found in the Gardens of Stone NP, around half the core pagoda country is not protected in reserves. The main pagoda areas not protected are the Genowlan/Airly mesas (as stated above – this 3,650 Ha area has since been reserved as the Mugii Murum-ban State Conservation Area), Newnes Plateau, and parts of Ben Bullen State Forest. Much of this area is covered by coal leases such as Airly, Baal Bone, Angus Place and Clarence.*

Given the area gazetted as the Mugii Murum-ban State Conservation Area amounts to 3,650 ha, then the total conserved area in the region is approximately 20,000 Ha. The remaining 40,000 ha has been proposed by OEH and environmental groups to be conserved as well, Page 133:

> *The Gardens of Stone Stage 2 proposal of an additional 40,000 ha was put forward in 2005 by the Colong Foundation for Wilderness, Blue Mountains Conservation Society and the Colo Committee* (Author's note: Colo is led by Dr Washington). *The proposal sought to form a State Conservation Area (SCA) over most of the area, which would have protected surface features but allows underground mining*.

4.4 Pagoda Ecology

Washington & Wray, 2011, from Page 133:

Given that biodiversity often is dependent on geodiversity, it is not surprising that the pagodas are a biodiversity hotspot for rare and threatened species. Pagoda areas offer many different habitats to species and also offer a refuge from fire and grazing to some plant species. Thus species survive there which may have gone extinct in the rest of the landscape. The rare Pagoda Daisy (Leucochrysum graminifolium, Figure 2a) is virtually restricted to pagodas. The rare Prostanthera hindii similarly is also mostly found on pagodas. In the northernmost part of the pagoda region, to the west of Nullo Mountain, a new species was found only a decade ago, now named Leionema scopulinum. It also is essentially limited to pagodas. Other rare or threatened plants often found on or near pagodas are Pseudanthus divaricatissimus, Banksia penicillata, Acacia asparagoides, Epacris muelleri and Philotheca obovalis (Washington 2001a). The 'regionally significant' Eucalyptus oreades is commonly found on and around pagodas. There are several threatened animals species found in and around pagodas. The Broad-headed Snake (Hoplocephalus bungaroides) is found on pagodas (as it lives under loose surface rock), while Glossy Black Cockatoos (Calyptorhynchus lathami) feed on Allocasuarina species found on and adjacent

to pagodas. Raptors such as the endangered Peregrine Falcon (Falco peregrinus) use adjacent cliff habitats (e.g. Genowlan Point).

As discussed in later sections of this report (**Section 5.1**), although many of the species mentioned above do occur on habitat within pagoda landforms, they are by no means limited to these habitats and occur in a wide range of geologies, and across a much wider area than the Blue Mountains. They also occur predominantly outside of the Contracted Project Disturbance Boundary, with the exception of the Superb Lyrebird (Figures C.1 to C.16) and *Acacia asparagoides* which occurs within and beyond the Contracted Project Disturbance Boundary (Figure C1 to c.16). These two species are not threatened species. As explained in Section 8, they occur outside the Contracted Project Disturbance Boundary and are unlikely to be directly impacted.

Muir, 2005 Page 16, 17 describes the fauna in this habitat:

The distribution of vertebrate fauna across the Gardens of Stone has not been systematically surveyed. Marsupials sparsely populate the more open woodlands and birds and reptiles are more prevalent among the shrub heaths, along escarpments and gullies. These latter environments, where nutrients and moisture accumulate, provide food and shelter for amphibians in the leaf litter and shelter in the undergrowth for small mammals. Small birds benefit from these thickets, and lyrebirds and macropods take refuge from predators and the weather. The escarpments and pagoda areas provide a great diversity of habitats. Even a small area offers crevices, gullies, overhangs, massive orange cliffs and thick heath, all of which provide shelter. These areas support populations of Brushtailed Rock Wallabies, the Broad-headed Snake and its preferred prey Leseuer's Gecko, Heath Monitors, as well as populations of Brown Antechinus, Bush Rats and the endangered Southern Brown Bandicoot. The gully habitats provide shelter for Greater Gliders, Sugar Gliders and Ringtailed Possums.

On current scientific data, there is no unique "pagoda landscape fauna" that are only found in this type of habitat, although species of conservation significance can and do occur there. Although many of the species mentioned above do occur on habitats associated with pagoda landforms, they are by no means limited to these habitats and occur in a wide range of geologies and habitats, and across a much wider area than just the Blue Mountains. This is dealt with in more detail within the species profiles and associated maps in Appendix C.

The habitats that pagoda landforms create (small crevices, incised gullies, overhangs, cliffs and thick heath) occur within areas classified as SPLs in the Project Boundary and will not be directly impacted. Very few frogs were recorded in the Project Boundary, none of which were threatened.

There are no recent records of the Brush-tailed Rock Wallabies in the vicinity of the Project Boundary and a population is unlikely to occur, despite suitable habitat features. Moreover, as discussed elsewhere in this report, the Brush-tailed Rock Wallaby is impacted mainly by fox predation. Physical damage to cliffs and caves (and pagoda landforms) is not generally regarded as a significant threat to the species (DEC (NSW) 2005, SEWPaC 2012). Predation by foxes is likely to be the limiting factor excluding Brush-tailed Rock Wallabies from the Project Boundary.

A record of the Broad-headed Snake (BHS) was recorded just to the east of the Project Boundary and large areas of potential habitat occur in Ben Bullen State that will not be impacted by this Project. In the case of the BHS, illegal reptile collecting and a lack of suitable prey habitat limits the occupancy potential of this species (see peer review by Dr Arthur White in Appendix B and (DEC (NSW) 2005)). The gully habitats in the Project Boundary are part of a very extensive and conserved habitat that occurs throughout the neighbouring Gardens of Stone National Park, Wollemi National Park, Newnes Plateau, and Wolgan Valley.

Some areas of potential foraging habitat for the Large-eared Pied Bat, Eastern Bentwing-bat and the Lyrebird will be removed by the Contracted Project. As indicated in **Chapter 5** and demonstrated in **Appendix C**, these species are not restricted to pagoda landforms and occur widely across NSW and in the National Parks, and therefore will not be significantly impacted by the Contracted Project. In addition, the Biodiversity Offset Package will conserve potential foraging habitat for these species. Given that Ulan and Moolarben Mine extensions occur in the same landscapes, and potentially affect the same bats, and have not been required to extensively avoid impacts to foraging habitats of both bat species, it is unreasonable, and not necessary that the Coalpac Project be required to do so.

4.5 Existing Stability of Pagodas

Since the Coalpac Consolidation Project has never proposed an open cut mine that would remove these significant features, the major issue the PAC Report had was the potential damage that would be incurred on the SPLs as a result of blasting vibration and subsidence from highwall mining. Some comments from the PAC-nominated experts are provided below.

Washington & Wray, 2011, from Page 133 state that “pagodas are quite geologically stable”:

The major impact on the pagodas has been subsidence due to longwall coal mining, where the ground surface can drop by up to 1.5 metres. While pagodas are quite geologically stable under normal conditions, the stresses of subsidence both crack pagodas and cause extensive cliff collapses.

Note that the highwall mining methods proposed for the Project are considered to be much more stable than longwall mining methods, and minimal subsidence (< 20 mm) is predicted to occur (GEONET 2011). Hebblewhite (2013) and GEONET (2013a, b) provides further comment on these aspects.

In addition, comments from the Blue Mountains Conservation Society infer that the slopes formed by open cut mining would contribute to the destabilisation of pagodas, and ultimately lead to failure. Geotek Solutions (GeoTek Solutions 2013) has provided expert comment on the stability of Sandstone Outcrops and SPLs in relation to open cut mining slopes, and has concluded that there are no inherent stability issues.

Muir, 2005 Page 13, 14 also describes the pagoda stability in terms of geological time:

"Pagodas increase their relief relative to the spurs upon which they stand at a rate of 3–14 metres every million years until they collapse via flank retreat (~25 m/My) or spur slopes are consumed as gorges widen (Wilkinson et al., 2005)."

4.5.1 Can Mining and Pagodas co-exist?

Washington & Wray, 2011, from Page 141, 142 state:

"Despite these significant values, the geoheritage of the pagodas is still under threat, largely due to underground longwall coal mining, but also due to damage by human trampling. There have however been advances over the years as recognition of their geoheritage value has increased. For example, the orientation of some coal mining longwalls have been changed, or terminated earlier, to protect particular pagoda formations (e.g. Oakbridge Colliery stopped a longwall short of the 'Artefact' pagodas in Baal Bone Colliery…). Protection zones have also been created in coalmine operation plans to protect some areas containing pagodas and swamps. The use of 'bord and pillar' coalmining can reduce subsidence if the pillars are retained (as Centennial Coal has agreed to do in some areas), and hence can protect overlying pagodas (emphasis added)."

Note that Hebblewhite (2013) has the same view as Washington and Wray (2011) and comments on the inherent stability of bord and pillar first workings and their similarity in nature and stability to highwall mining pillars.

Muir, 2005 Page 22 describes how appropriate regulation can allow coal mining to be carried out:

"By having regard to conservation of the area's natural and cultural values, coal mining operations can minimise their impacts on the proposed State Conservation Area. …. The recently-introduced coalmine subsidence management planning process should ensure that the values of the Gardens of Stone area are protected for future generations. Under subsidence management plans upland swamps, pagodas and cliff lines all qualify for protection from mine subsidence. Protection zones require parts of the coal seam to be retained to ensure that the surface environment does not experience environmentally unacceptable subsidence during mining operations."

The Coalpac Consolidation Project does not mine or disturb the surface in relation to any of these features, and specifically selected the Highwall Mining (HWM) method in order to reduce the damage potential to the Sandstone Outcrops and the gullies in the Ben Bullen SPL. Furthermore, the HWM method allows pillar widths to be increased or large blocks of coal left intact (i.e. no extraction), without any operational difficulty.

In the cases of Longwall and Bord & Pillar underground mining, management of pillar widths is much more difficult. This is particularly the case for longwall mining, as the longwall equipment is very expensive to relocate along the block to avoid SPLs without significant operational delays and increased costs.

The damage potential of alternate mining methods are summarised as shown in the following table.

Table 4.1 Damage Potential of Alternate Mining Methods

Mining Method	Coal extraction	Damage Potential for surface features
Open Cut Strip Mining	100%	Very High (certain)
Underground Longwall Mining	68% (typically)[1]	High
Underground Bord & Pillar Mining	55% (typically)[2]	Moderate
Highwall Mining	42%[3]	Low

1. Areas Measured using CAD software from Baal Bone Mine Plan, 11 panels to the immediate north of Invincible Colliery, including the area of mains on the western side of the panels. This area extracted 68% of the coal under the Wolgan SF SPL

2. Estimated as an average from measurements of area using CAD software at Invincible Colliery under the Ben Bullen SF SPL

3. Taken from the Coalpac Consolidation Project EA highwall mining study by Geonet Consulting Engineers (2011)

In summary it would appear that with appropriate management and mitigation measures (including avoidance, comprehensive design, adequate subsidence management plans, and pro-active regulation), highwall mining can recover an important NSW State resource and still afford adequate protection for the Sandstone Outcrops and the gullies in and adjacent to the Ben Bullen SPL.

4.6 Conclusion

Pagoda landforms are rock formations that have substantial conservation values. They are of considerable interest geologically, and the vegetation and rock outcrops of the pagoda landforms do provide habitat for species of conservation values (although there is no compelling evidence that such species are consistently “pagoda dependent”).

Where they predominate in a landscape, we recognise that they form SPLs. Washington and Wray (2011) have attempted to broadly map these landscapes and have estimated that they occur over an area of 60,000 ha. The higher resolution of the Cumberland Ecology mapping has focussed on the SPLs as areas of higher ecological and biodiversity values, and has not included the intervening landscape. In addition, we have identified additional lands outside this mapped area including Significant Pagoda Landscapes in Wollemi National Park and Buddawang National Park and note that they are considerably more widespread than stated in Washington and Wray (2011).

SPLs are currently conserved within a number of National Parks including Wollemi, Morton and Gardens of Stone.

We have now mapped the SPLs within the Project Boundary and note that they are confined to an area in the southeast of the Invincible mining area only, and that they do not occur in other mining areas in the northern part of Invincible, or the East Tyldesley and Cullen Valley mining areas.

The Exhibited Project made provision to protect pagoda landforms, and associated cliffs and caves and it is concluded by GEONET (GEONET 2011, 2013a, b) and Hebblewhite {Hebblewhite, 2013 #5266} that highwall mining will have a negligible impact upon such features. Notwithstanding that, the mine plan has been contracted away from the mapped Ben Bullen SPL within the Project Boundary and the new proposal for the Contracted Project mine plan is presented in **Chapter 7**.

Chapter 5

Analysis of OEH Information Supplied to the PAC

5.1 Analysis of Information Requested from OEH

Following the public hearings, the PAC wrote to OEH and requested further information about ecological and conservation matters. Specifically, the PAC requested information about:

- Options for mitigating impacts to flora and fauna associated with pagodas and adjacent areas;
- The significance of additional species reported from the Project Area; and
- The significance of vegetation on the Permian sediments.

Terry Bailey of the OEH wrote back to Dr Shepherd of the PAC on 6th of November 2012 and enclosed three responses to the aforementioned issues. The PAC has evidently placed great weight on the OEH responses and many of the PAC conclusions and recommendations concerning biodiversity seem to be based upon information provided in the OEH enclosures to the Bailey letter. Cumberland Ecology has now had the belated opportunity to consider these responses and has reviewed them in the following sections of this Chapter.

Peter Christie of the OEH also wrote to the PAC on 4th of December 2012, stating:

> "*I write with reference to the meeting of representatives of the Office of Environment and Heritage (OEH) with the Planning Assessment Commission (PAC) on 7th November 2012 at which OEH presented additional information in response to specific requests from the PAC. At this meeting, a number of additional issues were raised with regard to the assessment of and impact to Aboriginal cultural heritage and the foraging habitat for bat species*."

Peter Christie then supplied further information on the value of the Project Boundary for threatened bat species in letter dated 6th November 2012.

In the final section of this chapter, Cumberland Ecology reviews and responds to the letter from Peter Christie about the value of the Project Area for threatened bats.

5.1.1 Options for Mitigating Impacts to Flora and Fauna Associated with Significant Pagoda Landforms and Adjacent Areas

According to Enclosure 1 of the OEH letter dated 6th November, the PAC requested the following information from OEH:

> *"with regard to potential impacts of highwall mining on pagodas and adjacent areas, OEH's views on options for mitigating impacts to flora and fauna associated with these areas, including an assessment of critical habitat in proposed high wall areas."*

It is notable that the PAC asked OEH for "*options for mitigating impacts to flora and fauna*", including "*critical habitat*". OEH responded by stating that "*critical habitat*" has a specific meaning under the TSC Act and that no critical habitat occurred for any species in the Project Boundary. OEH therefore wrote:

> "*The following assessment has taken the PAC's reference to critical habitat to mean habitat that is crucial to the survival of local populations of particular species based on knowledge of their specific requirements."*

No definition was in turn given by OEH for "*crucial*" (and the term is not referred to in the TSC Act, EPBC Act or threatened species survey guidelines) but the Oxford Dictionary meaning is "*decisive or critical*" and so we take this to mean habitat essential for the survival of local populations.

For the purposes of threatened species assessments, the term "*local populations*" has a meaning under Section 5A of the EP&A Act and refers to populations that occur within the subject land (or Project Boundary). The OEH Enclosure 1 to the letter dated 6th November, lists the following species for consideration as important local threatened species:

- Broad-headed Snake;
- Cave Roosting Bats (Eastern Bentwing-bat and Large-eared Pied Bat); and
- Brush-tailed Rock Wallaby.

It is notable that there are no known local populations of the Brush-tailed Rock Wallaby or the Broad-headed Snake that use the Project Boundary, as stated in the Ecological Impact Assessment. Although potential habitat for these species occurs, the species have not been found in the land proposed to be mined. Cumberland Ecology appropriately concluded that the Project Boundary has potential habitat for these species in the Ecological Impact Assessment and the Response to Submissions.

However, for the purposes of preparing this report, we spoke with a recognised expert in the Broad-headed Snake, Jonathon Webb, who has surveyed Ben Bullen State Forest for the snake in the past. He has co-authored most of the recent literature on the species and has surveyed for the snake in the western Blue Mountains and elsewhere (Webb and Shine 1997a, Webb J. K. & Shine R. 1997c, a, b, Webb and Shine 1997b, Webb and Shine 1998, Webb J. K. & Shine R. 1999, Webb et al. 2005). He notes from past experience that the

Broad-headed Snake habitats of Ben Bullen are in poor condition and he believes that this is largely as a result of past collections of the species made by illegal reptile collectors. As such we believe there is no verified local population of the species in the Project Boundary. Moreover, the Broad-headed Snake record adjacent the Project Boundary was visited during habitat assessment by Dr Arthur White. His comment on the habitat at the location of the snake record stated "*the site was devoid of sandstone and was not habitat for the Broad-headed snake*". Dr White also noted during habitat assessment that "*the area in question is frequented often by bushwalkers and trail bikers and the snakes are not observed*. *The relative lack of prey species along most of the sandstone areas also implies that the snakes are likely to be very scarce in this area*". Dr White's report is provided in Appendix B.

In communications with the PAC, OEH proceeded to write exclusively about standoff zones as a means for mitigating impacts to threatened species, and has modelled various standoff zones (i.e. undisturbed vegetation buffers) that could be kept between the proposed future mine and pagoda habitat.

Cumberland Ecology notes that in Enclosure 1, OEH rapidly depart from what was requested by the PAC:

- Rather than discuss critical habitat, they redefine it as "crucial habitat" and discuss crucial habitat;
- OEH only discusses fauna associated with pagodas and adjacent areas, not threatened plants;
- Species that are not known to occur in the Project Boundary (e.g. Brush-tailed Rock Wallaby) are treated as local populations;
- OEH maps "*geodiversity features*" across the Project Boundary but this term includes pagodas, cliffs, large and small rock outcrops, and in some cases simply hill tops that are not rock outcrops whereas the PAC requested information about pagodas and adjacent area (presumably the deeply incised valleys); and
- The term "*mitigation*" is solely interpreted by OEH as being standoff zones, whereas there are many different types of mitigation strategies available for consideration including rehabilitation of mined land, creating artificial habitat (in the case of Broad-headed Snake), pre-clearance surveys, seasonal clearing to avoid the certain stages in threatened species lifecycles, reduction of feral predators such as foxes and cats, protection of habitats in nearby areas, etc.

OEH has assumed that the only way to mitigate the impacts of mining is with the use of buffers (standoff zones) and the zones considered range from 50 m, as proposed in the Exhibited Project mine plan, through to 780 metres. The latter distance is the greatest distance a Broad-headed Snake has been measured as travelling from an escarpment in Morton National Park, 160 km to the south of the Project, in different habitats to those that occur on site. We do not consider this to be a valid approach to mitigation for this Project.

Cumberland Ecology believes that the analysis by OEH is flawed in a number of respects. First, after consultation with Dr Webb, and reading current literature about the species (Webb and Shine 1997a, Webb J. K. & Shine R. 1997c, a, b, Webb and Shine 1997b, Webb and Shine 1998, NSW National Parks & Wildlife Service 1999, NSW NPWS 1999b, Webb J. K. & Shine R. 1999, DECC (NSW) 2005, Webb et al. 2005, Newell D. A. & Goldingay R. L. 2005., SEWPAC 2013a) we understand that the species if often absent from ostensibly suitable sites on pagodas and cliffs. The reason for this is that illegal collection of bush rock and/or snakes has denuded or destroyed such habitats, particularly in accessible areas such as Ben Bullen State Forest.

As such, buffers from open cut mining areas would not protect the snake. Based on the results of Cumberland Ecology surveys and consultation with Dr Webb, it seems that the snake may not even be present. In addition to that, and if it were present it seems that better alternatives would be available to mitigate impacts on the Broad-headed Snake. Based on the recent literature and upon consultation with Dr Webb, these include but are not limited to:

- Clearing forest and woodland mapped as potential habitat (mapped by Dr Arthur White in **Figure 1** of **Appendix B**) within the Contracted Project Disturbance Boundary during winter, when snakes may be sheltering under rocks in such habitats;

- Conducting preclearance surveys in selected areas in winter when snakes may be sheltering under rocks. Captured snakes to be relocated into suitable habitat areas to the east in the Ben Bullen State Forest;

- Ensuring that there remains undisturbed forest around some portions of the SPL and Sandstone Outcrops (as there will be to the north, east and south of the Ben Bullen SPL of the Contracted Project);

- Replacement of bushrock and the use of artificial shelter sites on Sandstone Outcrops and the SPL in rehabilitation, as these have been shown to increase the occurrence of both snakes and their preferred food, the Velvet Gecko;

- Maintaining some hollow trees at the bases of the Sandstone Outcrops and the SPL (Cumberland Ecology have verified that hollow trees will remain within the 50 m wide standoff zone between the Sandstone Outcrops and the SPL and the edge of the proposed open cut);

- Rehabilitating vegetation within the mined areas to eventually replace the vegetation cleared;

- Provision of funding for an indirect offset that entails funding for additional habitat surveys of Broad-headed Snake in the wider area of the western Blue Mountains to further the knowledge of the species (as suggested by Webb pers. comm. 2013).

Cumberland Ecology has been engaged to monitor Brush-tailed Rock Wallabies for the past ten years at Shannon Creek, west of Grafton and has a good understanding of the species and its ecology. We note that like the Broad-headed Snake, the Brush-tailed Rock Wallaby

is absent from many ostensibly suitable sites and understand that its absence is largely if not entirely due to predation by foxes. Hence, irrespective or any standoffs provided in the Project Boundary, Brush-tailed Rock Wallabies are unlikely to return to habitats in and near the Project Boundary unless foxes are controlled. Several foxes were recorded from the Project Boundary and they are considered to be relatively abundant in the area and in Ben Bullen State Forest.

As described earlier in this chapter, SPL areas only occur in the southeast of the Project Boundary and do not occur in the north and north-west of the Project Boundary. For this reason, when OEH maps and analyse what is purported to be "geodiversity features and alternative standoff zones" they have mapped broad areas of potential standoff zones around areas where there are clearly no SPLs. They have then extended boundaries out to 318 or 780 metres from such areas to consider benefits for wildlife.

Cumberland Ecology has been engaged to work for Department of Planning and Infrastructure to peer review the flora and fauna assessments of proposed mining extensions for the Ulan and Moolarben Coal Mines. Cumberland Ecology has also prepared ecological assessments of the Emirates Wolgan Valley Resort in a nearby section of the Blue Mountains. These three developments are in land that has essentially the same threatened species issues as the Coalpac Consolidation Project. However, none of these approved developments have had 318 metre standoff zones proposed to protect flora and fauna habitats from sandstone pagodas, cliffs and caves. There is no reason to do so for the Coalpac Consolidation Project.

The OEH Enclosure 1 states that the Threatened Species Profile Database (TSPD) of OEH is the repository for threatened species information used by the "Biometric Tool for Property Vegetation Planning and BioBanking". OEH stated that for the Broad-headed Snake, Brush-tailed Rock Wallaby and the two threatened bats the TSPD prescribes a 500 metre buffer between cliffs and escarpments and proposed developments. I have examined the literature on each of these threatened species on the TSPD and note that each has a list of priority actions to recover the species. These priority actions have been reproduced for each species and are shown in **Appendix D**. I note that none of the priority actions specify such a large buffer area. In fact, no buffers are suggested at all for any of the species priority actions.

I also note that the Coalpac Consolidation Project is a State Significant Development (SSD) proposal. As such, assessments do not need to consider the Biometric Tool for Property Vegetation Planning. The Biometric Tool has been developed for use in rural areas and is not applied to SSDs. Similarly, Bio-Banking does not apply to the Project as the proponent has not elected to use Bio-Banking.

Cumberland Ecology staff made inquiries about the 500 metre buffer and have consulted OEH staff. To date we have not been shown where this recommendation comes from, or the information upon which it is based.

i. Conclusion

The information supplied by OEH to the PAC in Enclosure 1 about mitigating impacts to flora and fauna associated with pagodas and adjacent areas is flawed. The species considered will not necessarily benefit from such large standoffs, a range of alternate mitigation measures are available and recent mining projects in similar sandstone landscapes (e.g. Ulan and Moolarben Mines) have not been required to have standoffs of such large size.

The geodiversity features mapped and assessed by OEH should not be viewed as SPL. They include hilltop areas that neither have significant cliffs nor pagodas.

5.1.2 Significance of Additional Species Reported from the Project Area

According to Enclosure 2 of the OEH letter dated 6th November, the PAC requested the following information from OEH:

"with regard to reports by Special Interest Groups of additional threatened species that were not reported in the Environment Assessment, OEH's response to the significance of these species, and suggested steps to avoid, mitigate or manage the impacts to them."

In Enclosure 2, OEH noted that Cumberland Ecology had listed and considered all of the threatened fauna considered likely to use the habitats within the Project Boundary.

OEH wrote that a representative of the Special Interest Groups identified a number of plant species from within the Project Boundary that were not discussed in the EA and these included "rare" plants ("ROTAP" = rare or threatened Australian plants) after a publication by Briggs and Leigh (1995).

OEH note that the ROTAP species are not listed threatened species. However, OEH state "*considering their restricted distribution and the general lack of information on the reservation status of three of these species, OEH considers that potential impacts to them are of concern*. *Moreover, in the absence of detailed assessment information, OEH cannot gauge the significance of predicted or potential impacts resulting from the Project*."

For the purposes of this report, Cumberland Ecology has analysed the distribution of the ROTAP species in question and all other species mentioned by the Special Interest Groups and the PAC as being reliant upon or strongly associated with pagodas. The results of these analyses are provided in Appendices B and C. The results show that essentially none of the ROTAP plant species occur only in the area proposed to be mined. The results also show clearly that the distributions of such species are:

- Not restricted to pagoda landforms – they occur in many other areas, including areas with different geology and geomorphology;
- Not particularly close to the area proposed to be mined; and
- Quite unlikely to be significantly directly impacted by mining.

Special Interest Groups also recorded several ROTAP species within the Project Boundary (**Figure 5.1**). As demonstrated in **Figure 5.1** the majority of ROTAP species occur well beyond the Contracted Project Disturbance Boundary and therefore will not be directly impacted by the Project.

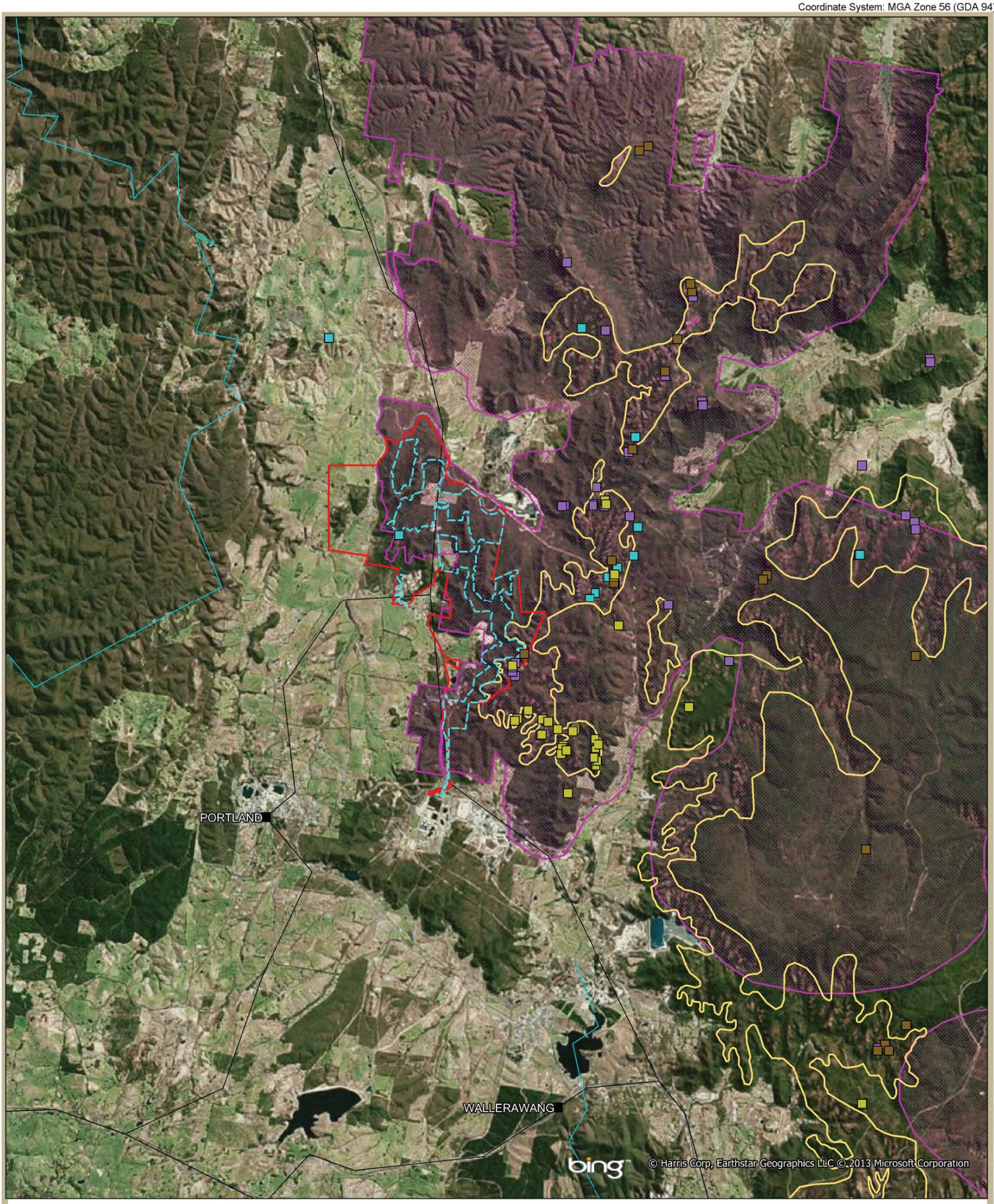


Figure 5.1. ROTAP Species recorded in the Region

Similarly, OEH identified six threatened plants that it believes may not have been surveyed for, and therefore missed, within the mining area. Cumberland Ecology has prepared assessments for these species, including maps and species profiles (**Appendix F**). These species include *Acacia bynoeana*, *Prostantera stricta*, *Darwinia peduncularis*, *Persoonia acerosa*, *Thesium australe* and *Euphrasia arguta*.

We note that none of these species are particularly likely to occur in the area to be mined, though several could occur either in the areas proposed to be avoided by mining (eg *Thesium* in the Box Gum Woodland). We reiterate in this report that we are familiar with all species except *Prostanthera*, having found them on other Project sites, and have surveyed for them in the Project Boundary without locating them. Furthermore, surveys by the Special Interest Groups also did not locate these species in the Project Boundary.

A summary of each species analysis during the preparation of the EA is provided below. For more information on habitat requirements and distribution see **Appendix F**.

Acacia bynoeana records in NSW occur largely east of the Great Dividing Range and within the Blue Mountains National Park. One records within the Lithgow LGA since 1980 and is located near Bogee approximately 30 km from of the Project Boundary. The Project is west of the Great Dividing Range.

Prostantera stricta occurs in the Widden Valley district of New South Wales. The species is also known from Mt Vincent and Genowlan Mountain in the Central Tablelands. The species is found at Dingo Creek and the Widden and Baerami Valleys in the Central Western Slopes. Known records within Lithgow LGA occur around Capertee Valley and further north. The closest record is approximately 15km away. Furthermore, there are no riparian zones in the Project Boundary for this species.

*Darwinia peduncularis o*ccurs as local disjunct populations in coastal NSW with a couple of isolated populations in the Blue Mountains. Within the Lithgow LGA known records occupy habitats within Wollemi National Park. The closest known record is approximately 20 km north east of Project Boundary.

Persoonia acerosa is not well known in the Lithgow LGA, and is more common south east of the Lithgow LGA. The closest record occurs in Newnes State Forest approximately 25 km south-east of the Project Boundary.

Thesium australe and *Euphrasia arguta* are not known to occur in the Project Boundary or even within the Lithgow LGA.

We note that OEH on the one hand cannot be assured that these six plant species do not occur in the Project Boundary, as OEH does not accept the statements made by Cumberland Ecology about the EIA survey effort, and OEH has not mapped or checked previous database records in nearby sites. Yet, on the other hand, again without conducting surveys or database assessments, OEH states it "*considers it unlikely that these species would occur within the offset areas currently proposed by the Proponent."* This approach is at best inconsistent between impact areas and offset areas, and at worst, seems to show a

bias in the assessment process. The outcome has been that the PAC has received misleading information from OEH.

The shrub *Bursaria spinosa* subspecies *lasiophylla* is a plant that is fed upon by larvae of the Endangered Purple Copper Butterfly. We note that OEH mentions that this species of plant has been found as scattered individuals in the far north of the proposed Project Boundary and in the south east. This means that the Purple Copper Butterfly could conceivably occur in the Project Boundary and be impacted by the proposed open cut. Although these scattered potential food plants for the Butterfly were not located by Cumberland Ecology, the EA noted that an impact on the species was possible (as stated in the EA Appendix J, p.3.32). We maintain that the paucity of *Bursaria* in the open cut area is such that impacts to the Butterfly are not likely to be major.

i. Conclusion

Enclosure 2 within the OEH letter indicates that Cumberland Ecology had considered the impacts of the Project on all likely threatened fauna species listed under the EPBC Act and TSC Act.

We believe that we have also considered all potential impacts to threatened flora, as required by the DGRs. We have now also considered impacts to ROTAP plants mentioned by the Special Interest Groups and the OEH, which is not what was required by the DGRs. Our analysis has shown that no significant impacts are likely to ROTAP species.

Our analysis of "pagoda-dependent" flora and fauna has also shown that most such species are not restricted to pagoda landform habitats and occur much more widely (see **Appendix C**). Those that do have a more restricted distribution are generally found outside the areas proposed for mining and are unlikely to be significantly impacted. As stated earlier in this chapter, the great majority of Significant Pagoda Landforms are located well away from the Project Boundary and no SPLs are considered likely to be damaged or indirectly impacted by the Project in a way that would create a significant impact upon such species.

We believe that the PAC has placed too much emphasis on protection of "pagoda-dependent flora and fauna".

5.1.3 The Significance of the Vegetation on Permian sediments

According to Enclosure 3 of the OEH letter dated 6th November, the PAC requested the following information from OEH:

"OEH's response to an assertion by the Colong Foundation for Wilderness that the underlying geology of the Project Area (Permian sediments of the Illawarra Group that have produced rolling and flattish terrain of higher nutrient levels) is different to surrounding areas and that this has implications for the conservation value of the Project Area"

Cumberland Ecology has reviewed this assertion and it is agreed that some of the forest and woodland communities on the lower slopes occur on soils derived from Permian sediments that contain higher levels of nutrients than soils derived from Narrabeen Sandstone. Increased fertility does mean that vegetation can produce more food, and so support more insect prey for bats and other fauna, than areas of lower fertility.

Figure 5.2 demonstrates the occurrence of Permian sediments within a specific area known as the Western Coalfields (Southern Part) Plan (Yoo, E.K., 1998, Western Coalfield Regional Geology (northern part) 1:100,000, 1st edition. Geological Survey of New South Wales, Sydney). This Plan covers approximately 355,315 ha. Approximately 43,903 ha of Permian landscape has been mapped throughout the Plan and is illustrated as brown in **Figure 5.2**. Approximately 835 ha occurs in the Project Boundary, and of this, approximately 645 ha will removed during open cut mining and put back during rehabilitation. This equates to the removal of 1.46% of Permian landscape occurring across the Western Coalfield (Southern Part) Plan. Notwithstanding some of the Permian landscape would occur on cleared land, a large proportion occurs as bands along the western side of the Great Dividing Range which contains large National Parks such as Wollemi National Park and Gardens of Stone National Park. As such, a high proportion of such landscapes are already within conservation reserves.

Communities that occur on the higher fertility Permian sediments that will be impacted by the Project are discussed in Chapter 8 and include:

- Tableland Gully Ribbon Gum Blackwood Applebox Forest;
- Capertee Rough-barked Apple - Red Gum - Yellow Box Grassy Woodland (Box Gum Woodland listed under the EPBC Act);
- Capertee Rough-barked Apple - Red Gum - Yellow Box Woodland: non grassy;
- Tableland Broad-leaved Peppermint - Brittle Gum - Red Stringybark Grassy Woodland;
- Tableland Slopes Brittle Gum – Broad-leaved Peppermint Grassy Forest;
- Tableland Gully Mountain Gum - Broad-leaved Peppermint Grassy Forest; and
- Cox's Permian Red Stringybark - Brittle Gum Woodland.

We maintain the view that we have adequately identified and mapped vegetation communities that occur on soils derived from Permian sedimentary rocks. Furthermore, we have discussed the conservation values of these and note that some are not well represented in conservation reserves. It is inevitable that there will be some disagreement regarding the identification vegetation community boundaries, and this is evidenced by the many different formal community descriptions for a single community. Cumberland Ecology still stands by their mapping and the occurrence of Box Gum Woodland based on quadrat data (a method not employed by OEH in their mapping of the Project Boundary) and our extensive experience on Box Gum Woodland.

What is important to note is that Cumberland Ecology's mapping addresses OEH's concerns by identifying vegetation on Permian sediments that have been over-cleared and are poorly represented. Of the list of impacted vegetation on Permian sediments (above,), several have been identified as conservation significant vegetation on Permian sediment due to clearing and poor reservation. These include:

- Tableland Gully Ribbon Gum Blackwood Applebox Forest;
- Capertee Rough-barked Apple - Red Gum - Yellow Box Grassy Woodland (Box Gum Woodland listed under the EPBC Act);
- Tableland Slopes Brittle Gum – Broad-leaved Peppermint Grassy Forest; and
- Tableland Gully Mountain Gum - Broad-leaved Peppermint Grassy Forest.

It is important to note that these communities (except Capertee Rough-barked Apple - Red Gum - Yellow Box Grassy Woodland is listed under the EPBC Act and TSC Act) are not listed as endangered or even vulnerable under NSW or Commonwealth legislation.

The Contracted Project mine plan was modified to protect the most extensive remnants of Capertee Rough-barked Apple - Red Gum - Yellow Box Grassy Woodland. Similarly, other significant vegetation communities that OEH said were over cleared and poorly represented in conservation reserves have also been avoided to varying degrees (see **Section 9.1**). This is discussed briefly below.

Permian geology, and so vegetation on Permian-derived soils, is widespread in the locality, as shown within **Figure 5.2**. Such soils do occur in local National Parks and State Forests including:

- Gardens of Stone National Park
- Turon National Park;
- Ben Bullen State Forest;
- Sunny Corner State Forest; and
- Wolgan State Forest.

As outlined in Chapter 9, an offset package is proposed so as to compensate for residual ecological impacts of the Contracted Project. Amongst the current offsets, there are four properties that contain vegetation of more fertile habitats – Gulf Mountain, Yarran View, Hyrock-Hartley and Hillview-Billabong. The two latter properties contain a suite of vegetation types on Permian sediments and are located in close proximity to the Project Boundary.

As explained in Chapter 9, the offset package is proposed to be expanded by the acquisition of additional lands of approximately 1,007 ha, to bring the offset ratio for forest and woodland vegetation to a minimum of 4:1. The target for acquisition of the additional area required should therefore be forest and woodland on Permian sediments, so as to boost the area of such vegetation held in conservation.

Additionally, Coalpac will progressively rehabilitate the mined land using local native species. In the long term, many of the plant species that dominate the areas with Permian soils will be regenerated.

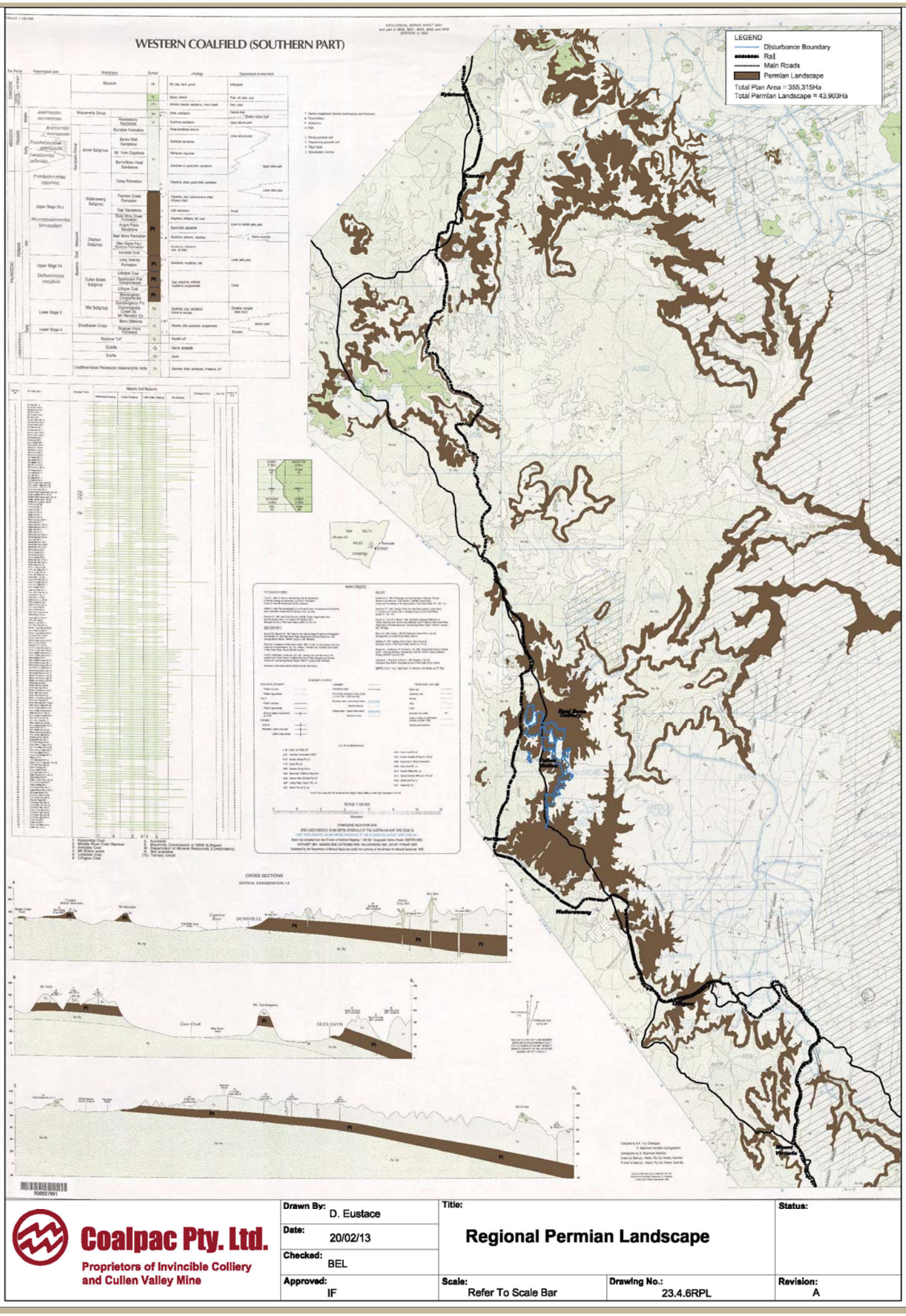


Figure 5.2. Regional Extent of Permain Landscapes (Base map Source: Department of Mineral Resources 1992)

5.1.4 Analysis of Natural Vegetation of the Wallerawang 1:100,000 Map Sheet (Benson and Keith 1990) and the Project Boundary

On the 28th September 2012, the Colong Foundation for Wilderness (a special interest group) fulfilled a request by the PAC to provide further information on the importance of vegetation on Permian sediments.

In their letter to the PAC, the Colong Foundation make reference to vegetation mapping of the Project Boundary by Benson and Keith (1990). Cumberland Ecology has reviewed this mapping and finds the vegetation descriptions broad (some map units contain complexes of several community types and capture a variety of different habitats) and crudely maps vegetation across the Project Boundary. We note that OEH also make mention that Benson and Keith's regional scale mapping of 1:100,000 scale was not appropriate for use in the development of Western Blue Mountains Mapping scale of 1:25,000 (DEC (NSW) 2006).

OEH also made recent comment in Enclosure 1 of OEH letter to PAC dated 6th November saying:

> *Benson and Keith (1990) map a complex of several vegetation types on Permian sediments without discriminating between the individual types comprising the complex.*

After conceding that the Benson and Keith (1990) mapping is coarse, the Colong Foundation accuses Cumberland Ecology of producing misleading vegetation mapping by labelling what they believe to be a poorly conserved map unit "10h Tableland Grassy Woodland Complex" (Benson and Keith 1990) as Exposed Blue Mountains Sydney Peppermint - Silvertop Ash Shrubby Woodland, a community containing two of the most commonly found eucalypt trees in the Great Blue Mountains Region,

Cumberland Ecology has reviewed Benson and Keith mapping of the Project Boundary and despite the Colong Foundation Group assertions, we find that the "10h Tableland Grassy Woodland Complex" does not occur in the Project Boundary or adjacent the Project Boundary (**Figure 5.3**).

Overall, we believe that Benson and Keith's mapping is now dated and relatively inaccurate (as acknowledged by OEH (2006)). It is mapped at a coarse scale and is not as fine grained as the mapping that we produced for the EA. For example, during our review of Benson and Keith's mapping of the Project Boundary, we noted the following coarse features of the mapping:

- Benson and Keith (1990) map seven vegetation types and complexes across the Project Boundary (**Figure 5.3**). Cumberland Ecology has mapped 19 different vegetation communities across the Project Boundary including a number of conservation significant communities mentioned in **Section 5.1.3** (**Figure 8.1**);
- The slopes and forested valley floor has been mapped as "*10i Talus-slope Woodland"* not "*10h Tableland Grassy Woodland Complex"* by Benson and Keith (1990) (see **Figure 5.3**).

- The description of "*10i Talus-slope Woodland"* is broad and covers the following different habitats;
    - Exposed dry slopes (low rainfall);
    - Sheltered slopes;
    - Groundcovers from scattered clumps of grass on bare rocky hillsides to a herbaceous ground layer on sheltered sites;
    - Creek banks and small flats.
- "*10i Talus-slope Woodland*" contains a number of trees species that were not recorded by Cumberland Ecology or Special Interests Groups in the Project Boundary such as, *Eucalyptus fibrosa* (Red Ironbark), *E. polyanthemos* (Red Box), *E. cypellocarpa* (Monkey Grey Gum) and *E. punctata* (Grey Gum).

It is evident that map unit "*10i Talus-slope Woodland"* contains a diverse array of habitats that Cumberland Ecology has used to separate the complex into individual vegetation types. This mapping does provide some useful information on broad vegetation patterns in the Project Boundary, but should not be used to compare such mapping due to is broader scale.

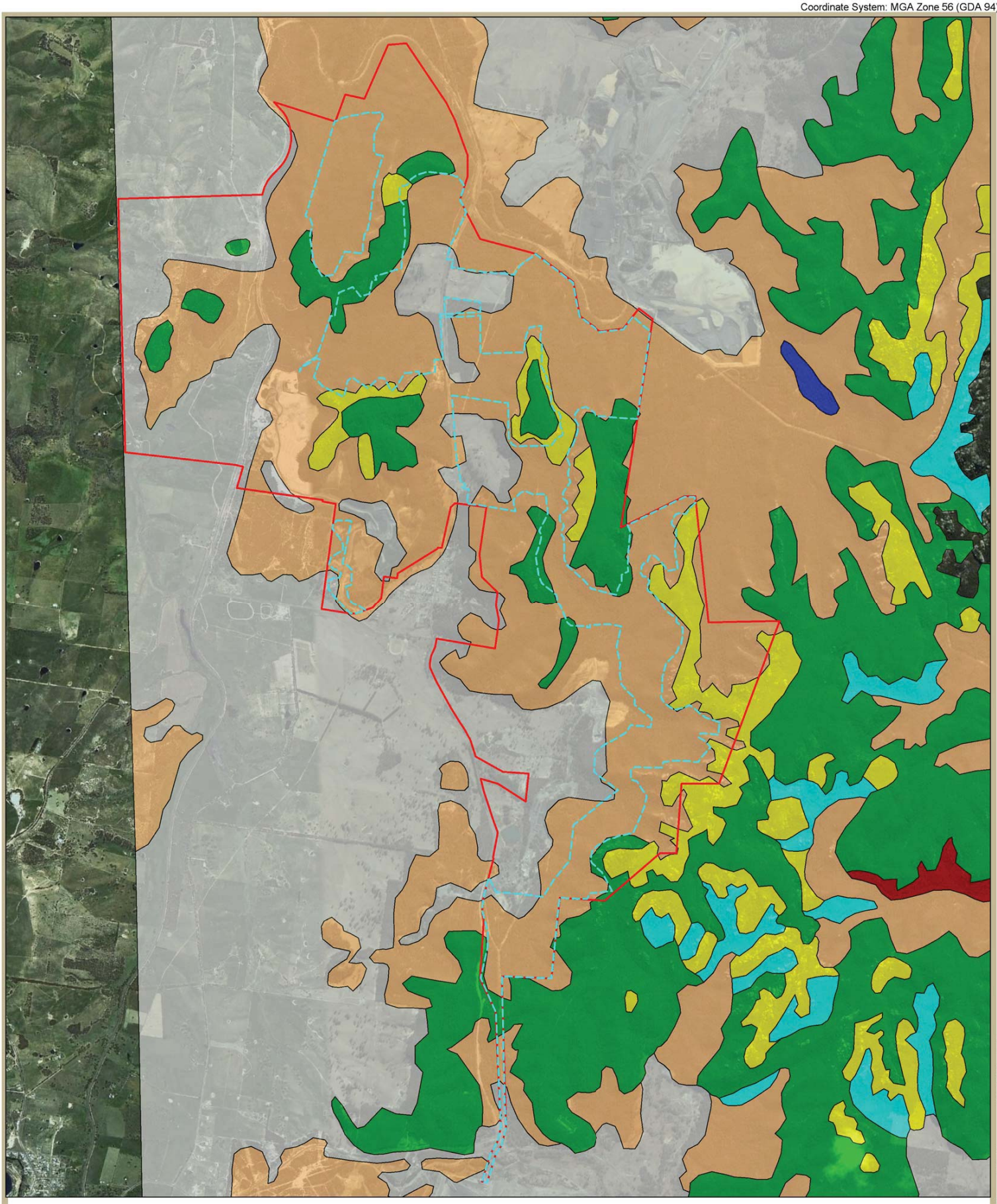


Figure 5.3. Benson and Keith (1990) Vegetation Mapping of the Project Boundary

5.1.5 Presence of Box Gum Woodland and Derived Native Grassland

Despite OEH's assertions in their letter to the PAC dated 6th November 2012, we maintain the view that Box Gum Woodland is present in the Project Boundary. This is because we assessed the vegetation and followed both the State and Commonwealth guidelines for identifying Box Gum Woodland (DEH 2006, Threatened Species Scientific Committee 2006, DECC (NSW) 2007). The guidelines clearly state that quadrats must be used in order to determine the presence of Box Gum Woodland and/or Derived Native Grassland. This guideline was not followed by OEH during their assessment of the vegetation.

Our assessment approach is set out in Section 2.3.2 of the Exhibited EIA.

The SEWPaC policy statement (DEH 2006) asks a series of questions to guide the confirmation of the presence of CEEC Box Gum Woodland and is provided below in italics. Answers to these questions relating to the Box Gum Woodland in the Project Boundary are provided in normal text following each question in italics.

- *"Is it or was it one of the most common overstorey species White Box, Yellow Box or Blakely's Red Gum?"*

Cumberland Ecology found *Eucalyptus blakelyi* (Blakely's Red Gum) to be locally dominant in areas mapped as Box Gum Woodland. OEH support this observation on Page 15 of Enclosure 1 of OEH letter to PAC dated 6th November 2012, by stating "*the species [Blakley's Red Gum] can be locally dominant."*

- *"Does the patch have a predominantly native understorey (understorey consists of more than 50% perennial species)?"*

Cumberland Ecology can confirm that the native understorey is predominantly native in quadrats.

- *"Is the patch 0.1 ha or greater in size?"*

Cumberland Ecology can confirm that the patch sizes are greater than 0.1 ha in size.

- *"There are 12 or more understorey native species present (excluding grasses). There must be at least one important species (SEWPaC provide a list of characteristic species and identifies important species)."*

Cumberland Ecology can confirm that more than 12 understorey species (excluding grasses) and at least one important species were recorded in the quadrats of Box Gum Woodland in the Project Boundary (see Appendix A of the Exhibited EIA).

NSW and Commonwealth guidelines also describe the community as having a grassy understorey dominated by tussock grasses (Threatened Species Scientific Committee 2006) and OEH (NSW NPWS 2003, NSW Scientific Committee 2004c, NSW NPWS 2005, DECC (NSW) 2007).

In the OEH letter to the PAC dated 6th November 2012, OEH describe *a ground layer dominated by grasses such as cool temperate species such as Snow Grass [a tussock grass].* Cumberland Ecology can also confirm this.

Below are a series of photographs within areas mapped as Box Gum Woodland in the Project Boundary.

Photograph 5.1 Box Gum Woodland in the Project Boundary. Note the grassy ground layer and dominance of large smooth barked Blakely's Red Gums.

Photograph 5.2 Box Gum Woodland in the Project Boundary. Note the grassy ground layer and dominance young smooth barked Blakely's Red Gums.

5.1.6 Value of the Project Area for Threatened Bat Species

The letter from Peter Christie to the PAC on 4th of December 2012 contained the following statements about bat habitat:

"OEH has presented information to the Department of Planning and Infrastructure and to the PAC with regard to the considerable known and potential value of foraging and breeding habitats within and adjacent to the Project Area for the threatened bat species Large-eared Pied Bat (Chalinolobus dwyeri) and Eastern Bentwing Bat (Miniopterus schreibersii oceanensis). At the 7 November meeting, OEH also presented information that demonstrated a large portion of the Project Area consists of wet and dry grassy forests and woodlands that are characteristic of the Southern Tablelands, and that consequently the Proponent had over-represented Sydney Sandstone vegetation types that typically occur on less fertile soils.

It has been asserted by the Proponent that the latter vegetation types are well represented within the large areas of NPWS Estate to the east of the Project Area, which therefore provide considerable alternative habitat for these bat species. However, given the relative fertility of soils upon which they occur and the resulting greater productivity of these ecosystems (including macroinvertebrate prey items), habitats within the Project Area are

likely to be of greater foraging value for bats than Sydney Sandstone vegetation types. OEH therefore considers that a lack or unsatisfactory level of avoidance of foraging habitat by the Project may have significant implications for local threatened bat populations. Suggested avoidance and mitigation of impacts to foraging habitat (in the form of supportable standoff zones) were presented to the PAC at the 7 November meeting."

Cumberland Ecology has completed species profiles and mapped the known occurrences of both bat species and these are provided within **Appendix C**, sections C 2.2 and C 2.3 respectively. The analyses show that both bat species noted by OEH are widespread across the Blue Mountains, and in the case of the Eastern Bentwing-bat, across other landscapes further east extending to the coast. On this basis, we maintain the view that vegetation types that support both bat species are well represented to the east of the site and within various National Parks, including the Gardens of Stone National Park and the Blue Mountains National Park.

OEH has claimed that a lack of avoidance of more fertile forest and woodland types by the Project may have "significant implications" for local threatened bat populations. What such "significant implications" mean is not stated, but presumably OEH are implying that local populations of the bats could become extinct.

Our analysis of the species profiles and mapped records for both species suggests that the species and their local populations would be secure, even in a worst case scenario whereby the entire mine site is not rehabilitated (which is not proposed). This is not only because extensive habitats are conserved to the east, but because broad areas of forest and woodland will remain unmined in the Project Boundary (e.g. the areas containing CEEC that have been avoided by the Contracted Project mine plan), areas around Cullen Bullen and Cullen Valley Mine, and areas west of the railway line that are not proposed for mining under the contracted mine proposal. Furthermore, extensive areas of undisturbed forest and woodland will also be retained in Ben Bullen State Forest and other areas to the north and north east of the Project Boundary. In addition, clearing for mining is progressive over the Project duration of 21 years, so that foraging habitat is not immediately removed, thereby minimising impact.

Given that Ulan and Moolarben Mine extensions occur in the same landscapes, and potentially affect the same bats, and have not been required to extensively avoid impacts to foraging habitats of both bat species, it is unreasonable, and not necessary that the Coalpac Project be required to do so.

Chapter 6

Compatibility with Gardens of Stone Stage 2 Proposal

6.1 Introduction

The PAC refuted claims made in the EA and Ecological Impact Assessment that rehabilitation would be successful for the Project and drew the following conclusions:

- *"The rehabilitated areas cannot be returned to their pre-existing landforms across the Project area (p155 PAC report);*
- *The biodiversity characteristics of rehabilitated areas cannot replicate the existing characteristics and will inevitably be less diverse and species rich (p155 PAC report); and*
- *The [Planning Assessment] Commission is not in a position to comment on the merits or otherwise of the Gardens of Stone Stage 2 reservation proposal. However, the Commission is in a position to conclude that the Project and reservation of Garden's of Stone Stage 2 are incompatible if reservation is intended to include Ben Bullen State Forest, either now or in the foreseeable future. The Commission is also of the view that significant scarring of the landscape will remain for decades, if not permanently (p155 PAC report)."*

In the submission to the PAC subsequent to the public hearing, OEH stated on page 10 of its formal submission:

> *"Given the level of biodiversity loss and topographical change as a result of mining, OEH has strong doubts that the proposed rehabilitation of the mine will contribute to the achievement of Gardens of Stone 2 reservation proposal. Accordingly, OEH does not support the addition of rehabilitated areas to the National Parks and reserves system at this time."*

In the submission to the PAC subsequent to the public hearing, OEH confirmed that its interest was in reservation of the entirety of Ben Bullen State Forest east of the Castlereagh Highway and north of Cullen Bullen. OEH stated on page 10 of its formal submission:

> *"OEH notes the Proponents allusion to the relative small proportion of the GOS2 proposal that would be affected by the Project (p.154). OEH assert that although the proportions are low (given the large extent of the GOS2 proposal), the impact of the Project on land of high reservation priority is nonetheless very large. Further, OEH*

reiterate that all of Ben Bullen State Forest is of reservation priority to OEH, and not just the area identified by the Colong Foundation that lies east of the Castlereagh Highway."

Cumberland Ecology is unaware of any State Government proposal for Gardens of Stone Stage 2. We have consulted with OEH to find out about such a proposal but no information (especially mapping) has been forthcoming from OEH and we note that no details of a formal proposal for Gardens of Stone Stage 2 were presented by OEH to the PAC.

The only proposal for Gardens of Stone Stage 2 we are aware of is one proposed by the Colong Foundation for Wilderness, Blue Mountains Conservation Society and the Colo Committee (Muir 2005) (i.e. SIGs). Cumberland Ecology has been informed that during meetings with Coalpac during February and March 2013, both OEH and the Office of the Minister for the Environment and Heritage advised that there is no existing proposal generated by Government, or under consideration by Government, to extend the Gardens of Stone NP. OEH and the Office of the Minister for the Environment further advised that no decision regarding the specific issue of the future conservation plans for BBSF would be made until after the Coalpac Consolidation Project had been determined.

This position is inconsistent with the PAC Review Report which states that "the OEH proposal is for the reservation of the whole of BBSF" and that, further, this proposal is "a high priority for OEH".

As such it should not be part of any Project assessment or determination process..The purpose of this Chapter is to consider the validity of the claims by OEH in its submission to the PAC, and the validity of conclusions drawn by the PAC about the compatibility of rehabilitation within the reserve system.

6.2 Impacts to Ben Bullen State Forest and Gardens of Stone Stage 2 State Conservation Area Proposal

In the EIA, Cumberland Ecology made the point that the area of mining proposed by the Project within Ben Bullen State Forest is small, relative to the overall area of the State Conservation Area Proposal. As discussed in Chapters 7-9 of this report, the proposed footprint of the open cut mine for the Contracted Project is proposed to be reduced substantially and so the area of the proposed State Conservation Area that would be mined and progressively rehabilitated is even smaller than was stated in the EA. The revised figures for predicted impacts to the proposed State Conservation Area are provided below.

Additionally, as covered in Section 6.3, the Gardens of Stone Stage 2 (GOS2) conservation proposal is for a State Conservation Area and under NSW legislation mining areas can be permitted.

6.2.1 Impacts to Ben Bullen State Forest

Ben Bullen State Forest covers approximately 6,783 ha. The Project is largely located within the State Forest, with approximately 1,442 ha of the Project Boundary (58%) lying within it. Of this, approximately 673 ha occurs within the Contracted Project Disturbance Boundary. Therefore the Project will result in the progressive removal and rehabilitation of 8% of Ben Bullen State Forest over 21 years, at an average rate of 32 ha per annum. The removal of forest and woodland will occur on the western edge of Ben Bullen State Forest, adjacent to the Castlereagh Highway.

Short term impacts to parts of Ben Bullen State Forest are expected to be high; however the progressive removal and subsequent rehabilitation will cause the long-term impacts to Ben Bullen State Forest to be low. Further, Coalpac is committed to continue high quality rehabilitation of Ben Bullen State Forest.

6.2.2 Impacts to Gardens of Stone Stage 2 Proposal

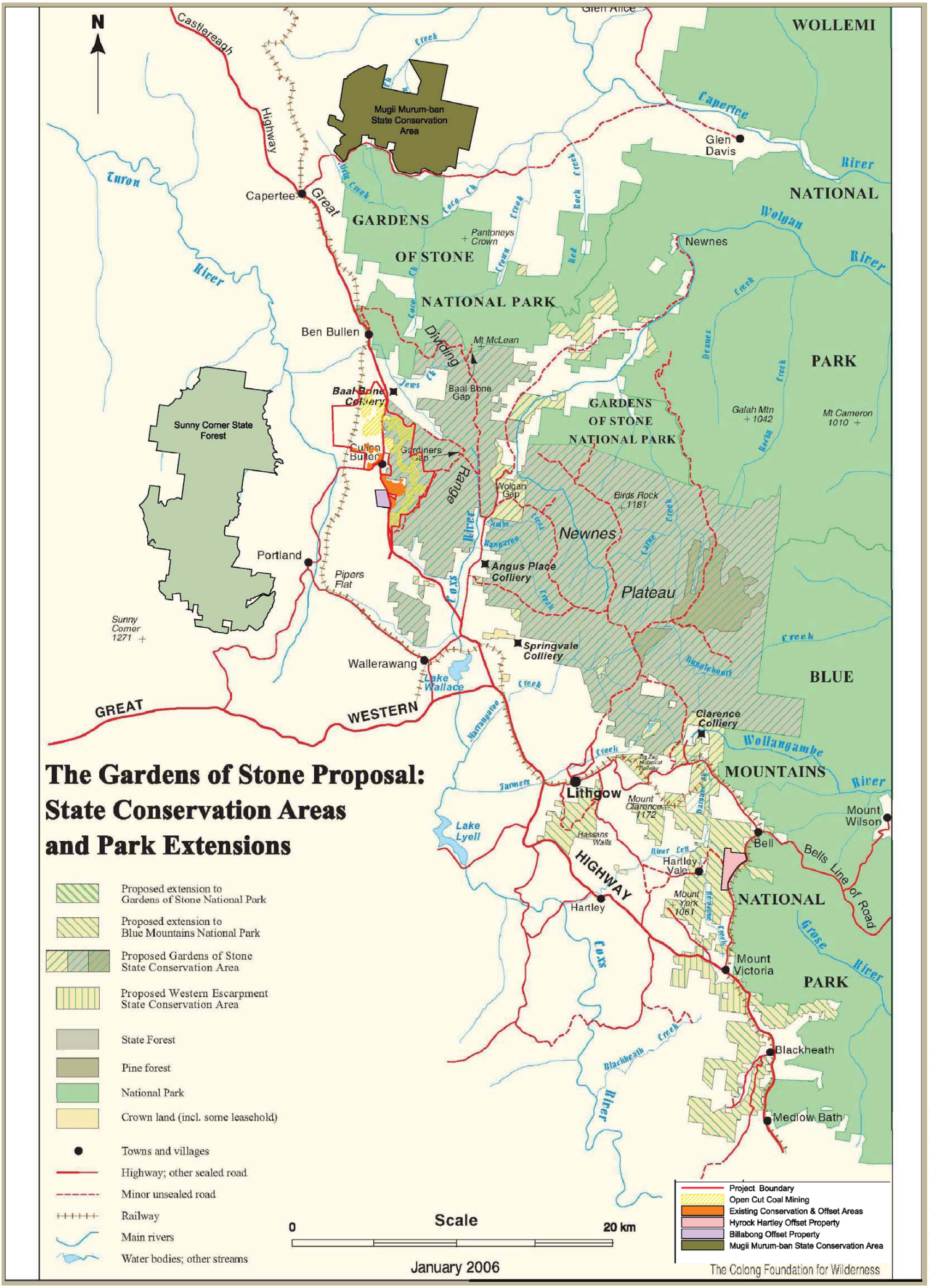
The Colong Foundation for Wilderness (in collaboration with other associated NGOs) has a proposal to expand the Gardens of Stone conservation area (Muir, 2005). The proposal, known as the GOS2 covers an area approximately 39,888 ha and consists of six divisions that are proposed to extend the Blue Mountains National Park and Gardens of Stone National Park by creation of two new conservation areas: the Gardens of Stone State Conservation Area and Western Escarpment State Conservation Area. The division that the Project Boundary lies within is the Baal Bone and Long Swamp Division (BBLSD). The BBLSD has been nominated by the Colong Foundation for inclusion into GOS2 for its "massed pagoda 'villages' that stand above the diverse swampy plains".

Although parts of the Project are located within the GOS2, it constitutes 1.2% of the proposed conservation area and the clearing of this vegetation is to be rehabilitated in stages as mining progresses. Moreover the proposed biodiversity offset areas for the Project (see **Section 9.2**) will add to and complement some of the objectives of GOS2. The Project will have negligible impact upon Sandstone Outcrops and the Ben Bullen SPL. It will not remove any "pagoda villages" or cliff lines (i.e. SPLs) within the Project Boundary. Of the 673 ha proposed to be disturbed by the Project, approximately 470 ha are located within the BBLSD. This constitutes approximately 6.03% of the total area of BBLSD. This value (470 ha) is lower because areas of Ben Bullen State Forest to the west of the Castlereagh Highway have not been included in the BBLSD of GOS2 as proposed by Muir (2005)..

As discussed in Section 6.1, no information is available on the OEH's proposal for GOS2.

A Project biodiversity offset property, Hyrock Hartley, is located within the western escarpment division in an area proposed as an extension to the Blue Mountains National Park. The western escarpment division covers 4,000 ha. The Hyrock Hartley property covers approximately 236 ha of intact native sandstone vegetation and constitutes 5.9% of the western escarpment division and 0.6% of the GOS2.

For further information relating to how the Project will benefit the GOS2 refer to **Section 6.3.1** of the Exhibited Project EIA.



The Gardens of Stone Proposal: State Conservation Areas and Park Extensions

Figure 6.1. The Gardens of Stone Stage 2 Proposal and the Contracted Project Mine Plan (Muir, 2005)

I:\...\13007\Figures\RP1_SOE_20130218\Figure 6.1. GoS2

6.3 Permissibility of Mining in a Conservation Area

Mining operations can be permitted in conservation areas, particularly State Conservation Areas, as shown within the excerpts below. Given that the key geological features and biodiversity features (the cliffs and SPLs) are not to be impacted by the proposed mining, Cumberland Ecology remains of the opinion that rehabilitated mining areas could be validly incorporated into a future State Conservation Area for Gardens of Stone Stage 2 (if designated).

According to the *National Parks and Wildlife Act 1974 No 80* the following is applicable to State Conservation Areas:

"30G State conservation areas

> *(1) The purpose of reserving land as a state conservation area is to identify, protect and conserve areas:*
>
> > *(a) that contain significant or representative ecosystems, landforms or natural phenomena or places of cultural significance, and*
> >
> > *(b) that are capable of providing opportunities for sustainable visitor or tourist use and enjoyment, the sustainable use of buildings and structures or research, and*
> >
> > *(c) that are capable of providing opportunities for uses permitted under other provisions of this Act in such areas, including uses permitted under section 47J, so as to enable those areas to be managed in accordance with subsection (2).*
>
> *(2) A state conservation area is to be managed in accordance with the following principles:*
>
> > *(a) the conservation of biodiversity, the maintenance of ecosystem function, the protection of natural phenomena and the maintenance of natural landscapes,*
> >
> > *(b) the conservation of places, objects and features of cultural value,*
> >
> > *(c) provision for the undertaking of uses permitted under other provisions of this Act in such areas (including uses permitted under section 47J) having regard to the conservation of the natural and cultural values of the state conservation area,*
> >
> > *(ca) provision for the carrying out of development in any part of a special area (within the meaning of the Hunter Water Act 1991) in the state conservation area that is permitted under section 185A having regard to the*

conservation of the natural and cultural values of the state conservation area,

(d) provision for sustainable visitor or tourist use and enjoyment that is compatible with the conservation of the state conservation area's natural and cultural values and with uses permitted under other provisions of this Act in such areas,

(e) provision for the sustainable use (including adaptive reuse) of any buildings or structures or modified natural areas having regard to the conservation of the state conservation area's natural and cultural values and with uses permitted under other provisions of this Act in such areas,

(f) provision for appropriate research and monitoring.

47J Provisions relating to mining

(1) In this section, mining interest means:

(a) any mining lease under the Mining Act 1992, or

(b) any mining licence under the Offshore Minerals Act 1999, or

(c) any lease under the Petroleum (Onshore) Act 1991.

(2) Subject to this section, the Mining Act 1992, the Offshore Minerals Act 1999, the Petroleum (Onshore) Act 1991 and the Petroleum (Offshore) Act 1982 apply, at any time, to lands within a state conservation area to the extent to which those Acts are in force at that time.

(3) A mining interest shall not be granted in respect of lands within a state conservation area without the concurrence in writing of the Minister.

(4) A renewal of, or extension of the term of, a mining interest in respect of lands within a state conservation area (other than an existing interest referred to in section 47H) shall not be granted under the Mining Act 1992, the Offshore Minerals Act 1999 or the Petroleum (Onshore) Act 1991 without the concurrence in writing of the Minister.

(5) Except as provided in this section, nothing in this Division affects the right, title or interest of any person (other than a person who is or was trustee of the lands comprised in a state conservation area) in respect of minerals in any such lands.

(6) A mineral claim must not be granted under the Mining Act 1992 over any lands within a state conservation area.

(7) Where a provision of the Mining Act 1992 or the Offshore Minerals Act 1999 prevents, or has the effect of preventing, a person from exercising in lands within a state conservation area any of the rights conferred by either of those Acts or by an

instrument under either of those Acts, except with the consent or an authorisation of the Minister for the time being administering the Mining Act 1992 or the Offshore Minerals Act 1999, as the case requires, that Minister shall not, in the case of any such lands, give consent or an authorisation under that provision without the approval of:

(a) where the lands are not within an irrigation area or special land district as defined in the Crown Lands Act 1989—the Minister, or

(b) where the lands are within such an irrigation area—the Minister for the time being administering the Water Management Act 2000, or

(c) where the lands are within such a special land district—the Minister for the time being administering the Crown Lands Act 1989 obtained after consultation with the Minister administering the Water Management Act 2000."

As can be seen from the preceding excerpts, mining can be permitted in a conservation area. The Project is considered to be consistent with the above legislation and will enable the Gardens of Stone Stage 2 (if designated) to fulfil its function of conservation of biodiversity, the maintenance of ecosystem function, and the maintenance of natural landscapes.

6.4 Mining and Conservation Areas in Australia

The PAC concluded that mining was likely to scar the landscape permanently within the Project Disturbance Area, that it would inevitably result in a lower biodiversity and that as such the Project would be incompatible with the future consideration to conserve Ben Bullen State Forest within a Gardens of Stone Stage 2.

As discussed above, there is no legal impediment for inclusion of mined areas within State Conservation Areas. Moreover, numerous national parks in NSW and elsewhere throughout Australia have old mining areas within them. Examples of such national parks include the Blue Mountains National Park itself, the Myall Lakes National Park, the Alpine National Park and others.

The oldest examples of mining in Australia are within old gold mining districts within NSW and Victoria. In these areas, mining was effectively uncontrolled, entailed no restoration of the landscapes and no rehabilitation of vegetation after mining concluded. Moreover, mined areas were also subjected to timber harvesting and grazing, and have had weeds and feral animals introduced.

Undoubtedly, many of the old gold mining areas still bear these scars and many have lost biodiversity. But, it is important to take a balanced appraisal of such mining and it is relevant to the Project to consider the fate of some gold mining districts, as a significant number of mining areas are now located within National Parks. This applies to some of the oldest

mining districts in central and northern Victoria (eg Chiltern National Park), Kiandra (within the old Kosciusko National Park), and others.

Within old mined landscapes in such parks, vegetation has regrown unassisted and has in many cases regrown to form mature forest and woodland. In places such as Chiltern National Park, such vegetation is now regarded as being of high conservation value and supports threatened species. For example, Chiltern National Park is the last area of Victoria that supports a population of the critically endangered Regent Honeyeater (P. Menkhorst, Recovery Team, Regent Honeyeater, *pers. comm.*).

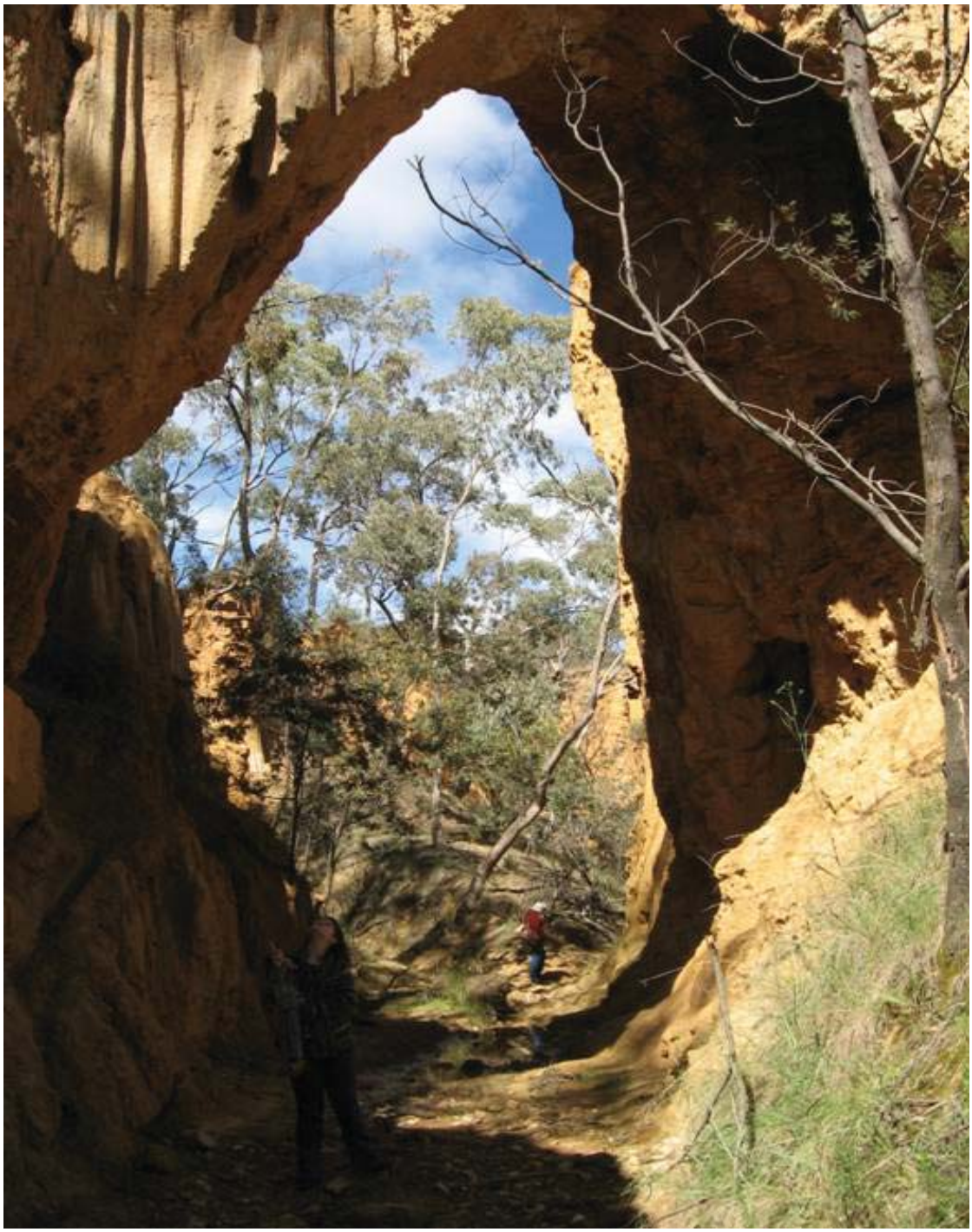
Cumberland Ecology does not advocate mining in all future conservation areas as such, but points out that a balanced approach to allow mining in selected areas should not automatically preclude future reservation or sterilise such areas of biodiversity in the long term.

The photographs below show the extent of old gold mining in Victoria and NSW, and provide selections of photographs from previously mined areas where native woodland vegetation is now sustainably re-established. What we draw from these examples is that if the Project is scientifically rehabilitated, with the landscape restored and flora regenerated, then the land could be incorporated into the Gardens of Stone Stage 2 State Conservation Area in future.

Photograph 6.1 Alluvial mining in the 1800s in central Victoria showing the extent of uncontrolled environmental change.

Photograph 6.2 Old Gold miners cottage in Mt Alexander, Victoria. Woodland in the background has regrown since mining, without specific mitigation or rehabilitation.

Photograph 6.3 Unremediated shallow alluvial mining areas used for gold mining in the 1850s with regenerated woodland.



Photograph 6.4 Golden Gully was actually the first place on the Hill End/Tambaroora Gold Fields to be mined. Gold was found in the area of Golden Gully in 1851 after gold miners from Ophir (where gold was first discovered)

6.5 Mining & Rehabilitation for the Coalpac Coal Project

The photograph below shows the landscape around the existing, approved Cullen Mine, with existing forest and woodland in grey-green, and a lighter green rehabilitated area regenerating after open cut mining. These areas shown on **Photograph 6.5** represent the oldest rehabilitation established at Cullen Valley Mine, established in 2002. Under the proposal, the Contracted Project would entail open cut mining of a similar nature, although high points in the landscape including SPLs, cliffs and caves, will not be mined by open cut methods.

As stated in the EIA, and the Response to Submissions, Cumberland Ecology reiterates that we believe the rehabilitation to date at Cullen Valley Mine has demonstrated forest and woodland is being rehabilitated and that the mined landscape is being restored to a landscape that, while not a facsimile of the original, is comparable topographically. This has been independently verified by annual monitoring conducted from 2010-2012 (Ecobiological 2010, 2012). We also note the monitoring of rehabilitation has shown a considerable diversity of native plant species. We observe that as the rehabilitation has undisturbed forest and woodland upslope there is a high probability that seeds will disperse into rehabilitation and boost species diversity in the long term.

Further evidence of successful mine rehabilitation occurs at Mt Piper Power Station (less than 4km away). Mt Piper Power Station has 18 year old rehabilitation data from open cut workings. A series of photos of this rehabilitation are provided in **Appendix I**.

We believe that the PAC conclusion that the landscape will be permanently, significantly and visibly scarred, and that the biodiversity significantly diminished in the long term is not warranted based upon the results to date for 11 year old rehabilitation at Cullen Valley Mine and 18 year old rehabilitation at Mt Piper Power Station.

Photograph 6.5 Landscape around the existing, approved Cullen Mine, with existing forest and woodland in grey-green, and a lighter green rehabilitated area regenerating after open cut mining.

6.6 Conclusion

Mined areas can legally be included in State Conservation Areas in NSW and there are many examples of old coal mining areas that are now within National Parks and which support considerable biodiversity, including old and established forest and woodland, and threatened species habitats.

The results of Cullen Valley Mine rehabilitation to date, combined with inferences about unaided regeneration of vegetation on heavily mined areas from the old gold fields, indicates that if the proponent of the Project continues to rehabilitate land as undertaken in the Cullen Valley Mine, then the landform and a high proportion of the biodiversity is likely to be restored in the longer term.

The PAC conclusions that the Project and reservation of GOS2 "are incompatible if reservation is intended to include Ben Bullen State Forest, either now or in the foreseeable future" appears incorrect. Similarly, the conclusion by the Commission "that significant scarring of the landscape will remain for decades, if not permanently" does not seem warranted. It is also in conflict with the opinions and comments expressed by the PAC (and especially Dr Shepherd and Mr Woodward) to Coalpac staff, with regard to the quality of rehabilitation they inspected during their site visit on the 18th September 2012 (Bret Leisemann pers.comm 2012)

On a final note, the PAC appears to have drawn significantly and given considerable weight to the opinions of OEH about mining impacts, rehabilitation and future biodiversity of rehabilitation. We note that in our consultation with OEH representatives prior to the exhibition of the EA, OEH stated that rehabilitation was not of relevance to their Department and that their staff had no experience with or interest in rehabilitation. Given the lack of a mandate or experience to consider it, and a lack of expertise and interest in rehabilitation within OEH, it seems incorrect for the PAC to place such weight on OEH's opinion about rehabilitated mined environs and their suitability for inclusion in a State Conservation Area. Alternate opinion should have been sought from DTIRIS-DRE or a specialist in coal mine site rehabilitation.

Contracted Mine Plan

This Chapter presents a description of the Contracted Project mine plan. A central key issue for the PAC was the high conservation value of the Pagoda rock formations and associated gully habitats below. This is the starting point for the mine plan changes. The Contracted Mine Plan has reduced the open cut mining footprint, lessening the proximity to, and potential for indirect impacts upon, SPLs and their gully habitats.

7.1 Contracted Mine Plan Overview

The Contracted Mine Plan has undergone a number of changes to the open cut footprint to reduce impacts and address issues raised in the PAC Report (see **Section 1.2.2**).

Generally, the Contracted Mine Plan has reduced the disturbance footprint assessed in the EIA by 196 ha (from 958 ha to 762 ha). The reduced disturbance footprint centres on habitats around the SPLs in the south-east of the Project Boundary and completely avoids open cut mining on Hillcroft.

By reducing the Contracted Project Disturbance Boundary to 762 ha, a number of changes have been made to the Project as assessed in the EIA, resulting in key biodiversity savings. These changes include:

- No open cut mining on Hillcroft (avoidance of 109 ha of native vegetation, including a substantial Capertee Stringybark population);
- Avoidance of all *Persoonia marginata* in the Project Boundary (inset 1 of **Figure 7.2**); and
- Increased setbacks of open cut mining from SPLs and gully habitats (inset 2 of **Figure 7.2**):
    - setbacks up to 240 m from the Exhibited Project mine plan in gully habitats adjacent to the Ben Bullen SPL)
    - avoidance of an additional 16.17 ha of vegetation including gully habitat adjacent the Ben Bullen State Forest SPL.

Figure 7.1 shows the Contracted Project mine plan layout.

Figure 7.2 compares the Exhibited Project Disturbance Boundary with the Contracted Project Disturbance Boundary and highlights the key areas where additional land has been excluded from open cut mining.

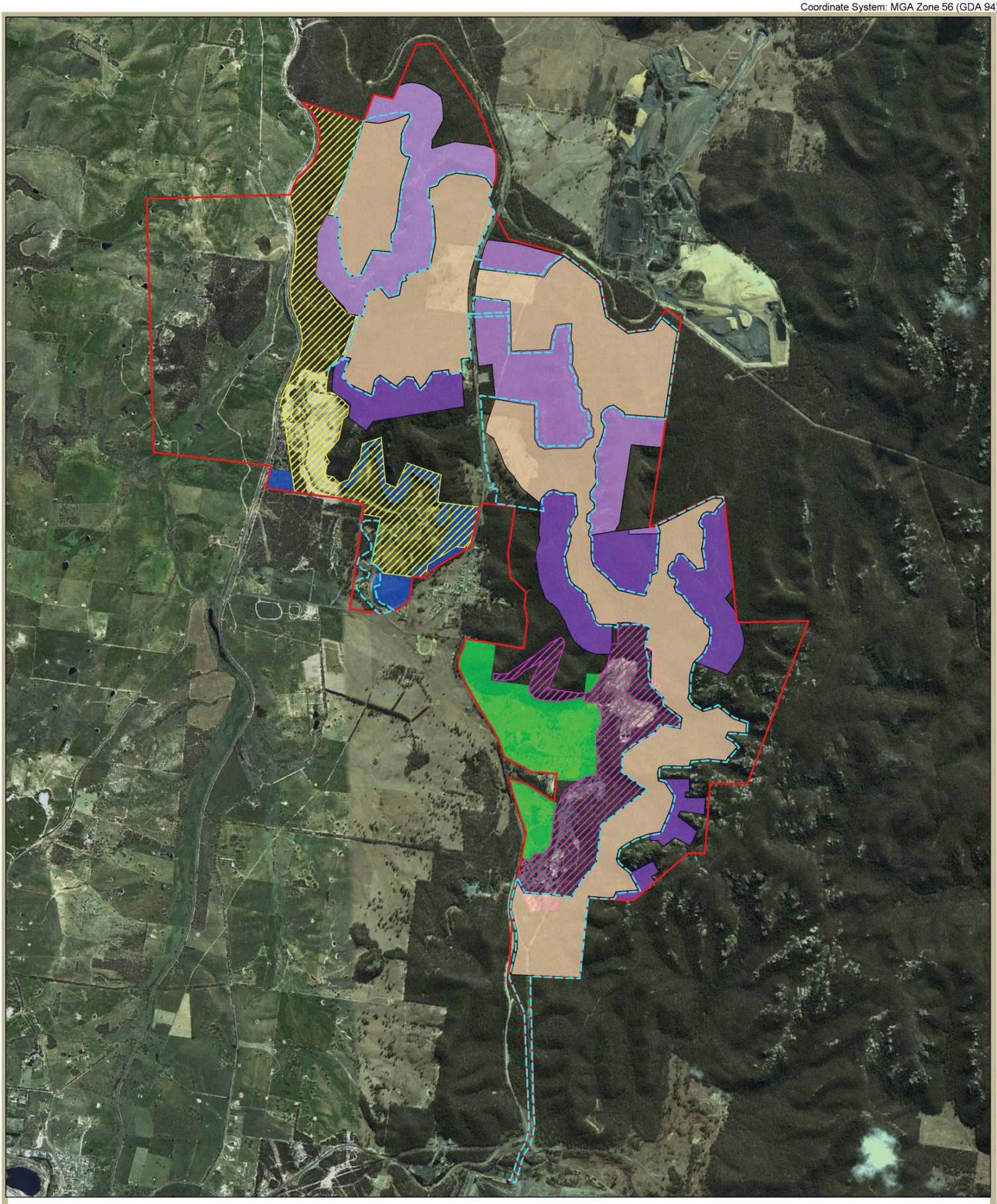


Figure 7.1. Contracted Mine Project Plan Overview

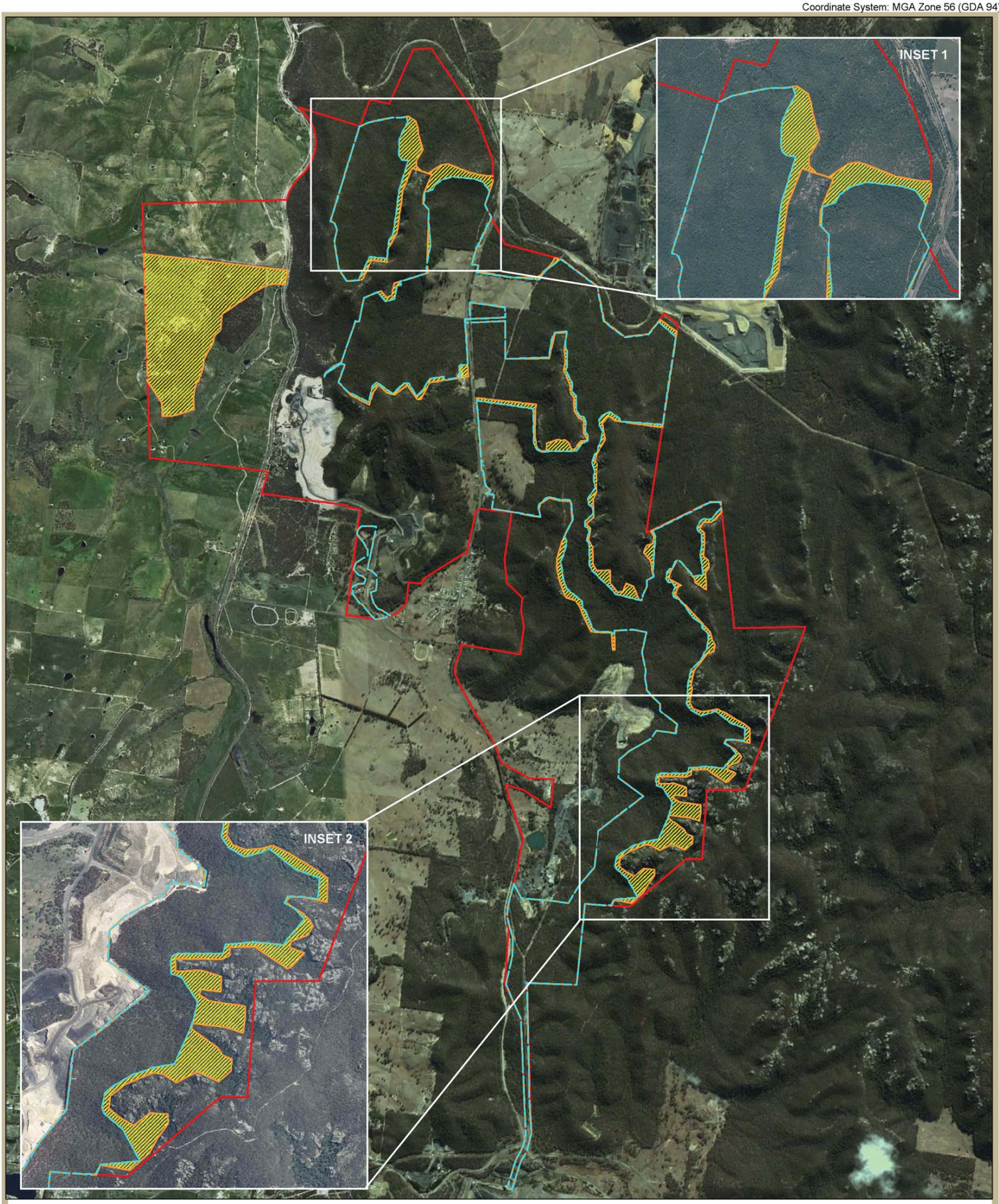


Figure 7.2. Exhibited Project Disturbance Boundary and Contracted Project Disturbance Boundary

7.2 Contracted Mine Plan Increases Pagoda Landform Preservation and Avoids More Gully Habitat

7.2.1 Recognition of SPLs in the Project Boundary

A review of the mine plan has been carried out in order to review where greater certainty of protection can be afforded to the SPLs. The only SPL in the Project Boundary is the Ben Bullen SF Significant Pagoda Landform (see **Figure 4.3** and **Figure 4.4**). This area is at the south-eastern end of the Invincible Colliery open cut and highwall mining areas.

As shown in the **Figure 7.3** below, the Contracted Project Disturbance Boundary avoids large areas of Ben Bullen State Forest SPL.

Figure 7.3. Ben Bullen State Forest SPL and the Contracted Project Disturbance Boundary

Figure 7.4. Contracted Project High Wall Mining Areas. (Note HWM restricted to lower topography areas and intact blocks of coal left in place under pagoda rock formations.)

Chapter 8

Impact Assessment of Contracted Project

8.1 Introduction

A comprehensive impact assessment of the Project was provided in **Chapter 4** of the Exhibited Project EIA. This provided a wealth of detail on the expected impacts of the Project on threatened flora and fauna considered to have potential to be impacted. Since submission, receipt of public submissions and review of the EA by the PAC, the mine plan has been revised to further reduce its ecological footprint, which will affect the impact assessment calculations presented in the EA.

The purpose of this Chapter is to present a revised impact assessment of the Project, taking into consideration the Contracted Mine Plan prepared by Coalpac. The areas of impacted and retained vegetation have been updated and the significance of the alterations to biodiversity impacts are discussed. This Chapter also considers some of the issues raised by the PAC such as insufficient discussion of the general biodiversity values of the Project Boundary and impacts to non-threatened species.

The EA provides significant background information on the impacts predicted to occur as a result of the Project and discusses these in detail. The purpose of this chapter is not to repeat the detailed information present in the EA; rather it briefly summarises the revised impacts in terms of area of land to be impacted, and its effect on the biodiversity that utilise it. Further background detail on impacting processes can be found in the EA.

8.2 Summary of the Impacts of the Contracted Project

The Contracted Project has the potential to have a substantial impact on the ecology of the local area. It also has the potential to impact on C/EECs and several threatened flora and fauna species listed under the TSC Act and/or the EPBC Act.

The following is a summary of the predicted impacts of the Contracted Project Disturbance Boundary on threatened biodiversity:

- Approximately 15.24 ha of Box Gum Woodland and 1.96 ha of Derived Native Grassland, listed under the TSC Act and the EPBC Act (a reduction of approximately 7% of the impacts predicted in the Exhibited Project EIA);

- Approximately 1.96 ha of Box Gum Woodland Derived Native Grassland listed under the TSC Act only;
- 204 ha of known and potential *Eucalyptus cannonii* habitat, constituting an estimated 15,428 individuals (a reduction of approximately 27% of the impacts predicted in the Exhibited Project EIA); and
- 762 ha of native forest, woodland and grasslands, habitat for various fauna species known to occur or considered to potentially occur will be removed (a reduction of approximately 20% of the impacts predicted in the Exhibited Project EIA).

The Project will remove approximately 762 ha of native vegetation providing suitable foraging, shelter and breeding habitat for a suite of threatened woodland birds including the Varied Sittella, Scarlet Robin, Speckled Warbler, Brown Treecreeper, Square-tailed Kite, Little Lorikeet and Diamond Firetail. Blossom dependant and migratory species are also expected to be impacted by the removal of these treed habitats. Species to be affected include the Regent Honeyeater, Painted Honeyeater and Black-chinned Honeyeater and the Swift Parrot. Other threatened birds expected to be impacted by habitat disturbance for the Project include the Gang-gang Cockatoo, Powerful Owl and Masked Owl.

The following threatened mammals are expected to be impacted by habitat disturbance for the Project: Yellow-bellied Glider, Squirrel Glider and Spotted-tailed Quoll. A suite of threatened microbats including the hollow dependant Eastern False Pipistrelle, Eastern Freetail-bat, Yellow-bellied Sheathtail-bat and Greater Broad-nosed Bat and cave dwelling Large-eared Pied Bat and Eastern Bent-wing Bat are also expected to be impacted.

Notwithstanding these expected impacts, large areas of suitable habitat will remain in the Project Boundary (1,190 ha of forest and woodland) and in the wider locality within the protected Wollemi National Park, Gardens of Stone National Park, Winburndale Nature Reserve and other large remnants including Newnes State Forest, Sunny Corner State Forest, Wolgan State Forest and some parts of adjacent Ben Bullen State Forest. In addition, a range of mitigation measures are proposed to be implemented, including protecting and conserving suitable habitat for these species via establishing offset properties, and progressively rehabilitating impacted land to develop high quality habitat within the Project Boundary.

Since the preparation of the EA, the Project Disturbance Boundary has been significantly revised for the Contracted Project to reduce the overall area of impact and avoid key habitats. All impacts to known occurrences of *Persoonia marginata* have been avoided. Although no SPLs are to be directly disturbed by mining, the Contracted Project Disturbance Boundary provides further setbacks to these sensitive habitat areas. This will reduce further the level of indirect disturbance that these areas may experience, and will also provide greater foraging habitat adjoining SPLs. Some species typically shelter in the SPLs and Sandstone Outcrops and forage in the lower lying woodland gullies, and the Contracted Project Disturbance Boundary will avoid impacts to more extensive areas of this kind of habitat. Typically, these species such as the Broad-headed Snake and the Brush-tailed Rock Wallaby do not forage far from shelter habitat (although they are known to on

occasions) and therefore the Contracted Project Disturbance Boundary will protect significantly greater habitat for these species.

More detailed discussion of the impacts of the Contracted Project on vegetation communities, flora and fauna species, including indirect impacts such as edge effects and cumulative impacts is provided below.

8.3 Impacts to Vegetation Communities

The Contracted Project Disturbance Boundary will remove approximately 762 ha of native vegetation that comprises the following native plant communities:

- Tableland Gully Snow Gum - Ribbon Gum Grassy Forest;
- Tableland Gully Snow Gum - Ribbon Gum Grassy Forest Low Diversity Derived Native Grassland;
- Tableland Gully Ribbon Gum Blackwood Applebox Forest;
- Tableland Gully Ribbon Gum Blackwood Applebox Forest Derived Native Grassland;
- Capertee Rough-barked Apple - Red Gum - Yellow Box Grassy Woodland (Box Gum Woodland listed under the EPBC Act);
- Capertee Rough-barked Apple - Red Gum - Yellow Box Grassy Woodland Derived Native Grassland (Box Gum Woodland listed under the EPBC Act);
- Capertee Rough-barked Apple - Red Gum - Yellow Box Woodland: non grassy;
- Capertee Rough-barked Apple Red Gum Yellow Box Woodland Derived Native Grassland (Box Gum Woodland listed under the TSC Act);
- Exposed Blue Mountains Sydney Peppermint - Silvertop Ash Shrubby Woodland
- Tableland Scribbly Gum – Narrow-leaved Stringybark Shrubby Open Forest;
- Tableland Broad-leaved Peppermint - Brittle Gum - Red Stringybark Grassy Woodland;
- Tableland Broad-leaved Peppermint - Brittle Gum - Red Stringybark Grassy Woodland Low Diversity Derived Native Grassland;
- Tableland Slopes Brittle Gum – Broad-leaved Peppermint Grassy Forest;
- Tableland Slopes Brittle Gum – Broad-leaved Peppermint Grassy Forest Derived Native Grassland;

- Tableland Gully Mountain Gum - Broad-leaved Peppermint Grassy Forest;
- Tableland Gully Mountain Gum Broad-leaved Peppermint Grassy Forest Derived Native Grassland;
- Tableland Gully Mountain Gum Broad-leaved Peppermint Grassy Forest Low Diversity Derived Native Grassland;
- Cox's Permian Red Stringybark - Brittle Gum Woodland; and
- Pagoda Rock Sparse Shrubland.

The area of direct impact has been calculated from the extent of the Contracted Project Disturbance Boundary as shown on **Figure 8.1** (below).

A comparison of the areas of each community to be removed under the Exhibited Project Mine Plan and the Contracted Mine Plan is shown in **Table 8.1**

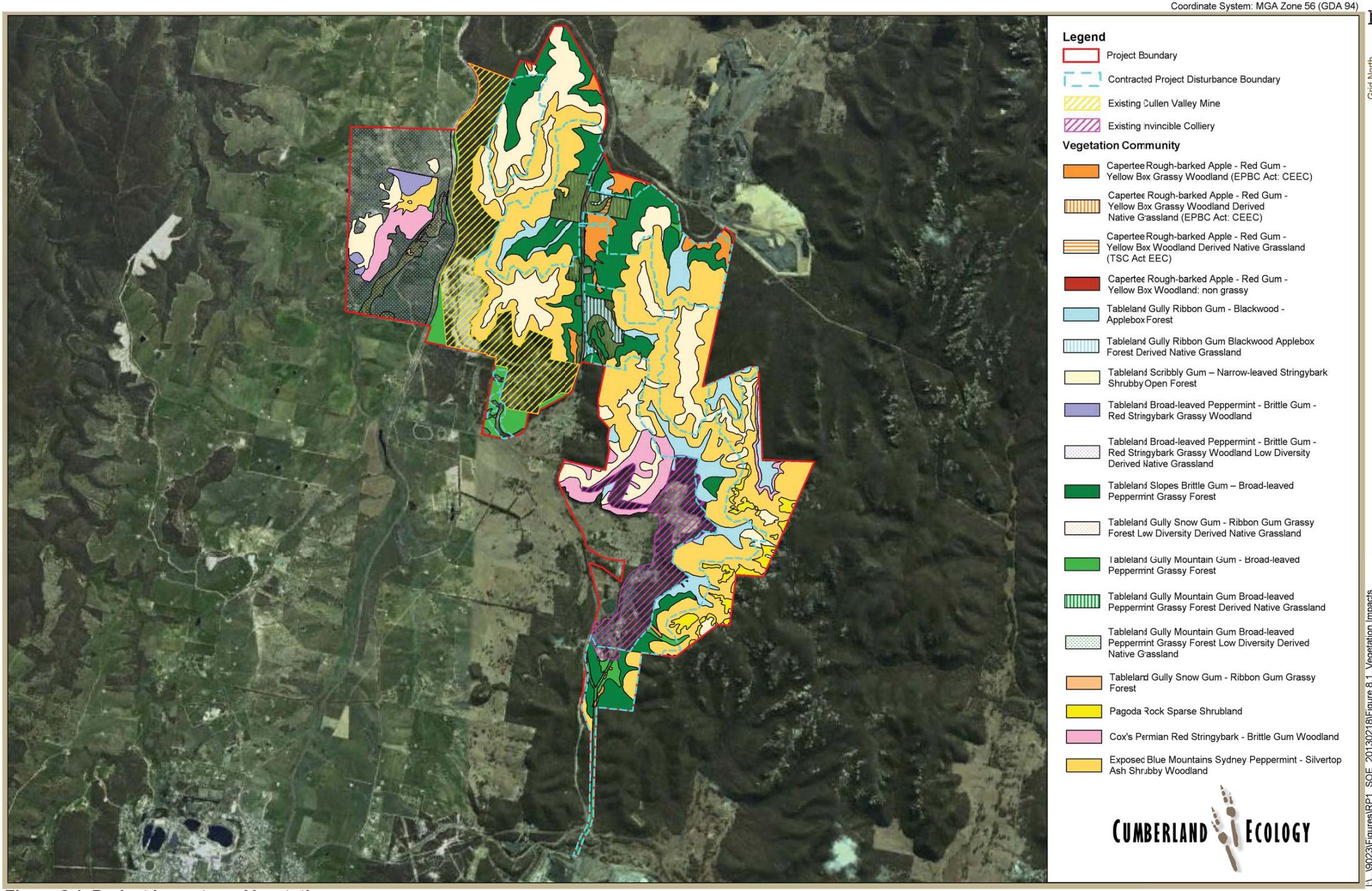


Figure 8.1. Project Impacts on Vegetation

Table 8.1 Vegetation Impact Comparison Between Exhibited Project and Contracted Project Mine Plan

Map Unit#	Vegetation Community	Area of Vegetation within Project Boundary (ha)	Area of Vegetation Impacted (ha) Exhibited Project Mine Plan	Area of Vegetation Impacted (ha) Contracted Project Mine Plan	Area of Vegetation Retained (ha) Contracted Mine Plan
MU11	Tableland Gully Snow Gum - Ribbon Gum Grassy Forest	0.90	0.00	0.00	0.90
MU11 DNG	Tableland Gully Snow Gum - Ribbon Gum Grassy Forest Low Diversity Derived Native Grassland	23.35	0.00	0.00	23.35
MU13	Tableland Gully Ribbon Gum Blackwood Applebox Forest	111.81	93.94	91.15	20.66
MU13a	Tableland Gully Ribbon Gum Blackwood Applebox Forest Derived Native Grassland	16.62	15.02	15.03	1.59
MU20	Capertee Rough-barked Apple - Red Gum - Yellow Box Grassy Woodland (EPBC)	46.18	16.21	14.96	31.21
MU20 DNG	Capertee Rough-barked Apple - Red Gum - Yellow Box Grassy Woodland Derived Native Grassland (EPBC)	0.27	0.27	0.27	0.00
MU20a	Capertee Rough-barked Apple - Red Gum - Yellow Box Woodland: non grassy	0.12	0.11	0.11	0.01
MU20b	Capertee Rough-barked Apple Red Gum Yellow Box Woodland Derived Native Grassland (TSC EEC)	1.99	1.96	1.96	0.03
MU30	Exposed Blue Mountains Sydney Peppermint - Silvertop Ash Shrubby Woodland	679.11	370.43	295.18	383.93
MU32	Tableland Scribbly Gum – Narrow-leaved Stringybark Shrubby Open Forest	332.43	112.51	74.80	257.63
MU33	Tableland Broad-leaved Peppermint - Brittle Gum - Red Stringybark Grassy Woodland	13.71	13.02	0.00	13.71
MU33 DNG	Tableland Broad-leaved Peppermint - Brittle Gum - Red Stringybark Grassy Woodland Low Diversity Derived Native Grassland	215.23	42.72	0.00	215.23

Table 8.1 Vegetation Impact Comparison Between Exhibited Project and Contracted Project Mine Plan

Map Unit#	Vegetation Community	Area of Vegetation within Project Boundary (ha)	Area of Vegetation Impacted (ha) Exhibited Project Mine Plan	Area of Vegetation Impacted (ha) Contracted Project Mine Plan	Area of Vegetation Retained (ha) Contracted Mine Plan
MU34	Tableland Slopes Brittle Gum – Broad-leaved Peppermint Grassy Forest	260.85	185.77	182.86	78.00
MU34 DNG	Tableland Slopes Brittle Gum – Broad-leaved Peppermint Grassy Forest Derived Native Grassland	57.07	50.10	49.23	7.84
MU35	Tableland Gully Mountain Gum - Broad-leaved Peppermint Grassy Forest	51.70	18.87	17.98	33.72
MGBlP DNG	Tableland Gully Mountain Gum Broad-leaved Peppermint Grassy Forest Derived Native Grassland	12.84	12.43	12.43	0.41
MGBlP DNG	Tableland Gully Mountain Gum Broad-leaved Peppermint Grassy Forest Low Diversity Derived Native Grassland	2.79	0.85	0.85	1.94
MU37	Cox's Permian Red Stringybark - Brittle Gum Woodland	92.02	23.71	5.05	86.97
MU43	Pagoda Rock Sparse Shrubland	32.87	0.05	0.00	32.87
	TOTAL	**1951.88**	**957.97**	**761.86**	**1190.02**

Table 8.2 shows the area of each of these communities that is present within the Project Boundary, the area to be removed, and the area remaining in the Central West CMA and within NSW as a whole.

Note that the areas of impact presented here are lower than those presented in the Exhibited Project EA. The Exhibited Project Disturbance Boundary has been revised since the EA was exhibited to further reduce the ecological impacts of the Project which has resulted in a reduction in the area of vegetation to be removed for the Contracted Mine Plan.

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Table 8.2 Vegetation Impacts in a Regional and State Wide Context

Vegetation Community (DEC 2006)	Central West Broad vegetation Type	Vegetation Class (Keith 2004)	Area of Vegetation in the Project Boundary (ha)	Area within Contracted Project Disturbance Boundary (ha)	Area retained within Project Boundary (ha)	CWCMA Extent (ha)	% removed within CW Catchment	Extent of vegetation within NSW (ha)	% Removed within NSW
Capertee Rough-barked Apple - Red Gum - Yellow Box Grassy Woodland (EPBC)	Stringybark - Box - Gum Woodland	Western Slopes Grassy Woodland	46.18	14.96	31.22	224,242.13	0.007%	500,000-900,000	0.0030%
Capertee Rough-barked Apple - Red Gum - Yellow Box Grassy Woodland Derived Native Grassland (EPBC)	Stringybark - Box - Gum Woodland	Western Slopes Grassy Woodland	0.27	0.27	0.00	224,242.13	0.000%	500,000-900,000	0.0001%
Capertee Rough-barked Apple - Red Gum - Yellow Box Woodland: non grassy	Stringybark - Box - Gum Woodland	Western Slopes Grassy Woodland	0.12	0.11	0.01	224,242.13	0.000%	500,000-900,000	0.0000%
Capertee Rough-barked Apple Red Gum Yellow Box Woodland Derived Native Grassland (TSC EEC)	Stringybark - Box - Gum Woodland	Western Slopes Grassy Woodland	1.99	1.96	0.03	224,242.13	0.001%	500,000-900,000	0.0004%
Tableland Gully Ribbon Gum Blackwood Applebox Forest	Mountain Gum – Peppermint Forest at High Altitudes	Southern Tableland Grassy Woodland	111.81	91.15	20.66	28,651.11	0.318%	140,000-230,000	0.0651%
Tableland Gully Ribbon Gum Blackwood Applebox Forest Derived Native Grassland	n/a	n/a	16.62	15.03	1.59	n/a	n/a	n/a	n/a
Tableland Scribbly Gum – Narrow-	Inland Scribbly Gum	Southern	332.43	74.80	257.63	53,049.15	0.141%	650,000-	0.0115%

Table 8.2 Vegetation Impacts in a Regional and State Wide Context

Vegetation Community (DEC 2006)	Central West Broad vegetation Type	Vegetation Class (Keith 2004)	Area of Vegetation in the Project Boundary (ha)	Area within Contracted Project Disturbance Boundary (ha)	Area retained within Project Boundary (ha)	CWCMA Extent (ha)	% removed within CW Catchment	Extent of vegetation within NSW (ha)	% Removed within NSW
leaved Stringybark Shrubby Open Forest	Woodland	Tableland Dry Sclerophyll Forests						1,250,000	
Tableland Broad-leaved Peppermint - Brittle Gum - Red Stringybark Grassy Woodland	Mountain Gum – Red Stringybark Open Forest at High Altitudes	Southern Tableland Dry Sclerophyll Forest	13.71	0.00	13.71	81,070.92	0.000%	650,000-1,250,000	0.0000%
Tableland Broad-leaved Peppermint - Brittle Gum - Red Stringybark Grassy Woodland Low Diversity Derived Native Grassland	Mountain Gum – Red Stringybark Open Forest at High Altitudes	Southern Tableland Dry Sclerophyll Forest	215.23	0.00	215.23	n/a	n/a	n/a	n/a
Tableland Slopes Brittle Gum – Broad-leaved Peppermint Grassy Forest	Mountain Gum – Peppermint Forest at High Altitudes	Southern Tableland Dry Sclerophyll Forest	260.86	182.86	78.00	81,070.92	0.226%	650,000-1,250,000	0.0281%
Tableland Slopes Brittle Gum – Broad-leaved Peppermint Grassy Forest Derived Native Grassland	n/a	n/a	57.07	49.23	7.84	n/a	n/a	n/a	n/a
Tableland Gully Mountain Gum - Broad-leaved Peppermint Grassy Forest	Mountain Gum – Peppermint Forest	Southern Tableland Dry	51.70	17.98	33.72	28,651.11	0.063%	650,000-1,250,000	0.0028%

Table 8.2 Vegetation Impacts in a Regional and State Wide Context

Vegetation Community (DEC 2006)	Central West Broad vegetation Type	Vegetation Class (Keith 2004)	Area of Vegetation in the Project Boundary (ha)	Area within Contracted Project Disturbance Boundary (ha)	Area retained within Project Boundary (ha)	CWCMA Extent (ha)	% removed within CW Catchment	Extent of vegetation within NSW (ha)	% Removed within NSW
	at High Altitudes	Sclerophyll Forest							
Tableland Gully Mountain Gum Broad-leaved Peppermint Grassy Forest Derived Native Grassland	n/a	n/a	12.84	12.43	0.41	n/a	n/a	n/a	n/a
Tableland Gully Mountain Gum Broad-leaved Peppermint Grassy Forest Low Diversity Derived Native Grassland	n/a	n/a	2.79	0.85	1.94	n/a	n/a	650,000-1,250,000	0.0001%
Tableland Gully Snow Gum - Ribbon Gum Grassy Forest	Mountain Gum – Peppermint Forest at High Altitudes	Tableland Clay Grassy Woodland	0.90	0.00	0.90	28,651.11	0.000%	160,000-250,000	0.0000%
Tableland Gully Snow Gum - Ribbon Gum Grassy Forest Low Diversity Derived Native Grassland	n/a	n/a	23.35	0.00	23.35	n/a	n/a	n/a	n/a
Pagoda Rock Sparse Shrubland	no match	Sydney Montane Heath	32.87	0.00	32.87	no match available	n/a	60,000-100,000	0.0000%
Cox's Permian Red Stringybark - Brittle Gum Woodland	Mountain Gum – Peppermint Forest at High Altitudes	Southern Tableland Dry Sclerophyll Forest	92.02	5.05	86.97	81,070.92	0.006%	650,000-1,250,000	0.0008%
Exposed Blue Mountains Sydney	Sydney Sanstone	Sydney Montane	679.11	295.18	383.93	65,131.33	0.453%	180,000-	0.1640%

Table 8.2 Vegetation Impacts in a Regional and State Wide Context

Vegetation Community (DEC 2006)	Central West Broad vegetation Type	Vegetation Class (Keith 2004)	Area of Vegetation in the Project Boundary (ha)	Area within Contracted Project Disturbance Boundary (ha)	Area retained within Project Boundary (ha)	CWCMA Extent (ha)	% removed within CW Catchment	Extent of vegetation within NSW (ha)	% Removed within NSW
Peppermint - Silvertop Ash Shrubby Woodland	Woodland	Dry Sclerophyll Forest						240,000	
TOTAL			**1951.88**	**761.86**	**1190.01**	**452,144.65**	**0.169%**	**1,690,000**	**0.0704%**

As can be seen in **Table 8.1** and **Table 8.2**, although the Contracted Project will result in the removal of approximately 762 ha of native vegetation, there are large areas of each vegetation community present in surrounding areas, and in many cases in nearby conservation reserves. The majority of the vegetation communities present in the Project Boundary are common and widespread, and for this reason are not listed under conservation legislation. No community is at the limit of its distribution and the area of each community proposed to be removed within the Contracted Project Disturbance Boundary is not critical for the survival of these communities. Taking the impacts to all vegetation communities together, the Project will impact on 0.169% of the vegetation present in the CWCMA and 0.07% of the native vegetation present in NSW (**Table 8.2**). Consequently, the areas to be removed are not considered to be significant in the regional or state context.

As noted in the EA, Capertee Rough-barked Apple Red Gum Yellow Box Woodland (and derived native grassland) is listed as an EEC under the TSC Act and the EPBC Act. The conservation significance of this community and a detailed impact assessment for this community is presented in **Section 4.2.3** of the Ecological Impact Assessment. Approximately 46.57 ha of this community is present in the Project Boundary, of which 17.2 ha will be removed. This is a reduction of 1.2 ha or 7% of the impacts predicted for the Exhibited Project Disturbance Boundary. Large areas of this community occur in the CWCMA and in NSW (see **Table 8.2**). In the context of the large areas remaining in the CWCMA and in NSW as a whole, and taking into consideration the extensive mitigation and compensation measures proposed, this is not considered to comprise a significant impact to this community.

The PAC states that three of the communities recorded from the Project Area (Ribbon Gum Grassy Forest on alluvial flats, Mountain Gum Apple Box Blakely's Red Gum Grassy Forest; and Broad-leaved Peppermint Brittle Gum Red Stringybark Grassy Open Forest) are considered by OEH to be poorly reserved, and on this basis, recommend that impacts to these communities be avoided. These communities have not been identified in any recognised mapping, but share similar habitat to the following vegetation communities mapped by Cumberland Ecology in the EA:

- Tableland Gully Ribbon Gum Blackwood Applebox Forest;
- Tableland Gully Mountain Gum - Broad-leaved Peppermint Grassy Forest;
- Capertee Rough-barked Apple - Red Gum - Yellow Box Grassy Woodland; and
- Tableland Slopes Brittle Gum – Broad-leaved Peppermint Grassy Forest.

These communities are discussed in more detail below.

8.3.1 Tableland Gully Ribbon Gum Blackwood Apple Box Forest

This forest occurs in the hills of the dry Capertee Valley along narrow gully systems, however it is likely to be distributed south to the Abercrombie Region and beyond (DEC (NSW) 2006). It is also likely to be more extensive across the adjoining catchment to the west of the Hawkesbury – Nepean. According to the DEC (2006) (now OEH), reservation

status is difficult to assess given the absence of comparable mapping to the west, however it is more than likely that it is poorly reserved and suffered moderate levels of clearing.

Approximately 93 ha of this community will be removed for the Contracted Project; however a further 20 ha will be retained within the Project Boundary. While it is likely that this community is poorly reserved, this is true for many native vegetation communities that are not threatened. This community corresponds to the Central West BVT of Mountain Gum Peppermint Forest at High Altitudes. Approximately 28,651 ha of this community is present within the CWCMA outside of the Project Boundary and the Project will remove approximately 0.31% of this variant of this community in the CMA (see **Table 8.2**). It is not considered to be sufficiently rare to warrant formal protection by listing under the TSC Act or the EPBC Act, and therefore moderate impacts to this community are considered to be acceptable. Large areas of similar vegetation will be conserved within the offset areas that will provide similar values to those present in this community.

8.3.2 Tableland Gully Mountain Gum Broad Leaved Peppermint Grassy Forest

This community occurs in the deeper gullies and sheltered slopes of the metamorphic and Permian hills of the western Cox's catchment (DEC (NSW) 2006). Reservation levels of this community are low, although improved only by the recent additions of Mt Walker to the reserve network (DEC (NSW) 2006). Clearing has been largely restricted to accessible sites, though across the range of the community levels of clearing are likely to be greater (DEC (NSW) 2006)

Approximately 19 ha of this community will be removed for the Contracted Project; however a further 33 ha will be retained within the Project Boundary. While it is likely that this community is poorly reserved, this is true for many non-listed native vegetation communities. This community corresponds to the Central West BVT of Mountain Gum Peppermint Forest at High Altitudes. Approximately 28,651 ha of this community is present within the CWCMA outside of the Project Boundary and the Project will remove approximately 0.06% of this community in the CMA. This community is not considered to be sufficiently rare to warrant formal protection by listing under the TSC Act or the EPBC Act, and therefore moderate impacts to this community are considered to be acceptable. As shown above, the Contracted Project will remove a very small proportion of this community that is present in the CMA and is not likely to threaten the long term persistence of this community. Large areas of similar vegetation will be conserved within the offset areas that will provide similar values to those present in this community.

8.3.3 Capertee Rough-barked Apple - Red Gum - Yellow Box Grassy Woodland

This community occurs on gentle rises, gullies and depressions in the dry Capertee Valley (DEC (NSW) 2006). This community is poorly reserved and has been heavily cleared and fragmented by past agricultural land use (DEC (NSW) 2006).

Approximately 17.2 ha of this community will be removed for the Contracted Project; however a further 31.25 ha will be retained within the Project Boundary. This community corresponds to the Central West BVT of Stringybark - Box - Gum Woodland. Approximately 224,242 ha of this community is present within the CW CMA outside of the Project Boundary and the Project will remove approximately 0.007% of this community in the CMA. This community is listed under the critically endangered under the EPBC Act and endangered TSC and thus warrants formal protection under each Act.

8.3.4 Tableland Slopes Brittle Gum – Broad-leaved Peppermint Grassy Forest

This community favours the metamorphic slopes west of Lithgow, and is maybe more typical of the forests further west on the tablelands (DEC (NSW) 2006). The recent addition of Mount Walker to the reserve system greatly improves the reservation status of the community. However, across its range reservation status remains poor and clearing and grazing activities persist in accessible terrain (DEC (NSW) 2006).

Approximately 182 ha of this community will be removed for the Contracted Project; however a further 78 ha will be retained within the Project Boundary. While it is likely that this community is poorly reserved in the region, this is true for many non-listed native vegetation communities. This community corresponds to the Central West BVT of Mountain Gum Peppermint Forest at High Altitudes. Approximately 81,170 ha of this community is present within the CWCMA outside of the Project Boundary and the Project will remove approximately 0.23% of this community in the CMA. This community is not considered to be sufficiently rare to warrant formal protection by listing under the TSC Act or the EPBC Act, and therefore moderate impacts to this community are considered to be acceptable. As shown above, the Contracted Project will remove a very small proportion of this community that is present in the CMA and is not likely to threaten the long term persistence of this community. Large areas of similar vegetation will be conserved within the offset areas (including Hillview/Billabong) that will provide similar values to those present in this community.

8.4 Impacts to Habitat

The PAC Report stated that there had been an over-emphasis on threatened species and ecological communities, and that the impact assessment should consider the "overall quality of the habitat under threat", rather than focussing on components of biodiversity listed under the EPBC Act and TSC Act. In order to address these concerns, in this section, I describe the overall biodiversity values of the Project Boundary as a function of the topography and landscape features present that provide a diversity of habitats, as well as its location in the region and the proximity of large areas of conserved native vegetation in State Forests and protected native vegetation in National Parks.

The Project Boundary is located in a highly biodiverse part of NSW. Large blocks of remnant native vegetation remain in the area, in particular in several National Parks and State

Forests that occur in the vicinity of the Project Boundary including the following (see **Figure 6.1** and **Figure 9.1**):

- Gardens of Stone National Park
- Blue Mountains National Park;
- Turon National Park;
- Wollemi National Park;
- Ben Bullen State Forest;
- Sunny Corner State Forest;
- Wolgan State Forest; and
- Newnes State Forest.

The Project Boundary is approximately 1,951 ha in size, and the areas that have not been modified by previous mining operations contain large expanses of open forest and woodland communities.

The Project Boundary encompasses a wide variety of landscapes, from rugged ridgelines containing weathered sandstone, Sandstone Outcrops and a SPL, to deep gullies and undulating rolling land. A series of steep sided gullies associated with the sandstone landscape form numerous ephemeral gullies. A range of factors including the ridge and valley topography, altitude, aspect and exposure result in small localised microclimates which provide a diverse range of habitat for both flora and fauna. The primary fauna habitats located within the Project Boundary are:

- Open forest communities;
- Woodland communities;
- Pagodas and caves; and
- Permanent water bodies such as dams and ephemeral creeks.

Within the forest and woodland communities in the Project Boundary, the following key habitat features provide suitable habitat for a wide range of fauna types including: amphibians, reptiles, birds, bats and arboreal and terrestrial mammals:

- Woodland and forest vegetation – shelter and forage for birds including raptors and microbats;
- Dense understorey vegetation – shelter and foraging habitat for amphibians, reptiles, small birds and terrestrial mammals;

- Fallen logs, debris and leaf litter – shelter habitat for amphibians, reptiles and terrestrial mammals;
- Rocky outcrops – shelter and breeding habitat for amphibians, reptiles terrestrial mammals and cave dwelling microbats;
- Hollow-bearing living trees and stags – providing shelter and breeding habitat for a range of reptiles, birds, arboreal mammals and microbats;
- Nectar-producing trees and shrubs – foraging habitat for insects, blossom-dependant birds, arboreal mammals and megachiropteran bats (flying-foxes);
- Feed trees, shrubs and grasses for a range of species – food for small birds, cockatoos and herbivorous mammals;
- Ecotonal (edge) communities – foraging habitat for many species;
- Ephemeral drainage lines - foraging, shelter and breeding habitat for amphibians, aquatic reptiles, wetland birds and aquatic mammals; and
- Constructed farm dams with limited aquatic vegetation - foraging and breeding habitat for amphibians, aquatic reptiles and wetland birds.

A key component of the biodiversity present in the Contracted Project Boundary is the ecotone between the Sandstone Outcrops and SPLs, and the lower lying gullies and woodlands on the slopes. This mosaic of habitats provides important habitat for many species. Some, such as the Brush-tailed Rock Wallaby and the Broad-headed Snake are known to shelter in the SPLs and Sandstone Outcrops, and to travel to the more fertile lower slopes to feed. It is this combination of refuge and foraging habitat that makes this area important for some fauna species.

This has been recognised by Coalpac, and the Exhibited Project Disturbance Boundary has been revised to provide a greater buffer area between the Sandstone Outcrops and SPLs and mining activity. This will reduce the disturbance to shelter habitat and will provide more foraging habitat in the lower lying gullies. These gullies are important foraging areas and the preservation of greater areas of these gullies will benefit those species that rely on these habitats adjacent to the Sandstone .Outcrops and SPLs.

8.5 Impacts to Flora Species

This section outlines the impacts of the Project on flora species, taking into consideration the Contracted Mine Plan, which has resulted in a significant reduction in area of disturbance for many species. This section also addresses some of the issues raised by the PAC in relation to flora species; in particular it contains a broader discussion of non-listed flora species including several species listed as ROTAP that have been identified on the Project Boundary by Cumberland Ecology and others.

More than 400 flora species have been recorded in the Project Boundary by Cumberland Ecology, with less than 20% of these being exotic. Additional flora species have been recorded by other groups since the completion of the surveys for the EA. This is a very high diversity that is due to the diversity of microhabitats present in the area, as outlined in more detail in **Section 8.2.2**.

The dominant plant families encountered in the open forest and woodland have been consistently represented by the Myrtaceae, Fabaceae, Asteraceae and Poaceae families. The most common genera encountered are *Eucalyptus* and *Acacia*, with over 24 and 15 species respectively. Poaceae (grass family) is the family represented by the highest diversity of species, although it is not strongly represented by any one genus. Over 10 species of orchid have been recorded.

Several threatened flora species have been recorded from the Project Boundary including the following species;

- *Eucalyptus aggregata* (Black Gum), listed as Vulnerable under the TSC Act;
- *Eucalyptus cannonii* (Capertee Stringybark), listed as Vulnerable under both the TSC Act and the EPBC Act; and
- *Persoonia marginata* (Clandulla Geebung), listed as Vulnerable under both the TSC Act and the EPBC Act.

Although they were not recorded from the Project Boundary, several additional threatened species have been assessed as having potential to occur due to the presence of suitable habitat and occurrence in the Lithgow LGA. These include the following species:

- *Eucalyptus pulverulenta* (Silver-leaved Mountain Gum), listed as Vulnerable under the EPBC Act and TSC Act;
- *Grevillea obtusiflora ssp. obtusiflora,* listed as Endangered under the EPBC Act and TSC Act;
- *Grevillea obtusiflora ssp. fecunda,* listed as Endangered under the EPBC Act and TSC Act;
- *Prostanthera cryptandroides subsp. cryptandroides*, listed as Vulnerable under the EPBC Act and TSC Act
- *Grevillea evansiana*, listed as Vulnerable under the EPBC Act and TSC Act; and
- *Derwentia blakelyi*, listed as Vulnerable under the TSC Act

The threatened species recorded from the Project Boundary or with potential to occur have been discussed in detail in the EA and a comprehensive impact assessment on threatened flora species is provided in **Section 4.5** of the EIA. This assessment concluded that with the

implementation of the proposed impact mitigation and compensation measures, no significant impact was predicted to occur to threatened flora species.

Furthermore, the Project Disturbance Boundary has been revised since the Exhibited Project EA, which has resulted in a reduction in the area of impact for all known threatened flora species in the Project Boundary. The Contracted Project Disturbance Boundary avoids all impacts to known habitat for *Persoonia marginata*, and has resulted in a reduction in impact to *Eucalyptus cannonii* of 73.94 ha, or 27% of the Exhibited Project Disturbance Boundary. A comparison of the amount of habitat to be removed by the Contracted Project Disturbance Boundary and the Exhibited Project Disturbance Boundary for all the above listed species is shown in **Table 8.3**.

8.5.1 ROTAP Species

Although not listed under State or Commonwealth conservation legislation, several ROTAP species have been recorded from the Project Boundary by Cumberland Ecology or subsequently by others. These include the following species:

- *Gonocarpus longifolius;*
- *Acacia asparagoides;*
- *Leionema lamprophyllum subsp. orbiculare*;
- *Laucochrysum graminifolium*; and
- *Philotheca obovalis*

Furthermore, specimens of *Bursaria spinosa subsp. lasiophylla* were recorded since the field surveys for the EA in and near the Project Boundary. This species is not listed as threatened or as a ROTAP species, however it is known to be suitable habitat for the Bathurst Copper Butterfly (*Paralucia spinifera*) which is listed as Vulnerable under the EPBC Act and as Endangered under the TSC Act. The ROTAP species are considered in more detail in subheadings below.

i. Gonocarpus longifolius

Gonocarpus longifolius has been recorded in ranges from Armidale to the Blue Mountains, east of Rylstone, on the North and Central Coasts, Central Tablelands, and Central Western Slopes divisions. Surveys in the ranges around the Goulburn River valley have revealed considerable populations (> 1000 plants) both within and outside of existing conservation reserves (Bell 2001). The species is particularly common in the northern portions of Wollemi National Park, stretching some 70 km from the California Trail to Cox's Gap. Other populations are also known from the Singleton Military Area, which probably represents the eastern most limit of the species (Bell 2001).

The Contracted Project Disturbance Boundary has resulted in all areas of known habitat for this species being entirely avoided (see **Table 8.3**). No specimens or areas of habitat for

this species will be disturbed. Accordingly, the Contracted Project is considered unlikely to result in an increased risk of extinction for this species.

ii. Acacia asparagoides

Acacia asparagoides occurs from Newnes Junction to Lawson, in the Blue Mountains. There is a single specimen from Boonoo Boonoo River, on the North Coast, outside this distribution range. It is known to grow in dry sclerophyll forest or occasionally heath on sandstone (Botanic Gardens Trust 2013b)

It is not considered to be sufficiently rare to warrant formal protection by listing under the TSC Act or the EPBC Act, and therefore moderate impacts to this community are considered to be acceptable. Approximately 682 ha of habitat for this species will be removed by the Contracted Project, however this is a substantial reduction of 153 ha compared to that predicted for the Exhibited Project. Large areas of potential habitat will remain outside the Project Disturbance Boundary and potential habitat for this species will remain in the locality. Accordingly, the Project is considered unlikely to result in an increased risk of extinction for this species.

iii. Leionema lamprophyllum subsp. orbiculare

Leionema lamprophyllum subsp. obiculare occurs from Kandos Weir (east of Rylstone) to Lithgow, in the Blue Mountains, NSW. It occurs in the NSW botanical subdivision of Central Coast. It grows in heath on exposed ridges at higher altitudes (Botanic Gardens Trust 2013c).

It is not considered to be sufficiently rare to warrant formal protection by listing under the TSC Act or the EPBC Act, and therefore moderate impacts to this community are considered to be acceptable. However, the Contracted Project Disturbance Boundary has resulted in all areas of known habitat for this species being avoided (see **Table 8.3**). No specimens or areas of habitat for this species will be disturbed. Accordingly, the Contracted Project is considered unlikely to result in an increased risk of extinction for this species.

iv. Leucochrysum graminifolium

Leucochrysum graminifolium grows on exposed sites on sandy soils; from Lithgow district to Newnes. (Botanic Gardens Trust 2013d) It occurs in the NSW botanical subdivisions of Central Coast and Central Tablelands.

It is not considered to be sufficiently rare to warrant formal protection by listing under the TSC Act or the EPBC Act, and therefore moderate impacts to this community are considered to be acceptable. However, the Contracted Project Disturbance Boundary has resulted in all areas of known habitat for this species being avoided (see **Table 8.3**). No specimens or areas of habitat for this species will be disturbed. Accordingly, the Contracted Project is considered unlikely to result in an increased risk of extinction for this species.

v. Philotheca obovalis

Philotheca obovalis grows in heath and dry sclerophyll forest on sandstone; chiefly in the Blue Mountains although it has also been recorded at Kydra Mountain. It occurs in the NSW botanical subdivisions of Central Coast, Central Tablelands and Southern Tablelands (Botanic Gardens Trust 2013e).

It is not considered to be sufficiently rare to warrant formal protection by listing under the TSC Act or the EPBC Act, and therefore moderate impacts to this community are considered to be acceptable. However, the Contracted Project Disturbance Boundary has resulted in all areas of known habitat for this species being avoided (see **Table 8.3**). No specimens or areas of habitat for this species will be disturbed. Accordingly, the Contracted Project is considered unlikely to result in an increased risk of extinction for this species.

8.6 Impacts to Fauna Species

This section outlines the impacts of the Contracted Project on fauna species, which has resulted in a significant reduction in area of disturbance for many species to those impacts predicted in the Exhibited Project.

More than 130 fauna species have been recorded in the Project Boundary by Cumberland Ecology, and other undetected species are certainly present. This is a very high faunal diversity that is nearly certainly due to the diversity of microhabitats present in the area, as outlined in more detail in **Section 8.2.2**. A total of 10 threatened fauna species have been recorded from the Project Boundary and potential habitat is present for a further 25 species. These include microchiropteran bat species, terrestrial mammals, large owls and cockatoos, nectarivorous birds and woodland dependent bird species. An assessment of the impacts of the Contracted Project on threatened fauna species recorded from the Project Boundary or considered to have potential to occur has been provided in **Chapter 4** of the Exhibited Project EIA.

The precautionary principle has been enacted in the impact assessment process and all threatened species which have potential habitat present have been assessed as though they occur. As explained in detail in **Chapter 5** and **Chapter 6** of the Exhibited Project EIA, a substantial offsets and mitigation strategy has been developed for the Project to mitigate the impacts of the Project on fauna species. This includes protecting habitat within the Project Boundary but outside of the Contracted Project Disturbance Boundary; rehabilitation of mined landscapes to woodland and forest in the long term and the provision and protection for long term conservation of large areas of offset land that will provide habitat for fauna species. With the implementation of the proposed mitigation and compensation measures, no significant impact is predicted to occur to threatened species as a result of the Contracted Project.

That notwithstanding, the Exhibited Project Disturbance Boundary has been revised since the EA was exhibited, and the areas of impact have been reduced. Approximately 152 ha of impact have been avoided through modification of the mine plan design proposed for the Contracted Project. A detailed breakdown of the changes in area of habitat for these

threatened species is provided in **Table 8.3**. Many of the threatened fauna species are able to use the majority of the Disturbance Boundary, and therefore the Contracted Project has resulted in an increase in 152 ha or 18% of habitat relative to the Exhibited Project mine plan.

It is recognised that the Project Boundary is highly diverse and supports a wide range of habitats for native species as discussed in **Section 8.2.2**. That notwithstanding, large areas of similar habitats are protected in nearby conservation reserves, and the habitat present in the Project Boundary is not considered to be critical for the survival of any fauna species. The offsets and rehabilitation that are proposed will benefit these species as well as the threatened species, and viable populations currently present in the Project Boundary are expected to persist into the future in these areas.

Table 8.3 provides a comprehensive summary of predicted impacts for all threatened species, vegetation communities and ROTAP species previously discussed in this chapter.

Table 8.3 Project Impacts on Threatened Species, ROTAPs and Vegetation Communities

Scientific Name	Common Name	Status			Habitat (Forest, Woodland, Shrubland) / Map Unit	Recorded in the Project Boundary	Area of Habitat in Exhibited Project Disturbance Boundary (ha)	Area of Habitat in Contracted Project Disturbance Boundary (ha)	Impact Reduction (ha)	Impact Reduction (%)
		TSC	EPBC	ROTAP			TOTAL IMPACT (ha)	TOTAL IMPACT (ha)		
FLORA										
Eucalyptus cannonii	Capertee Stringybark	V	V		13, 20, 32, 34, 37, 35, 33	Y	278.00	204.06	73.94	27%
Persoonia marginata	Clandulla Geebung	V	V		32	Y	3.09	0.00	3.09	100%
Eucalyptus aggregata	Black Gum	V			11	Y	0.00	0.00	n/a	n/a
Gonocarpus longifolius				3RC	43	N	0.05	0.00	0.05	100%
Acacia asparagoides				2R	S, F, W	Y	835.63	682.09	153.54	18%
Leionema lamprophyllum subsp. orbiculare				2R	43	Y	0.05	0.00	0.05	100%
Leucochrysum graminifolium				2R	43	Y	0.05	0.00	0.05	100%
Philotheca obovalis				3RCa	43	Y	0.05	0.00	0.05	100%
Eucalyptus pulverulenta	Silver-leaved Mountain Gum	V	V		30, 32	N	482.94	369.98	112.96	23%

Table 8.3 Project Impacts on Threatened Species, ROTAPs and Vegetation Communities

Scientific Name	Common Name	Status		Habitat (Forest, Woodland, Shrubland) / Map Unit	Recorded in the Project Boundary	Area of Habitat in Exhibited Project Disturbance Boundary (ha)	Area of Habitat in Contracted Project Disturbance Boundary (ha)	Impact Reduction (ha)	Impact Reduction (%)
Grevillea obtusiflora ssp. obtusiflora		E	E	F, W	N	835.63	682.09	153.54	18%
Grevillea obtusiflora ssp. fecunda		E	E	F, W	N	835.63	682.09	153.54	18%
Prostanthera cryptandroides subsp. cryptandroides		V	V	43, 32, 20	N	128.77	89.76	39.01	30%
Grevillea evansiana		V	V	43, 30	N	370.48	295.18	75.30	20%
Derwentia blakelyi		V		11, 13, 20	N	110.15	106.12	4.03	4%
FAUNA									
Reptiles									
Hoplocephalus bungaroides	Broad-headed Snake	V	V	S, F, W	N	561.12	477.23	83.89	15%
Varanus rosenbergi	Rosenberg Goanna	V		S, F, W	N	835.63	682.09	153.54	18%
Birds									
Callocephalon fimbriatum	Gang Gang Cockatoo	V		F, W	Y	834.58	682.09	152.49	18%
Calyptorhynchus	Glossy Black Cockatoo	V		S, F, W	N	834.63	682.09	152.54	18%

Table 8.3 Project Impacts on Threatened Species, ROTAPs and Vegetation Communities

Scientific Name	Common Name	Status		Habitat (Forest, Woodland, Shrubland) / Map Unit	Recorded in the Project Boundary	Area of Habitat in Exhibited Project Disturbance Boundary (ha)	Area of Habitat in Contracted Project Disturbance Boundary (ha)	Impact Reduction (ha)	Impact Reduction (%)
lathami									
Climacteris picumnus victoriae	Brown Treecreeper	V		F, W	Y	834.58	682.09	152.49	18%
Daphoenositta chrysoptera	Varied Sittella	V		F, W	Y	834.58	682.09	152.49	18%
Glossopsitta pusilla	Little Lorikeet	V		F, W	N	834.58	682.09	152.49	18%
Grantiella picta	Painted Honeyeater	V		F, W	N	834.58	682.09	152.49	18%
Lathamus discolor	Swift Parrot	E	E, M	F, W	N	834.58	682.09	152.49	18%
Lophoictinia isura	Square-tailed Kite	V		F, W	Y	834.58	682.09	152.49	18%
Melanodryas cucullata cucullata	Hooded Robin	V		F, W	N	834.58	682.09	152.49	18%
Melithreptus gularis gularis	Black-chinned Honeyeater	V		F, W	N	834.58	682.09	152.49	18%
Neophema pulchella	Turquoise parrot	V		F, W	N	834.58	682.09	152.49	18%
Ninox connivens	Barking Owl	V		F, W	N	834.58	682.09	152.49	18%
Ninox strenua	Powerful Owl	V		F, W	Y	834.58	682.09	152.49	18%
Petroica boodang	Scarlet Robin	V		F, W	Y	834.58	682.09	152.49	18%

Table 8.3 Project Impacts on Threatened Species, ROTAPs and Vegetation Communities

Scientific Name	Common Name	Status		Habitat (Forest, Woodland, Shrubland) / Map Unit	Recorded in the Project Boundary	Area of Habitat in Exhibited Project Disturbance Boundary (ha)	Area of Habitat in Contracted Project Disturbance Boundary (ha)	Impact Reduction (ha)	Impact Reduction (%)
Petroica phoenicea	Flame Robin	V		F, W	N	834.58	682.09	152.49	18%
Pomatostomus temporalis temporalis	Grey-crowned Babbler	V		F, W	N	834.58	682.09	152.49	18%
Pyrrholaemus saggitatus	Speckled Warbler	V		F, W	Y	834.58	682.09	152.49	18%
Stagonopleura guttata	Diamond Firetail	V		F, W	N	834.58	682.09	152.49	18%
Tyto novaehollandiae	Masked Owl	V		F, W	N	834.58	682.09	152.49	18%
Xanthomyza phrygiai	Regent Honeyeater	CE	E, M	F, W	N	834.58	682.09	152.49	18%
Mammals									
Cercartetus nanus	Eastern Pygmy Possum	V		S, F, W	N	834.63	682.09	152.54	18%
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	S ,F, W	Y	834.58	682.09	152.49	18%
Dasyurus maculatus	Spotted-tail Quoll	E	E	S, F, W	N	834.63	682.09	152.54	18%
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V		F, W	Y	834.58	682.09	152.49	18%
Miniopterus schreibersii oceanensis	Eastern Bentwing Bat	V		S, F, W	Y	834.58	682.09	152.49	18%

Table 8.3 Project Impacts on Threatened Species, ROTAPs and Vegetation Communities

Scientific Name	Common Name	Status		Habitat (Forest, Woodland, Shrubland) / Map Unit	Recorded in the Project Boundary	Area of Habitat in Exhibited Project Disturbance Boundary (ha)	Area of Habitat in Contracted Project Disturbance Boundary (ha)	Impact Reduction (ha)	Impact Reduction (%)
Mormopterus norfolkensis	Eastern Free-tail Bat	V		F, W	Y	834.58	682.09	152.49	18%
Petaurus australis	Yellow-bellied Glider	V		F, W	N	834.58	682.09	152.49	18%
Petaurus norfolcensis	Squirrel Glider	V		F, W	Y	834.58	682.09	152.49	18%
Saccolaimus flaviventris	Yellow-bellied Sheathtailbat	V		F, W	N	834.58	682.09	152.49	18%
Scoteanax rueppellii	Greater Broad-nosed Bat	V		F, W	Y	834.58	682.09	152.49	18%
Petrogale penicillata	Brush-tailed Rock Wallaby	V	E	S, F, W	N	444.97	371.08	73.89	17%
Phascolarctos cinereus	Koala	V	V	F, W	N	142.16	124.21	17.95	13%
Ecological Communities									
MU11	Tableland Gully Snow Gum - Ribbon Gum Grassy Forest					0.00	0.00	n/a	n/a
MU11 DNG	Tableland Gully Snow Gum - Ribbon Gum Grassy Forest Low Diversity Derived Native Grassland					0.00	0.00	n/a	n/a

Table 8.3 Project Impacts on Threatened Species, ROTAPs and Vegetation Communities

Scientific Name	Common Name	Status		Habitat (Forest, Woodland, Shrubland) / Map Unit	Recorded in the Project Boundary	Area of Habitat in Exhibited Project Disturbance Boundary (ha)	Area of Habitat in Contracted Project Disturbance Boundary (ha)	Impact Reduction (ha)	Impact Reduction (%)
MU13	Tableland Gully Ribbon Gum Blackwood Applebox Forest					93.94	91.15	2.79	3%
MU13a	Tableland Gully Ribbon Gum Blackwood Applebox Forest Derived Native Grassland					15.02	15.03	-0.01	0%
MU20	Capertee Rough-barked Apple - Red Gum - Yellow Box Grassy Woodland (EPBC)	E	CE			16.21	14.96	1.25	8%
MU20 DNG	Capertee Rough-barked Apple - Red Gum - Yellow Box Grassy Woodland Derived Native Grassland (EPBC)	E	CE			0.27	0.27	0.00	0%
MU20a	Capertee Rough-barked Apple - Red Gum - Yellow Box Woodland: non grassy					0.11	0.11	0.00	0%
MU20b	Capertee Rough-barked Apple Red Gum Yellow Box Woodland Derived Native Grassland (TSC EEC)	E				1.96	1.96	0.00	0%

Table 8.3 Project Impacts on Threatened Species, ROTAPs and Vegetation Communities

Scientific Name	Common Name	Status	Habitat (Forest, Woodland, Shrubland) / Map Unit	Recorded in the Project Boundary	Area of Habitat in Exhibited Project Disturbance Boundary (ha)	Area of Habitat in Contracted Project Disturbance Boundary (ha)	Impact Reduction (ha)	Impact Reduction (%)
MU30	Exposed Blue Mountains Sydney Peppermint - Silvertop Ash Shrubby Woodland				370.43	295.18	75.25	20%
MU32	Tableland Scribbly Gum – Narrow-leaved Stringybark Shrubby Open Forest				112.51	74.80	37.71	34%
MU33	Tableland Broad-leaved Peppermint - Brittle Gum - Red Stringybark Grassy Woodland				13.02	0.00	13.02	100%
MU33 DNG	Tableland Broad-leaved Peppermint - Brittle Gum - Red Stringybark Grassy Woodland Low Diversity Derived Native Grassland				42.72	0.00	42.72	100%
MU34	Tableland Slopes Brittle Gum – Broad-leaved Peppermint Grassy Forest				185.77	182.86	2.92	2%
MU34 DNG	Tableland Slopes Brittle Gum – Broad-leaved Peppermint Grassy				50.10	49.23	0.87	2%

Table 8.3 Project Impacts on Threatened Species, ROTAPs and Vegetation Communities

Scientific Name	Common Name	Status	Habitat (Forest, Woodland, Shrubland) / Map Unit	Recorded in the Project Boundary	Area of Habitat in Exhibited Project Disturbance Boundary (ha)	Area of Habitat in Contracted Project Disturbance Boundary (ha)	Impact Reduction (ha)	Impact Reduction (%)
	Forest Derived Native Grassland							
MU35	Tableland Gully Mountain Gum - Broad-leaved Peppermint Grassy Forest				18.87	17.98	0.89	5%
MGBlP DNG	Tableland Gully Mountain Gum Broad-leaved Peppermint Grassy Forest Derived Native Grassland				12.43	12.43	0.00	0%
MGBlP DNG	Tableland Gully Mountain Gum Broad-leaved Peppermint Grassy Forest Low Diversity Derived Native Grassland				0.85	0.85	0.00	0%
MU37	Cox's Permian Red Stringybark - Brittle Gum Woodland				23.71	5.05	18.66	79%
MU43	Pagoda Rock Sparse Shrubland				0.05	0.00	0.05	100%

8.7 Edge Effects

As discussed in the Exhibited Project EA, the Project will result in habitat fragmentation which leads to "edge effects". This refers to changes in physical and biological conditions at an ecosystem boundary or interface between adjacent ecosystems (Fischer and Lindenmayer 2007), particularly between natural habitats such as forests and disturbed or developed land (Yahner 1988). Edge effects result in an extension of the potential ecological impacts of a Project beyond the areas to be cleared and into areas of forest and woodland that are being retained. The impacts of edge effects are discussed in more detail in Section 4 of the Exhibited Project EIA and in Section 4.13.8 of the Response to Submissions Report.

As edge effects extend the ecological impacts of a Project beyond the areas to be directly cleared, the overall disturbance footprint is greater than the area to be removed. Accordingly, in order for the full ecological impact of the Project to be understood, the PAC has recommended that the edge effects from the Project be quantified.

It is difficult to calculate edge effects with any degree of precision, due to the variable nature of the impacts attributed to edge effects. To quantify edge effects that have not yet occurred would be arbitrary. Edge effects have been well documented and studied extensively however the studies have been extremely site specific and cannot be accurately applied to this Project. Accurate studies can only be carried out once mining commences should the Project be approved. This can be managed via the Biodiversity Management Plan (BMP).

Cumberland Ecology is unaware of other mining projects in NSW where the proponent has been asked to quantify or estimate edge effects. Despite this, to address OEH's concerns on edge effects, the Contracted Project Disturbance Boundary not only reduces the area of direct disturbance by 20% (when compared to the area of the Exhibited Project Disturbance Boundary), but also reduces the periphery by 10%. The perimeter of the Contracted Project Disturbance Boundary is 48.28 km (5.48 km smaller than the perimeter of the Exhibited Project Disturbance Boundary). This reduction in the disturbance footprint focuses on reducing the extent of direct impacts along the SPL and associated wet gullies and thus potential indirect impacts such as edge effects. Adjacent to the BBSF SPL, this reduction in the perimeter of the open cut amounts to 25%. Similarly no open cut mining is proposed to forest and woodland west of the railway line on Hillcroft avoiding further impacts from fragmentation.

As explained in the Response to Submissions, the EIA discussed the likely impacts of edge effects and has estimated the degree of impact. Edge effects are likely to be highly localised to the areas surrounding the Contracted Project Disturbance Boundary, based on site observations around the existing mines. Noise, light and dust levels are expected to reduce relatively rapidly with increasing distance from the area of direct disturbance. Edge effects are not expected to penetrate deep into retained vegetation as the majority of retained vegetation occur upslope of operations (except some areas of Box Gum Woodland), eliminating potential impacts from runoff and sedimentation from mining areas.

All retained native vegetation including Box Gum Woodland will be subject to strict management measures such as monitoring and controlling weed levels, diverting water from disturbed sites into water treatment basins, erecting and maintaining sediment fencing around vegetation will be implemented to reduce edge effects. Edge effects will be addressed comprehensively in the BMP to be prepared for the Contracted Project, should it be approved.

8.8 Cumulative Impacts

The locality surrounding the Project Boundary contains a variety of mining and other industrial development that includes:

- Baal Bone Colliery (closed);
- Mount Piper Power Station Extension;
- Ivanhoe North Colliery (closed);
- Neubeck Coal Project Proposal; and
- Pine Dale Coal Mine;
    - Yarraboldy Extension;
    - Stage 1 and Stage 2 Extensions.

All were considered in the EA with the exception of the Pine Dale Stage 2 Extension AND Neubeck Coal Project (for which public information was not available at the time of publication).

On current information publically available, most of the surrounding projects are not seeking approval to clear large areas of vegetation.

Baal Bone Colliery proposes to continue underground mining in the northern parts of Ben Bullen State Forest. Mining has now concluded in Longwalls 28-31 and has not directly impacted vegetation through clearing.

The Mount Piper Power Station Extension proposes to avoid direct impacts to remnant native vegetation by restricting construction to pre-cleared areas containing regrowth and planted gardens.

Ivanhoe North Colliery will result in the clearance of approximately 12.3 ha of relatively undisturbed native vegetation.

The Neubeck Coal Project is a new proposal for an open cut coal mine at Blackmans Flats, approximately 5 km east of the Project. The only publically available information to date is a preliminary briefing paper, which does not contain details on areas of vegetation to be removed. Until more information is available to the public, it can only be noted at this stage.

The Yarraboldy Extension of Pine Dale Coal Mine will remove 27 ha of vegetation, 14 ha being native vegetation. Pine Dale Coal Mine Stage 1 Extension will remove approximately 60 ha and Stage 2 Extension will remove approximately 170 ha, the majority of which occurs in Ben Bullen State Forest.

Collectively, the Project makes up the majority of the cumulative impacts. The cumulative impacts of Pine Dale and the Project amount to approximately 998 ha of vegetation removal. That notwithstanding, both the Project and the Pine Dale Extension projects will be required to provide offsets to compensate for the impacts of these projects. Collectively, this will result in the protection of a very large area of forest for conservation.

Areas of the Ben Bullen State Forest will be subject to open cut, highwall and underground mining within the next two to three decades, however beyond that no further disturbance is likely to occur as a result of mining. The coal proposed to be mined by the Contracted Project is the last remaining coal to be mined in the Cullen Bullen area, and as such the cumulative impacts are finite and known.

8.9 Impacts to SPLs

A large focus of the PAC's response was due to perceived impacts to pagoda landforms (defined here as SPLs). As outlined in Chapter 3, these areas were recognised early in the assessment process by Coalpac being significant areas, however as impacts to these areas are being avoided, they were not discussed in detail.

To provide an assessment of the potential impacts of the Contracted Project on SPLs, it is important to provide regional context. According to the mapping of "pagoda country" conducted by Washington and Wray (2011), approximately 60,000 ha of pagoda country occurs in the region. As discussed in **Section 4**, this area was an indicative area of where pagodas occur, and it did not map the distribution of the actual pagodas themselves (SPLs).

As outlined in **Section 2.3**, Cumberland Ecology has conducted an analysis of the extent of SPLs in the region. Approximately 25,893 ha of SPL have been recorded from the region, extending from Northern Wollemi Park to Lithgow (see **Figure 4.3**). Much of this area (18,851 ha) is outside of the pagoda country mapped by Washington and Wray (2011), mostly to the north of the Project Boundary, north-east of the town of Kandos (see **Figure 4.3**).

Of the total area of SPLs mapped in the region, approximately 113 ha occur in the Project Boundary. This is equivalent to approximately 0.44% of the total area of SPLs in region.

None of the SPLs present in the Project Boundary were proposed to be disturbed, either under the Exhibited Project or the Contracted Project. Stand-off from open cut mining and the exclusion of highwall mining under the sandstone pagoda formations within the SPLs (highwall mining is proposed only under the gullies), as proposed in the Contracted Project, will eliminate the potential for structural damage to them. A subsidence assessment has been conducted that concludes that the sandstone pagoda formations within the SPLs will

not be impacted by subsidence as a result of highwall mining and thus will be preserved in the landscape.

Taking into consideration the very small percentage of SPL that occur within the Project Boundary, and the fact that it will not be directly disturbed by open cut or highwall mining activity, it is concluded that the Contracted Project will not impact on the SPLs in the Project Boundary.

Chapter 9

Mitigation and Offsetting of Contracted Mine Plan

The purpose of this chapter is to outline the mitigation and offsetting measures proposed to ameliorate the impacts of the Contracted Project on flora and fauna. A suite of substantial mitigation measures has been prepared to mitigate these impacts.

9.1 Mitigation Measures

9.1.1 Avoidance

Avoiding environmental impacts has been considered in the design of the Contracted Project mine plan to reduce vegetation clearance, further avoid SPLs and associated gully habitat and to minimise clearance of threatened flora and fauna habitat. These avoidance measures were achieved through either completely excising open cut methods in some gullies below SPLs or increasing setback of both open cut and highwall extraction.

i. Vegetation

In total the Contracted Project mine plan will avoid 61% (1,190 ha) of all native vegetation located within the Project Boundary (a reduction of 20% compared to the Exhibited Project mine plan).

Significant modification to the design of the mine plan for the Contracted Project has reduced the need for clearing large blocks of CEEC Box Gum Woodland. This was largely achieved in the northern portions of the Project Boundary, around the Cullen Valley and East Tyldesley area. The Contracted Project will avoid 31.25 ha of Box Gum Woodland listed under the EPBC Act and TSC Act.

The alignment of the conveyor to the Mount Piper Power Station has also been located adjacent to and partially within an existing power line infrastructure alignment to reduce the amount of unnecessary vegetation clearing. These avoidance measures have excluded a further 186 ha of native vegetation from surface mining disturbance within the Project Boundary over the life of the mine (21 years).

OEH's analysis of the vegetation made mention of three vegetation types that were of higher conservation significance and should be avoided. The vegetation names given by OEH do not correspond to any known mapping projects nor are there any detailed floristic or structural descriptions of each vegetation type. For this reason the three vegetation types noted by OEH in the PAC Report were aligned to four vegetation communities by

Cumberland Ecology based on habitat and area occupancy within the Project Boundary. The avoidance of higher conservation vegetation on Permian sediments is provided below:

- 18% of Tableland Gully Ribbon Gum Blackwood Applebox Forest;
- 65% of Tableland Gully Mountain Gum - Broad-leaved Peppermint Grassy Forest;
- 68% of Capertee Rough-barked Apple - Red Gum - Yellow Box Grassy Woodland; and
- 30% of Tableland Slopes Brittle Gum – Broad-leaved Peppermint Grassy Forest.

In addition, 57% of Exposed Blue Mountains Sydney Peppermint - Silvertop Ash Shrubby Woodland will also be avoided. This community occupies the talus slopes and extends down to the valley floor.

The table below shows the avoidance of vegetation communities in Project Boundary.

Table 9.1 Contracted Mine Plan Vegetation Avoidance

Vegetation Community	Area of Vegetation within Project Boundary (ha)	Area of Vegetation Avoided in Contracted Mine Plan (ha)	Percentage avoided (%)
Tableland Gully Snow Gum - Ribbon Gum Grassy Forest	0.90	0.90	100%
Tableland Gully Snow Gum - Ribbon Gum Grassy Forest Low Diversity Derived Native Grassland	23.35	23.35	100%
Tableland Gully Ribbon Gum Blackwood Applebox Forest	111.81	20.66	18%
Tableland Gully Ribbon Gum Blackwood Applebox Forest Derived Native Grassland	16.62	1.59	10%
Capertee Rough-barked Apple - Red Gum - Yellow Box Grassy Woodland (EPBC)	46.18	31.21	68%
Capertee Rough-barked Apple - Red Gum - Yellow Box Grassy Woodland Derived Native Grassland (EPBC)	0.27	0.00	0%
Capertee Rough-barked Apple - Red Gum - Yellow Box Woodland: non grassy	0.12	0.01	6%
Capertee Rough-barked Apple Red Gum Yellow Box Woodland Derived Native Grassland (TSC EEC)	1.99	0.03	2%
Exposed Blue Mountains Sydney Peppermint -	679.11	383.93	57%

Table 9.1 Contracted Mine Plan Vegetation Avoidance

Vegetation Community	Area of Vegetation within Project Boundary (ha)	Area of Vegetation Avoided in Contracted Mine Plan (ha)	Percentage avoided (%)
Silvertop Ash Shrubby Woodland			
Tableland Scribbly Gum – Narrow-leaved Stringybark Shrubby Open Forest	332.43	257.63	77%
Tableland Broad-leaved Peppermint - Brittle Gum - Red Stringybark Grassy Woodland	13.71	13.71	100%
Tableland Broad-leaved Peppermint - Brittle Gum - Red Stringybark Grassy Woodland Low Diversity Derived Native Grassland	215.23	215.23	100%
Tableland Slopes Brittle Gum – Broad-leaved Peppermint Grassy Forest	260.85	78.00	30%
Tableland Slopes Brittle Gum – Broad-leaved Peppermint Grassy Forest Derived Native Grassland	57.07	7.84	14%
Tableland Gully Mountain Gum - Broad-leaved Peppermint Grassy Forest	51.70	33.72	65%
Tableland Gully Mountain Gum Broad-leaved Peppermint Grassy Forest Derived Native Grassland	12.84	0.41	3%
Tableland Gully Mountain Gum Broad-leaved Peppermint Grassy Forest Low Diversity Derived Native Grassland	2.79	1.94	70%
Cox's Permian Red Stringybark - Brittle Gum Woodland	92.02	86.97	95%
Pagoda Rock Sparse Shrubland	32.87	32.87	100%
TOTAL	**1951.88**	**1190.02**	**61%**

ii. Flora and Fauna

The Contracted Project Disturbance Boundary completely avoids Persoonia marginata habitat within the Project Boundary. This will result in 16.19 ha of habitat that will not be directly impacted. The total extent of this population reaches far beyond the bounds of the Project Boundary and totals 49.77 ha.

The Contracted Project Disturbance Boundary avoids 704.65 ha (22,172 individuals) of Eucalyptus cannonii habitat within the Project Boundary.

A number of ROTAP species were recorded in the Project Boundary by Special Interest groups. The majority of these species occur in Pagoda Rock Sparse Shrubland in the Project Boundary which is located well beyond the Contracted Project Disturbance Boundary and will not be removed. Thus the Project will avoid habitat removal for the following species:

- *Acacia asparagoides;*
- *Leionema lamprophyllum subsp. orbiculare;*
- *Leucochrysum graminifolium*; and
- *Philotheca obovalis*.

iii. Significant Pagodas Landforms and Gully Habitats

Such modifications have also led to further setbacks from the EA mine plan of open cut mining up to 240 m in gullies adjacent to the Ben Bullen State Forest SPL. This has achieved an additional avoidance of 16.17 ha of gully habitat adjacent the SPL and native vegetation on Permian sediments.

Coalpac has committed to the exclusion of highwall mining under the sandstone pagoda formations within the SPLs (highwall mining is proposed only under the gullies).

The Blast Management Plan will include a 200m zone from the SPL wherein blasting will only proceed on a progression based on a TARP with defined limits for measurable blast responses (e.g. vibration limits at the SPL) (Terrock 2013).

The Contracted Project Disturbance Boundary not only reduces the area of direct disturbance by 20% (when compared to the area of the Exhibited Project Disturbance Boundary), but also reduces the periphery by 10%. The perimeter of the Contracted Project Disturbance Boundary is 48.28 km (5.48 km smaller than the perimeter of the Exhibited Project Disturbance Boundary). This reduction in the footprint size focuses on reducing the disturbance frontage along the SPL associated wet gullies and thus potential edge effects. Adjacent to the BBSF SPL, this reduction in the perimeter of the open cut amounts to 25%. Similarly no open cut mining is proposed to forest and woodland west of the railway line on Hillcroft avoiding further impacts from fragmentation.

9.1.2 Mitigation Measures

Where the design of the Contracted Project is implemented on the ground, measures can be established to mitigate some of the direct and indirect impacts of the proposed construction and operation.

One of the key mitigation strategies for the Contracted Project is the rehabilitation of open cut mining areas. This includes maximising the biodiversity and connectivity within the landscape through management of existing Coalpac rehabilitation sites and the establishment of new rehabilitation sites.

All land disturbed by the Contracted Project will be progressively rehabilitated in accordance with the conceptual mine plan. The majority of disturbed land will be returned to native forest and woodland. Areas of grassland within the Contracted Project Disturbance Boundary may be rehabilitated back to grassland only.

Therefore, the Contracted Project will rehabilitate:

- 682.09 ha of native vegetation including:
    - 17.20 ha of Box Gum Woodland and Derived Native Grassland C/EEC;
    - 204 ha of *Eucalyptus cannonii* habitat, and
    - 77.54 ha of non-listed grasslands.

A detailed rehabilitation plan will be designed for the Contracted Project with the intention of providing pre-mining biodiversity values. Coalpac's rehabilitation of previously mined areas is progressing well (EcoBiological 2012).

Rehabilitation of threatened plant habitats will aim to achieve similar densities of *Eucalyptus cannonii*. Rehabilitation of Eucalyptus cannonii habitat is not expected to be difficult as seed viability appears to be high as the species can be easily propagated from seed (NSW NPWS 2000). The ease of propagating this species is sanctioned by the prevalence of nurseries supplying tubestock within its natural range. The species has been planted in existing rehabilitation which will continue for the Contracted Project.

Rehabilitation of threatened plant habitats will aim to achieve similar densities of Eucalyptus cannonii. Rehabilitation of Eucalyptus cannonii habitat is not expected to be difficult as seed viability appears to be high as the species can be easily propagated from seed (NSW NPWS 2000). The ease of propagating this species is sanctioned by the prevalence of nurseries supplying tubestocks within its natural range. The species is apparently already in existing rehabilitation which will continue for the Contracted Project.

The following mitigation measures were described in the Exhibited Project EA and will be utilised for the Contracted Project. These include:

- Minimise disturbance of native vegetation during construction and ahead of Project mining operations;
- Prepare a consolidated Coalpac Biodiversity Management Plan that contains detailed mitigation measures for the Project and includes the existing Invincible Colliery and Cullen Valley Mine offsets to provide a cohesive, integrated and holistic approach. This plan should include (but not be limited to) information such as protocols for vegetation clearing (including inspection of hollows), feral animal and pest control, rehabilitation objectives, and further detailed design measures;
- Prepare and implement a nest box management procedure (refer below);

- Implement a two stage clearing protocol for all hollow-bearing trees. All hollow-bearing trees to be felled should be marked and a catalogue of their species and approximate dimensions recorded so that hollows or nest boxes can be affixed to similar standing trees located in offset, revegetation or rehabilitation areas;

- Undertake ongoing weed management and monitoring;

- Prepare a Rehabilitation/Revegetation Management Plan which should include (but not be limited to):

    - Planting a variety of locally occurring native species, including trees, shrubs and selected herbaceous plants to compensate for any impacts to habitat;

    - Increasing the overall vegetation cover;

    - Incorporating existing natural vegetation and habitat features removed during clearing activities where appropriate; and

    - Establishing linkages between patches of remnant native vegetation.

    - As part of the Coalpac Biodiversity Management Plan, develop a flora and fauna monitoring program for the Project. This monitoring plan should enhance and complement the existing monitoring plan. This plan should also include monitoring and control of exotic weeds and feral animals; and

    - As part of the Water Management Plan, prepare a consolidated Sediment and Erosion Control Plan which includes leading practice erosion and sediment controls.

9.1.3 Additional Mitigation Measures of the Contracted Mine Plan

In addition to the mitigation measures summarised above and described in the Exhibited Project EA, Coalpac has increased measures to further reduce impacts to a biodiversity identified by OEH and subsequently the PAC.

i. Broad-headed Snake

Additional considerations to reduce potential impacts to the Broad-headed Snake include:

- Clearing forest and woodland mapped as potential habitat (mapped by Dr Arthur White in **Figure 1** of **Appendix B**) within the Contracted Project Disturbance Boundary during winter, when snakes may be sheltering under rocks in such habitats;

- Conducting preclearance surveys in selected areas in winter when snakes may be sheltering under rocks. Captured snakes to be relocated into suitable habitat areas to the east in the Ben Bullen State Forest;

- Ensuring that there remains undisturbed forest around some portions of the SPL and Sandstone Outcrops (as there will be to the north, east and south of the in the Ben Bullen SPL of the Contracted Project);

- Replacement of bushrock and consideration the use of artificial shelter sites on Sandstone Outcrops and the SPL in rehabilitation, as these have been shown to increase the occurrence of both snakes and their preferred food, the Velvet Gecko;

- Maintaining some hollow trees at the bases of the Sandstone Outcrops and the SPL (Cumberland Ecology have verified that hollow trees will remain within the standoff zone between the Sandstone Outcrops and the SPL and the edge of the proposed open cut);

- Rehabilitating vegetation within the mined areas to eventually replace the vegetation cleared;

- Provision of funding for an indirect offset that entails funding for additional habitat surveys of Broad-headed Snake in the wider area of the western Blue Mountains to further the knowledge of the species (as suggested by Webb pers. comm.).

ii. Brush-tailed Rock Wallaby

This species has not been found on site or in the adjacent SPL area. However, a fox baiting program will be implemented for the life of the mine so as to reduce fox predation pressure on small native mammals, including, potentially the Brush-tailed Rock Wallaby, if it recolonises the SPL habitat or other Sandstone Outcrops on site.

iii. Cave-dependant Bats

All of the major cliff lines and caves with the Sandstone Outcrops, and all of the SPL habitats will be protected from direct and indirect impacts of mining. Foraging habitats cleared by mining will be rehabilitated so that in the long term the species is able to re-use mined areas. Monitoring will be conducted to verify that the bat remains and uses the habitats within the Project Boundary and in adjacent areas for the life of the mine.

9.2 Offsetting

Coalpac has developed a BOS for the Exhibited Project with the objective of offsetting the residual impacts on biodiversity, particularly on threatened ecological communities and habitat for threatened species. The BOS has been devised to comply with the current principles for offsetting set out by SEWPaC (DEWR, 2007) and by OEH (DECC (NSW), 2008a) and also address concerns raised by OEH in the PAC Report (NSW Planning Assessment Commission (PAC) 2012b, a).

The Project will require the provision of a Biodiversity Offsets Package (BOP) to compensate for the predicted ecological impacts of the proposed open cut mine and associated infrastructure. The BOP is the combination of offsets used to compensate the outstanding

residual impacts of the Project that will result after various avoidance and mitigation measures have been implemented.

The BOP addresses the impacts of the Project in a strategic and meaningful way that will deliver a real biodiversity outcome. It will ensure that the Project is not conducted at a cost to biodiversity conservation. A "maintain or improve" approach is to be undertaken that retains the ecological condition of the landscape within the locality by conserving, where practically possible, and increasing representative woodland and forest communities within designated areas.

Maintain or improve is defined as increasing the net area and condition of ecological communities within the locality of the proposed development in the medium to long term by permanently conserving and improving the condition of representative examples of vegetation communities and habitats for threatened species that are to be impacted by the proposed development. This definition has been based upon the key principles of offsetting, and particularly that:

- Offsets should be targeted to the ecological communities and threatened species that will be impacted by the Project;
- Offsets should be commensurate with the magnitude of the impacts; that is, there should be a net increase in the size and condition of the community types, populations or habitat types that will be impacted by the Project; and
- Offsets should be lasting; that is, there should be a level of legal protection for offset areas.

The BOP consists of three priorities that together will ensure the best compensatory outcomes are achieved for the predicted ecological impacts of the Project. The BOP has been designed to meet State and Commonwealth offset requirements and protect and improve biodiversity within the locality with the most efficient utilisation of resources.

9.2.1 Revised Biodiversity Offset Package

The most recent BOP is provided in the Project's Response to Submissions (Hansen Bailey Environmental Consultants 2012). Coalpac included an additional offset property, Gulf Mountain to that described in the Exhibited Project EA.

The Revised Biodiversity Offset Strategy and Revised Biodiversity Offset Package provided in the Response to Submissions reproduced below.

Table 9.2 Revised Biodiversity Offset Strategy

Vegetation Type	Project Boundary Disturbance (ha)	Proposed Offset (ha)	Proposed Offset Ratio
CEEC & EEC[1]	18.44	221.7	12.0

Table 9.2 Revised Biodiversity Offset Strategy

Vegetation Type	Project Boundary Disturbance (ha)	Proposed Offset (ha)	Proposed Offset Ratio
Non CEEC & EEC (native only)	818.41	2,808	3.4
Total	**836.85**	**3,030**	**3.6**

Notes: 1 includes EPBC Act and TSC Act Box Gum Woodland and Derived Native Grassland.

Table 9.3 Revised Biodiversity Offset Package

Vegetation Type	Hillcroft (ha)	Yarran View (ha)	Billabong/ Hillview (ha)	Hyrock Hartley (ha)	Gulf Mountain[2] (ha)	Total[2] (ha)
CEEC & EEC[1]	-	186.80	34.90	0.00	0.00	221.7
Non C/EEC (native only)	989.50	256.30	48.50	236.09	1277.73	2808
Total	**989.50**	**443.10**	**83.40**	**236.09**	**1277.73**	**3030**

1 includes EPBC Act and TSC Act Box Gum Woodland and Derived Native Grassland.

2. OEH noted an existing covenant on Gulf Mountain restricting clearing and as a result, only valued the property at 80% effective. This has not been included in the offset calculations.

9.2.2 Revised Biodiversity Offset Package Property Descriptions

Coalpac are currently managing existing offset properties totalling approximately 166 ha of forest, woodland and grassland, which will be managed as long-term compensatory conservation areas.

A brief description of offset properties that make up the Revised BOP is provided below.

i. Hillcroft Offset Property

The primary objective for acquiring Hillcroft was to create a substantial wildlife corridor between Ben Bullen State Forest and Sunny Corner State Forest to compliment GOS2, to conserve *Eucalyptus cannonii, Persoonia marginata* and Booroolong Frog habitat and rehabilitate similar vegetation to that within the Project Boundary. The property can be divided into two broad landscapes, farmed land in the eastern portion and good quality remnant native vegetation in the western portion.

ii. Yarran View Offset

The property borders the Wollemi National Park (refer to Figure 9.1) and covers approximately 450 ha. The primary objective for acquiring Yarran View is to conserve and rehabilitate CEEC Box Gum Woodland and Derived Native Grassland. The Yarran View property contains an array of different habitats such as rocky exposed ridge tops; steep slopes, cleared and semi cleared woodlands on undulating lower slopes and a small creek (Lee Creek). Almost half of the property contains remnant vegetation in good condition. This offset property in Bylong Valley and is located within a Regent Honeyeater hotspot.

iii. Hillview/Billabong Offset Property

The Hillview/Billabong property covers an area of approximately 83 ha and is situated on the western side of the Castlereagh Highway west of the Invincible Colliery (see **Figure 9.1**). The primary objective for acquiring Hillview/Billabong is to conserve and rehabilitate similar vegetation to that located within the Project Disturbance Boundary and conserved Eucalyptus cannonii habitat. Hillview/Billabong covers 83 ha and contains 41 ha of Eucalyptus cannonii habitat, 48.5 ha of impacted vegetation on Permian sediments and 35 ha of CEEC Box Gum Woodland and Derived Native Grassland.

iv. Hyrock Hartley Property

This property is located 35 km south-east of the Project Boundary in Hartley Vale (refer to **Figure 9.1**) and is across the road from the Blue Mountains National Park. It is covered in high quality remnant sandstone vegetation supporting similar habitats to those found within the Project Boundary. Hyrock Hartley has varying habitats that resemble the Project Boundary such habitat associated with rocky cliff and caves exposed heathlands and shrub lands, sheltered deep soiled gullies. In addition, the property also contains riparian habitats.

This property supports sandstone and Permian sediments similar to that within the Project Boundary. Threatened species known to occur on the property include the Spotted-tailed Quoll, Giant Dragonfly and Blue Mountains Water Skink. The property also provides suitable habitat for the Brush-tailed Rock-wallaby, Large-eared Pied Bat, Eastern Bentwing-bat and Broad-headed Snake. This property will complete a gap in the Blue Mountain National Park extension as part of the GOS2.

9.2.3 Contracted Mine Plan Biodiversity Offset Package

In response to the PAC Report, Coalpac has revised the Exhibited Project mine plan to further avoid threatened flora, fauna, endangered ecological communities and their habitats with particular attention around further avoiding pagoda landforms and the habitat they provide. The Contracted mine plan completely avoids open cut mining on land within Hillcroft property.

Please note that Hillcroft property has been excluded from the Contracted BOP, giving a total area of offset land of 2,040 ha (rounded down).

The BOP of the Contracted Mine Plan is provided below in **Table 9.4**

Table 9.4 Contracted Mine Plan Biodiversity Offset Package

Vegetation Type	Yarran View (ha)	Billabong/ Hillview (ha)	Hyrock Hartley (ha)	Gulf Mountain[2] (ha)	Total
CEEC & EEC[1]	186.8	34.9	0.0	0.0	221.7
Non CEEC & EEC (native only)	256.3	48.5	236.1	1277.7	1818.6
Total	**443.1**	**83.4**	**236.1**	**1277.7**	**2040.3**

1 includes EPBC Act and TSC Act Box Gum Woodland and Derived Native Grassland.

2. OEH noted an existing covenant on Gulf Mountain restricting clearing and as a result, only valued the property at 80% effective. This has not been included in the offset calculations.

The Contracted Mine Plan Biodiversity Offset ratio excluding rehabilitation is provided below. With the exclusion mine rehabilitation (761.9 ha credited at 50%) the offset ratio is 2.7:1.

Table 9.5 Contracted Mine Plan Biodiversity Offset Ratio (without rehabilitation)

Vegetation Type	Project Boundary Disturbance (ha)	Proposed Offset[2] (ha)	Proposed Offset Ratio[2]
CEEC & EEC[1]	17.2	221.7	12.9
Non CEEC & EEC (native only)	744.7	1818.6	2.4
Total	**761.9**	**2040.3**	**2.7**

1 includes EPBC Act and TSC Act Box Gum Woodland and Derived Native Grassland.

2. OEH noted an existing covenant on Gulf Mountain restricting clearing and as a result, only valued the property at 80% effective. This has not been included in the offset calculations.

The Contracted Mine Plan Biodiversity Offset ratio, including mine rehabilitation, is provided below. With the inclusion of mine rehabilitation (761.9 ha credited at 50%) the Contracted Mine Plan Biodiversity Offset ratio is 3.2:1.

Table 9.6 Contracted Mine Plan Biodiversity Offset Ratio (with rehabilitation)

Vegetation Type	Project Boundary Disturbance (ha)	Proposed Offset[2] (ha)	Proposed Offset Ratio[2]
CEEC & EEC[1]	17.2	230.3	13.4
Non CEEC & EEC (native only)	744.7	2191.0	2.9
Total	**761.9**	**2421.2**	**3.2**

1 includes EPBC Act and TSC Act Box Gum Woodland and Derived Native Grassland.

2. OEH noted an existing covenant on Gulf Mountain restricting clearing and as a result, only valued the property at 80% effective. This has not been included in the offset calculations.

9.2.4 Target Biodiversity Offset Package

In recognition of a shortfall in the required offset ratio, Coalpac has committed to achieving a total minimum ratio of 4:1 for native vegetation excluding mine rehabilitation. This requires the acquisition of an additional 1,007 ha (rounded up) of forest and woodland (as described in **Table 9.9)** so that the total Contracted Project Biodiversity Offset Package is 3,047 ha (rounded down). This is provided in the table below.

Coalpac's commitment to a minimum 4:1 offset ratio is comparable to other approved mining project in NSW, including Ulan Coal Mine (4:1 ratio), Duralie Coal Mine (3.3:1 ratio) and Maules Creek Coal Mine (4.3:1 ratio).

Table 9.7 Target Biodiversity Offset Package (without rehabilitation)

Vegetation Type	Project Boundary Disturbance (ha)	Proposed Offset [2] (ha)	Proposed Offset[2] Ratio
CEEC & EEC[1]	17.2	221.7	12.9
Non CEEC & EEC (native only)	744.7	2825.7	3.8
Total	**761.9**	**3047.4**	**4.0**

1 includes EPBC Act and TSC Act Box Gum Woodland and Derived Native Grassland.

2. OEH noted an existing covenant on Gulf Mountain restricting clearing and as a result, only valued the property at 80% effective. This has not been included in the offset calculations.

9.2.5 Offset Acquisition

To ensure the Contracted Project BOP adequately compensates residual impacts and expected time lags between mine rehabilitation and vegetation clearing, a specific offset selection criterion was developed.

Firstly the selection criterion considered the quantum of land required to reach a minimum of 4:1 offset ratio as well as concerns raised by OEH in the PAC Report. Therefore the offset criterion considered the following:

- Reach a 4:1 offset ratio;
- The loss of vegetation (corresponding to Tableland Wet Sclerophyll Forest and Southern Tableland Dry Sclerophyll Forest by Keith (2004)) on Permian sediments;
- Low likelihood of finding ROTAPs on offset properties; and
- Potential impacts to the Broad-headed Snake, Brush-tailed Rock Wallaby and cave-dwelling bats.

It has already been demonstrated that the majority of ROTAPs recorded in the Project Boundary occur beyond the Contracted Project Disturbance Boundary and will not be directly impacted (see **Section 8**). Hence the need to offset residual impacts to ROTAPs is neither warranted nor necessary and has not been included in the selection criteria below.

It has also been demonstrated in **Chapter 5** and **Section 9.1** that the Broad-headed Snake, Brush-tailed Rock Wallaby, Large-eared Pied Bat and Eastern Bentwing-bat would be secure in the future, even in a worst case scenario whereby the entire mine site is not rehabilitated (which is not proposed). Firstly, there is no population of Brush-tailed Rock Wallaby in the Project Boundary to be impacted. For the other species, extensive habitats are conserved to the east, and broad areas of forest and woodland will remain unmined in the Project Boundary (e.g. the areas containing CEEC that have been avoided by the Contracted Project mine plan), areas around Cullen Bullen and Cullen Valley Mine, and areas west of the railway line that are not proposed for mining under the Contracted Project. Furthermore, extensive areas of undisturbed forest and woodland will also be retained in Ben Bullen State Forest and other areas to the north and north east of the Project Boundary in National Parks. In addition, clearing for mining is progressive over the Project duration of 21 years, so that habitat is not immediately removed, thereby minimising impact. Hence the need to offset residual impacts to foraging habitat of the Broad-headed Snake and cave-dwelling bats (Large-eared Pied Bat and Eastern Bentwing-bat) has been greatly reduced through avoidance and mitigation measures.

An offset property that would adequately compensate residual impacts should contain the following attributes:

1. At least 1,007 ha of forest and woodland preferably corresponding to vegetation classes Tableland Wet Sclerophyll Forest and Southern Tableland Dry Sclerophyll Forest by Keith (2004); and

2. Property or portions of the property should occur on Permian sediments;

The selection criteria follows the offset policy documents for both Commonwealth and State Agencies (DEWR 2007, DECCW 2010).

Coalpac has sought further consultation with OEH in January and February 2013 to provide an updated list of potential offset properties deemed suitable by OEH – a table similar to that provided on page 105 in the Response to Submissions (Hansen Bailey Environmental Consultants 2012). In the meantime, Cumberland Ecology and Coalpac consulted with various real estate agencies in the Capertee Valley, Bylong Valley, Rylstone, Ben Bullen and Cullen Bullen area.

On the 28th February 2013 OEH supplied a belated list of potential offset properties to Cumberland Ecology. Due to the delay, Cumberland Ecology has not been able to assess each property as per the selection criteria below, but will consider the list of properties during ongoing investigations and will consult OEH throughout this process.

9.2.6 Summary of Potential Offset Properties Using the Selection Criteria

This section summarises the results of desktop assessments of potential offset properties using the "selection criteria" above.

For more detailed property information including aerial photography (see **Appendix H**).

Figure 9.1 provides an overview of the Contracted Mine Plan Biodiversity Offset Package, including existing offsets and potential offset properties that could be acquired. These are discussed in a summary table below.

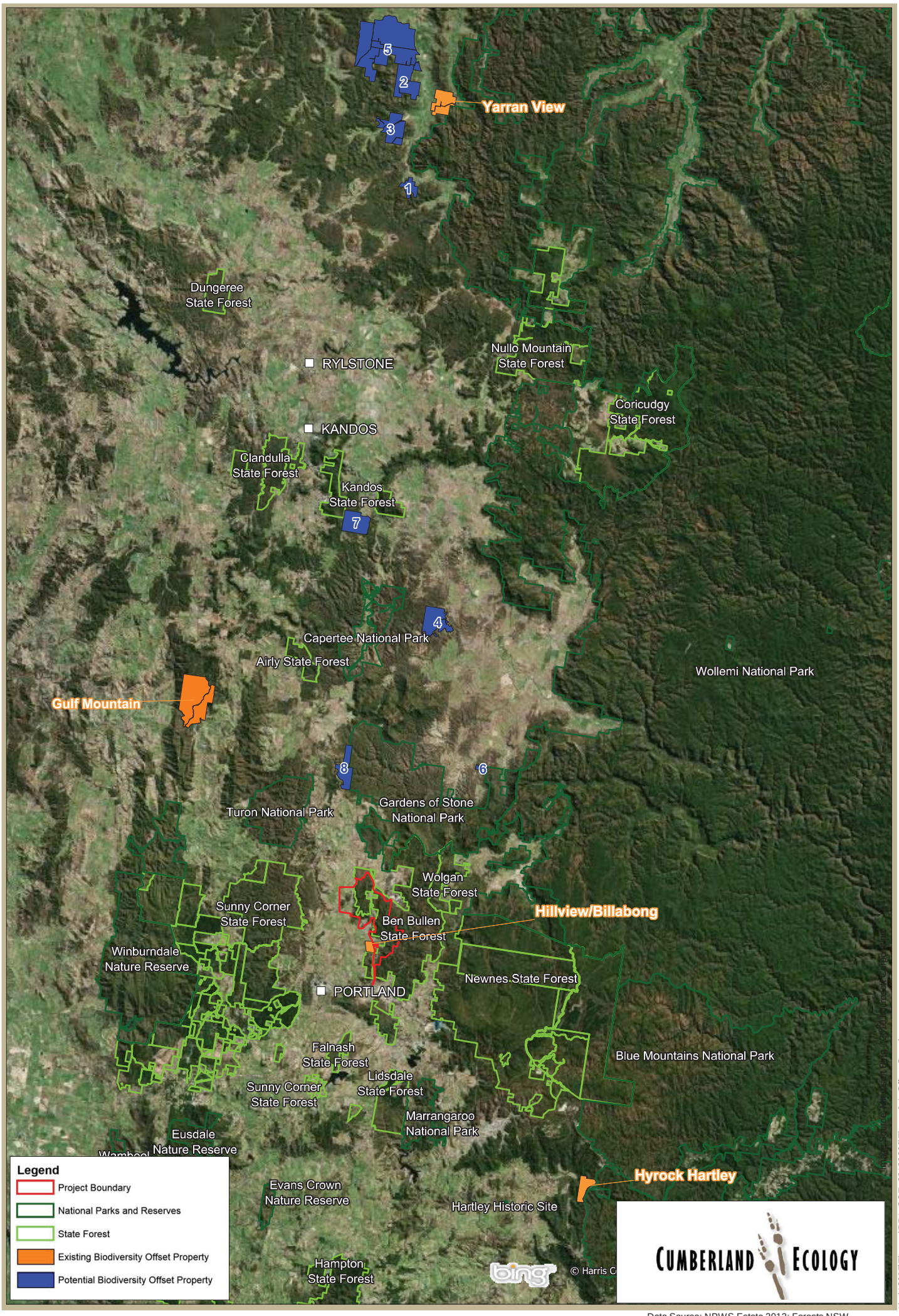

Figure 9.1. Contracted Mine Plan Biodiversity Offset Package Overview

As can be seen in **Figure 9.1** and **Table 9.8** (below), a number of potential offset properties have been considered in the preparation of this report. Coalpac has found a number of potential offset properties that address some of the selection criteria. Further investigation would be required to verify and quantify vegetation communities and threatened species habitats.

The table below summaries the key values as per the aforementioned selection criteria for the potential offset properties.

Table 9.8 Summary of Biodiversity Values of Potential Offset Properties

Potential Offset Property	Biodiversity Values According to Selection Criteria
Potential Offset Property 1*	This property is 200 ha in size and does not border a National Park. It contains approximately 140 ha of intact vegetation and 60 ha of cleared and semi-cleared land. The intact vegetation does not correspond to any impacted vegetation classes by Keith (2004). Property occurs on Permian and Triassic sediments. The Broad-headed Snake and Brush-tailed Rock Wallaby have been recorded within 5 km of the property. A full list of other threatened species recorded within 5 km are provided in Appendix H.
Potential Offset Property 2*	This property is 540 ha in size and does not border a National Park. Property occurs on Permian and Triassic sediments. Project contains approximately 260 ha of intact vegetation and 280 ha of cleared land. Vegetation classes do not correspond to impacted vegetation classes in the Project Boundary and valleys would require revegetation. *Eucalyptus cannonii* has been recorded within 5 km of the property. This property adjoins Braithwaite. A full list of threatened species recorded within 5 km are provided in Appendix H.
Potential Offset Property 3*	This property is 580 ha in size and does not border a National Park. Property occurs on Permian and Triassic sediments. The property contains approximately 135 ha of intact vegetation and 409 ha of cleared land. Vegetation classes do not correspond to impacted vegetation classes in the Project Boundary and valleys would require revegetation. This property adjoins vegetation with rock outcrops occurring between Property 2 and Property 3. *Eucalyptus cannonii,* Broad-headed Snake and Brush-tailed Rock Wallaby have been recorded within 5 km of the property. A full list of other threatened species recorded within 5 km are provided in Appendix H.
Potential Offset Property 4*	This property is 579 ha in size and does not border a National Park, though adjoins intact vegetation that connects to Capertee National Park. The property contains approximately 529 ha of intact vegetation and 50 ha of cleared land. Property occurs on Permian and Lower to middle Devonian. Vegetation classes do not correspond to impacted vegetation classes in the Project Boundary. A full list of threatened species recorded within 5 km are provided in Appendix H.
Potential Offset Property 5*	This property is 2,559 ha in size and does not border a National Park though is of adequate size to become one in its own right. Property occurs on Tertiary, Triassic and Quaternary (overlying Permian). The majority of the valley floor is cleared and

Table 9.8 Summary of Biodiversity Values of Potential Offset Properties

Potential Offset Property	Biodiversity Values According to Selection Criteria
	covers 1200ha and would require revegetation. The slopes and higher country have not been cleared and cover 1359 ha of native vegetation. Some of the vegetation corresponds to Southern Tableland Dry Sclerophyll Forest, an impacted vegetation class in the Project Boundary. A full list of threatened species recorded within 5 km are provided in Appendix H including *Eucalyptus cannonii*.
Potential Offset Property 6*	This property is 50 ha in size and borders on Gardens of Stone National Park. Property occurs on Permian and Lower to middle Devonian. This property is completely forested. Vegetation classes on the property do not correspond to impacted vegetation classes in the Project Boundary. *Eucalyptus cannonii*, Large-eared Pied Bat has been recorded within 5km of the property. A full list of other threatened species recorded within 5 km are provided in Appendix H.
Potential Offset Property 7*	This property is 236 ha in size and borders Kandos State Forest. Property occurs on Permian and Lower to middle Devonian. The property contains approximately 20 ha of cleared land and 216 ha of native vegetation. Some of the vegetation on the property corresponds to Southern Tableland Dry Sclerophyll Forest, a class of vegetation impacted by the Project. *Eucalyptus cannonii*, Eastern Bentwing-bat and Large-eared Pied Bat has been recorded within 5 km of the property. A full list of other threatened species recorded within 5km are provided in Appendix H.
Potential Offset Property 8*	This property is 400 ha in size and borders Gardens of Stone National Park. Located approximately 8km north of the Project Boundary. The property occurs on Permian and Lower to middle Devonian. The property contains approximately 93 ha of cleared land and 306.83 ha of native vegetation. Some of the vegetation on the property corresponds to Southern Tableland Dry Sclerophyll Forest, a class of vegetation impacted by the Project. Valleys would require revegetation. *Eucalyptus cannonii* has been recorded within 5 km of the property. A full list of other threatened species recorded within 5km are provided in Appendix H.

** Property names and Lot and DPs have been excluded for confidentiality reasons. Further property details can be supplied upon request by DP&I and/or other NSW regulators.*

9.2.7 Contracted Project Biodiversity Offset Commitment

For the Biodiversity Offset Package to achieve a 4:1 ratio, Coalpac will commit to finding at least an additional 1,007 ha of forest and woodland as described below. Coalpac shall implement the biodiversity offset strategy summarised in the table below to the satisfaction of the Director-General.

Table 9.9 Summary of Contracted Project Biodiversity Offset Package

Biodiversity Offset Property	Offset Type	Minimum Size (ha)
Yarran View	Existing vegetation to be managed and additional vegetation to be established. Protect and manage 43.01 ha of Box Gum Woodland CEEC and restore 143.77 ha of Box Gum Woodland and Derived Native Grassland CEEC	443.1
Hillview/Billabong	Existing vegetation to be managed and additional vegetation to be established. Protect and manage 5.53 ha of Box Gum Woodland CEEC and restore 29.34 ha of Box Gum Woodland Derived Native Grassland CEEC	83.4
Hyrock Hartley	Existing vegetation to be protected and managed	236.1
Gulf Mountain	Existing vegetation to be protected and managed	1277.7
Additional Offset Property	Protect and manage forest and/or woodland adjoining a conservation area that is not on a mining tenement. Protect and manage vegetation that corresponds to Southern Tableland Wet Sclerophyll Forest (Keith 2004) and/or Southern Tableland Dry Sclerophyll Forest (Keith 2004).	1007.1
Total		**3047.4**

Chapter 10

Conclusion

The Exhibited Project mine plan as described in the Environmental Assessment dated March 2012 and its associated ecological impacts have been reassessed in view of the PAC conclusions and recommendations, and the information upon which the PAC formed such opinions. Subsequently the Contracted mine plan has been modified and covers a smaller area to that exhibited and the ecological impacts will be reduced. A detailed assessment of potential impacts to SPLs, and flora and fauna said to be dependent upon them, has been conducted. It is concluded that the Contracted Project, would have a negligible impact upon SPLs and no significant impact on the flora and fauna associated with them. It should be noted that this is consistent with the findings of the ecological assessment for the original mine plan.

Our work also indicated that much of the information from OEH and the NGOs that the PAC based its ecological information on was either lacking in appropriate context, or simply flawed. Our assessments for this report show that there is not a suite of species that is strongly associated with pagoda landforms (any more so than they are associated with large sandstone outcrops, cliffs and/or caves of the greater Blue Mountains, Sydney, Wollongong, or Newcastle regions. Our work also indicates that we have taken due consideration of all relevant threatened species and that we have not failed to factor in assessments of other species of conservation concern that could occur within the Contracted Project Disturbance Boundary.

As required by the DGRs, the ecological assessment has focussed on threatened species and communities described under the TSC Act and EPBC Act. In addition to the DGRs, this report has also considered impacts to a suite of ROTAP plants, and we have found that none of these are likely to be substantially impacted by the Contracted Project.

The PAC recommended a 300 metre buffer be applied to extend from pagoda landforms westward across the proposed mine site to protect foraging habitats of such threatened species as Broad-headed Snake, Brush-tailed Rock Wallaby and Large-eared Pied Bat. However, such a large buffer is not justified in view of the habitats within the Project Boundary, lack of records for the species within the Project Boundary, and the treatment of such species within other recently approved coal projects within comparable sandstone landscapes (e.g. Moolarben and Ulan mines). In the case of the Broad-headed Snake and the Brush-tailed Rock Wallaby such buffers do not appear to address key threats to the species: i.e. illegal collecting of the Broad-headed Snake, and predation by red fox on the Brush-tailed Rock Wallaby.

The PAC concluded that the Exhibited Project Disturbance Boundary cannot be adequately rehabilitated and that there is no evidence of successful regeneration/rehabilitation to mature woodland on any NSW open cut mine site. The notions that mature native Australian forest communities cannot be established on disturbed ground is incongruous with current rehabilitation research and site based observations. Cumberland Ecology is of the view that there is sufficient evidence that woodland and open forests can be regenerated to maturity on disturbed land including previously mined areas. Evidence to date, based on annual biodiversity surveys, of rehabilitation work at Cullen Valley Mine has shown that species diversity and density is progressing well towards achieving the species target levels based on the composition of adjacent mature woodland. The landscape following mining when rehabilitated is not permanently scarred. It does not appear that the PAC has considered the success of rehabilitation efforts undertaken to date at Cullen Valley Mine. Some of Cullen Valley Mine rehabilitation is now approximately 11 years old and progressing well.

With regard to GOS2, we are unaware of any formal NSW Government position on this potential conservation area extension. Despite our consultation with OEH, we have not been provided with formal mapping or documentation of such a proposal and note that no such proposal was provided to the PAC. The only proposal we are aware of is that of the Colong Foundation, a SIG.

The PAC concluded that the proposed mining of Ben Bullen State Forest was incompatible with any future proposal for GOS2. We disagree with this conclusion for the following reasons. Firstly, under the current mining proposal the vast majority of land nominated for conservation by the Colong Foundation would not be mined. Secondly, the nomination by Colong Foundation is for a State Conservation Area, where mining operations can legally occur and have previously occurred for other developments of a similar nature. Finally, we have noted that old mining areas are located within many of the NSW and other Australian National Parks. Hence, we conclude that the mining proposal is not incompatible with the Colong Foundation proposal for GOS2.

Based on the above understanding the ecological recommendations of the PAC have been addressed, either by accepting them, or in the case of several of the recommendations, by refuting them, as shown in **Table 10.1** below.

Table 10.1 Response to Ecological Recommendations by the PAC

Ecological Recommendations by the PAC	Response to Recommendations
Recommendation 45: The Commission [PAC] recommends that the pagodas and the associated escarpments be considered natural features of special significance and that they be fully protected from any mine-induced impacts.	The SPLs have been accurately mapped and are outside the Project Disturbance Boundary (Section 4). They will be protected from the impacts of mining (Section 4 and Section 8)
Recommendation 46: The Commission recommends that highwall mining not be permitted under the pagodas or escarpments in the Project area.	The majority of Significant Pagoda Landforms are fully protected from highwall mining.
Recommendation 47: The Commission recommends that to provide adequate protection for threatened species and other fauna that use the pagoda landform, a minimum setback distance of 300m be maintained from the open-cut highwall to the pagodas and the escarpments.	This recommendation from the PAC has been fully examined and is disputed (Chapter 5). Smaller but appropriate buffers are proposed combined with a suite of other mitigation measures that will protect threatened species (and ROTAP plants) associated with pagodas, cliffs and caves.
Recommendation 48: The Commission recommends that, given the significance and sensitivity of the pagodas and the pagoda landform environment, before the Project is submitted for determination the uncertainties in the Proponent's supporting information identified in section 6.2 [of the PAC Report] are resolved and the caveats and qualifications on the various commitments are removed so that the Determining Authority has an unequivocal understanding of what the outcomes will be and the risks associated with them.	The Hebblewhite (2013) review concluded that approval of highwall mining is suitable and recommended, and presents no greater risk than underground mining methods, and it recommends a monitoring program and the rigorous Subsidence Management Plan process to direct and regulate the detailed mine design required before highwall mining can be carried out in the Project Boundary. Slope stability studies (Geotek Solutions, 2013) have quantified the risk of slope instability from open cut mining at distances as proposed to the SPL as extremely low.
Recommendation 49: The Commission recommends that concerns about the adequacy of the flora assessment and identification of the vegetation associations present in the Project area be resolved to the satisfaction of OEH prior to approval of any extension to open-cut mining in the Project area and prior to any assessment of adequacy or otherwise of the biodiversity offset package.	The vegetation communities and conservation significance of ROTAP and other flora have been re-examined. Issues raised by conservation groups and OEH have been responded to (Chapter 4 and Chapter 5).
Recommendation 50: The Commission recommends that, given the acknowledged high quality and species richness of the native vegetation present in the Project area, the assessment focus	The DGRs specifically required a focus on assessment of impacts to threatened species and that was done. In the current report, impacts to ROTAP species and other species

Table 10.1 Response to Ecological Recommendations by the PAC

Ecological Recommendations by the PAC	Response to Recommendations
should be on the overall quality of the habitat under threat and its biodiversity value rather than just on the threatened species component which is the focus of the EA.	of conservation interest have been dealt with (Chapter 8). The overall quality and diversity of habitats within the Project Disturbance Boundary has been noted and provision will be made to offset impacts to such habitats (Chapter 9).
Recommendation 51: The Commission recommends that calculation of edge effects be required to the satisfaction of OEH before the Project is submitted for determination.	The Exhibited Project EA considered edge effects, and they have been reconsidered within this assessment. The majority of edges to be created by mining will be upslope of mining, meaning that edge effects such as erosion will not impact retained native vegetation. Based upon the results of current mining, edge effects are not considered likely to be extensive, though their precise extent cannot readily be mapped (Chapter 8)
Recommendation 52: The Commission recommends that the cumulative impacts on the biodiversity values of Ben Bullen State Forest and the region of this Project, together with the proposed Pine Dale Stage 2 Extension, be considered before any assessment of this Project is finalised.	This has been dealt with in the current report and it is concluded that extensive areas of undisturbed forest and woodland will remain within Ben Bullen State Forest and the region in which this Project is to occur. No threatened species, endangered ecological communities or habitats/species of conservation significance will be unsustainably impacted by the proposed project. The land within the Contracted Project Disturbance Boundary is proposed for rehabilitation to forest and woodland in the long term (Chapter 8)
Recommendation 53: The Commission recommends that the following three principles be accepted as underpinning assessment of biodiversity impacts for this Project:	
Rehabilitation cannot restore the existing vegetation associations or ecological balance of the area;	This is disputed based upon the current rehabilitation work done on site, and information available from other sites. It is asserted that forest and woodland can be reinstated in the Contracted Project Disturbance Boundary. While rehabilitation is not likely to provide a facsimile of the original

Table 10.1 Response to Ecological Recommendations by the PAC

Ecological Recommendations by the PAC	Response to Recommendations
	vegetation, it is asserted that rehabilitation can provide new habitats for many native plants and animals and restore an ecological balance in the area in the long term (Chapter 6).
Rehabilitation to mature woodland is unproven for open cut mines in NSW; and	It is agreed that rehabilitation on open cut mines in NSW requires further research work and development. However, mature woodland can occur on mined land, as evidenced by a number of examples on unremediated gold mining sites in NSW and Victoria, and examples of mining within the Blue Mountains including Mount Piper Power Station (Chapter 6 and Appendix I).
The impacts on biodiversity from this Project are incompatible with reservation proposals for Gardens of Stone Stage II.	This is disputed for several reasons. First, and foremost, we are unaware of any Government proposal for Gardens of Stone Stage 2. We have consulted with OEH to find out about such a proposal but no information has been forthcoming from OEH and we note that no details of a proposed Gardens of Stone Stage 2 were presented by OEH at the PAC. The only proposal for Gardens of Stone Stage 2 we are aware of is one proposed by the Colong Foundation (Muir, 2005) (i.e. a non-government organisation). Secondly, because the SPL will not be impacted by the Project and the Project will only disturb a small proportion of the land within the GOS2 Proposal. Moreover, it is noted that there are many historic mining areas now located within National Parks and other conservation reserves in NSW and other woodland areas of Australia. See Chapter 6.
Recommendation 54: The Commission recommends that, given the considerable uncertainties concerning the likelihood of rehabilitation on this Project area being capable of delivering a satisfactory biodiversity outcome, rehabilitation not be given credence as a mitigation strategy in the assessment.	This is disputed because other recently approved mines have been permitted to count rehabilitation as a credible part of their mitigation strategies and have had rehabilitation areas counted as part of offsetting, with a 50% discount applied to factor in time lag and limitations of rehabilitation. Moreover, the current mine has

Table 10.1 Response to Ecological Recommendations by the PAC

Ecological Recommendations by the PAC	Response to Recommendations
	a good track record for rehabilitation and this does not appear to have been adequately assessed by the PAC. The current rehabilitation has restored landform and has re-established a good vegetative cover of native woodland and open forest plant species. We therefore maintain our assertion that rehabilitation should be a valid part of any mitigation for the mining.
Recommendation 55: The Commission recommends that, until the baseline biodiversity characteristics of the site have been resolved to the satisfaction of OEH [Office of Environment and Heritage], assessment of the adequacy or otherwise of the revised offset package should not proceed. The Commission also recommends that particular attention be given in the assessment to the essential nature of the trade-off being proposed, i.e. it is a proposal designed to exchange a number of fragmented areas that generally require extensive rehabilitation work and are currently not considered suitable for reservation, for a single area of high quality habitat that adjoins other areas of high quality habitat and is already proposed for reservation.	The baseline biodiversity characteristics of the site have been reconsidered in light of the remapping of vegetation by OEH. The OEH mapping was considered but was found to be flawed in a number of respects, particularly with regard to the presence of the critically endangered Box Gum Woodland. We remain of the view that Box Gum Woodland occurs in the Project Boundary and the main occurrences of it have been avoided by the Exhibited Project and Contracted Project mine plans. The offset package has been carefully considered and the current inclusions within it are appropriate to offset the residual impacts of the project to a considerable extent. furthermore, it is proposed that additional offsets will be sought and that these will combine to form an offset package that compensates for residual impacts at a ratio of 4:1, not including mine rehabilitation. As we have demonstrated within Chapter 9 of this report, the additional offsets are available and can be chosen in consultation with OEH. An overall ratio of 4:1 is comparable with other recently approved mining projects in NSW.

I, Dr David John Robertson:

Acknowledge that I have read the Expert Witness Code of Conduct and agree to be bound by it; and declare that I have made all the inquiries which I believe are desirable and appropriate and that no matters of significance which I regard as relevant have, to my knowledge, been withheld from this document.

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References

ANPS. 2013a. Australian Native Plant Society.

ANPS. 2013b. Australian Native Plants Society

Australian Museum. 2013. The webite of the Australian Museum.

Bell, S. A. J. 2001. Notes on the distribution and conservation status of some restricted plant species from sandstone environments of the upper Hunter Valley, New South Wales. Cunninghamia **7(1):** :77–88.

Bell, S. A. J. 2008. Rare or threatened vascular plant species of Wollemi National Park, central eastern New South Wales. Cunninghamia **10**:331-371.

Benson, D. and L. McDougall. 1998. Ecology of Sydney Plant Species Part 6: Dicotyledon Family Myrtaceae. Cunninghamia **5**:808-984.

Benson, D. H. and D. A. Keith. 1990. The Natural Vegetation of the Wallerawang 1: 100 000 map sheet. Cunninghamia **2**:305-336.

Benson, D. H. and L. McDougall. 2001. Ecology of Sydney plant species Part 8: Dicotyledon families Rutaceae to Zygophyllaceae. Cunninghamia **7**:241-462.

Birds in Backyards. 2013. Birds in Backyard website.

Blue Mountains Conservation Society. 2011. Rare Plants of Ben Bullen State Forest. Hut News, Wentworth Falls, NSW.

Botanic Gardens Trust. 2013a. PlantNET. National Herbarium of NSW, Royal Botanic Garden, Sydney.

Botanic Gardens Trust. 2013b. PlantNET - Acacia asparagoides.

Botanic Gardens Trust. 2013c. PlantNET - Leionema lamprophyllum subsp. obiculare

Botanic Gardens Trust. 2013d. PlantNET - Leucochrysum graminifolium.

Botanic Gardens Trust. 2013e. PlantNET - Philotheca obovalis.

Briggs, J. D. and J. H. Leigh. 1995. Rare or Threatened Australian Plants. CSIRO, Canberra.

Briggs, J. D. and J. H. Leigh. 2006. Rare or Threatened Australian Plants Revised Edition. CSIRO, Melbourne.

Brooker, M. and D. Kleinig. 1990. Field guide to eucalypts of south eastern Australia, Volume 2. Inkata, Melbourne.

CHAH, T. C. o. H. o. A. H. 2013. Australia's Virtual Herbarium.

Cogger, H. G., E. E. Cameron, Sadlier R .A, and P. Eggler. 2003. The Action Plan for Australian Reptiles. Australian Nature Conservation Agency. Endangered species program.

Conn, B. J. 1997. Four rare and/or threatened new species of *Prostanthera* Section *Prostanthera* (Labiatae) from New South Wales. Telopea **7**:231-244.

Cumberland Ecology. 2012. Coalpac Consolidation Project Ecological Impact Asessment. Cumberland Ecology Pty. Ltd., Epping.

DEC (NSW). 2005. Broad-headed Snake - profile. Department of Environment and Conservation (NSW), Hurstville.

DEC (NSW). 2006. The Vegetation of the Western Blue Mountains. Department of Environment and Conservation, Hurstville.

DECC. 2007. Terrestrial Vertebrate Fauna of the Greater Southern Sydney Region: Volume 1 - Background Report. . A joint project between the Sydney Catchment Authority and the Department of Environment and Climate Change (NSW) (DECC) under the Special Areas Strategic Plan of Management (SASPoM) by the Information and Assessment Section, Metropolitan Branch, Climate Change and Environment Protection Branch. Hurstville, NSW.

DECC. 2009. Gardens of Stone National Park Plan of Management. Department of Environment Environment and Climate Change NSW.

DECC (NSW). 2005. Threatened Species Information: Broad-headed Snake. NSW Department of Environment and Climate Change, Hurstville.

DECC (NSW). 2007. Guidelines for Identifying Endangered Ecological Communities: White Box – Yellow Box – Blakely's Red Gum Woodland.

DECCW, editor. 2010. DECCW Interim Policy on Assessing and Offsetting Biodiversity Impacts of Part 3A Developments. NSW Department of Environment Climate Change and Water, Hurstville, NSW.

DEH. 2006. EPBC Act Policy Statement 3.5 - White Box - Yellow Box - Blakely's Red Gum grassy woodland and derived grasslands. Department of Environment and Heritage, Canberra, ACT.

DEWR. 2007. Draft Policy Statement: Use of environmental offsets under the *Environment Protection and Biodiversity Conservation Act 1999*.

DSE (VIC). 2003. Flora and Fauna Guarentee Action Statement - Austral Toad Flax (*Thesium australe*).

Ecobiological. 2010. Existing Rehabilitation Assessment: Cullen Valley Mine and Invincible Colliery. . Ecobiological Pty Ltd., Warners Bay.

Ecobiological. 2012. Annual Flora, Fauna and Rehabilitation Monitoring Invincible Colliery and Cullen Valley Mine, Castlereagh Highway, NSW. Ecobiological Pty. Ltd, Warners Bay, NSW.

Fischer, J. and D. B. Lindenmayer. 2007. Landscape modification and habitat fragmentation: a synthesis. Global Ecology and Biogeography **16**:265-280.

GEONET. 2011. Assessment of Stability and Subsidence SHM Highwall Mining Coalpac Consolidation Project. GEONET Consulting Group, Taringa, QLD.

GEONET. 2013a. Letter to Coalpac re: Definition of Barrier Pillar Stability. GEONET Consulting Group, Taringa, NSW.

GEONET. 2013b. Letter to Coalpac re: Review of Coal UCS Data: Invincible Colliery. GEONET Consulting Group, Taringa, NSW.

GeoTek Solutions. 2013. Slope Stability Assessment of Sandstone Cliffs Next to Proposed Open Cut Mining, Invincible and Cullen Valley Mines

Hansen Bailey Environmental Consultants. 2012. Coalpac Consolidation Project Environmental Assessment Response to Submissions. Hansen Bailey Environmental Consultant, Singleton, NSW.

Hebblewhite, B. K. 2013. Review of Highwall Mining Component – Coalpac Consolidation Project (CCP). Hebblewhite, B.K.,, Beecroft, NSW.

Horton, B. M., D. M. Crayn, S. W. Clarke, and H. Washington. 2004. *Leionema scopulinum* (Rutaceae), a new species

from Wollemi National Park. Telopea **10**:815-822.

IUCN. 2012. IUCN Red List of Threatened Species. Version 2012.2.

Knight, P. a. 2003. The Field Guide of the Birds of Australia. Seventh edition. Harper Collins. ISBN 0207198217.

Leigh, J., R. Boden, and J. Briggs. 1984. Extinct and Endangered Plants of Australia. The Macmillan Company of Australia Pty Ltd, Melbourne.

Menkhorst, P. a. H., E., . 2010. National Recovery Plan for the Brush-tailed Rock-wallaby Petrogale penicillata. . Department of Sustainability and Environment, East Melbourne.

Muir, K. 2005. Gardens of Stone Park Proposal Stage 2. Colong Foundation for Wilderness Ltd.

Newell D. A. & Goldingay R. L. 2005. Distribution and habitat assessment of the Broad-headed Snake Hoplocephalus bungaroides. Australian Zoologist **33**:168-179.

NSW National Parks & Wildlife Service. 1999. Broad-headed Snake.*in* N. N. P. W. Service., editor. Threatened Species Information, Sydney.

NSW NPWS. 1999a. Threatened Species Information: *Acacia bynoeana*. NSW National Parks and Wildlife Service, Hurstville.

NSW NPWS. 1999b. Threatened Species Information: Broad-headed Snake. NSW National Parks and Wildlife Service, Hurstville, NSW.

NSW NPWS. 2000a. Persoonia acerosa - Threatened Species Information.

NSW NPWS. 2000b. Prostanthera stricta - Threatened Species Information.

NSW NPWS. 2002. Brush-tailed Rock-wallaby (*Petrogale penicillata*) Draft Recovery Plan. NSW National Parks and Wildlife Service, Hurstville.

NSW NPWS. 2003. White Box - Yellow Box - Blakely's Red Gum (Box Gum) Woodland: Fact Sheet. Department of Environment and Conservation (NSW), Hurstville, NSW.

NSW NPWS. 2005. Identification Guidelines for Endangered Ecological Communities: White Box Yellow Box Blakely's Red Gum Woodland (Box-Gum Woodland). National Parks and Wildlife Service, Hurstville NSW.

NSW Planning Assessment Commission (PAC). 2012a. Coalpac Consolidation Project Review: Appendices a to E. Sydney, NSW.

NSW Planning Assessment Commission (PAC). 2012b. Coalpac Consolidation Project Review: Main Report. PAC, Sydney, NSW.

NSW Planning Assessment Commission (PAC). 2012c. Proposed Coalpac Consolidation Project - Castlereagh Highway, Culle Bullen letter dated 25 September 2012.*in* Neil Shepard, editor. PAC, Sydney, NSW.

NSW Planning Assessment Commission (PAC). 2012d. Proposed Coalpac Consolidation Project - Castlereagh Highway, Cullen Bullen letter dated 11 October 2012.*in* N. Shepard, editor. PAC, Sydney, NSW.

NSW Scientific Commitee. 2011. Euphrasia arguta - critically endangered species listing.

NSW Scientific Committee. 2004a. *Darwinia peduncularis* (a shrub) - vulnerable species listing. Department of Environment and Conservation (NSW), Hurstville.

NSW Scientific Committee. 2004b. Glossy black-cockatoo - vulnerable species listing. Department of Environment and Conservation (NSW), Hurstville.

NSW Scientific Committee. 2004c. White box yellow box Blakely's red gum woodland - endangered ecological community listing. Department of Environment and Conservation (NSW), Hurstville, NSW.

OEH. 2012a. Austral Toadflax - profile.

OEH. 2012b. *Darwinia peduncularis* - Threatend Species Profile. OEH, Hurstville.

OEH. 2012c. Eastern Bentwing-bat - profile. Office of Environment and Heritage, Hurstville.

OEH. 2012d. Glossy Black-Cockatoo - profile. Office of Environment and Heritage, Hurstville.

OEH. 2012e. Large-eared Pied Bat - profile. Office of Environment and Heritage, Hurstville.

OEH. 2012f. The Native Vegetation of North-west Wollemi National Park and Surrounds - Draft. Office of Environment and Heritage, Department of Premier

and Cabinet, Sydney.

OEH. 2012g. Persoonia acerosa - Threatened Species Profile.

OEH. 2013a. Atlas of NSW Wildlife.

OEH. 2013b. Euphrasia arguta - profile.

Pringle, R. M., J. K. Webb, and R. Shine. 2003. Canopy structure, microclimate, and habitat selection by a nocturnal snake, *Holocephalus bungaroides*. Ecology **84**:2668-2679.

Queensland Department of Environment and Resource Management (Qld DERM). 2011. National recovery plan for the Large-eared Pied Bat Chalinolobus dwyeri. Draft. Report to the Department of Environment and Water Rources, Canberra. Queensland Parks and Wildlife Services., Brisbane.

SEWPaC. 2011a. *Acacia bynoeana* in Species Profile and Threats Database. Department of Sustainability, Environment, Water, Population and Communities, Canberra, ACT.

SEWPaC. 2011b. Chalinolobus dwyeri in Species Profile and Threats Database. Department of Sustainability, Environment, Population and Communities, Canberra, ACT.

SEWPaC. 2011c. *Hoplocephalus bungaroides* in Species Profile and Threats Database. Department of Sustainability, Environment, Water, Population and Communities, Canberra, ACT.

SEWPaC. 2012. *Hoplocephalus bungaroides* - Broad-headed Snake.*in* E. Department of Sustainability, Water, Population and Communities, editor. Species Profile and Threats Database, Canberra.

SEWPAC. 2013a. Hoplocephalus bungaroides - Broad-headed Snake SPRAT Profile. Species Profile and Threats Database.

SEWPaC. 2013b. Petrogale penicillata in Species Profile and Threats Database.

Tame, T. 1992. Acacias of southeast Australia. Kangaroo Press Pty Ltd, Kenthurst.

Tas. DPIPWE. 2003. Threatened Species Notesheet - *Thesium australe*. Tasmanian Department of Primary Industries, Parks, Water and Environment.

Terrock. 2013. PAC Review - Blast Management Response. Terrock Consulting Engineers, Eltham, VIC.

The Blue Mountains Botanic Garden- Mount Tomah. 2013. Plant of the Month.

Threatened Species Scientific Committee. 2006. Commonwealth Listing Advice on White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland. Department of Environment and Heritage, Canberra.

Washington, H. 2001. Vegetation survey of Gardens of Stone National Park. Unpublished report to NPWS Blue Mountains Region, Ecosolution Consulting.

Washington, H. G. and A. L. Wray. 2011. The Geoheritage and Geomorphology of the Sandstone Pagodas of the North-western Blue Mountains Region (NSW). Proceedings of the Linnean Society of NSW **132**:131-143.

Webb, J. and R. Shine. 1997a. Out on a Limb: Conservation implications of tree-hollow use by a threatened snake species (*Hoplocephalus bungaroides*: Serpentes, elapidae). Biological Conservation **81**:21-33.

Webb J. K. & Shine R. 1997a. A field study of Spatial Ecology and movements of a threatened snake species, *Hoplocephalus bungaroides*. Biological Conservation **82**:203-217.

Webb J. K. & Shine R. 1997b. Out on a limb: conservation implications of tree-hollow use by a threatened snake species (*Hoplocephalus bungaroides:* Serpentes, Elapidae). Biological Conservation **81**:21-33.

Webb J. K. & Shine R. 1997c. Using thermal ecology to predict retreat-site selection by an endangered snake species. Biological Conservation **86**:233-242.

Webb J. K. & Shine R. 1999. Paving the way for habitat restoration: can artificial rocks restore degraded habitats of endangered reptiles? Biological Conservation **92**:93-99.

Webb, J. K. and R. Shine. 1997b. A field study of spatial ecology and movements of a threatened snake species, *Hoplocephalus bungaroides*. Biological Conservation **82**:203-217.

Webb, J. K. and R. Shine. 1998. Using thermal ecology to predict retreat-site selection by an endangered snake species. Biological Conservation **86**:233-242.

Webb, J. K., R. Shine, and R. M. Pringle. 2005. Canopy removal restores habitat quality for an endangered snake in a fire suppressed landscape. Copeia **4**:894-900.

Yahner, R. H. 1988. Changes in wildlife communities near edges. Conservation Biology **2**:333-339.

Appendix A

CV - Dr David Robertson

Dr. David Robertson, Director

Curriculum Vitae

Summary

Dr David Robertson's ecological career has spanned 27 years since completion of his PhD at Melbourne University in 1985. He is a specialist ecologist with expertise in both botany and zoology and has worked as an ecological consultant since 1993.

During part of his career, David has also been a lecturer in plant taxonomy, plant ecology and freshwater ecology at Charles Sturt University and Australian Catholic University. This has developed his capability to work in both aquatic and terrestrial flora and fauna inventory, management of threatened species, ecological risk assessment, wetland rehabilitation and management, and ecological research for environmental impact assessment.

Throughout his career, David has worked on a wide variety of ecological projects. This includes ecological projects across Australia, including New South Wales, Queensland, ACT, Victoria, Tasmania and Western Australia. He has also gained international experience as the senior ecologist involved with consultancies in Hong Kong, Sri Lanka and the Philippines.

Since the inception of Cumberland Ecology Pty Ltd in 2003, David and his team of ecologists at Cumberland Ecology have worked on ecological investigations throughout NSW, averaging 60-80 projects per year. They have worked extensively within the Hunter Valley, Gunnedah Basin, Sydney Region, on coastal projects and in the Western Blue Mountains.

David has had, and continues to have, direct involvement in many large-scale vegetation mapping and flora and fauna impact assessment projects.

David has worked on many projects that entail the preparation of ecological offsets and Cumberland Ecology has been engaged to monitor such offsets. Cumberland Ecology has helped to formulate offsets for many mining projects in NSW, and also for mines in north Queensland and in Mindanao. Under David's direction, an array of monitoring work has been and is being conducted at sites in the Hunter Valley, Gunnedah, Coffs Harbour and Western Sydney.

Education

David undertook his tertiary education at Melbourne University, completing a Bachelor of Science majoring in botany and zoology. This included a thesis submitted as part of the requirements for the B.Sc. Honours Degree at The University of Melbourne School of Botany:

Aspects of the Ecology of *Eucalyptus sideroxylon* (A. Cunn, ex W. Wool) at Point Addis, Victoria (November 1980).

He completed his Doctor of Philosophy in 1985 at the School of Botany, which was entitled::

Interrelationships between Kangaroos, Fire and Vegetation Dynamic at Gellibrand Hill Park, Victoria (August 1985).

Professional Memberships and Affiliations

Currently David is a member of:

- Ecological Society of Australia
- Ecological Consultants Association of NSW
- He is also an accredited BioBanking Assessor.

Employment History

David has lectured in ecology and aquatic biology at Charles Sturt University. Consultancy employment includes as a senior ecologist with the Australian Museum, senior ecologist in charge of the Ecological Services Practice for ERM Australia, and Director of Cumberland Ecology (current).

Table 1 Employment History

Employer	Position	Date
Cumberland Ecology Pty Ltd	Director	2003 - 2012 (ongoing)
Environmental Resources Management	Senior Ecologist	1997-2003
Australian Catholic University	Lecturer	1998-1999 (part time)
Australian Museum Business Services	Senior Ecological Consultant	1995-1996
Charles Sturt University	Lecturer	1987-1994
University of Melbourne	Research Fellow	1986-1987

Consultancy Experience

Recent consultancy work has included:

- Participation in numerous large ecological impact assessments and offsetting projects for mining projects in NSW, Queensland and Mindanao;
- Provision of expert testimony, acting as a Court appointed expert for the Land and Environment Court;
- Management of high level flora and fauna investigations for Environmental Impact Assessments;
- Development of ecological management plans;
- Habitat reconstruction;
- Development of offset packages for compensatory habitats; and
- Management of negotiations about the level of mitigation measures required for flora and fauna impacts.

David has worked on many projects that have required the provision of offsets and is currently engaged in monitoring offsets for a suite of projects across NSW. In 2011 he was engaged directly by Department of Planning to prepare a draft methodology for offsetting major projects and to do so he conducted a review of Australian and international literature on the subject. In recent years he has also been engaged by Department of Planning to review proposed mining offset packages for Cleary Brothers Sand Quarry at Gerroa, Ulan Mine Extension, Moolarben Mine Extension, Ravensworth Mine Extension and Anvil Hill Mine. He is also currently working on the development of an offset package for a large copper and gold mine in Mindanao in the Philippines.

In addition to the aforementioned project work, Dr Robertson and five of his staff have been trained in the use of BioBanking assessments and Dr Robertson is an accredited BioBanking practitioner. Biobanking is one means by which offsets can be evaluated using a systematic, landscape scale of assessment. Cumberland Ecology has conducted many such assessments of projects large and small since the inception of this method.

Consultancy Publications (examples)

Relevant Australian Projects

Cumberland Ecology (2012). Project Stone: Terrestrial and Aquatic Ecology Assessment Report. Prepared for Hansen Bailey on behalf of Macmines Austasia Pty Ltd. Carlingford Court, NSW.

Cumberland Ecology (2012). Drayton South Ecology Impact Assessment Final Report. Prepared for Hansen Bailey. Carlingford Court, NSW.

Cumberland Ecology (2011). Maules Creek Coal Project: Ecological Assessment. Prepared for Hansen Bailey. Carlingford Court, NSW.

Cumberland Ecology (2011). Drayton South Project: Pre-feasibility Study Ecological Assessment. Prepared for Hansen Bailey. Carlingford Court, NSW.

Cumberland Ecology (2010). Bengalla Mine Development Consent Modification: Ecological Impact Assessment for a Section 75W Application for an Overburden Emplacement Area. Prepared for Hansen Bailey. Carlingford Court, NSW.

Cumberland Ecology (2010). Mount Pleasant Project Modification - Ecological Assessment. Prepared for Coal & Allied Operations Pty Limited. Carlingford Court, NSW.

Cumberland Ecology (2009). St Marys Property Western Precinct Stage 1 Development Applications: Supplementary Flora and Fauna Report. Prepared for Maryland Development Company. Carlingford Court, NSW, Cumberland Ecology.

Cumberland Ecology (2009). Mt Arthur Coal Consolidation Project. Ecological Assessment. Final Report. Prepared for Hansen Bailey. Carlingford Court, NSW.

Cumberland Ecology (2009). Mount Thorley Warkworth Gap Analysis Report. Carlingford Court, NSW.

Cumberland Ecology (2009). Calga Sand Quarry Southern Extension Ecological Assessment. Prepared for R.W. Corkery & Co. on behalf of Rocla Pty Ltd. Carlingford Court, NSW.

Cumberland Ecology (2006). Emirates Wolgan Valley Resort and Spa: Flora and Fauna Assessment for the Upgrade of Power Services. Prepared for HLA-Envirosciences. Carlingford Court, NSW.

Philippines Projects

Cumberland Ecology (2010). Tampakan Copper - Gold Mine Project - Off-Lease Linear Infrastructure Terrestrial and Freshwater Ecological Assessment. Prepared for Hansen Bailey. Carlingford Court, NSW.

Cumberland Ecology (2010). Tampakan Copper - Gold Mine Project - Tampakan Power Station, Port & Filter Plant ESIA. Prepared for Hansen Bailey. Carlingford Court, NSW.

Cumberland Ecology (2010). Tampakan Copper-Gold Mine Project - Terrestrial Ecological Assessment. Prepared for Hansen Bailey. Carlingford Court, NSW.

Monitoring Reports

Cumberland Ecology (2011). Ecological Monitoring Report: Mt Arthur Coal Flora and Fauna Monitoring Program - Summer 2011. Prepared for BHP Billiton. Carlingford Court, NSW.

Cumberland Ecology (2009). Mt Arthur Coal 2008 Flora and Fauna Monitoring Program - draft Ecological Monitoring Report. Prepared for Mt Arthur Coal. Carlingford Court, NSW, Cumberland Ecology Pty Ltd.

Cumberland Ecology and Greenloaning Biostudies (2007). Vertebrate Pest Management Results Summary,. For: Department of Commerce. Carlingford Court, NSW.

Cumberland Ecology and Greenloaning Biostudies (2007). Ecological Monitoring Report for Threatened Species, Weeds and Vertebrate Pests (Autumn 2007),. Prepared for The Clarence Valley and Coffs Harbour Regional Water Supply Project. Carlingford Court, NSW.

Cumberland Ecology and Greenloaning Biostudies (2008). Ecological Monitoring Report for Threatened Species, Weeds and Vertebrate Pests (Autumn 2008). Prepared for Clarence Valley Council. Carlingford Court, NSW.

Cumberland Ecology and Greenloaning Biostudies (2009). Ecological Monitoring Report for Threatened Species, Weeds and Vertebrate Pests (Autumn/ Winter 2009). Prepared for Clarence Valley Council. Carlingford Court, NSW.

Cumberland Ecology and Greenloaning Biostudies (2012). Ecological Monitoring Report for Threatened Species, Weeds and Vertebrate Pests (Autumn 2011). Prepared for Clarence Valley Council. Carlingford Court, NSW.

Cumberland Ecology and Greenloaning Biostudies (2012). Ecological Monitoring Report for Threatened Species, Weeds & Vertebrate Pests (Spring/Summer 2011). Prepared for Clarence Valley Council. Carlingford Court, NSW.

Peer Reviews

Cumberland Ecology (2012). Peer Review of State and Commonwealth Ecological Impact Assessment Reports for the Proposed Mount Penny Coal Mine, Bylong. Prepared for Wells Environmental Services. Carlingford Court, NSW.

Cumberland Ecology (2011). Peer Review of Wallarah Underground Coal Project. Prepared for Hansen Bailey. Carlingford Court, NSW.

Cumberland Ecology (2011). Re Peer Review of EcoLogical Report: "Proposed Framework for Assessing the Cumulative Risk of Mining on Natural Resource Assets in the Namoi Catchment". Prepared for Aston Resources. Carlingford Court, NSW.

Cumberland Ecology (2010). Review of Response to Submissions Relating to Continued Operations at Ulan Coal. Prepared for Department of Planning. Carlingford Court, NSW.

Cumberland Ecology (2010). Re: Review of Revised Statement of Commitments and Offset Strategy - Moolarben Coal Project. Prepared for Department of Planning. Carlingford Court, NSW.

Conference Papers

Robertson, D. J. (2011). Tampakan Copper-Gold Project - Analysis of the Fauna and Vascular Flora of the Tampakan project area, Mindanao, Philippines (110725_Botanical Congress[final].pptx) International Botanical Congress. Melbourne.

Robertson, D. J. (1983). Vegetation management towards native mammal reintroduction at Gellibrand Hill State Park. Royal Australian Institute of Parks and Recreation 56 th National Conference. Latrobe University.

Robertson, D. J. (1991). Macrobenthic communities in four billabongs of the Murrumbidgee River: seasonal changes versus water quality. Australian Society for Limnology. Lorne.

Murray, P. and D. Robertson (1993). Methods for rapid assessment of macroinvertebrate communities using multivariate analysis. Australian Society for Limnology. Calloundra.

Hardwick, L., D. Robertson, et al. (1995). The relationship between macroinvertebrate communities and riparian vegetation in Tarcutta Creek, a lowland tributary of the Murrumbidgee River, NSW.

Academic Publications

Robertson, D. J. and C. Nannestad, (eds.). (1994). Proceedings of the forum on European Carp. Wagga Wagga, NSW, Murrumbidgee Catchment Management Committee.

Wark, M. C., M. D. White, D. J. Robertson, and P. F. Marriot. (1987). Regeneration of heath and heath woodland in the North Eastern Otway Ranges following the wildfire of February 1983. Proceedings of the Royal Society of Victoria **99**:51-88.

Wilson, B. A. and D. J. Robertson (1990). "Factors affecting small mammal distribution and abundance in the Eastern Otways." Proceedings from the Ecological Society of Australia, **39**(2): 35-40.

Holdway, D. A., M. J. Barry, D. Logan, and Robertson. D.J (1994). “Acute toxicity of pulse-exposed fenvalerate and esfenvalerate to larval crimson-spotted rainbow fish (*Melanotaenia fluviatilis*)”. Aquatic Toxicology.

Robertson, A. I., A. J. King, M. R. Healey, D. J. Robertson, and S. Helliwell (1995). “The Impact of Carp on Billabongs”. Prepared for the Environment Protection Authority, NSW, Riverina Region

Appendix B

Biosphere Broad-headed Snake Habitat Assessment Report

Biosphere Environmental Consultants Pty Ltd
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Assessment of Habitat for the Broad-headed Snake *Hoplocephalus bungaroides* Coalpac Consolidation Project – Contracted Project

Introduction

The Coalpac Consolidation Project is the consolidation of two existing mines, Invincible Colliery and Cullen Valley Mine at Cullen Bullen, NSW. The Contracted Project mine plan will remove 762 ha of native forest, woodland and grassland by open cut mining. Highwall mining is proposed along sections of the eastern escarpments where Significant Pagoda Landforms (SPLs) and Sandstone Outcrops occur. The highwall mining excavations proposed for the Project are considered to be much more stable than longwall mining excavations, and minimal subsidence (< 20 mm) is predicted to occur (GEONET 2011). Hebblewhite (2013) provides further comment on these aspects.

The area bordering the western flanks of the Newnes Plateau contains habitat for the endangered Broad-headed Snake *Hoplocephalus bungaroides.* These snakes are not well studied in this northern part of their range and preliminary field studies on this species in the nearby Wollemi and Yengo National Parks has already indicated some behavioural differences for snakes in these areas. (B. Croak pers. comm.). Most ecological information about this species is derived from detailed studies carried out in the southern parts of their range, especially in the Morton National Park, in the southern highlands of New South Wales (Webb and Shine 1997a, b; 1998 a, b).

Unlike most threatened reptiles in NSW the ecology of the Broad-headed Snake has been well documented (see Newell and Goldingay 2004). It is a habitat

specialist, often relying on tree hollows during summer and exfoliated rock in rock outcrops during the cooler months (Webb and Shine 1997a, 1998a). These factors may make it particularly vulnerable to anthropogenic disturbance. Depletion of rock habitat via the collection of bush rock for garden ornamentation in areas around Sydney has been extensive (Shine *et al*. 1998). This has led to the listing of bush rock removal as a threatening process under the NSW *Threatened Species Conservation Act 1995* (TSC Act). Other forms of habitat degradation have been documented and appear to be extensive (Goldingay 1998; Goldingay and Newell 2000; Pringle *et al*. 2003).

This species was known from Blue Mountains and Wollemi National Parks (NP) (Cogger *et al*. 1993; Shine *et al*. 1998), Yengo NP (Shine *et al*. 1998), Dharug NP (NPWS 1998), Marramarra NP (NPWS 1999) and Ku-ring-gai Chase NP (NPWS 1999).

Newell and Goldingay (2005) surveyed for this species across its entire range and assessed habitat suitability in each area on the basis of the number and suitability of surface shelter rocks and the availability of its main prey items, the Lesueurs Velvet Gecko *Oedura lesueuri*. They found that there was little correlation between the amount of habitat available and the density of snakes in an area. For example, the Blue Mountains NP contained the highest levels of suitable surface rocks and prey items yet it ranked as one the lowest in terms of snake density. The reason for this was attributed almost entirely to reptile poaching in accessible areas.

Habitat areas in Wollemi and Yengo NP rated fairly poorly for both surface rocks and prey availability and snake density were relatively low.

In 2012, a Broad-headed Snake was reported from an area immediately east of the Project Boundary (Wildlife Atlas). This was the first record of the species in the general vicinity of the Project Boundary.

In February 2013, Dr Arthur White from Biosphere Environmental Consultants P.L. and Mr Ryan Sims from Cumberland Ecology P.L. surveyed the sandstone escarpment areas close to or within the Project Boundary to determine where habitat for the Broad-headed Snake was present and whether habitat areas were likely to be impacted by the proposed Contracted Project Disturbance Boundary.

Methods

Aerial survey maps of the Project Boundary and immediate surrounds were examined to determine the extent of sandstone escarpment areas and to determine access to each area. Having located all potential habitat areas, the sites were visited on the 6th of February 2013 so that each area could be

“ground-truthed” to validate or refute the presence of habitat suitable for the Broad-headed Snake in each area.

Sandstone exposures were deemed to contain habitat for the Broad-headed snake if they also contained (Webb and Shine 1997a):

1. medium to tall forest within 250 m of the sandstone outcrop
2. the outcrop contained loose, exfoliated pieces of sandstone that were not underlain by organic matter or on soil, that could be used as refuge habitat by either the Broad-headed Snake or their prey;
3. the sandstone contained deep fissures or cracks that could be used as shelter habitat by either the Broad-headed Snake or their prey.

Results

Using GPS tracking technology, it was possible to track the routes taken through the sandstone areas and to use the GPS way points and routes taken to demarcate the areas of potential habitat for the snake.

Using this technology, eight areas of potential habitat were located: six of these areas (areas 1-6) were located in the eastern areas of the Project Boundary adjacent the SPL (Figure 1); Two further sites were located in the northern portion of the Project Boundary , area 7 was located on the eastern side of the Castlereagh Highway (south of the Baal Bone Mine Precinct (Figure 1), while area 8 was located on the western side of the Castlereagh Highway, north of Tyldesley Hill (Figure 1).

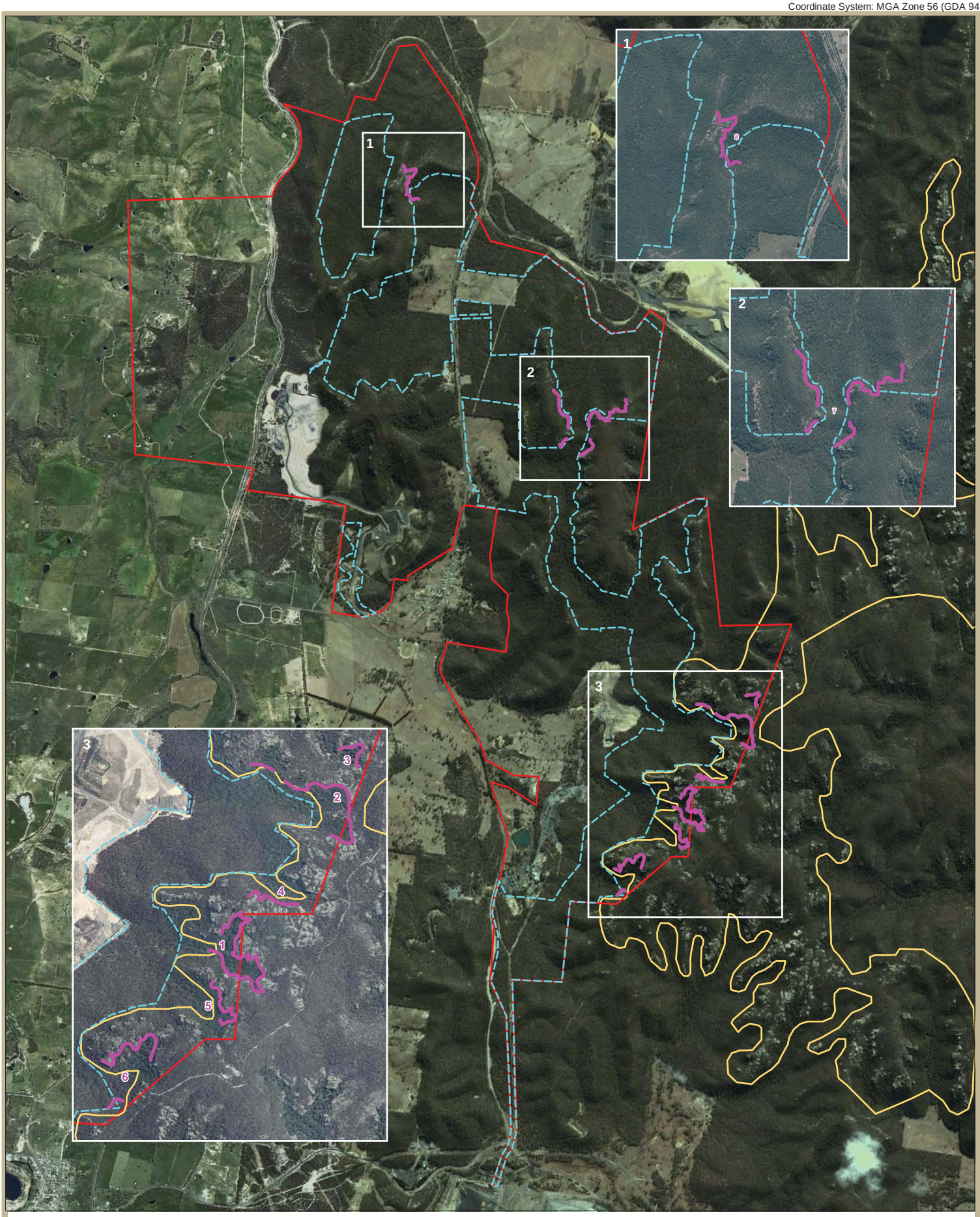

Figure 1. Broad-headed Snake Habitat

Discussion

The Extent of Broad-headed Snake Habitat

Sandstone escarpments and outcrops are quite numerous and extensive in the areas around the Project Boundary. Prominent sandstone walls, rounded pagoda landforms and sandstone ledges demarcate the edges of the Sydney Basin sandstones, where they have been incised or weathered away to create narrow gullies or broad valleys.

Despite the extent of the sandstone exposures in the Project Boundary, the amount of potential habitat for the Broad-headed snake was quite modest in comparison. A lot of the sandstone areas were discounted as snake habitat as they devoid of exfoliating rocks and lacked crevices or cracks. There appears to some variation in the integrity of the sandstone in this area: in some areas of the Project Boundary the sandstone was fine-grained and only poorly consolidated. As this sandstone weathered, it did not crack or peel, but shed sandstone grains as loose dust. Consequently, there were no surface rocks to be found, nor any talus scree (Figure 2).

Figure 2
Sandstone Exposures in Area 2 Devoid of Exfoliating Rocks

The pagoda shape was created by ironstone bands within the sandstone. The ironstone was more resistant to weathering than the sandstone; thus unprotected sandstone above the ironstone layers eroded quickly and smoothly to produce round domes. The ironstone layers halted the mass erosion but were gradually being etched away wherever the ironstone was thin or disrupted. The resultant weathering created the rounded, but layered tower features known as pagoda landforms.

Broad-headed Snake habitat was present in some areas of the Project Boundary where the coarser grained sandstones were present. These rocks peeled when weathered, but in places, they also contained deep joints which had weathered out to produce crevices and narrow canyons. This sort of weathering is most noticeable around the incised gullies behind the sandstone walls (i.e. where the Newnes plateau was being actively incised).

Newell and Goldingay (2005) also commented on the relative paucity of suitable habitat for the Broad-headed Snake in the northern parts of its range (although they had not surveyed the Newnes plateau or the plateaus to the west in the Cullen Bullen area). Ben Croak, a Ph.D student from the University of Sydney is undertaking studies of the Broad-headed Snake in the northern parts of their range and struggled to locate suitable habitat in the areas of Wollemi and Yengo NP where he searched (B. Croak pers. comm.; Croak *et al.* 2013). Both Yengo and Wollemi NP are renowned for the spectacular sandstone walls and canyons that make up these parks but this does not appear to constitute habitat for the snakes.

Broad-headed Snake Record in Ben Bullen State Forest

During our survey of the site we also visited the area where the 2012 record was made. The site visited was based on the GPS data provided by the OEH Wildlife Atlas. The site was devoid of sandstone and was not habitat for the Broad-headed snake.

Either the GPS record is faulty or the observation was faulty. Of these two scenarios, it is likely that the GPS record is faulty as the comments provided with the record report that the snake was under rock. This needs to be further resolved.

Areas of Broad-headed Snake Habitat likely to be Impacted by the Expansion of the Mine

The vast majority of potential Broad-headed Snake habitat falls outside the Contracted Project Disturbance Boundary (Figure 1). Coalpac's reduced open cut footprint around the SPL will mean that no potential habitat will be directly impacted in this area.

Despite the provision of these stand-offs there is always some chance of minor direct or indirect impacts on the few areas of habitat within the Contracted Project Disturbance Boundary. The proportion of impacted habitat is very low in comparison to the amount of potential habitat to be avoided by the Contracted Project. Moreover there are large areas of potential habitat conserved in Ben Bullen State Forest, to the immediate east of the Project Boundary. Given the patchy distribution of suitable winter habitat, the apparent paucity of available prey habitat and accessibility to the area by snake poachers, these habitat areas would support few (if any) Broad-headed Snakes, and the impacts are not likely to be detrimental to the species in the local area.

Moreover there are large areas of potential habitat remaining in Ben Bullen State Forest, to the immediate east of the Project Boundary. Given the patchy distribution of suitable winter habitat, the apparent paucity of available prey habitat and accessibility to the area by snake poachers, these habitat areas would support few (if any) Broad-headed Snakes, and the impacts are not likely to be detrimental to the species in the local area.

A comprehensive suite of mitigation measures is proposed by Coalpac to further reduce impacts (see below).

Mitigation Measures Proposed to Offset Potential Impacts on the Broad-headed Snake

Cumberland Ecology (2013) has proposed a series of mitigation measures to offset any potential impacts on Broad-headed snake habitat. These include:

- winter pre-clearance surveys when the snake is likely to be under rocks on the escarpment areas; captured snakes to be relocated into suitable habitat areas to the east in the Ben Bullen State Forest;
- clearing summer habitat during winter (the area of potential habitat inside of the mining boundary as indicated by the purple lines in figure 1.)
- replacement of bushrock and incorporation of artificial bushrock (eg. Webb and Shine 2000) in rehabilitation and within selected cliff areas inside of the disturbance boundary;
- not clearing all tree with hollows from the bases of the pagodas and cliffs;
- provision of funding for an indirect offset that entails funding for additional habitat surveys of Broad-headed Snake in the wider area of the western Blue Mountains to further the knowledge of the species (as suggested by Webb pers. comm.).

All of these measures are quite sensible and likely to assist Broad-headed Snakes to persist in the area. From my assessment, I see the most useful direct action to be the replacement of bushrock and the incorporation of artificial rock in selected areas during mine rehabilitation.

It is apparent that very little exfoliation occurs in the sandstone areas in the Project Boundary and the absence of surface rocks appears to be a major habitat deficiency. Increasing the amount of surface rock in the area will assist gecko prey species to increase their abundance, which in turn, may assist the Broad-headed Snakes to be able to access a more plentiful food resource.

The proposal to conduct targeted surveys for the snakes in the wider area is also a useful action. Based on the extent of habitat close to the Invincible Colliery mine site, it would appear that Broad-headed Snakes are likely to be very uncommon in the immediate area. However, this may not be the case deeper into the plateau to the east of the Project Boundary.

The protection of core habitat area is a much better conservation strategy that devoting most resources towards the protection and enhancement of marginal habitat areas.

Broad-headed snakes are patchily distributed within their distributional range (Newell and Goldingay 2005). In many locations (especially in the northern parts of its range), the species is only recorded once. The lack of sightings may be a reflection of the nocturnal activity patterns of this snake as well as a true reflection of its scarcity in certain areas.

There is only one sighting on the Wildlife Atlas within 5 km of the mine boundary and that was made last year. The area in question is frequented often by bushwalkers and trail bikers and the snakes are not observed.

The relative lack of prey species along most of the sandstone areas also implies that the snakes are likely to be very scarce in this area.

Dr Arthur White
25 February 2013.

References

Cogger, H. G., Cameron, E. E., Sadlier, R. A. and Eggler, P. 1993. The action plan for Australian reptiles. Australian Nature Conservation Agency, Canberra, Australian Capital Territory.

Croak, B., Crowther, M., Webb, J., and Shine, R. 2013. Movements and habitat use of the Broad-headed snake in the north of their range. Abstract. 37th Meeting Australian Herpetological Society.

Cumberland Ecology. 2013. Ecological Assessment for the Coalpac Consolidation Project – Contracted Project; Response to the PAC Review Report. Cumberland Ecology P.L, Epping, NSW.

GEONET. 2011. Assessment of Stability and Subsidence SHM Highwall Mining Coalpac Consolidation Project. GEONET Consulting Group, Taringa, QLD.

Newell, D. A. and R.L. Goldingay. 2005. Distribution and habitat assessment of the Broad-headed Snake *Hoplocephalus bungaroides*. Australian Zoologist, vol. 33(2): 168-179.

NPWS 1999. Broad-headed snake, *Hoplocephalus bungaroides*. Threatened species information. NSW National Parks and Wildlife Service, Hurstville.

Pringle, R. M., Webb, J. K. and Shine, R. 2003. Canopy structure, microclimate, and habitat selection by a nocturnal snake, *Hoplocephalus bungaroides*. Ecology 84: 2668-2679.

Shine, R. and Fitzgerald, M. 1989. Conservation and reproduction of an endangered species: the broad-headed snake, *Hoplocephalus bungaroides* (Elapidae). Australian Zoologist 25: 65-67.

Shine, R., Webb, J., Fitzgerald, M. and Sumner, J. 1998. The impact of bush-rock removal on an endangered snake species, *Hoplocephalus bungaroides* (Serpentes: Elapidae). Wildlife Research 25:285-295.

Webb, J.K. and Shine, R.1997a. Out on a limb: conservation implications of tree-hollow use by a threatened snake species (*Hoplocephalus bungaroides*: Serpentes, Elapidae) . Biological Conservation 81: 21-33.

Webb, J.K. and Shine, R.1997b. A field study of spatial ecology and movements of a threatened snake species, *Hoplocephalus bungaroides*. Biological Conservation 82: 203 -217.

Webb, J. K. and Shine, R. 1998a. Using thermal ecology to predict retreat-site selection by an endangered snake species (*Hoplocephalus bungaroides*: Serpentes, Elapidae). Biological Conservation 86: 233-42.

Webb, J. K. and Shine, R.1998b. Ecological characteristics of a threatened snake species, *Hoplocephalus bungaroides* (Serpentes, Elapidae) . Animal Conservation 1: 185-93.

Webb, J. K. and Shine, R. 2000. Paving the way for habitat restoration: can artificial rocks restore degraded habitats of endangered reptiles? Biological Conservation 92: 93-99.

Webb, J. K., Brook, B.W. and Shine, R. 2002. Collectors endanger Australia's most threatened snake, the broad-headed snake, *Hoplocephalus bungaroides*. Oryx 36:170-8 1.