



# ANVIL HILL PROJECT

environmental assessment

## Response to Submissions PART B

# **Anvil Hill Project Environmental Assessment Response to Submissions Part B**

**Prepared by**  
**Umwelt (Australia) Pty Limited**  
**on behalf of**  
**Centennial Hunter Pty Limited**

Project Director:	Barbara Crossley
Project Manager:	Barbara Crossley
Report No. 2330/R04/Final	Date: November 2006



2/20 The Boulevard  
PO Box 838  
Toronto NSW 2283

Ph: 02 4950 5322  
Fax: 02 4950 5737  
Email: [mail@umwelt.com.au](mailto:mail@umwelt.com.au)  
Website: [www.umwelt.com.au](http://www.umwelt.com.au)

## TABLE OF CONTENTS

<b>1.0</b>	<b>Introduction .....</b>	<b>1.1</b>
<b>2.0</b>	<b>Ecology .....</b>	<b>2.1</b>
<b>2.1</b>	<b>Government Agency Submissions .....</b>	<b>2.1</b>
2.1.1	Department of Environment and Conservation .....	2.1
<b>2.2</b>	<b>Interest Groups and Community Submissions.....</b>	<b>2.7</b>
2.2.1	General Vegetation/Setting Issues.....	2.7
2.2.2	Ecological Survey/Results.....	2.9
2.2.3	Impact Assessment and Management Outcomes .....	2.19
<b>3.0</b>	<b>Noise and Vibration.....</b>	<b>3.1</b>
<b>3.1</b>	<b>Government Agency Submissions .....</b>	<b>3.1</b>
3.1.1	Department of Environment and Conservation .....	3.1
3.1.2	Muswellbrook Shire Council .....	3.5
<b>3.2</b>	<b>Interest Groups and Community Submissions.....</b>	<b>3.6</b>
3.2.1	Renzo Tonin Submission.....	3.6
3.2.2	Other Community Submissions .....	3.12
<b>4.0</b>	<b>Air Quality .....</b>	<b>4.1</b>
<b>4.1</b>	<b>Government Agency Submissions .....</b>	<b>4.1</b>
4.1.1	Department of Environment and Conservation .....	4.1
<b>4.2</b>	<b>Interest Groups and Community Submissions.....</b>	<b>4.4</b>
<b>5.0</b>	<b>References .....</b>	<b>5.1</b>

## GRAPHS

<b>3.1</b>	<b>Typical Dose-Response Relationship for Reaction to Aircraft Noise ...</b>	<b>3.8</b>
<b>3.2</b>	<b>Conceptual Model of the Effect of Background Noise Level on Reaction to Noise.....</b>	<b>3.8</b>

## FIGURES

2.1	Conceptual Corridor Strategy.....	2.1
2.2	Neighbouring Property .....	2.14
4.1	Measured PM <sub>10</sub> Concentrations in the Study Area.....	4.2
4.2	Predicted annual average PM <sub>2.5</sub> concentrations - µg/m <sup>3</sup> .....	4.6
4.3	Predicted maximum 24-hour average PM <sub>2.5</sub> concentrations - µg/m <sup>3</sup> .....	4.6

## APPENDICES

1	Bird Species Sighted by Peter Hogan at Anvil Hill
---	---

## 1.0 Introduction

This document has been prepared in response to a request from the Director-General in accordance with section 75H(6) of the *Environmental Planning and Assessment Act 1979* (NSW) (EP&A Act) that Centennial Hunter Pty Limited (Centennial) prepare a response to the issues raised during the public exhibition period for the Anvil Hill Project (Project). Part A of Centennial's Response to Submissions was lodged with the Department of Planning (DoP) on 31 October 2006 and specifically addressed greenhouse, climate change and ESD issues. This report is Part B of Centennial's Response to Submissions and focuses on the issues of ecology, air quality (apart from greenhouse emissions), noise and blasting. Holmes Air Sciences, Wilkinson Murray, Umwelt, Sparke Helmore and Centennial contributed to preparation of this report.

A further response will be prepared in relation to the remaining issues raised during the public exhibition period for the Project. A revised draft Statement of Commitments will also be prepared, considering feedback received by submissions and during the IHAP process.

## 2.0 Ecology

### 2.1 Government Agency Submissions

The Department of Environment and Conservation (DEC) was consulted regarding the approach to the ecological assessment, throughout preparation of the EA. DEC provided a detailed review of ecological issues in the EA (Reference No. DOC06/52579) and this section focuses on response to these issues. Other government agencies (Department of Primary Industries (DPI) and Department of Natural Resources (DNR)) raised ecological management issues in the context of other aspects of their submissions and these will be addressed in Part C of the Response to Submissions.

#### 2.1.1 Department of Environment and Conservation

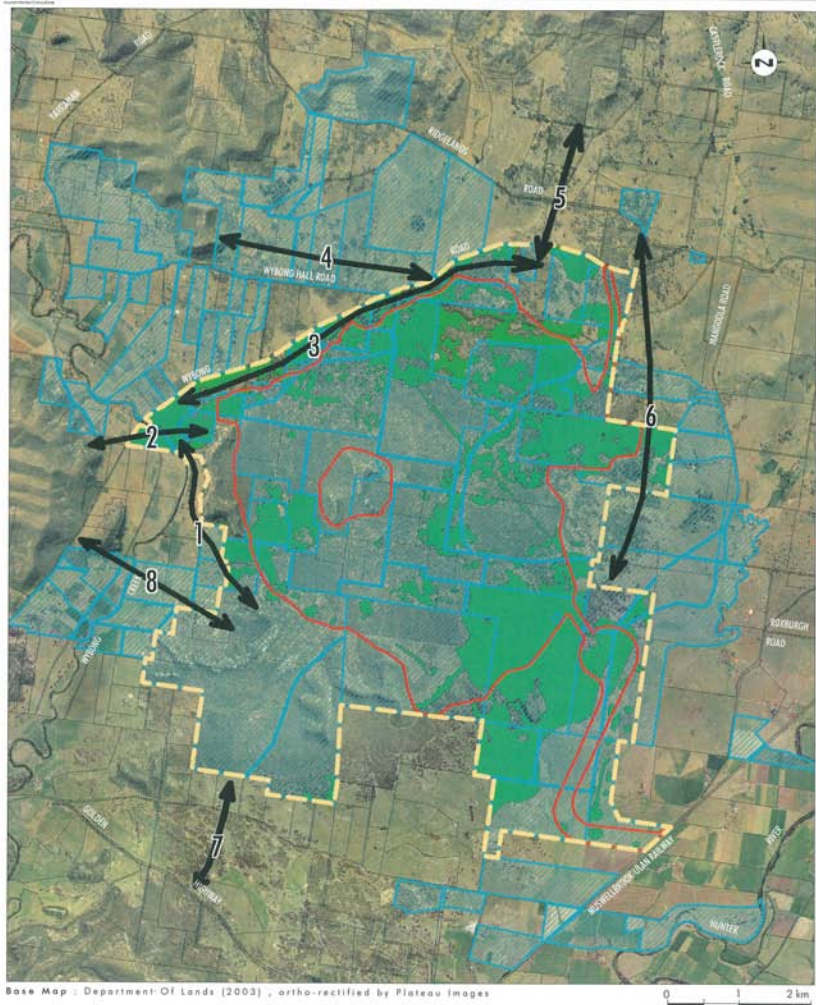
DEC's submission notes that the *'EA provides a comprehensive and detailed examination and comparison of the biodiversity of the area to be directly affected by the mine (the Proposed Disturbance Area) and of surrounding areas that have been proposed as offsets (the Proposed Offset Area).'* The submission raised no issues with the survey method or results, which was reinforced in the DEC presentation to the IHAP, stating that DEC was comfortable with the level of rigor of the assessment.

Issues raised by DEC mainly related to the need for refinement of management outcomes. Centennial's progress with addressing these issues was discussed with DEC during a meeting on 1 November 2006 and DEC provided further comment following that meeting in correspondence dated 7 November 2006. Key issues raised by DEC in its original submission (shown in bold text below), together with any relevant clarifying comment provided on 7 November, are addressed below.

**Project approval should not be granted until additional offset areas are secured (approximately 600 ha) and an approach for securing proposed corridors is agreed to between Centennial, Dept of Planning and DEC.**

The EA provides details of the proposal to offset 1707 hectares of land within the Proposed Offset Area (POA), comprising the Conservation Area and Habitat Enhancement Area. Within this area, 1034 hectares is currently treed and a further 471 hectares will be revegetated or regenerated (see **Table 2.1**). It is proposed to retain 202 hectares of grassland habitat within the POA to provide for habitat, including edge habitat, for threatened woodland birds, micro-bats and flora that are known or likely to occur. Centennial has committed to long term protection of these areas (refer to Section 6.8.1 of the EA)

As presented at the IHAP, Centennial has been acquiring substantial additional land since submission of the EA and is prepared to commit further land to satisfy DEC's requirement for additional offset areas. The current status of land owned or agreed for purchase by Centennial is shown on **Figure 2.1**, in the context of the proposed offset areas and corridor options included in the EA.



Legend

- Study Area
- Proposed Disturbance Area
- Conceptual Corridors
- Centennial Owned Or Agreement Properties
- Proposed Revegetation Areas

FIGURE 2.1

Conceptual Corridor Strategy

Table 2.1 - Area of Proposed Treed and Grassland Offsets

Management Area	Area Disturbed by the Project (Ha)	Area of Existing Treed Vegetation Immediately Protected (Ha)	Area of Treed Vegetation to be Established (Ha)	Total Area of Treed Vegetation at end of Project (Ha)	Net Change in Treed Vegetation Area (Ha)	Total Area of Grassland at end of Project (ha)	Total of Management Area (ha)
<b>Disturbance</b>							
Proposed Disturbance Area	1304	0	2074	2074	+770	164	2238
<b>Sustainable Agriculture</b>							
Sustainable Agriculture Area	0	3	45	48	+45	169	217
<b>Proposed Offset Areas</b>							
Conservation Areas	0	869	178	1047	+178	31	1078
Habitat Enhancement Areas	0	165	293	458	+293	171	629
<b>Offsets Sub-total</b>	<b>0</b>	<b>1034</b>	<b>471</b>	<b>1505</b>	<b>471</b>	<b>202</b>	<b>1707</b>
<b>Total</b>	<b>1304</b>	<b>1037</b>	<b>2590</b>	<b>3627</b>	<b>+1286</b>	<b>535</b>	<b>4162</b>



Based on the current status of land ownership and the approach to land acquisition, Centennial is confident that an additional 600 hectares of land will be able to be secured to meet this requirement. As the land ownership status is constantly evolving while Centennial continues to negotiate with numerous land owners likely to be significantly affected by the Project, it would be most appropriate to allow further land acquisition to progress, prior to confirming which areas are secured as additional offset. This will allow the additional offset areas to be targeted based on best available ecological outcomes. Such an approach is consistent with DEC's proposed condition 8.3 in Attachment 2 of its submission.

The EA concluded that the proposal had satisfied the required goal of "no net loss of flora and fauna values in the area in the medium to long term". In seeking to target appropriate areas to supplement the existing offset strategy, Centennial and Umwelt sought clarification from DEC on the preferred nature and location of additional offset areas. During the meeting it was confirmed that it was appropriate to locate additional offset areas in a manner that may be a part of, or maximises the functionality and effect of external corridors. Further, in correspondence of 7 November 2006, DEC advised that:

The proponent will need to demonstrate that the offset proposal yields the maximum possible percentage of treed vegetation of good condition within the additional proposed offset areas. As a guide, the DEC suggests that any new offset area should have at least a similar ratio of treed vegetation to that which exists in the Conservation and Habitat Enhancement offset areas proposed in the EA. The EA proposes the following offsets:

	Total Area (ha)	Existing Treed Vegetation (ha)	% of area covered by existing treed vegetation
Conservation Area	1078	869	81
Habitat Enhancement Areas	629	165	26
Total	1707	1034	61

Therefore, to maintain consistency with Centennial's current approach, an additional offset area of 600 hectares would need to contain a minimum 61% (approximately 370 hectares) of treed vegetation.

Centennial considers that sufficient land will be acquired over the next year, to meet this additional requirement. Appropriate wording will be included in the revised Statement of Commitments to ensure that there is sufficient certainty for all parties that such an outcome will be achieved.

In relation the issue raised regarding long term protection of the offset areas, Centennial is committed to the long term protection of Offset Areas. This protection may be achieved by one of the following mechanisms:

- Project Approval Conditions
- Voluntary Planning Agreement
- Voluntary Conservation Agreement
- Property Vegetation Plans
- Zoning of the Land – Environment Planning Instrument
- Covenants on the Land Title.

## Corridors

DEC raised concern regarding the security of proposed corridor areas. There also appears to be some confusion regarding the proposed corridor strategy. As outlined in Section 9.5.4.4 of Appendix 9 of the EA, Centennial committed to establishment of one external corridor to the north (either corridor option 4 or 5) and one external corridor to the west (either corridor option 2 or 8). These commitments were made to achieve the establishment of a substantial sub-regional corridor network both within and external to the Study Area, during and after mining operations. As noted above, Centennial has acquired substantial additional land within these corridor areas since lodgement of the EA. The intent is to secure external corridors to the north and west of the Study Area, connecting it with substantial proximate vegetation on Crown land, and indirectly connect it to local national parks and nature reserves.

In its correspondence of 7 November 2006, DEC recommended that Centennial actively seek to secure Corridors 5 and 7 as well as the corridors “already secured”. Most of the land in Corridor Options 2, 4 and 8 are now owned by Centennial, or under agreement. It is also important to note that no corridors are as yet secured in terms of their ecological corridor functioning. All of these corridors comprise substantial areas of grassland, and would require revegetation and regeneration before they could function as ecological corridors. As noted above, the intent is to secure and manage the most appropriate corridor options based on ecological value, rather than simply based on current land availability.

The assessment of corridor options detailed in Section 9.5.4 of Appendix 9 of the EA provides a discussion of the potential benefits and constraints to each of the eight corridor options assessed. Corridor Option 7 would enable connectivity to Myambat Military Area, which is presumably a secure end-point for a corridor, and contains vegetation and habitat similar to that in the Study Area. Its primary constraint is that the Myambat remnant is not connected to other large forested remnants, being entirely surrounded by cleared agricultural lands. Corridor Option 7 was therefore considered to be of lesser regional value in terms of connectivity than Corridor Options 2, 4, 5 and 8. These latter corridors could all potentially connect directly to large expanses of Crown land, and indirectly to Manobalai Nature Reserve and/or Goulburn River National Park. The vegetation and habitat present in each of these is also similar to that in the Study Area. Thus, from a regional connectivity perspective, the combination of a northern and western corridor is preferred over any other arrangement that includes Corridor Option 7. This option includes large tracts of private land that does not otherwise have to be acquired by Centennial due to mining affectation. The EA recognised the existing stepping stone function of Corridor Option 7 and it is considered that this may be able to be enhanced by contribution from the WULMS process, in cooperation with private landholders.

Corridor Options 2 or 8 are of similar ecological value for western connectivity. Based on ecological value, the preferred northern corridor is Option 5. Centennial does not currently own or have agreement for much of the land in this corridor option, but expects to do so given that a large portion of this area falls within the noise and/or dust affected area. As the land ownership status is constantly evolving while Centennial continues to negotiate with numerous land owners likely to be significantly affected by the Project, it would be most appropriate to allow further land acquisition to progress, prior to confirming which of the northern and western options are secured as corridors. This will allow the corridors to be targeted based on best available ecological outcomes. Such an approach is consistent with DEC's proposed condition 10.3 in Attachment 2 of its submission.

Further, there is a significant opportunity to enhance the function of Corridor Option 6, which is essentially an internal corridor on the eastern side of the POA. This corridor contains several large remnants, and provides likely habitat for a range of threatened woodland birds, micro-bats and woodland/grassland flora. It is proposed that further land will be secured for offset in this corridor as part of the additional offset area requested by DEC.

**In particular, there is a need to identify specific, measurable and time frame linked management actions to achieve biodiversity offsets.**

The Ecological Management Plan (EMP) will specify the types of protection, management and monitoring that are required to ensure the future viability of offset and corridor areas. The EMP will be prepared in consultation with relevant authorities, and will bind Centennial, through regular environmental auditing, to achieve the biodiversity offset outcomes that are proposed in the EA.

In its latest correspondence of 7 November 2006, DEC stated that '*performance measures should be agreed upon prior to the granting of development consent*'. To facilitate this, Centennial proposes to provide the framework of the performance measures in the revised Statement of Commitments.

**The package should identify funding/resources for specific components of the biodiversity offsets package, including the ongoing adaptive management of offsets, and the mechanism that provides a sound and legally enforceable means of allocating resources to securing biodiversity offsets throughout the life of the project and beyond.**

Through discussions with DEC on 1 November 2006 it was agreed that funding/resources for specific components of the biodiversity offsets package are not required, since the project approval provides a mechanism for enforcement of outcomes and it is up to Centennial to provide adequate funding to meet such commitments.

**DEC suggests that the number and relationship between environmental strategies and plans be reviewed with the aim to provide a clear environmental management framework...a schematic diagram outlining the links and relationships between strategies should be provided.**

As identified in Section 9 of the Ecological Assessment (Volume 4, Appendix 9a of the Environmental Assessment):

An Ecological Management Plan will be prepared (as part of the site Environmental Management Strategy or System) in order to provide further detail and information regarding the ongoing management and conservation of ecological features (particularly key threatened species) during the construction phase of the mine, the ongoing operation, and the post-mining landscape.

Specifically, this plan will include detail on:

- Pre-clearing surveys (relevant to the Proposed Disturbance Area (PDA));
- Tree felling (relevant to the PDA);

- Revegetation and regeneration (relevant to the Proposed Offset Areas (POA) and corridors);
- Habitat augmentation (relevant to the POA and corridors);
- Fencing/access (relevant to all areas);
- Rehabilitation (relevant to the PDA);
- Weed management (relevant to all areas);
- Feral fauna management (relevant to all areas);
- Bushfire management (relevant to all areas); and
- Monitoring program (including remnant; rehabilitation/revegetation/regeneration; fauna; threatened species; aquatic; and LFA for all areas).

**Rehabilitation with treed vegetation – will re-introduce only a fraction of the original floristic diversity and it will be many years before the faunal and flora diversity of the revegetated areas approaches the biodiversity of the treed vegetation areas...**

Grasses, understorey and herb species will be represented within all aspects of the revegetation to be carried out within the Study Area. The reference to “treed” vegetation is used simply to distinguish forested or wooded areas from grassland or pasture areas.

The staged clearing that is part of the Project will ensure that no habitat isolation occurs before it is necessary for the operation of the proposed mine. The staged mine plan can be seen in Figure 9.1 of the Ecological Assessment (Volume 4, Appendix 9a of the Environmental Assessment). The staged clearing and progressive rehabilitation approach will assist in minimising the lag-time between revegetation and habitat provision in post-mined areas. In addition to this, augmentation of existing habitat will occur once these areas are secured. This will greatly assist in the provision of key habitat features such as hollows. Similarly, external corridors will be established as soon as the Project is secured, in order to provide the ecological benefits of these areas as quickly as possible. Ongoing maintenance and management of these areas will assist in reducing the time taken for ecological benefits of these areas to be effective.

**Offsets and their actions must be enforceable – through development consent conditions, licence conditions, conservation agreement or a contract. Offsets must be monitored to ensure that the actions have been carried out and monitored to determine that the actions are leading to positive biodiversity outcomes.**

- **Ownership, tenure and management responsibilities for the offset lands must be identified in detail and formalised in legally enforceable agreements before this principle can be considered to have been adequately addressed.**
- **The EA refers to monitoring and adaptive management but no detail is provided.**
- **There is a need for clearly defined objectives, outcomes and performance measures and timeframes to determine the success of the biodiversity outcomes.**

- **The EA states that “the proposed offsets strategy has been designed to offset the ecological and Aboriginal cultural heritage impacts of the Project”. This aggregation makes it difficult to determine the quantum of offsets that are attributable to biodiversity alone.**

As noted above, it is agreed that the securing of corridors, further offset areas, and the determination of the appropriate mechanism for their protection, would be completed within one year of the granting of approval of the project. It is agreed in principle that:

- a further 600 hectares of offset area is required;
- the tenure of corridors and offset areas will be secured under an appropriate arrangement; and
- there will need to be ongoing management of offset and corridor areas by for at least the life of the mine.

A detailed Ecological Management Plan, which allows for adaptive management in response to unforeseen circumstances will be prepared in consultation with DoP and DEC.

The Ecological Management Plan discussed in the EA and the components of which are reiterated above, will detail the actions necessary to ensure the future viability and improvement of the biological diversity within offset areas, including corridors. The EMP will also address the objectives, desired outcomes and performance measures against which the biodiversity of the offset areas, and corridors, will be measured.

As discussed with DEC, it is not possible to clearly separate ecological and Aboriginal cultural heritage offsets from one-another, as both issues are able to be offset through the establishment of similar offset areas. The offset package proposed will enable the concurrent conservation of both ecological and Aboriginal cultural heritage matters, and the management plans under preparation for both matters will ensure that issues are addressed in a complementary fashion, so there is no conflict between management approaches.

## **2.2 Interest Groups and Community Submissions**

### **2.2.1 General Vegetation/Setting Issues**

#### **1 The Project will destroy 1300 hectares of the largest intact stand of vegetation on the Central Hunter Valley Floor.**

Table 5.1 of the Hunter Remnant Vegetation Project (HRVP) (Peake 2006) identifies the Wybong Uplands as being the second largest remnant, covering an area of 2067 hectares. The largest remnant is the nearby Myambat Military Area, covering a total of 2251 hectares.

#### **2 There are no reserves on the floor of the Hunter Valley that protect vegetation similar to that found in the Study Area.**

Very small areas of Wingen Maid Nature Reserve, Towarri National Park, Wollemi National Park and Goulburn River National Park protect vegetation that is similar to that in the Study Area. The vegetation protected by the 292 hectare Belford National Park has some similarity to that which occurs in the Study Area. This proposal will protect 1707 hectares (p. 6.8 of EA) in the conservation and habitat enhancement area.

**3 Hunter Remnant Vegetation Project (HRVP) (Hunter - Central Rivers CMA, Peake 2006) recommends the Wybong Uplands area for inclusion in conservation reserves, including areas that would be destroyed by the Project.**

One of the objectives of the HRVP was “to determine the distribution and conservation significance of native vegetation of the floor of the Hunter Valley.” In achieving this, the HRVP aimed not only to list vegetation communities of significance, but also areas that were of significance based on the relative area of remnant vegetation cover; diversity or uniqueness of vegetation communities; or the presence of significant or a high diversity of plant species.

Table 6.8 of the HRVP (Peake 2006) provided the following recommendations for the Wybong Uplands area:

protection through conservation agreements. Future protection as a nature reserve or as a managed trust reserve should be investigated.

The HRVP also noted that the:

immediate protection and management of five specific areas ... preferably all through gazettal as nature reserves, or otherwise through conservation agreements [including] Wybong Uplands ...

The Wybong Uplands is one of five areas that were recommended for protection and management. These five areas all contained relatively large proportions of remnant vegetation, in relation to the study area of the HRVP. The Wybong Uplands includes most of the contiguous stand of remnant vegetation that is present in the PDA and the POA, although it also includes the remainder of the contiguous vegetation to the immediate south and south-west of the POA and outside of the Anvil Hill Study Area. Notwithstanding this, much of the highly fragmented vegetation in the PDA and POA does not form part of the Wybong Uplands. So, while there is broad similarity between the Wybong Uplands and the Anvil Hill Study Area, there are substantial specific differences.

A sizeable proportion of the treed vegetation in the PDA does not form part of the Wybong Uplands area, as per Peake (2006). In general, approximately half of the Wybong Uplands would be disturbed by the project, while most of the remaining half would be protected in the POA.

**4 Old growth/regrowth definitions. Not according to *Native Vegetation Act 2003*, take convenient interpretation. Devalues vegetation by saying regrowth. Clearing history irrelevant. Old growth not only in POA.**

The *Native Vegetation Act 2003* provides no definition for the term ‘old growth’. This Act refers to ‘regrowth’ as any vegetation that has regrown since 1 January 1990. Despite these legal definitions, the *Native Vegetation Act 2003* does not apply to any clearing authorised under the *Mining Act 1992*, or for any designated development for which development consent has been granted under the EP&A Act, and has no legal jurisdiction over this Project.

The Ecological Assessment refers to the terms ‘regrowth’ and ‘old growth’ in an ecological (rather than legislative) context. In Section 4.3.1 of the Ecological Assessment (Volume 4, Appendix 9a of the Environmental Assessment), the context and ecological meaning of these terms are clearly defined. That is:



- Old growth vegetation refers to any vegetation that was present at the time of European arrival in Australia that still remains in essentially similar condition.
- Regrowth is, ecologically, any native vegetation that has been cleared and has regrown since that time.

Section 4.3.1 further states that:

- It is possible that the core of woodland vegetation present around Anvil Hill, Wallaby Rocks, Limb of Addy and the Western Rocks in the 1930s (**Figure 4.3**), and extant today (**Figure 4.1**), is “old growth” vegetation.

There is a reasonable probability that the POA contain a proportion of old growth vegetation, possibly 30%, while almost all (at least 90% or more) of the PDA contains regrowth vegetation. Key areas of likely old growth are Wallaby Rocks, Anvil Hill, Limb of Addy Hill, South-west Rocks and south of Anvil Creek.

**5 The Project would not be approved if undertaken under the *Native Vegetation Act 2003*; and is inconsistent with the objectives of this Act.**

As per Section 25 of the *Native Vegetation Act 2003*, this legislation does not apply to any clearing authorised under the *Mining Act 1992*, or any clearing that is, or that is part of, designated development within the meaning of the EP&A Act and for which development consent has been granted under that Act, and has no legal jurisdiction over this Project.

**6 The Study Area forms part of a large regional corridor providing movement pathways in a highly fragmented landscape. Mapping of regional and sub-regional corridors has identified the Study Area as a major contributor to the regional biodiversity corridor linking Wollemi National Park in the south with Manobalai Nature Reserve to the north.**

The existing and potential corridor function of the Study Area was considered in Section 9.5.4 of the Ecological Assessment (Volume 4, Appendix 9a of the Environmental Assessment) which provides a detailed account of the Conceptual Corridor Strategy proposed as part of this Project. This section contains a discussion on existing corridors, the design criteria used in the development of the conceptual corridor strategy, and discusses the relative merits and challenges of eight conceptual corridor options. These options involve both internal and external options of varying width. This section then goes on to identify the preferred options for the corridor strategy, namely connectivity via external options to/from the north and west, as well as internal connectivity via two options. An EA commitment was made to establish one external corridor to the north and one to the west, and this will serve to maintain and enhance the corridor function of the Study Area.

## **2.2.2 Ecological Survey/Results**

**7 The Project will harm/isolate/fragment an area that is home to high levels/numbers of species/biodiversity/threatened species, endangered populations, endangered ecological communities, regionally significant flora species and migratory species. The Project will result in significant impacts for some, and may push some of these to local and regional extinction.**

From all surveys in the Study Area, 597 plant species were recorded. Of the plants recorded, 95 (15.9%) were not native to the Study Area. Surveys of the Study Area identified six threatened flora species, two endangered populations and one EEC.

A total of 188 fauna species were recorded within the Study Area, with 13 (7%) of these species being introduced. Within the PDA, 166 species were recorded, while 179 were recorded within the POA. Nineteen threatened fauna species were recorded in the Study Area. This includes two species also listed as Vulnerable under the EPBC Act 1999. Four migratory species as listed under the EPBC Act 1999 were recorded within the Study Area.

From these, and based on the Test for Ecological Significance, it was considered that, in the absence of appropriate mitigation, the Project is likely to have a significant impact on narrow goodenia (*Goodenia macbarronii*) and may have a significant impact on painted diuris (*Diuris tricolor*) (see response to comment No. 9 below for discussions of the impact on *Diuris tricolor* at a Commonwealth level). The Project is, in the absence of appropriate mitigation, likely to or may have a significant impact on the following fauna species:

- brown treecreeper;
- speckled warbler;
- hooded robin;
- grey-crowned babbler;
- diamond firetail;
- squirrel glider;
- eastern freetail-bat;
- eastern bentwing-bat;
- eastern false pipistrelle;
- large-eared pied bat;
- large-footed myotis;
- greater broad-nosed bat; and
- eastern cave bat.

It is important to note that this conclusion of significance was reached **without** consideration of the impact mitigation measures (as per DEC Threatened Species Assessment Guidelines August 2005).

Section 9 of the Ecological Assessment (Volume 4, Appendix 9a of the Environmental Assessment) discusses the Impact Mitigation that was included as part of the Project to alleviate the impact on these species. The outcomes of the proposed Impact Mitigation were considered when assessing the overall goal of no net loss of flora and fauna values in the area in the medium to long term. The outcome of the assessment was that the Project is not expected to cause local or regional extinction of any threatened species, endangered populations or EECs.



- 8     *Goodenia macbarronii*...the records of this species within the PDA represent the largest area of known habitat for this species within the Hunter Region. Most of this known habitat will be lost as a result of the Project. ...would be likely to result in the extinction of the population. Offsetting will not work for this species.**

During the first year of ecological surveys undertaken for the EA, *Goodenia macbarronii* was located at a number of locations within the PDA, as well as in a population to the north-west of the Study Area. Subsequent surveys in the same locations as well as in additional locations within the Study Area, did not re-locate the species, and did not locate any previously undiscovered locations, despite the presence of substantial potential habitat. Because *Goodenia macbarronii* is ephemeral, and highly responsive to seasonal rainfall, it is likely that there are further occurrences of the species in the Study Area that were not able to be detected during drier years.

The ecological assessment was undertaken based on the likely presence of further occurrences of *Goodenia macbarronii* in the PDA, as well as probable occurrences in parts of the POA, due to the identification of potential habitat in those areas. Furthermore, it is recognised that there are numerous occurrences of this species throughout its range in NSW, and likely unidentified occurrences in the upper Hunter Valley. Finally, the POA will protect substantial potential habitat for the species, which will be managed to encourage the establishment of the species.

As a result of the assessment, it was concluded that the project would be unlikely to significantly impact the species.

- 9     *Diuris tricolor* not only in POA. Widespread in PDA. Likely to fragment one of few occurrences in Upper Hunter. *Diuris tricolor* – fragment and increase risk of extinction.**

*Diuris tricolor* was recorded on a single occasion within the POA. Further records of this species occurring within the PDA were recently provided by Anvil Hill Project Watch Association (AHPWA). The Ecological Assessment acknowledged that this species was likely to occur more extensively within the PDA and the POA, and assessed the impact on this species based on that likelihood. The Study Area records form part of a larger known population of this species located within the Wybong District, which is known to contain many hundreds of plants (T. Peake unpubl. data). The outcome of the assessment was that the Project is not expected to cause local or regional extinction of the species.

- 10    *Oligochaetochilus* sp. aff. *praetermissus* new species, not in assessment. May be in PDA.**

*Oligochaetochilus* sp. aff. *praetermissus* is a new taxon that has not been scientifically described. This species has been recently recorded on outcrops in the southern POA. It is unlikely that this species would be present on the Permian geology below the conglomerate outcrop landscape, and therefore it is very unlikely that it would be affected by the proposed development. It is not listed as threatened under the TSC Act or the EPBC Act.

- 11    *Prasophyllum* sp. aff. *petilum* largest extant population of undescribed species potentially in PDA**

*Prasophyllum* sp. aff. *petilum* is a new taxon that has not been scientifically described. It is also known to occur along Thomas Mitchell Drive near Muswellbrook, as well as at Tambar Springs and Ilford. This species has been recently recorded by Christine Phelps along Limvady Road in the PDA. It is not listed as threatened under the TSC Act or the EPBC Act.

## **12 *Commersonia rosea* is likely to be more widespread than the single occurrence identified in surveys.**

It is agreed that *Commersonia rosea* could be more widespread than the single occurrence identified by the surveys. This species was targeted by the extensive surveys completed as part of the Project. Despite not gaining further records, this species was considered in detail within the impact assessment. It is likely to occur primarily in the Shrubland formation on conglomerate outcrops, although there may be small areas where it could potentially occur on the Permian landscape below the conglomerate outcrops. Large areas of potential habitat (classified within the Shrubland formation) are protected within the POA.

## **13 Koala Survey –**

- **Did playback occur during breeding season?**
- **Requirements of SEPP 44 were not met, level of survey not adequate**
- **Did not target areas near scats**
- **Used SEPP 44 trees, not from Draft Recovery Plan**
- **Random statistical site selection not suitable to detect population and would not detect high frequency of feed trees**
- **Should allow Australian Koala Foundation (AKF) to survey.**

Call playback for the koala was undertaken during the koala's breeding and non-breeding seasons. Male koalas bellow during both the breeding and non-breeding season, although to a lesser extent during the non-breeding season.

The combination of 158 vegetation survey sites, 23 hours of walking surveys, 19 hours of driving surveys, 29 call playback sessions, 75 kilometres of visual canopy searches and the searching of 493 tree bases for koala scats is a very comprehensive survey effort. SEPP 44 does not define a required minimum survey effort, however the survey effort completed to target the koala substantially exceeds the requirements of the DEC (2004) *Threatened Biodiversity Survey and Assessment Guidelines*. The level of ecological survey has been described by DEC (following their assessment of the EA) as being comprehensive and detailed.

The feed tree species identified in SEPP 44 were used to identify potential koala habitat, as this is the legislative requirement under the EP&A Act 1979. The Draft Koala Recovery Plan feed tree list includes (at Anvil Hill):

- primary feed trees:
  - forest red gum – very limited numbers, mostly along Anvil Creek;
- secondary feed trees:
  - Dwyer's red gum – restricted to outcrops;
  - western grey box – restricted to very small areas, along Anvil Creek and Big Flat Creek;
  - grey box – moderately common throughout; and
  - grey gum – abundant on and surrounding outcrops.

Random statistical site selection was used to provide adequate, non-biased coverage of the large site. The only areas that support at least a moderate density of koala feed tree species

are around the base of escarpments, where grey gum (*Eucalyptus punctata*) is the most common tree species. These areas are almost entirely contained within the POA. Although every form of survey will undoubtedly result in some data collection bias, it is considered that the extensive survey effort across most of the Study Area is likely to have provided significant opportunity to locate areas of high density koala feed tree species if they existed.

The fauna survey component of the EA, including the SEPP 44 assessment, was led by Steven Cox, Senior Ecologist, Umwelt, who is currently completing his PhD thesis on the viability of a koala population in the Bathurst area. He has extensive experience in the survey of koalas in low density populations following four years of field study including population density estimates. Considering the high level of expertise and experience of Umwelt staff in koala survey and population assessment, it is unlikely that surveys by a member of a koala-focused organisation would provide any significant additional expertise that would have modified the survey outcomes.

While no koala scats were identified across the 55 survey sites as part of the condition assessment a single group of scats were identified opportunistically under a single tree in the POA approximately one kilometre south of the PDA during other survey activities (see Appendix 9 Sections 5.5 and 5.2.1.11 and Figure 5.1).

DEC was consulted extensively throughout the Project (including specifically regarding survey effort and target threatened species issues) and has indicated on a number of occasions its high level of satisfaction with the survey effort.

#### **14 Habitat usage of glossy black-cockatoo in PDA**

Habitat for this species (in the form of specific feed tree species) is most dominant in the Drooping Sheoak Woodland vegetation community.

As identified in Section 4.2.1.6 of the Ecological Assessment (Volume 4, Appendix 9a of the Environmental Assessment):

Drooping Sheoak Woodland occurs in four discrete locations within the Study Area...restricted to 1 hectare within the Proposed Offset Areas and 0.8 hectare within the Proposed Disturbance Area (**Figure 4.1**). It occurs predominantly on the eastern spur extending from the Anvil Hill complex, as well as to the west of Limb of Addy. This community is interspersed with the Ironbark Woodland Complex. Drooping sheoak, which through its presence defines the community, frequently occurs as a mid-understorey in Ironbark Woodland Complex around the lower slopes of the Anvil Hill complex, Wallaby Rocks, and the Western Rocks. However, only in the few areas detailed above does it occur in such density to the exclusion of other trees that it has been able to be mapped as a separate community.

Other key habitat features (such as large hollows) required by this species are found across the Study Area in various densities.

#### **15 Brush-tailed rock wallaby – identification of scats should be interpreted as the species existing in the Study Area**

The brush-tailed rock-wallaby (and the identified scats) are discussed in detail in Section 5.2.1.13 of the Ecological Assessment (Volume 4, Appendix 9a of the Environmental Assessment). This section notes the difficulty in ageing the scats, as well as the total lack of visual records of this species despite extensive targeted (and generalised) survey. Specific potential habitat for this species will be retained and protected within the POA.

Apart from the 379.5 person hours (approximately 33 days) of general fauna survey, an additional 64.5 person hours of targeted brush-tailed rock wallaby habitat searches (see Appendix 9 Section 3.5.1.2) were undertaken specifically assessing escarpment and cliff areas with highest potential brush-tailed rock wallaby habitat within the study area (see Appendix 9 Figure 3.3). Targeted habitat searches involved the searching of rocky outcrops, cliff lines, caves and overhangs for signs of brush-tailed rock wallaby presence. Not all caves and overhangs could be reached safely. All rocky outcrops, cliff lines and caves occurred in the POA (see Section 3.5.1.2 and Figure 3.3).

Brush-tailed rock wallaby scats were recorded at four locations in the POA, all on Limb of Addy Hill (see Appendix 9 Sections 5.2.1.13 and 9.5.2.2 and Figure 5.1 - note that two of the locations were 30 metres apart). All scats collected were dry and old in appearance and could not be aged other than as 'old' (see Appendix 9 Appendix F Section 32). Once fresh scats dry out, usually within a day or two, they become old scats that could be between a couple of days old and several years old (Barbara Triggs pers. comm.). As well as being old in appearance all scats were found in overhangs and caves and were in dry sheltered positions where they could not be trampled by wildlife or degraded by the weather (see Appendix 9 Figure 5.1). The failure to find scats in positions other than those where they were protected from wildlife and weather suggests that the scats were most likely several years old as there was no force (trampling, weather or dung beetles) acting to break the scats down. Repeat visits were made to the main deposit and no fresh scats (still moist and dark in colour) were identified. No scats were recorded in the PDA. No animals were recorded through observation in either the POA or the PDA.

The brush-tailed rock wallaby scats were all identified in escarpment habitat in the POA. All of the escarpment habitats occur in the POA and all will be conserved, however some areas potential foraging habitat in nearby woodland surrounding escarpment habitat will be removed in the PDA (see Appendix 9 Appendix F Section 32).

While not specifically targeting the brush-tailed rock wallaby a total of 462 person hours (38.5 person days) of fauna survey, 106 flora assessment plots (29 plots in escarpment areas) and approximately 73 kilometres of flora transects were completed across the Study Area during 2004 and 2005. During these surveys field staff covered a large portion of the Study Area including escarpment areas and at other times were able to view the escarpment areas from lower positions. During this time no brush-tailed rock wallabies were recorded opportunistically from either observation of animals or from the discovery of scats.

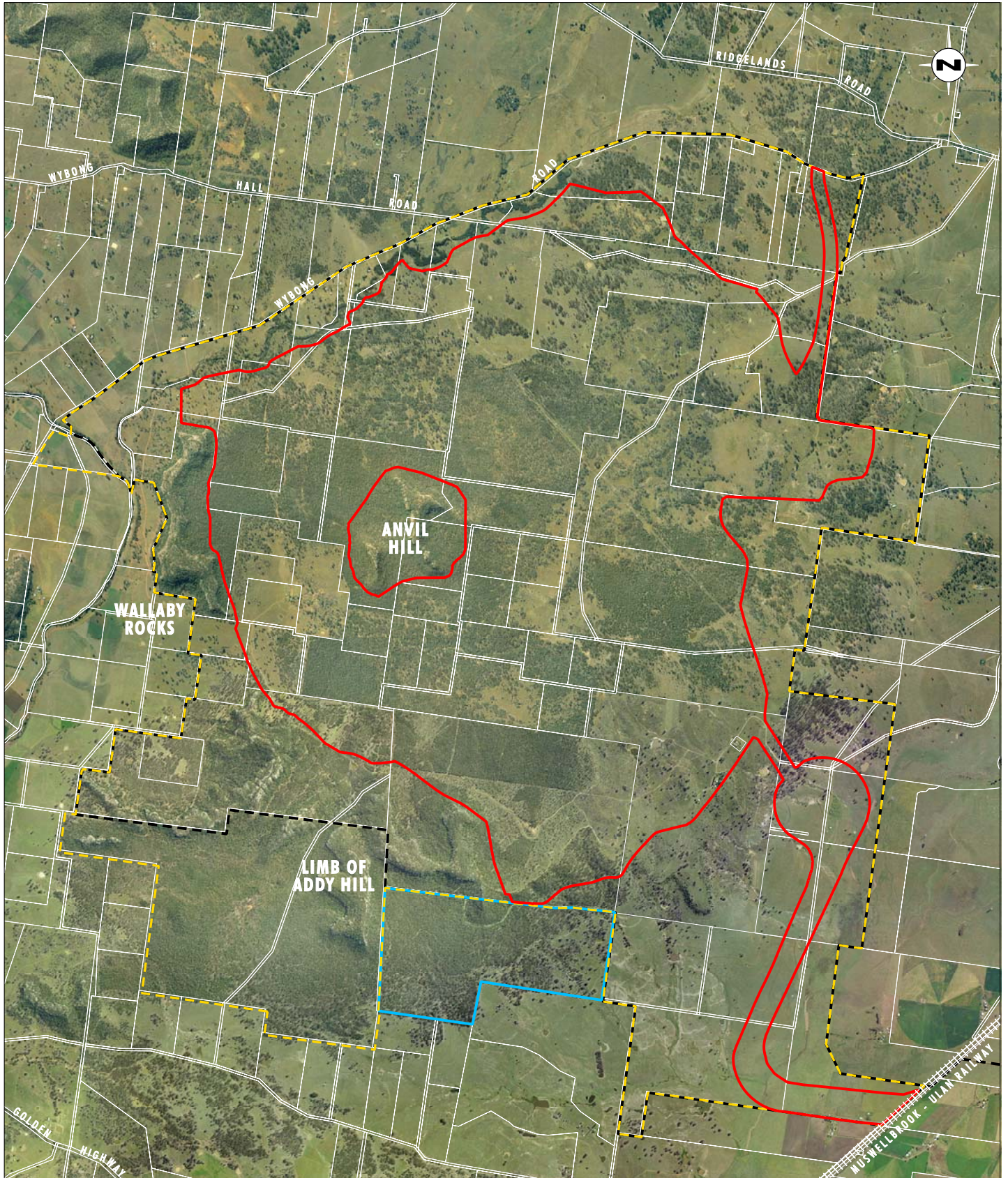
Independent scat evidence of the brush-tailed rock wallabies past presence was collected by Abel Ecology (2005) who found aged pellets in a cave. Abel Ecology (2005) produced a flora and fauna report for a 172 hectare property neighbouring the Study Area (see **Figure 2.2**). Figures produced by Abel Ecology (2005) do not identify the location from which the pellets were collected.

Within the Central Evolutionary Significant Unit (ESU), a mapped biogeographic region in which Anvil Hill is located, there is one listed endangered population, a number of populations facing marked declines, and a growing number of extinct populations (NSW Scientific Committee 2003a).

It is assumed that the population is extinct due to:

- the lack of fresh scat material in the POA;
- the lack of sightings of brush-tailed rock wallabies in the POA;
- the lack of scat evidence or sightings of brush-tailed rock wallabies in the PDA;





Base Map: Dept. of Lands (2003), ortho-rectified by Plateau Images

0 0.5 1.0 2km  
1:45 000

### Legend

- Proposed Disturbance Area
- - - Project Application Area
- - - Umwelt Study Area
- Abel Ecology (2005) Study Area

**FIGURE 2.2**

**Neighbouring Property**



- the large survey effort; and
- the two year period over which surveys were undertaken.

Two final voids are planned to remain in place at the completion of mining, located at the south-western end of the proposed mining area associated with the Main and Southern Pit workings (refer to Volume 1 Figure 5.5). The proposed final voids could potentially provide steep, rocky habitat at their high-wall margins, which will have slopes ranging between 30° and 50° and will generally be about 50 metres deep.

DEC was consulted extensively throughout the Project (including specifically regarding survey effort and target threatened species issues) and has on a number of occasions indicated its high level of satisfaction with the survey effort.

## **16 Regent honeyeater and swift parrot – significant impact**

Neither of these species was recorded within the Study Area, despite large amounts of survey effort during the appropriate detection seasons. There are no anecdotal records of these species from the Study Area. Tests of Significance were completed for both species, with the result that there would be no significant impact on these species from the proposed development.

## **17 Survey times/effort:**

- **Not best for orchids, as seen from low diversity in records – only targeting threatened species?**
- **Survey for *Pomaderris reperta* in POA, but not PDA.**
- **Not enough owl call playback**
- **Did not target spotted-tailed quoll latrine sites**

Flora surveys were undertaken during the following months and seasons:

- summer (December, February);
- autumn (March, April, May);
- winter (June, July); and
- spring (September, October).

The months of September and October, which are typically the best times to detect terrestrial orchids in the Upper Hunter Valley, were surveyed by Senior Ecologists over several years.

Seventy approximate ten-hour person-days of flora surveys by Umwelt and HLA Envirosciences staff were spent in the field undertaking specific botanical surveys. During these surveys, all plant species encountered (including non-threatened species) were recorded or sampled for later identification. Effort was made to search all strata, including groundcover and tree canopies.

Surveys for *Pomaderris reperta* were completed as part of the extensive flora surveys described in Section 3.3 of the Ecological Assessment (Volume 4, Appendix 9a of the

Environmental Assessment). This included extensive surveys across both the PDA and the POA. Specimens of *Pomaderris* were sent to Mr Neville Walsh, of the National Herbarium of Victoria, for expert identification. The Project also included the provision of assistance to the Royal Botanic Gardens Melbourne Pomaderris Study Group for their ex-situ conservation program for *Pomaderris reperta*. This group collected cutting of this species for ex-situ propagation. Umwelt ecologists later collected fertile material from flowering *Pomaderris reperta* and provided that to the group.

Call playback is one of a number of survey methods used to target owl species, particularly threatened species. This method was used in conjunction with previous records, nocturnal spotlighting and diurnal habitat searches. The masked and powerful owls were recorded from the Study Area. These species were included within the impact assessment as having habitat across the majority of the Study Area. Call playback was successful in detecting the masked owl. The powerful owl was detected through habitat searching and identification of pellets. The barking owl was recorded by local residents and reported by the AHPWA. Based on these data, these species were assumed to occur across Study Area, and were assessed accordingly.

No spotted-tailed quoll latrine sites were encountered during the considerable amount of field survey completed within the Study Area, including surveys of rocky escarpment areas, rocky slopes and rocky creek beds, all locations where quoll latrines would typically be expected. Travis Peake, Ecology Manager, Umwelt, who undertook a large proportion of the field work, has extensive research experience in the identification of spotted-tailed quoll latrines, and was thus unlikely to overlook them if they were present in the areas he surveyed. In addition to this, scats were collected (wherever encountered) and sent for expert identification, as well as content analysis. None of these resulted in the identification of the spotted-tailed quoll. Despite the lack of confirmed records, it is possible that this species may occur within the Study Area. It is likely that the Study Area forms habitat for a population of spotted-tailed quolls that extends to the west, north-west and south-west into the remote escarpment country of Manobalai Crown Land. It is also likely that the Study Area forms marginal habitat for a population with a core area in the remote escarpment country to the west, north-west and south-west. These conclusions were included within the impact assessment in the EA for this species.

DEC was consulted extensively throughout the Project (including specifically regarding survey effort and target threatened species issues) and has indicated on a number of occasions its high level of satisfaction with the survey effort.

**18 Why were local residents' records omitted, despite reference to them in Appendix H of the Ecological Assessment (Volume 5, Appendix 9b of the Environmental Assessment)?**

This was an oversight. It was intended to include local residents' records in Appendix H (to the Ecological Assessment) (Volume 5, Appendix 9b of the Environmental Assessment), where the empty end column was labelled "Local Resident Records". The records that were obtained were provided by Mr P. and Ms A. Hogan, whose property is situated almost entirely within the PDA. These records are provided as an attachment to this response and were considered in the assessment included in the EA (refer to **Appendix 1**).

The only threatened bird species included within this attachment that was not considered by the EA was the Australian bustard (*Ardeotis australis*). The record for this species was dated from the 1970s, and the record was annotated with the comment "doubt will see another". This is an appropriate assumption for this once widespread species, which is now reported by DEC (<http://www.environment.nsw.gov.au/threatspec/biodivcasestudies>) as being:

now scarce or absent from southern and south-eastern Australia.

With such a large, conspicuous species, it is likely that additional records would have been reported, had this species been extant within, or near to, the Study Area.

**19 ...fails to mention the extensive survey undertaken by DEC (2006) in studying the reserves [Manobalai] vertebrate fauna.**

The recent report on the vertebrate fauna of Manobalai Nature Reserve was not known to the authors when the Ecological Assessment was completed.

The surveys completed as part of this report did not locate any threatened fauna species that were not considered as part of the Ecological Assessment.

**20 If survey was over longer time and out of drought, more threatened species would be identified/underestimate threatened species numbers.**

It is neither feasible nor warranted to conduct such surveys over longer time periods or only outside drought conditions.

It is acknowledged that field survey (even the extensive work that was completed for this Project) could not expect to have identified every species occurring in the Study Area. As a result, considerable effort was paid to identifying threatened species that had the potential to occur within the Study Area (on the basis of previous records, presence of potential habitat and professional opinion). Such potentially-occurring species were afforded a high level of consideration within the Ecological Assessment. Indeed, many species included within the impact assessment were not identified within the Study Area, rather were included on the basis of their **potential** occurrence, therefore warranting detailed consideration as part of the impact assessment, and offset strategy. For example, one of these species, the spotted-tailed quoll (*Dasyurus maculatus maculatus*), was considered to be highly likely to be present, despite an absence of records, and was considered heavily in the impact assessment and design of impact mitigation measures.

**21 Species records:**

- **there is one sighting of squirrel glider on the boundary of the disturbance area, which does not reliably indicate the squirrel gliders use the POA.**
- **Some species not in offset area/only in PDA**
- **few occur in the PDA compared to POA**

This comment from Abel Ecology fails to acknowledge the record of the squirrel glider in the POA (as detailed in Table 5.2 of the Ecological Assessment (Volume 4, Appendix 9a of the Environmental Assessment), and depicted on Figure 5.1 of the Ecological Assessment). The presence of this species in the POA is also clearly stated in Section 5.2.1.12. Further to this, a detailed impact assessment for this species is provided in Section 8.8.2, which fully considers its presence in both the PDA and the POA.

Section 5.1 of the Ecological Assessment provides a discussion on the caution that should be employed when interpreting the fauna records. This section states:

Records of fauna species should be interpreted carefully, since a record of a species within a particular area **does not** suggest it **only** occurs within that specific part of the Study Area, and not within other parts. The high levels of mobility of many fauna species



(particularly many birds and mammals) mean that those species could readily occur in areas other than where they were recorded.

In addition to this, the mobility of many fauna species should be taken into account when interpreting population size (or abundance) of recorded species. This ability to travel throughout the Study Area would increase the possibility of recording the same individual within different parts of the Study Area. As it is not possible to readily distinguish between individuals, there is the potential for 'double-counting' of an individual. This would make the direct translation of number of records to a representation of population size inaccurate.

This clearly indicates that the EA does not consider a lack of records in a particular area as an indication of species' absence. Hypothetically, had the squirrel glider not been recorded in the POA (despite the fact that the Ecological Assessment clearly indicates that it was), the approach adopted for the assessment would have assumed habitat for this species in all examples of the Woodland and Riparian/Floodplain vegetation formations of the Study Area, regardless of whether the species had been recorded in only the PDA or POA.

Abel Ecology also state that *Diuris tricolor* is not in the offset areas. Again, this species is clearly identified as occurring within the POA on Figure 4.5 of the Ecological Assessment, as well as being discussed in detail in Table 4.7 and Section 4.4.1.2.

In relation to the number of records gained from the PDA versus the POA, there were a total of 97 threatened flora records from the Study Area (34 from the PDA and 63 from the POA) and a total of 221 records of threatened fauna from the Study Area (127 from the PDA and 94 from the POA). Four threatened flora species were recorded only from the POA, and six threatened fauna species were recorded only from the POA. Conversely, one threatened flora species and two threatened fauna species were recorded only from the PDA. The records of threatened species in the POA and PDA reflect those species' occurrence in the habitats of the Study Area, not the level of survey effort undertaken in either area. The overall level of survey undertaken in the POA and PDA was generally consistent.

## **22 Some areas to south are intact native grassland (not disturbed)**

No areas of grassland occurring in the Study Area were identified as being intact native grassland. All grassland is present as a result of previous clearing of open forest and woodland vegetation types, and is referred to as 'derived grassland.' It consists of a mixture of native and naturalised (non-native) species. The floristic composition varies from one place to another.

## **23 Aquatic survey done in dry times, therefore unreliable.**

The aquatic survey was undertaken over five days in November 2004. This survey included detailed literature reviews and database searches, habitat assessment, macroinvertebrate and vertebrate fauna sampling, and aquatic flora sampling. The ephemeral nature of the creeks and drainage lines and low water levels at the time of the survey prevented the use of the Australian Rivers Assessment Scheme (AusRivAS) method. Low flows and a lack of pool habitat also hindered the application of other quantitative assessment methods such as poddy trapping and dip netting, both of which require minimum water levels and channel dimensions. It is highly unlikely that there has been sufficient rainfall in the area in the recent past (five years), to allow a significant change to the nature and habitat provided within the aquatic habitats of the Study Area, such that significantly different flora and fauna species assemblages would be recorded. Similarly, no change to the sampling period or effort would have increased the chance of identifying threatened aquatic species, as the Hunter River catchment does not provide habitat for any of the listed threatened aquatic species,

populations and endangered ecological communities listed under the *Fisheries Management Act 1994*.

### **2.2.3 Impact Assessment and Management Outcomes**

#### **24 Indirect impacts on World Heritage Areas, nearby National Parks, RAMSAR wetlands etc.**

Wollemi National Park, located about 10 kilometres to the south of the Project Area, is part of the Greater Blue Mountains World Heritage Site. Mt Royal National Park and Barrington Tops National Park, located 50 and 55 kilometres to the east-north-east of the Project Area, are part of the Central Eastern Rainforest Reserves World Heritage Site.

Given the distance of these sites from the Project Area, there are no potential indirect impacts on World Heritage Properties.

#### **25 contribute to climate change and its expected impacts on threatened species, expected extinctions...**

Part A – Response to Submissions dealt with climate change issues.

#### **26 Anvil Hill will be isolated for long time.**

The staged clearing that is part of the Project will ensure that no habitat isolation occurs before it is necessary for the operation of the proposed mine. The staged mine plan is shown on Figure 9.1 of the Ecological Assessment (Volume 4, Appendix 9a of the Environmental Assessment), where it can be seen that the habitat surrounding Anvil Hill will not be isolated until at least Year 15 of the Project. By this time, revegetation works behind the advancing mine will be in place, and in some cases approaching 10 years old. The staged clearing and progressive rehabilitation approach will assist in minimising the lag time between revegetation and habitat provision in post-mining areas. The protection and enhancement of internal corridors (see Section 9.5.4.3) along Big Flat Creek and along Wallaby Rocks will assist in maintaining internal connectivity in the vicinity of Anvil Hill.

#### **27 Dust and noise impacts on flora and fauna**

The potential impacts of increased dust and noise on flora and fauna species were considered as part of the impact assessment. It is unlikely that these issues will cause a significant impact on threatened species, endangered populations or EECs.

Monitoring of a number of operational mine sites in the Hunter Valley has shown numerous examples of threatened flora and fauna species persisting in remnant vegetation on these sites, including adjacent to areas of high disturbance or activity which include impacts from dust and noise.

#### **28 Assessment deliberately understates value of vegetation and true impact of its loss**

The conservation significance of the vegetation communities mapped within the Study Area by Peake (2006) is discussed in Section 3.1.1 of the Ecological Assessment (Volume 4, Appendix 9a of the Environmental Assessment) in relation to the findings of the HRVP. Further to this, Section 4.2.1 addresses the conservation significance of each of the vegetation communities identified within the Study Area.

**29 Condition Assessment – site selection not entirely random – bias away from least disturbed woodland.**

Access was a consideration with the location of the condition assessment survey sites. Some areas of the Study Area (particularly the escarpment areas) are rugged and have limited access, however these areas were still assessed. The considerable track network across the Study Area enabled reasonable access to most areas, and therefore limited access-related bias in the sampling. DEC raised no issues with the sampling approach.

**30 ...located within two Mitchell landscapes...these landscapes are regionally significant, provide no opportunities for clearing offsets and should not be cleared any further.**

The location of the Study Area within such soil landscapes is not disputed.

**31 [Table 4.5 of EA]...Weeping Myall would be disturbed...no loss of any EEC is acceptable and that EECs cannot be offset.**

Section 4.2.1.15 of the Ecological Assessment (Volume 4, Appendix 9a of the Environmental Assessment) states:

Weeping Myall Woodland occurs in three highly restricted locations, in the north-west and east of the Study Area (**Figure 4.1**), covering a total of 1 hectare (**Table 4.5**). One of the known sites is within the rail loop of the Proposed Disturbance Area, however is expected to be able to be protected within the centre of the rail loop. The other known occurrences of this community occur within the Proposed Offset Areas or outside of the Study Area along Mangoola Road.

This example of the EEC will not be impacted as part of the Project, and will be protected within the rail loop, despite occurring within the PDA.

**32 The EA does not specify the actual area of the Wybong Upland vegetation that would be permanently destroyed and/or dislocated...**

Table 5.1 of the HRVP (Peake 2006) identifies the Wybong Uplands as covering an area of 2067 hectares. The Wybong Uplands includes most of the contiguous stand of remnant vegetation that is present in the PDA and the POA, although it also includes the remainder of the contiguous vegetation to the immediate south and south-west of the POA and outside of the Anvil Hill Study Area. Notwithstanding this, much of the highly fragmented vegetation in the PDA and POA does not form part of the Wybong Uplands. So, while there is broad similarity between the Wybong Uplands and the Anvil Hill Study Area, there are substantial specific differences.

A sizeable proportion of the treed vegetation in the PDA does not form part of the Wybong Uplands area, as per Peake (2006). In general, approximately half of the Wybong Uplands would be disturbed by the project, while most of the remaining half would be protected in the POA.

**33 ...the removal of Anvil Creek and Clarks Gully...is likely to result in adverse impacts on significant vegetation communities and threatened species habitat both within and adjacent to the mine disturbance area.**

The removal of Anvil Creek and Clarks gully will not impact on listed threatened aquatic species, populations and endangered ecological communities (*Fisheries Management Act 1994*) as the Hunter River catchment does not provide habitat for any of these. The potential

impact of the loss of riparian habitat on EECs and threatened species has been assessed as part of the Test for Ecological Significance in Appendix F of the Ecological Assessment (Volume 4, Appendix 9a of the Environmental Assessment) as well as being discussed in Sections 8.5.2 and 8.6.2.

- 34 the description of areas of offset vegetation community types or vegetation communities as 'potential habitat' for threatened species of plants and animals is ecologically invalid and scientifically indefensible...it is incumbent on the assessment to explain, with respect to species of particular significance, why they mainly occur here, in the development area, and not over there, in the offsets area.**

The use of the term 'potential habitat' throughout the Ecological Assessment has been included to acknowledge and classify the importance of vegetation communities/formations to particular threatened species. This phrase has been used to identify habitat where a particular species has the potential to occur, on the basis of previous records in similar habitat types, or on the basis of the presence of suitable habitat features for that species. The use of the term 'potential' does not restrict the likelihood of the occurrence of a species, rather acknowledges that the species could 'potentially' make use of that area.

- 35 by aggregating areas not only of vegetation communities, but also even vegetation formations, and describing such area as 'potential habitat'...the assessment deliberately seeks to mislead by understating the massive loss of habitat for such species the proposal would involve.**

Vegetation formations were used as the basic stratification unit for the Ecological Assessment because the vegetation communities that formed part of each vegetation formation were more or less similar in terms of the habitat they provided for the key threatened flora and fauna species listed. This approach was used to broadly group the areas of similar habitat within the Study Area, and to allow assessment of the relative importance of these habitat groups to threatened species. This approach increases the emphasis on habitat loss, as it clearly quantifies the impact on not only the vegetation community the particular threatened species was recorded from, but also the impact on the entire formation (of similar vegetation communities).

Formations were used instead of communities because no threatened fauna were community-specific in their occurrence in the Study Area.

- 36 More detail needed on actual numbers of threatened species to be protected in offset. No demographic data, so relative importance of POA compared to PDA is not measurable.**

The approach to the impact assessment (as stated above) was to quantify the impact of threatened species habitat, rather than actual numbers of threatened species. This approach acknowledges that field survey (even the large amount that was completed for this Project) could not expect to have identified every species, or every threatened species, occurring in the Study Area. As a result, considerable effort was made to identify threatened species that had the potential to occur within the Study Area (on the basis of previous records, presence of potential habitat and professional opinion). Such potentially-occurring species were afforded a high level of consideration within the Ecological Assessment.

DEC was consulted extensively throughout the Project (including specifically regarding survey effort and target threatened species issues) and has on a number of occasions indicated its high level of satisfaction regarding the survey effort.

**37 Unique bioregional setting – push lots of species to local extinction or range contractions**

It is acknowledged that the Study Area is situated in a unique bioregional setting, which contains a number of species located at or near their known distributional limits. The impact assessment has considered the known distributional ranges of threatened species, endangered populations and EECs as part of the Test for Ecological Significance.

**38 many of the impact assessments made indicate that significant effects will result...however, the conclusion reached is that there will be no significant effect from the proposal...**

This observation is a function the two-staged assessment process in the EA. Firstly, likely impacts on threatened species were considered in the absence of mitigation measures. Secondly, likely impacts were reassessed with the inclusion of appropriate mitigation.

The mitigation measures proposed as part of this Project are commonly employed in projects of this type, and are accepted as best practice impact mitigation measures. While there are numerous examples of rehabilitation projects of this type in the Hunter Valley, little literature is available to confirm the success of these measures on target threatened species. As such, the Ecological Assessment has been precautionary in not assuming proof of such successful impact mitigation within the Assessment of Significance.

The conclusion of 'no net loss of flora and fauna values in the area in the medium to long term' (as required by DoP) was reached in light of the expected positive result over the medium and long-term from the impact mitigation measures proposed. Such positive results include:

- increased provision of vegetated habitat in the long term;
- increased connectivity from the Study Area to large areas of nearby vegetation;
- enhancement of existing habitat through habitat augmentation, including the use of nest boxes;
- ongoing land management of the Study Area and external corridors, including weed and feral animal management, fencing, maintenance of nest boxes and revegetation.

A net increase in treed vegetation will be achieved by the implementation of the rehabilitation and offset strategies. These strategies will immediately protect 1037 hectares and result in a net increase of approximately 1286 hectares of treed vegetation in the medium to long term.

**39 Alluvial vegetation = better habitat. Will add to cumulative losses. Not enough riparian/floodplain vegetation in the POA.**

The project is expected to result in the loss of approximately 53 hectares (63%) of the Riparian/Floodplain vegetation formation within the Study Area. The potential impact of the loss of riparian habitat on EECs and threatened species has been assessed as part of the Test for Ecological Significance in Appendix F of the Ecological Assessment (Volume 4, Appendix 9a of the Environmental Assessment) as well as being discussed in Sections 8.5.2 and 8.6.2 of the EA. Approximately 31 hectares of this vegetation will be protected within the POA. In addition to this, 53 hectares of this vegetation formation is proposed to be revegetated within the post-mining landscape.



Additional opportunities exist for the establishment of this vegetation formation with the sustainable agricultural areas, and where proposed corridors cross riparian areas such as Wybong Creek. The proposal to include areas of *Acacia pendula*, which forms an endangered population and part of an EEC, within revegetated areas will also contribute to the overall return of this vegetation formation.

**40 Discounts presence of three EECs, Hunter Lowland Redgum Woodland and Swamp Oak Forest, and White Box-Yellow Box-Blakelys Red Gum Woodland on basis of comparison between diagnostic species, does not provide quantitative list of species in vegetation plots...not possible to independently verify conclusion that none of these EECs are present.**

A discussion on the likelihood for potential endangered ecological communities (EECs) within the Study Area is provided within Section 4.6 of Appendix 9 of the EA. Due to its physiographic location and general species composition, a comparison of the Forest Red Gum Riparian Woodland was made against the following EECs:

- Hunter Lowlands Redgum Forest;
- White Box – Yellow Box – Blakely's Red Gum Woodland (TSC Act);
- White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grasslands (EPBC Act);
- River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions (TSC Act);
- Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions (TSC Act); and
- Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions (TSC Act).

No other EECs (apart from Hunter Valley Weeping Myall Woodland (TSC Act) and Weeping Myall – Coobah – Scrub Wilga Shrubland of the Hunter Valley (EPBC Act), see below) were considered to have the potential to be present within the Study Area.

None of these EECs comprised a reasonable representation of species in the Forest Red Gum Riparian Woodland. In addition, most were either outside of their documented range, and/or outside of other environmental parameters, such as elevation and soil type, to suggest any similarity.

The EECs that had most similarity, and therefore warranted the most investigation, were:

- White Box – Yellow Box – Blakely's Red Gum Woodland (TSC Act);
- White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grasslands (EPBC Act); and
- River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions (TSC Act).

In these cases there was between 9% and 25% overlap between species recorded in the Forest Red Gum Riparian Woodland and those documented for the relevant EEC. While this

in itself does not rule out the potential for EECs to be present, there was also relatively little overlap between key community dominant species between the entities.

Of these three EECs, the River-flat Eucalypt Forest EEC appeared to have the greatest chance of similarity to the Forest Red Gum Riparian Woodland. The physiographic drivers and, to a lesser extent, the edaphic drivers mentioned in the EEC determination are present in the Forest Red Gum Riparian Woodland. The dominant canopy species in Forest Red Gum Riparian Woodland is forest red gum (*Eucalyptus tereticornis*), however other common trees can include rough-barked apple (*Angophora floribunda*), grey box (*E. moluccana*) or Blakely's red gum (*E. blakelyi*), and more rarely western grey box (*E. microcarpa*) or yellow box (*E. melliodora*). Black cypress pine (*Callitris endlicheri*) and bullock (*Allocasuarina luehmannii*) may also be locally abundant in some areas. Of these canopy species, it is only forest red gum (*E. tereticornis*) and rough-barked apple (*Angophora floribunda*) that are common, abundant species on both lists. In the case of forest red gum, it is believed that the majority of individuals occurring in the community are likely to be hybrids with Blakely's red gum (*E. blakelyi*). While grey box (*E. moluccana*) is present in both communities, it is relatively uncommon in Forest Red Gum Riparian Woodland, except for localised occurrences, and is usually a hybrid with western grey box (*E. microcarpa*). Other canopy species that can be common in areas are bullock (*Allocasuarina luehmannii*) and black cypress pine (*Callitris endlicheri*), neither of which occur on the River-flat Eucalypt Forest EEC list. The understorey, likewise, only shows real overlap between common and widespread shrubs that characterise a wide range of vegetation communities. Indeed, the most common and abundant shrubs in the Forest Red Gum Riparian Woodland community – native olive (*Notelaea microcarpa* var. *microcarpa*), western golden wattle (*Acacia decora*), sickle wattle (*A. falcata*) and silver-leaved wattle (*A. parvipinnula*) – are not on the River-flat Eucalypt Forest EEC list.

In summary, there is some floristic overlap between Forest Red Gum Riparian Woodland and three EECs, of which River-flat Eucalypt Forest probably has the highest potential to be present. While there is some overlap between canopy and shrub species, there is only major overlap between relatively common and widespread grasses and forbs. Many of the key characteristic species in the Forest Red Gum Riparian Woodland community are not represented in the River-flat Eucalypt Forest EEC. The Forest Red Gum Riparian Woodland community at Anvil Hill is a floodplain community, and appears to meet the physiographic and probably edaphic components of the EEC listing, but there is not any compelling evidence based on its floristic composition to include it as part of the River-flat Eucalypt Forest EEC.

All other vegetation communities present within the Study Area were thoroughly assessed for similarity to listed EECs. The only vegetation community that is consistent with an EEC is Weeping Myall Woodland, which is equivalent to the TSC-listed Hunter Valley Weeping Myall Woodland EEC. The assessment showed that it is not, however, consistent with the EPBC-listed Weeping Myall – Coobah – Scrub Wilga Shrubland of the Hunter Valley.

The plot data gathered by the study is being supplied to the IHAP Ecology Expert for his independent analysis.

**41 it is appropriate to explain the outcome of the consultation in terms of survey methods, analysis and results in the EIS, but this was not done.**

DEC was consulted extensively throughout the Project (including specifically regarding survey effort and target threatened species issues) and has on a number of occasions indicated its high level of satisfaction regarding the survey effort. In addition to this, DEC indicated in its submission that:

the EA provides a comprehensive and detailed examination and comparison of the biodiversity of the area to be directly affected by the mine (the PDA) and of surrounding areas that have been proposed as offsets (POA).

**42 fragmentation of escarpment areas to the south and east of the disturbance area is an issue of importance for fauna connectivity, similar to that of Anvil Hill,**

The staged clearing that is part of the Project will ensure that no habitat fragmentation/isolation occurs before it is necessary for the operation of the proposed mine. The staged mine plan can be seen in Figure 9.1 of the Ecological Assessment (Volume 4, Appendix 9a of the Environmental Assessment). This Figure also shows the progressive rehabilitation that will occur as areas of the mine are closed. The staged clearing and progressive rehabilitation approach will assist in minimising the lag-time between revegetation and habitat provision in post-mining areas. This will also serve to reduce the duration of potential fragmentation of areas within the POA. The protection and enhancement of internal corridors (see Section 9.5.4.3) along Big Flat Creek and along Wallaby Rocks will assist in maintaining internal connectivity throughout the Study Area, and the protection, enhancement and establishment of an external corridor system will further assist in reducing impacts from fragmentation.

**43 the reason for selecting some species as key species, identification of those key species, and the basis for selection is not made clear.**

Section 3.6.1.1 of the Ecological Assessment (Volume 4, Appendix 9a of the Environmental Assessment) states:

Key threatened species were defined as those that are likely to, or may possibly, be significantly impacted by the Anvil Hill Project.

These species are clearly listed in Tables 3.8 and 3.9 of the Ecological Assessment. Further, Section 8.11 of the Ecological Assessment states:

key threatened species were considered to be central to the purpose and design of the biodiversity offsets package.

**44 [general issues with habitat scores]...no basis given for confidence in the application of the algorithm...**

The information used in developing habitat scores as part of the Condition Assessment was based on a similar approach developed for the Mt Owen assessments. The Mt Owen approach to species-specific habitat scoring was developed by two industry-recognised experts, and was a widely accepted and commended approach to assist with offsetting goals. Despite this, the Mt Owen approach was used as a guide only, as it was recognised that a number of inherent limitations restricted the outcomes to being indications of habitat value, rather than absolute indicators.

**45 Cannot properly rehabilitate full ecosystems/return full suite of flora or fauna species, or their habitat, can't get same habitat or species back**

It is accepted that rehabilitation projects are yet to demonstrate the return of full pre-disturbance ecosystem function and complete suites of pre-disturbance flora and fauna assemblages. The aim for the revegetation and regeneration proposed as part of the Project is to reinstate general community features, however to maintain the reinstatement of pre-mining vegetation communities as a target for the rehabilitation program. It is recognised that the composition of the revegetated areas will change over time, particularly as native and



naturalised species colonise rehabilitated areas. Part of the revegetation planned will involve detailed research into methods and efficacy, as well as detailed local research trials.

#### **46 Can't guarantee recolonisation once corridors established**

While the recolonisation of revegetated areas by native species cannot be guaranteed, the provision of suitable movement opportunities along vegetated corridors containing suitable habitat for resident and transient species is the best practice method of encouraging fauna species to recolonise post-mining areas.

#### **47 Tenure or way in which study area (including POA and rehabilitated PDA) will be protected/conserved in long term. No actual commitment to offset areas. Should be VCA or PVP. Includes lifespan of protection. This makes the long term benefits of the offset package are uncertain.**

A range of options are being considered for the final tenure/conservation mechanism for the areas involved in offsets. Centennial is committed to long term protection of the proposed Conservation Area and Habitat Enhancement Area, and proposes to finalise the mechanism to achieve this, in consultation with DoP, DEC and DPI. The aim for this consultation is to identify the most suitable tenure/conservation mechanism to achieve the long-term conservation of offsets (except for the area identified for sustainable agriculture outcomes) and corridors. Options for these mechanisms currently include (but are not limited to):

- Project Approval Conditions;
- Voluntary Planning Agreement;
- Voluntary Conservation Agreement;
- Property Vegetation Plans;
- Zoning of the Land – Environment Planning Instrument; and
- Covenants on the Land Title.

#### **48 None of the 'mitigation measures' will adequately compensate the loss of biodiversity/threatened species/habitat...impacts irreversible**

The mitigation measures proposed as part of the Project are recognised as best practice methods. These measures have been included to improve on the existing offsetting packages by providing substantial revegetation and regeneration of the PDA and POA, internal and external corridor options, as well numerous ecological management measures such as fencing, bushfire management, habitat augmentation, weed and feral animal management and considerable monitoring plans. These, and other impact mitigation measures have been discussed in Section 9 of the Ecological Assessment (Volume 4, Appendix 9a of the Environmental Assessment), and will be addressed in detail within the Ecological Management Plan.

#### **49 Rehabilitation/mitigation will not provide habitat for very long time, wont make up for short term losses. No benefit for very long time.**

The staged clearing that is part of the Project will ensure that no habitat isolation occurs before it is necessary for the operation of the proposed mine. The staged mine plan can be seen in Figure 9.1 of the Ecological Assessment (Volume 4, Appendix 9a of the Environmental Assessment). The staged clearing and progressive rehabilitation approach

will assist in minimising the lag-time between revegetation and habitat provision in post-mined areas. The protection and enhancement of internal corridors (see Section 9.5.4.3) along Big Flat Creek and along Wallaby Rocks will assist in maintaining internal connectivity in the vicinity of Anvil Hill. In addition to this, augmentation of existing habitat will occur once these areas are secured. This will greatly assist in the provision of key habitat features such as hollows. Similarly, external corridors will be established as soon as the Project is secured, in order to provide the ecological benefits of these areas as quickly as possible. Ongoing maintenance and management of these areas will assist in reducing the time taken for ecological benefits of these areas to be effective.

## **50 No net loss not supportable, nor will it make up for losses in short term**

The phrase '*no net loss of flora and fauna values in the area in the medium to long term*' was provided as part of the Director-General's Requirements from DoP. This has been adopted as the overall goal within the Ecological Assessment in order to comply with the Requirements.

The conclusion of '*no net loss of flora and fauna values in the area in the medium to long term*' (as required by DoP) can be reached in consideration of the expected positive result from the impact mitigation measures proposed.

A net increase in treed vegetation will be achieved by the implementation of the rehabilitation and offset strategies. These strategies will immediately protect 1037 hectares and result in a net increase of approximately 1286 hectares of treed vegetation in the medium to long term. The inclusion of additional lands available to the offsets strategies is currently being discussed with DoP and DEC.

## **51 POA vegetation vs PDA vegetation. Not same. More like nearby conservation reserves. Not Woodland for Woodland. More escarpment and ridges in POA, so no good for many species.**

The vegetation of the POA and PDA is readily grouped into two broad physiographically-based types: lowland vegetation, which occurs on the highly weathered, undulating Permian geology; and outcrop vegetation, which occurs on the exposed Narrabeen conglomerate outcrops and slopes.

The lowland vegetation that is present in the POA is similar to that which occurs in the PDA in that consistent vegetation communities occur between the two areas. Structurally and floristically the two areas differ somewhat as a result of land use history. A sizeable proportion of the lowland vegetation in the POA is either old growth or is structurally diverse, with a complex shrub layer. Conversely, most of the lowland vegetation in the PDA is structurally simple, and was cleared in the last 70 years, based on examination of old aerial photographs. Despite the structural and floristic differences, field surveys and the resulting analysis indicates that the lowland vegetation occurring across the two areas is similar.

The key ecological difference between the PDA and the POA is the presence of the conglomerate outcrop vegetation in the POA. The vegetation occurring in this physiographic landscape does not occur in the PDA, and is similar to outcrop vegetation occurring in nearby conservation reserves.

## **52 Opposition to translocation**

It is not expected (or proposed) that translocation will form a major part of the revegetation works. It is acknowledged that this is not a preferred conservation option for DEC. The only

potential use for such an option is the salvage of species such as *Cymbidium canaliculatum*, including the salvage and repositioning of entire tree branches supporting this species.

### 53 Difficulties in cultivating some species

It is agreed that many species are difficult to cultivate, and this may prove difficult for the revegetation of some species.

Centennial proposes to appoint suitably qualified and experienced person(s) for the duration of the Project to oversee the environmental performance of the Project, including ongoing rehabilitation research and trials to enhance performance.

### 54 It is absolutely essential that the proposed conservation offset areas be acquired and established prior to any disturbance of existing forest.

DEC has indicated that it requires offset areas to be formally secured by one year following approval. Centennial has acquired the majority of the POA and has no problem with committing to acquiring the remaining land within one year of project approval, and immediately managing such land for such purposes.

### 55 Offset Ratios:

- **<1:1...government guidelines are of the order of 3:1 and upwards to 10:1 or higher**
- **refers to criticised Green Offsets for Sustainable Development...more appropriate principles in Offsets, Salinity and Native Vegetation (DLWC July 2001).**
- **Ratio of POA:PDA = 0.68 - not in accordance with DEC policy**
- **appropriate to specify offset criteria, since not according to DEC policy**

**...previous assessments by the CMA to maintain or improve biodiversity...have indicated offset ratios of at least 5:1 and up to 50:1 are required.**

The DoP Director-General's Requirements for the EA state that a comprehensive offset strategy must be included as part of the mitigation measures for the project to ensure that there is **no net loss of flora and fauna values in the area in the medium to long term.**

A key objective of the offsets is to adequately protect threatened species and their habitats. Surveys of an appropriate level were conducted to ensure that the habitat of the Proposed Offset Areas were appropriate for the target threatened flora, fauna, endangered populations and EECs.

A net increase in treed vegetation will be achieved by the implementation of the rehabilitation and offset strategies. As shown in **Table 2.2**, these strategies will immediately protect 1037 hectares and result in a net increase of approximately 1286 hectares of treed vegetation in the medium to long term.

**Table 2.2 – Offset Areas**

	Area Disturbed by the Project (Ha)	Area of Existing Vegetation Immediately Protected (Ha)	Area of Vegetation to be Established (Ha)	Total Area of Vegetation at end of Project (Ha)	Net Change in Treed Vegetation Area (Ha)
Proposed Disturbance Area	1304	0	2074	2074	+770
Conservation Areas	0	869	178	1047	+178
Habitat Enhancement Areas	0	165	293	458	+293
Sustainable Agriculture Areas	0	3	45	48	+45
<b>Total</b>	<b>1304</b>	<b>1037</b>	<b>2590</b>	<b>3627</b>	<b>+1286</b>

## **56 Justification of reduction in grassland – what about threatened species habitat**

Disturbed Grassland is a widespread unnatural vegetation community that occurs as a result of extensive modification of the natural woodland and open forest environments in the general locality. Despite this, it still has some conservation value for native flora and fauna. Rare or threatened plants such as tricolour donkey orchid (*Diuris tricolor*), lobed blue grass (*Bothriochloa biloba*) and narrow goodenia (*Goodenia macbarronii*) can still be present where suitable conditions exist. Threatened fauna species such as the hooded robin (*Melanodryas cucullata cucullata*) and turquoise parrot (*Neophema pulchella*) use grassland areas fringing woodland habitat for foraging. Despite this, the vegetation community is not, in itself, of conservation significance.

The reduction of Grassland areas through revegetation in the post-mined landscape is planned to provide increased woodland fauna habitat, while still retaining small pockets of grassland throughout the landscape. The proposed reduction of grassland will be coupled with a net increase in the woodland and riparian communities, where suitable habitat exists. Such an increase in woodland vegetation will benefit many threatened species identified within the Study Area, particularly small woodland birds and bat species.

## **57 Rehabilitation also must focus on grass and understorey and herb species**

Grasses, understorey and herb species will be represented within the revegetation to be carried out within the Study Area.

## **58 Local provenance species must be used**

The intent to use species of local provenance is identified in Section 9.5.3.2 of the Ecological Assessment (Volume 4, Appendix 9a of the Environmental Assessment). Only in exceptional circumstances (for example, extreme seasonal conditions, or if scientific trials dictate the need) would species from a wider provenance range be used. Part of the conceptual rehabilitation plan to be refined within the Ecological Management Plan will involve an extensive seed collection and propagation program to cultivate revegetation stock from sources within the Study Area.

**59 Where species not recorded from offsets, should offset additional areas known to contain them.**

A small number of species were recorded only from the PDA and not in the POA. These comprised narrow goodenia (*Goodenia macbarronii*), turquoise parrot (*Neophema pulchella*) and greater broad-nosed bat (*Scoteanax rueppellii*). The two fauna species have adequate habitat present within the POA – that is, hollows for roosting/breeding (including hollow fence-posts and branch hollows for the turquoise parrot) and foraging habitat in the form of open grassy vegetation for the turquoise parrot and general woodland habitat for the micro-bat. There are substantial areas of potential habitat for narrow goodenia in the POA.

**60 Amount of vegetation to be cleared is larger than that which will be protected by 435 ha**

A net increase in treed vegetation will be achieved by the implementation of the rehabilitation and offset strategies. These strategies will immediately protect 1037 hectares and result in a net increase of approximately 1286 hectares of treed vegetation over the life of the mine. The inclusion of additional lands to add to offset strategy is currently being discussed with DoP and DEC.

**61 Detail required on habitat enhancement**

The proposed habitat enhancement strategy is identified in Section 9.5.6 of the Ecological Assessment (Volume 4, Appendix 9a of the Environmental Assessment) and includes the installation of nest boxes, hollow salvage and the replacement of specific habitat features such as fallen timber and hollow logs. The intent of this strategy is documented in this section, however specific detail regarding quantification and locations for this augmentation will be provided within the Ecological Management Plan.

**62 Corridor strategy...not detailed...no indication of basis on which such corridor strategy has been or would be developed.**

Section 9.5.4 of the Ecological Assessment (Volume 4, Appendix 9a of the Environmental Assessment) contains a detailed description of the Conceptual Corridor Strategy. This section identifies existing corridors in the Study Area, details the design criteria used as part of the corridor options for the Project, details the benefits and challenges of eight corridor options for the Study Area, and provides a commitment to a number of options for the corridor strategy.

The purpose of the proposed corridors (both internal and external) is to provide:

- egress in face of advancing mine;
- connectivity throughout retained habitat;
- access for re-colonisation in post-mining landscape;
- additional areas of revegetation and remnant protection to add to overall Biodiversity Offset Strategy;
- further opportunity to conserve significant ecological features, for example Weeping Myall EEC to be conserved within corridor; and
- specific habitat types and features to allow fauna movement and habitation.

Conceptual corridor options were designed to:

- Be as wide as possible to maximise functioning, including a protected core area and buffer areas;
- Make use of existing vegetation to minimise requirements for revegetation, wherever possible;
- Be structurally and floristically diverse;
- Be planted with appropriate species of local provenance;
- Contain nesting/roosting habitat for target threatened species;
- Link existing vegetation fragments to provide a consolidated vegetated area;
- Link areas that have similar habitat;
- Have a minimal edge: area ratio, thus reducing impacts from 'edge effects';
- Contain minimal gaps, bottlenecks and barriers (such as roads);
- Be regularly managed and monitored; and
- Be appropriately secured.

**63 Consultant biased/not independent assessment/survey...More threatened species would be identified if consultant was independent, different assessment if independent**

It was recognised in a number of presentations to the IHAP panel that the Project team for the Environmental Assessment and Ecological Assessment possessed high levels of experience and local expertise. In particular, it was recognised that the lead ecologist and senior fauna ecologist, who were responsible for the majority of the field survey, were highly qualified professionals with considerable amounts of industry expertise.

There have been no concerns raised by the numerous authorities involved in the review of the Project regarding the expertise, qualifications or objectivity of the Umwelt Project team. All feedback from DEC, DoP and DEH regarding the ecological survey has indicated that the ecological survey has been extensive and rigorous.

**64 Needs independent review by DEH/EA, academics**

The Environmental Assessment (including the Ecological Assessment) has been subject to adequacy reviews, and more recent thorough reviews by DEC, DoP and DPI. The reports have also been reviewed by a number of other authorities, including the Hunter-Central Rivers CMA. In addition to this, the reports will be subject to a thorough review by DEH as part of the Referral process. Umwelt has consulted with DEH regarding various aspects of the Project on two occasions (in person) and DEH has indicated that it is satisfied with the substantial survey effort completed for the Ecological Assessment. DEC has also been consulted extensively as part of the Project and has indicated its high level of satisfaction with the survey effort.

The EA exhibition and IHAP process have provided further review and independent assessment of the ecological assessment.



## 65 Needs independent annual monitoring

As detailed in Section 10 of the Ecological Assessment, a detailed monitoring program is proposed as part of the Project. This monitoring program will focus on a number of features, including retained vegetation, regeneration and revegetation areas, fauna monitoring, nest box monitoring and target threatened species monitoring throughout the Study Area. The CSIRO developed Landscape Function Analysis will also be used as part of the monitoring program to evaluate the recovery of soil biophysical processes in rehabilitated areas in comparison to benchmark sites. The expected frequencies of these monitoring events will generally be annual, however the monitoring of revegetation is likely to occur more frequently in the initial establishment period. All monitoring methods and results will be subject to independent review by government agencies.

## 66 Ecological management plan (including rehab, pest & weed management, monitoring, fauna management, augmentation, bushfire) needs to be part of application. Needs review to include best practice.

As identified in Section 9 of the Ecological Assessment (Volume 4, Appendix 9a of the Environmental Assessment):

An Ecological Management Plan will be prepared (as part of the site Environmental Management Strategy or System) in order to provide further detail and information regarding the ongoing management and conservation of ecological features (particularly key threatened species) during the construction phase of the mine, the ongoing operation, and the post-mining landscape.

Specifically, this plan will include details on:

- Pre-clearing surveys (relevant to the PDA);
- Tree felling procedure (relevant to the PDA);
- Revegetation and regeneration (relevant to the POA and corridors);
- Habitat augmentation (relevant to the POA and corridors);
- Fencing/access (relevant to all areas);
- Rehabilitation (relevant to the PDA);
- Weed management (relevant to all areas);
- Feral fauna management (relevant to all areas);
- Bushfire management (relevant to all areas); and
- Monitoring program (including remnant; rehabilitation/revegetation/regeneration; fauna; threatened species; aquatic; and Landscape Function Analysis for all areas).

## 67 Did not use s5A or DEC Guidelines for impact assessment – Tests of Significance not appropriate.

The ‘Test for Ecological Significance’, used in the EA, was prepared at the request of DoP to provide an appropriate impact assessment structure in lieu of the standard Eight or Seven

Part Test normally used under Section 5A assessment. The new Part 3A process does not require the application of the Section 5A Seven Part Test. The Test for Ecological Significance was reviewed and approved for use by DoP. The DEC Guidelines are not the required impact assessment method for Part 3A projects, however, it should be noted that DEC has stated that it is satisfied with the survey methodology and impact assessment.

**68 Aims of monitoring in EIS not achievable, EFA not appropriate**

The Landscape Function Analysis (LFA), which is part of the broader Ecosystem Function Analysis (EFA), discussed in Section 10 of the Ecological Assessment (Volume 4, Appendix 9a of the Environmental Assessment) is not proposed to be the sole monitoring method. On examination of Section 10, it is clear that the LFA proposed is one component of a detailed Ecological Monitoring Plan to be implemented as part of the Project. Other components involve the monitoring of retained vegetation, revegetation and regeneration areas, fauna monitoring (including nest box monitoring), target threatened species monitoring, aquatic monitoring.

The LFA procedure uses rapidly acquired field assessed indicators to assess the biogeochemical functioning of landscapes, and is particularly useful in determining the landscape functioning of rehabilitated areas. The use of this procedure is becoming more common on the mines of the Hunter Valley and elsewhere, and complements other standard flora and fauna monitoring procedures.

**69 Completion criteria should be rephrased to require that the revegetated site has an equal diversity and density of flora species to that existing pre-mining. Completion criteria are vague and unenforceable.**

The completion criteria provided in Section 10.2 of the Ecological Assessment are conceptual only (as stated), and will be refined and detailed in consultation with DoP, DPI and DEC.

**70 Offset area already likely to be at carrying capacity. So no increased benefit.**

Within the POA there is ample opportunity to augment the existing habitat in order to increase the carrying capacity of the habitat for particular threatened species. This includes, for example, the installation of nest boxes in the POA to increase its capacity to cater for hollow-dependent species such as micro-bats, the glossy black-cockatoo and the squirrel glider. Other examples may include the supplementary planting of specific feed tree species such as drooping sheoak (*Allocasuarina verticillata*) for the glossy black-cockatoo, or *Acacia* species for the squirrel glider. Such augmentation would aim to increase the availability of key limiting features such as breeding and foraging habitat. Habitat augmentation will provide increased habitat resources in the POA in the short term.

In addition to the augmentation of existing habitat within the POA to improve its ability to offset the PDA, the planned revegetation and regeneration within the POA will serve to increase habitat availability over time. This revegetation and regeneration will focus on woodland habitat, while retaining important areas of fringing grassland. Revegetation and regeneration within the POA will provide increased habitat resources in the POA in the medium to long term.

**71 Nest boxes – would need lots and varied designs. Regular monitoring. Not equal to retention of hollows in the first place. Maintain for longer than life of mine.**

Nest boxes will need to be varied in design and be sufficient in numbers to enable the POA habitat to adequately compensate for the loss of hollow-bearing trees within the PDA. Details



on the number, location and recommended design of nest boxes, as well as monitoring frequencies, will be provided within the Ecology Management Plan. Additional information on the planned use of nest boxes within the Study Area is provided in Section 9.5.6.1 of the Ecological Assessment (Volume 4, Appendix 9a of the Environmental Assessment).

**72 Use of ‘value’ in relation to ‘no net loss’. Use of wording not appropriate.**

The phrase *‘no net loss of flora and fauna values in the area in the medium to long term’* was provided as part of the Director-General’s Requirements from the DoP. In accordance with DoP requirements, this goal was adopted in order to assess the likely impacts of the Project on threatened species, populations, ecological communities and vegetation in the medium and long-term.

**73 The species profiles used as a basis for the test are brief and worded in such a way as to minimise the importance of particular habitat requirements for individual species.**

The species profiles provided within the Ecological Assessment were completed as instructed by DEC, that is:

- Make use of the extensive information provided on the DEC Threatened Species Website (<http://www.threatenedspecies.environment.nsw.gov.au>);
- Adjust these profiles as necessary to reflect site-specific issues; and
- Provide key information relating to the habitat requirements of the species in question.

The profiles were not required (or intended) to provide extensive detail for each species.

**74 No use of Population Viability Analysis (PVA) in assessment of significance, therefore conclusions are invalid.**

The use of PVA was not a requirement of the Assessment of Significance that was used (and approved by DoP) for the impact assessment. The Ecological Assessment provides detailed information regarding the results of the survey, the extent of habitat for threatened species, endangered populations and EECs within the Study Area, and discusses the potential impacts of the Project on these important ecological features in detail. No government agencies required PVA to be undertaken for any threatened species, populations or ecological communities.

**75 ...the EPBC Act is referred to as the Environment Planning and Biodiversity Conservation Act 1999...The author appears to be unfamiliar with that Act, and the EIS has not been reviewed by a senior officer within the Umwelt organisation.**

The typographical error referred to is a single occurrence within the Environmental Assessment. The claim regarding unfamiliarity with the Act is clearly unfounded when referring to Section 8.10 (Volume 4, Appendix 9a of the Environmental Assessment) and Appendix G of the Ecological Assessment (Volume 5, Appendix 9b of the Environmental Assessment). These sections contain a thorough treatment of the requirements of this Act. A detailed Preliminary Referral is being prepared to provide to the Minister for the Environment (as foreshadowed in the Ecological Assessment) in order to satisfy the requirements of this legislation. DEH has been heavily involved throughout the consultation completed as part of this Project, including site visits.

The Ecological Assessment was subject to complete review by senior Umwelt staff, and advice from numerous organisations and agencies (such as DEC and DoP) which supports that it is a high quality and comprehensive report.

**76 Existing caves and overhangs were not inspected and no information is available on species/habitat present.**

Section 3.5.1.2 of the Ecological Assessment (Volume 4, Appendix 9a of the Environmental Assessment) details:

Targeted habitat searches were undertaken throughout the survey, focusing on threatened fauna species occurring within specific habitat types. Such surveys included target searches of rocky outcrops and cliff lines for fauna groups such as rock wallabies, reptiles and microbat colonies. Where it was considered safe to do so, overhangs and caves were searched for signs of presence such as tracks, scats, pellets, nests and hair. In many cases, caves or overhangs could not be reached safely and were not inspected. All caves, cliffs, rocky outcrops and overhangs occur within the Proposed Offset Areas, therefore most searches targeted this area.

A number of types of scat were found in caves and overhangs, including those later identified as brush-tailed rock wallaby scats. Inspections of caves also led to the discovery of a large number of owl pellets and debris that were later attributed to the masked owl.

Section 6.2.3.1 of the Ecological Assessment (Volume 4, Appendix 9a of the Environmental Assessment) is an example of habitat descriptions of these areas, which states:

The escarpment habitat areas within the Proposed Offset Areas provide specialist habitat for cave, overhang, crack and escarpment specialist species. Such fauna include cave roosting owls, cave/overhang/crack roosting bats, overhang nesting birds of prey and escarpment specialist macropod species such as rock wallabies. The escarpment habitat areas also provide habitat for reptile species requiring rocky habitat such as some broad-tailed gecko species.

Therefore, as documented in the EA, caves and overhangs were inspected across the Study Area, and a range of information was obtained regarding the species and habitats present.

**77 Licensed wildlife carers expect the volume of orphaned, injured and displaced native fauna to increase dramatically**

Centennial has proposed detailed measures to limit the potential to orphan or injure native fauna, including pre-clearance surveys, establishment of movement corridors and habitat enhancement. Any orphaned fauna will be managed in accordance with the EMP.

**78 Issue of regional scale connectivity of native vegetation needs to be undertaken, with a view to updating the DMR Synoptic Plan for this site.**

Section 9.5.4 of the Ecological Assessment (Volume 4, Appendix 9a of the Environmental Assessment) provides a detailed account of the Conceptual Corridor Strategy proposed as part of this Project. This section contains a discussion on existing corridors, the design criteria used in the development of the conceptual corridor strategy, and discusses the relative merits and challenges of eight conceptual corridor options. These options involve both internal and external options of varying width, in order to ensure that medium and long-term connectivity is restored and enhanced. This section then goes on to identify the preferred options for the corridor strategy, namely connectivity via external options to/from the north and west, as well as internal connectivity via two options. A commitment was made to this concept as part of the Environmental Assessment, and will serve to maintain and

enhance the corridor function of the Study Area. Discussions with DEC are under way to determine which corridors will be established.

**79 Should be scientific studies of effects of night lighting on species affected, including literature review.**

The potential impacts of increased night lighting on flora and fauna species were considered as part of the impact assessment. It is unlikely that this issue will cause a significant impact on threatened species, endangered populations or EECs.

Monitoring of a number of operational mine sites in the Hunter Valley has shown numerous examples of threatened flora and fauna species persisting in remnant vegetation on these sites, including adjacent to areas of high disturbance or activity.

**80 A true and accurate size and description of the area set for conservation offsets have not been made within the EIS by the consultant...**

The Ecological Assessment (Volume 4, Appendix 9a of the Environmental Assessment) includes a considerable amount of information regarding the POA, including (but not limited to):

- Section 4.2.1 – vegetation communities;
- Section 4.3 – management history;
- Section 4.4 – threatened flora records;
- Section 5.1 – fauna species;
- Section 5.2 – threatened fauna species;
- Section 6.1 – vegetation formations;
- Section 6.2 – fauna habitat values; and
- Section 7 – aquatic habitat.

Apart from these details regarding the ecological features of the POA, Section 9.5.2 provides a detailed discussion on the ecological significance of the POA.

**81 Animals, insects, flora cannot be moved about as proposed by the EA and survive. This has been attempted before with very limited success...**

It is not expected (or proposed) that translocation will form a major part of the revegetation works. It is acknowledged that this is not a preferred conservation option for DEC. The only potential use for such an option is the salvage of species such as *Cymbidium canaliculatum*, including the salvage and repositioning of entire tree branches or tree trunks supporting this species.

**82 Blackjack Mountain Landcare group will see all its hard work destroyed...**

The location of the works completed by the Blackjack Mountain Landcare Group (now disbanded) is mostly outside of the Study Area for the Project. Most of the area revegetated by this group is in the vicinity of Corridor Option 5, and any works that may be completed in the future as part of this corridor option will be as part of the WULMS strategy. A small

amount of work was also completed in part of the POA, in what will constitute Corridor Option 3. Any work undertaken by WULMS or within the POA will serve to supplement and protect the existing revegetation work done by this Landcare Group.

**83 Capacity of the offset site to accept additional fauna populations has not been adequately considered**

Within the POA there is ample opportunity to augment the existing habitat in order to increase the carrying capacity of the habitat for particular threatened species. This includes, for example, the installation of nest boxes in the POA to increase its capacity to cater for hollow-dependent species such as micro-bats, the glossy black-cockatoo and the squirrel glider. Other examples may include the supplementary planting of specific feed tree species such as drooping sheoak (*Allocasuarina verticillata*) for the glossy black-cockatoo, or *Acacia* species for the squirrel glider. Such augmentation would aim to increase the availability of key limiting features such as breeding and foraging habitat. Habitat augmentation will provide increased habitat resources in the POA in the short term.

In addition to the augmentation of existing habitat within the POA to improve its ability to offset the PDA, the planned revegetation and regeneration within the POA will serve to increase habitat availability over time. This revegetation and regeneration will focus on woodland habitat, while retaining important areas of fringing grassland. Revegetation and regeneration within the POA will provide increased habitat resources in the POA in the medium to long term.

**84 Controlled fencing and regular kangaroo culling should form part of the proponent's management plan and a condition of project consent**

Fencing and management of feral/pest animals will be addressed within the Ecological Management Plan, as indicated within Sections 9.4.2.1 and 9.4.2.3 of the Ecological Assessment (Volume 4, Appendix 9a of the Environmental Assessment).

**85 Edge effects of offset areas is not considered**

The implementation of a number of actions within the Ecological Management Plan will assist in minimising potential edge effects on the POA. Such actions will include weed management, bushfire management and fencing to control stock access, as well as revegetation/regeneration of target areas, and habitat augmentation. In fragmented environments it is proposed to reduce edge effects through revegetation or regeneration of woodland, although this will be balanced with the retention of derived grassland to allow the continued provision of habitat for grassland or edge-specialist threatened plants and birds. The ongoing monitoring and management of these areas will ensure the ecological integrity of these areas are protected and enhanced over time.

**86 Fate of less mobile species unable to make transition to the offset area has not been considered**

The staged clearing and retention of internal movement corridors within/adjacent to the PDA will allow for the egress of fauna species in the face of the advancing mine. A detailed pre-clearance survey requirement and tree-felling procedure (to be detailed within the Ecological Management Plan) will ensure as minimal impact on fauna species as possible.

**87 Increase of kangaroos and vermin on neighbouring properties**

The management of feral/pest animals will be addressed within the Ecological Management Plan, as indicated within Section 9.4.2.3 of the Ecological Assessment (Volume 4, Appendix 9a of the Environmental Assessment).

**88 Loss of fishing in local creeks**

The detailed aquatic assessment completed as part of the Ecological Assessment (Volume 4, Appendix 9a of the Environmental Assessment) has described the existing aquatic habitat and species located within the PDA and POA. It is not believed that the removal of Anvil Creek and Clark's Gully will result in the loss of significant fish habitat, or recreational fishing opportunities within the local area.

**89 Maintenance of nest boxes should occur for 120-240 years**

Nest boxes will be varied in design and be sufficient in numbers to enable the POA habitat to adequately compensate for the loss of hollow-bearing trees within the PDA. Details on the number, location and recommended design of nest boxes will be provided within the Ecology Management Plan. Additional information on the planned use of nest boxes within the Study Area is provided in Section 9.5.6.1 of the Ecological Assessment (Volume 4, Appendix 9a of the Environmental Assessment).

Ongoing management and maintenance of the POA will be detailed within the Ecological Management Plan, and will be tied in with the long-term tenure of the POA.

**90 No consideration for loss of pollinators to flora survival**

The protection of the POA will ensure the retention of habitat for pollinating species (such as nectarivorous birds, insects and bats) within the Study Area. The overall net increase in treed vegetation that will be achieved by the rehabilitation and offset strategies will benefit these species in the medium to long term.

**91 It is not stated whether the land will be protected indefinitely once the proponent has completed mining there**

The Ecological Management Plan, discussed in the EA, will detail the actions necessary to ensure the future viability and improvement of the biological diversity within offset areas, including corridors. The EMP will also address the objectives, desired outcomes and performance measures against which the biodiversity of the offset areas, and corridors, will be measured.

It is agreed that the future tenure of offset and corridor areas must be secured to enable the conservation of biodiversity values in those areas. Negotiations with DEC, DoP and DPI will continue to ensure that an appropriate outcome is achieved.

**92 Planned post mining revegetation does not replace the essential food source grasslands**

Despite being the result of previous clearing, the derived grassland within the Study Area still has some conservation value for native flora and fauna. Rare or threatened plants such as tricolour donkey orchid (*Diuris tricolor*), lobed blue grass (*Bothriochloa biloba*) and narrow goodenia (*Goodenia macbarronii*) can still be present where suitable conditions exist. Threatened fauna species such as the hooded robin (*Melanodryas cucullata cucullata*) and



turquoise parrot (*Neophema pulchella*) use grassland areas fringing woodland habitat for foraging. Despite this, the vegetation community is not, in itself, of conservation significance.

The reduction of Grassland areas through revegetation in the post-mined landscape is planned to provide increased woodland fauna habitat, while still retaining small pockets of grassland throughout the landscape. The proposed reduction of grassland will be coupled with a net increase in the woodland and riparian communities, where suitable habitat exists. Such an increase in woodland vegetation will benefit many threatened species identified within the Study Area, particularly small woodland birds and bat species.

The Revegetation Strategy provided in Figure 9.4 of the Ecological Assessment (Volume 4, Appendix 9a of the Environmental Assessment) is conceptual only, and will be revised prior to submission for final approval of the EMP.

**93 The consultant lists four key threatening processes but should also consider: predation by feral cats, loss and/or degradation of hilltopping sites for butterflies, competition and grazing by feral European rabbit, and human induced climate change**

Each of these Key Threatening Processes has been addressed within Appendix F of the Ecological Assessment (Volume 4, Appendix 9a of the Environmental Assessment).

**94 The impact of barbed wire fencing on fauna was not considered**

Section 9.4.2.1 of the Ecological Assessment Assessment (Volume 4, Appendix 9a of the Environmental Assessment) states:

The type of fencing used will consider the need for facilitation of fauna movement.

The location and type of proposed fencing will be detailed within the Ecological Management Plan, and the design of fencing will be included at this time. Fencing materials used will be designed to provide minimal impact on fauna species and to allow faunal movement through the Study Area.

**95 Increase of kangaroos and vermin on neighbouring properties**

As part of Centennial's Ecological Management Plan, a feral animal control programme will be developed and implemented. This programme will target feral animals found on Centennial controlled land and also encourage the involvement of neighbouring land owners to achieve a more regionally effective outcome.

Preliminary discussions have already been held with the Rural Lands Protection Board in relation to a co-ordinated programme involving Centennial and the Board. This co-ordinated approach was well received by the Board and they are keen to see the relationship develop.

Centennial has already undertaken a fox baiting programme on land that it owns. The aim of this programme was to reduce the level of predation on native wildlife on Centennial owned land and domestic livestock on neighbours land.

Centennial is aware of the additional grazing pressure that kangaroos place on agricultural land and the damage they can cause to fencing and vehicle traffic on public roads. As a result of this, kangaroo numbers will be closely monitored and culling will take place as required. Any culling undertaken will be in accordance with DEC / NPWS regulations.

## 3.0 Noise and Vibration

### 3.1 Government Agency Submissions

#### 3.1.1 Department of Environment and Conservation

##### 3.1.1.1 Issues Raised

DEC's submission indicated satisfaction with the methodology and assessment approach, and that the EA included an accurate assessment of noise and vibration impacts. In particular, DEC:

- '...is satisfied, based on a "desk-top" assessment, that all noise sensitive receiver locations have been identified and included within the noise modelling process in the determination of noise and vibration impacts.'
- 'agrees with the determined background noise levels for the Project area.'
- 'concurs with the presented PSNLs for the project.' Note that PSNLs refers to Project Specific Noise Levels.
- 'agrees that the operational noise criteria should be applied to control construction noise on the project site.'
- accepts the method of meteorological assessment.
- 'is satisfied that there are no additional feasible and reasonable actions the proponent could implement to mitigate the noise impacts, except for stopping all night-time activities, which DEC understands is not economically feasible.'
- agree that:
  - Significantly Affected residents are defined as residents located within noise impacted areas predicted to be greater than 5dB(A) above the Project Specific Noise Level (PSNL), in this case greater than 40dB(A)); and
  - Moderately Affected residents (defined as residents located within noise impacted areas predicted to be between 3-5dB(A) above the PSNL, in this case 38-40dB(A)).

However, DEC expressed considerable concern regarding the extent of noise and vibration impacts predicted in the EA. DEC re-iterated the impact assessment outlined in the EA, that being Significantly Affected noise impacts were predicted at 82 privately owned residences, and a further 73 privately owned residences would be Marginally Affected to Moderately Affected.

DEC acknowledged that Centennial is progressing discussions with noise affected private landholders to seek agreement in relation to purchase, and indicated that as at 8 August 2006, 11 significantly affected and two moderately to marginally affected private residences were subject to an agreement with Centennial. They state that twenty three residences (this does not include properties that are subject to an agreement with Centennial) are also predicted to be subject to excessive blasting impacts in addition to significant noise disturbance.

On this basis, DEC recommends that project approval should include a requirement for Centennial to reach negotiated agreements with all Significantly Affected residents. It is also recommended that project approval include an option for Moderately Affected residents to seek a negotiated agreement, if noise levels prove to be excessive.

### 3.1.1.2 Response to DEC Issues

Centennial recognise the need to reach agreement with those private landholders Significantly Affected by noise and vibration impacts for the Project to progress throughout the mine life, as proposed in the EA. For this reason, Centennial has been proactively seeking to purchase or reach agreement for purchase or compensation, in relation to such Significantly Affected private properties.

Since lodgement of the EA, Centennial has made considerable progress with purchase or reaching agreement in respect of an additional 32 Significantly Affected private residents. A summary of the current numbers of noise affected private residences and vacant properties is provided in **Table 3.1**.

**Table 3.1 - Number of Affected Private Residences and Vacant Land that are not subject to Agreement (as at 14/11/06)**

Stage of Operation	Number of Private Residences not subject to Agreement			Number of Vacant Private Properties Significantly Affected > 40 dBA (All Periods) - Not subject to Agreement
	Marginally Affected 36-37 dBA	Moderately Affected 38-40 dBA	Significantly Affected >40 dBA	
	All Periods	All Periods	All Periods	
Year 2	21	30	34	9
Year 5	25	24	43	10
Year 10	36	29	49	12
Year 15	32	16	32	9
Year 20	19	12	19	7
<b>All Years &amp; Periods</b>	<b>35</b>	<b>34</b>	<b>50</b>	<b>13</b>

Centennial is committed to purchasing or reaching agreement with as many of these private landholders as possible prior to commencement of the project. Currently, Centennial has verbal agreement with a number of further private residents and vacant landowners and are seeking to formalise these agreements in the near future. A further four private residents are located within the Mining Lease Application Area and Centennial are in continuing negotiation with these property owners.

It is expected that the number of affected private properties will continue to decrease prior to the Minister's determination of the project application, as Centennial continues to purchase and reach agreement in relation to landholdings within the proposed mining area and surrounding significantly affected land.

It is important to note that the total number of significantly affected private residences changes as the mine develops, with the maximum number of significantly affected private properties not expected to occur until Year 10 of the Project. During the early stages of the Project, the number of significantly affected properties is 34 in Year 2, 43 in Year 5 and 49 in Year 10.

On this basis, it is considered inappropriate and impractical for a project approval condition to include a requirement that Centennial reach agreement with all Significantly Affected residents prior to commencement of the project. There may be private residents that are predicted to be affected later in the project life, that do not wish to either sell or reach agreement at this time, and in many cases, some ten years prior to such affects occurring. Similarly, there may be other private residents that simply choose to remain at their property, and accept the level of noise impact that is predicted to occur at their property. The previously used common term of 'Compulsory Acquisition' provides an incorrect impression of property rights – Centennial have no ability to force people to sell their properties, such properties cannot be purchased unless the landholder wishes to sell. For this reason, previous development consents for major mining projects have dealt with the balancing of management of social, environmental and economic impacts by ensuring that the consent conditions provide adequate protection of the rights of such significantly affected property owners by imposing a requirement on the proponent to purchase or reach agreement with such identified properties, **at the request of the private landholder**.

On this basis, Centennial plans to continue to seek to purchase or reach agreement with as many Significantly Affected landholders as possible, prior to project determination and any subsequent commencement of the project, but there may be some of these properties that will remain privately owned on commencement of the project. It is suggested that a similar project approval condition as has been adopted by the Department of Planning for many major mining projects would be appropriate in relation to any remaining Significantly Affected private properties remaining following project approval. It is expected that such a condition would provide these landholders with certainty regarding the process of following project approval, including the following:

- For properties with environmental impacts beyond relevant acquisition consent limits, the following to be undertaken at the request of the land owner:
  - provision of property valuations and reimbursement of landholders should they wish to obtain an independent valuation;
  - reimbursement of all reasonable land owner legal and valuation expenses incurred during the negotiation process;
  - provision of the opportunity for significantly affected property owners to enter into agreements, to provide for continued ownership of their properties and certainty of the terms of acquisition, if they choose to relocate at some time in the future; and
  - reimbursement of relocation costs within the LGA or adjoining LGAs.

Alternatively, reasonable compensation may be provided as negotiated with land owners, as appropriate.

All reasonable attempts will be required for Centennial to reach an amicable agreement with affected land owners regarding compensation and/or acquisition. Should negotiations fail to reach agreement, Centennial will readily participate in any mediation processes as deemed necessary by DoP.

It is also suggested that the project approval could offer similar protection for Moderately Affected residents in that if the noise generated by the development exceeds the relevant significant affectation criteria, Centennial would be required, upon receiving a written request for acquisition from the landowner, to acquire the land in accordance with the relevant land acquisition procedures set out in any project approval.

## Blast Impacts on Cultural Heritage Sites

DEC also notes that the range of 'Estimated Significant Damage Thresholds' varies from 90 mm/s at Anvil Rock to 210-270 mm/s at many of the remaining rock shelters and, that in Year 15 of operations, vibration levels are predicted to exceed significant damage thresholds for four rock structures including the landmark Anvil Rock and The Book.

DEC considers that there would need to be a significant adjustment to the proposed blast criterion, or the work area modified to provide an appropriate buffer distance, to prevent damage to rock structures. A project approval should be subject to Centennial committing to meet such requirements.

Some discussion on potential blast vibration damage to rock shelters and rock formations took place during presentations to the IHAP. This issue was also raised in DEC's submission on the EA. Further clarification is provided below.

Table 8.3 in Appendix 12 "Noise & Vibration Assessment" indicates that in the latter half of the Project life some higher vibration levels (expressed as Peak Particle Velocities in mm/sec) are predicted to be experienced at some rock shelters and rock formations.

The main underlying causes of this trend are:

- the location of those items with respect to the planned mining sequence
- the trend towards thicker overburden being present in the latter years.

The culturally significant rock shelters are present on Wallaby Rocks and Limb of Addy Hill, all of which are adjacent to the area planned to be mined in the latter years of the mine life. The cultural heritage assessment acknowledged that there would be some potential impact on the rock shelters on Anvil Hill, which are of lower significance. Specific mitigation measures were proposed in Section 6.1.4 of Appendix 9, to mitigate impacts on these shelters.

Blast vibration levels diminish rapidly with increasing distance. As an example, with a total Maximum Instantaneous Charge of 2500 kg a PPV of 145 mm/sec at 180 metres could be expected to reduce to approximately 80 mm/sec at 250 metres distance

As with most open cut coal mines, the mine plan tends to commence where the coal resource is shallower and advance towards deeper areas. This is the most efficient and economic approach to mining gently dipping deposits such as at Anvil Hill.

As the coal seams deepen, so the thickness of overburden to be removed increases. For the purposes of calculating blasting vibration, it has been assumed that the blasthole's length equates to the full depth of overburden to the top of the coal-bearing strata and that the full column of explosive in each blasthole is detonated instantaneously. However, it has been assumed that each blast-hole will be detonated separately and in a delayed sequence to reduce peak vibration.

The quantity of explosive detonated at any time is termed the Maximum Instantaneous Charge (MIC). At the depths encountered as the mine gets deeper, the blasting design assumptions have resulted in quite high MICs (for instance in any given blasthole up to 3500 kg). Although this is not unusual for open cut mining, there is scope to reduce this, for



example by decking charges (that is, detonating sections of a blasthole delayed in time) or reducing blasthole diameter. Such practices are well proven.

As an example a PPV of 160 mm/sec at a distance of 200 metres could be reduced to approximately 88 mm/sec by halving the MIC (which can be practically achieved by using currently available decking practices to detonate each blasthole in 2 sections).

Other factors influence blast vibration including:

- whether the area to be blasted is very constrained versus having a “free face” to fire towards (free faces will be established as each pit area is commenced and will be well established when the mine is in proximity to the items listed in Table 8.3 of the Noise and Blast Assessment)
- direction of wavefront and relationship of timing of blasthole detonation in an over all blast pattern. With improvements to technology, such as electronic detonation giving much higher accuracy and control of blasting, techniques to control the wavefront and peak vibration are becoming more achievable in practice.

In keeping with the above, Centennial’s approach to ensuring Criterion PPV values are met at significant rock shelters and formations is to:

- Have a well-established record of blast planning and outcomes from the commencement of mine life, so that local transmissivity factors and performance are well understood and able to be confidently used in blast design
- Utilise up to date technology, such as electronic detonation systems, where it will enhance blast control and minimise potential damage situations
- In sensitive areas, design blasts with ameliorative techniques such as ensuring free faces and reducing MIC
- If techniques are not available to reduce PPVs to Criterion level, avoid blasting at such proximity to the specific item.

### 3.1.2 Muswellbrook Shire Council

Muswellbrook Shire Council’s submission stated that they supported the project and recommended a number of conditions for DoP to include in any approval for the Project. In general terms, Centennial agrees with the intent of these suggested conditions, but suggests that some clarification of wording may be required in the drafting of approval conditions.

#### 3.1.2.1 Blasting

**The Applicant or its Contractor shall not blast within 500 metres of a public road while such road is open for traffic.**

**The approval of Council is to be obtained for the closure of public roads during blasting operations.**

Centennial agrees that temporary road closure will be required during any blasting that occurs within 500 metres of a public road. For this project, this is only relevant to Wybong Road.

It is suggested that the intent of Council approval for temporary closure of Wybong Road during blasting operations can be achieved by preparation of a Road Closure Management Procedure, in consultation with Council.

**The Applicant shall monitor all blasts and record the over pressure and peak particle velocity levels.**

Centennial proposes to monitor all blasts, recording overpressure and peak particle velocity levels.

**The Applicant is to liaise with other coal mining operators to ensure that mine blasting is suitably staged and staggered to minimise blast impacts.**

As noted in Section 1.2.3 of the EA, the Project is some 12 kilometres from the nearest existing or approved mining operation, so there is minimal potential for timing of blasts to interact cumulatively in such a manner to disrupt residents.

### **3.1.2.2 Noise and Vibration**

**All properties which have been identified in the EA as being affected by the 40 dBA noise level are to be included for compulsory acquisition in terms of the industrial noise policy (INP).**

As noted in **Section 3.1.1.2** above, Centennial continues to seek to acquire or reach agreement with all Significantly Affected landowners. As noted above, the term 'compulsory acquisition' is intended to be compulsory on Centennial to acquire or reach agreement with Significantly Affected private landholders, at their request. The inclusion of an approval condition consistent with that outlined in **Section 3.1.1.2** above and consistent with those for recent major mining projects, will meet the intent of this recommended condition.

## **3.2 Interest Groups and Community Submissions**

Numerous community submissions raised potential noise impacts and many included blast impacts. In addition, Renzo Tonin and Associates was engaged by Anvil Hill Project Watch Association (AHPWA) to undertake a technical review of the noise and blast assessment. This technical review is addressed below, in addition to the issues raised in community submissions.

### **3.2.1 Renzo Tonin Submission**

The issues raised in the Renzo Tonin submission are summarised in bold below, with the response provided by Wilkinson Murray provided in normal type.

- 1. Very low background noise levels in this area throughout the day, evening and night periods makes this area a special case, in that for such unusually low background noise environments the standard approach of setting a minimum 30dB(A) background noise, as prescribed by the INP, would not adequately assess annoyance and nuisance upon noise sensitive receivers affected by the proposal.**

**2. Chapter 5.6.2.1 of the EA's main report, states:**

**"In those cases where the INP Project-specific assessment criteria in Table 5.11 are exceeded, it does not automatically follow that all people exposed to the noise would find the noise noticeable or unacceptable. ...."**

**Although this statement would be true for cases where the project-specific noise criteria have been derived from actual background noise levels, it is not correct to assume that 'negligible' [ $<1\text{dB(A)}$ ], 'marginal' [ $1\text{--}2\text{dB(A)}$ ] or 'moderate' [ $3\text{--}5\text{dB(A)}$ ] noise exceedances over the noise criteria would be unnoticeable to people, in areas with very low background noise levels.**

**3. The property acquisition noise exceedance criteria for this project is reported to be 'greater than  $40\text{dB(A)}$ '. This level represents an increase over existing background noise levels by an order of  $20\text{dB(A)}$ . This equates to noise levels reaching approximately four-times the loudness of existing levels before property owners are offered acquisition of their properties.**

**Therefore, it would follow that the property acquisition criteria applied on recent mining project developments would need to be set at a more stringent level in this case, which would then require the mining company to provide an offer of purchase to more property owners than indicated in the EA. If the acquisition criteria were to be set at  $5\text{dB(A)}$  less than the  $40\text{dB(A)}$  criteria proposed in the EA, then according to the summary results in Table 5.12 of the EA main report, then the number of properties to be acquired by the mining company would approximately double.**

The Renzo Tonin submission points out that many recorded background noise levels are below  $30\text{ dBA}$ , and some appear to be at the limit of detection of the meter used, indicating that the true background level may be even lower than the reported value. These points are acknowledged in the noise assessment included in the EA.

The Renzo Tonin submission recognises that under the DEC's Industrial Noise Policy (INP), background noise levels below  $30\text{ dBA}$  should be considered to be  $30\text{ dBA}$  for the purpose of setting noise criteria. However, it asserts that

... for such unusually low background noise environments the standard approach of setting a minimum  $30\text{dB(A)}$  background noise, as prescribed by the INP, would not adequately assess annoyance and nuisance upon noise sensitive receivers affected by the proposal.

An EA should not only present an assessment of noise compliance to relevant noise policies, but also has a responsibility to quantify and present accurately the likely impacts upon noise sensitive receivers affected by a proposal.

Points 1 to 3 of the submission all rest on the assumption that the use of a minimum background noise level of  $30\text{ dBA}$  is inappropriate in this case.

In response, Rob Bullen, Wilkinson Murray, would agree that if an acoustician believes that standard assessment procedures do not give an accurate description of likely noise impacts in a particular case, this should be pointed out in the noise assessment report. Of course, any such comments would represent only the personal view of the acoustician preparing the report, and may not necessarily be given great weight by an assessing authority.

In the present case, Wilkinson Murray does not share the view expressed in the Renzo Tonin submission that background noise level should be taken into account in noise assessment, even for the very low background levels found around the Anvil Hill project.

Data on the effect of background noise on reaction to noise from a specific source come almost entirely from studies of transportation noise (road, rail and aircraft). These sources typically have relatively high noise levels – generally well above the ambient background in the area. Studies of reaction to these sources result in “dose-response” relationships similar to that shown in **Graph 3.1**, which shows the proportion of respondents “seriously” and “moderately” affected by aircraft noise at various LAeq noise levels. Studies of the effect of background noise on these relationships (e.g. Fields & Walker, J Snd Vibn 85, 197; Taylor, Hall & Birney, J Snd Vibn 71, 261) consistently show no effect – that is, reaction to noise from any of these sources is the same whether the ambient background noise level is low or high. Of course, in these cases background noise levels are almost always more than 10 dB below the noise level from the source.

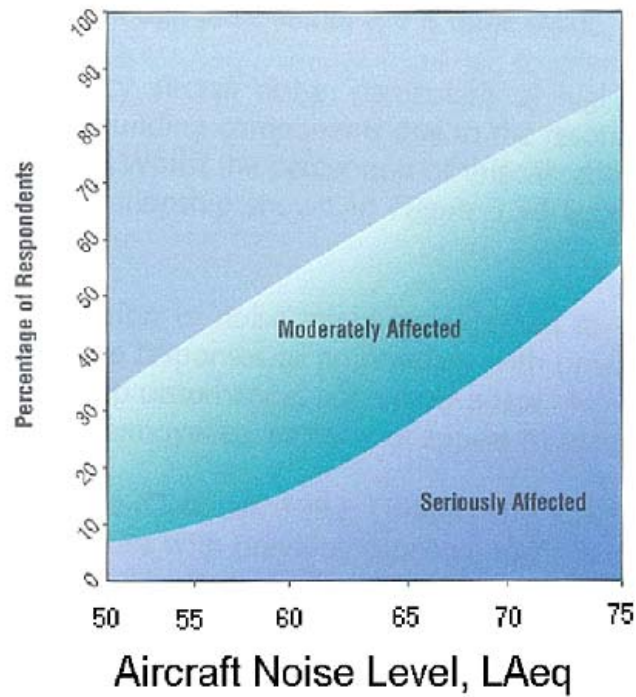
In the case of industrial noise, very limited survey data are available, but many years’ experience by practitioners and regulators indicates that in this case there IS a relationship between annoyance and background noise level. On the other hand, the same experience indicates there is a limit to the range of background noise levels over which the relationship applies. This experience is embodied in the INP “intrusiveness” criterion – “Background + 5 dBA”, but background limited to 30 dBA, i.e. the criterion is not less than 35 dBA.

A plausible conceptual model can explain these observations. This is shown in **Graph 3.2**. In this figure, the “no background” curve shows the “percentage moderately affected” curve from **Graph 3.1**, extended to lower LAeq noise levels by fitting a logistic curve. It is postulated that this curve represents the percentage of people who would be moderately affected by noise which is well above the background level – either because the noise level itself is high, as for the transportation noises typically studied, or because the background is low. If the background noise level is close to the level of noise from the source – say, within 10 dB – it can be assumed that reaction will reduce to below the “no background” value. The figure shows a straight-line decrease from the “no background” value at 10 dB above background, to no reaction if the source level is equal to the background. This relationship is obviously approximate, but serves to illustrate the general points of the model. **Graph 3.2** shows relationships for background levels of 30, 35 and 40 dBA.

The purpose of the noise criteria set out in the DEC’s Industrial Noise Policy is not to ensure that no-one experiences noise annoyance, but “to protect at least 90 per cent of the population living in the vicinity of industrial noise sources... for at least 90 percent of the time” (section 1.4.1). Considering **Graph 3.2**, the point at which 10% of people would be moderately affected by noise can be seen to be at roughly the background level plus 5 dB for background levels of 30, 35 and 40 dBA. However, for background levels below 30 dBA this relationship breaks down, and in fact the “no background” curve reaches 10% at a point not far below 35 dBA, indicating that a “cut-off” for noise criteria at about 35 dBA is reasonable.

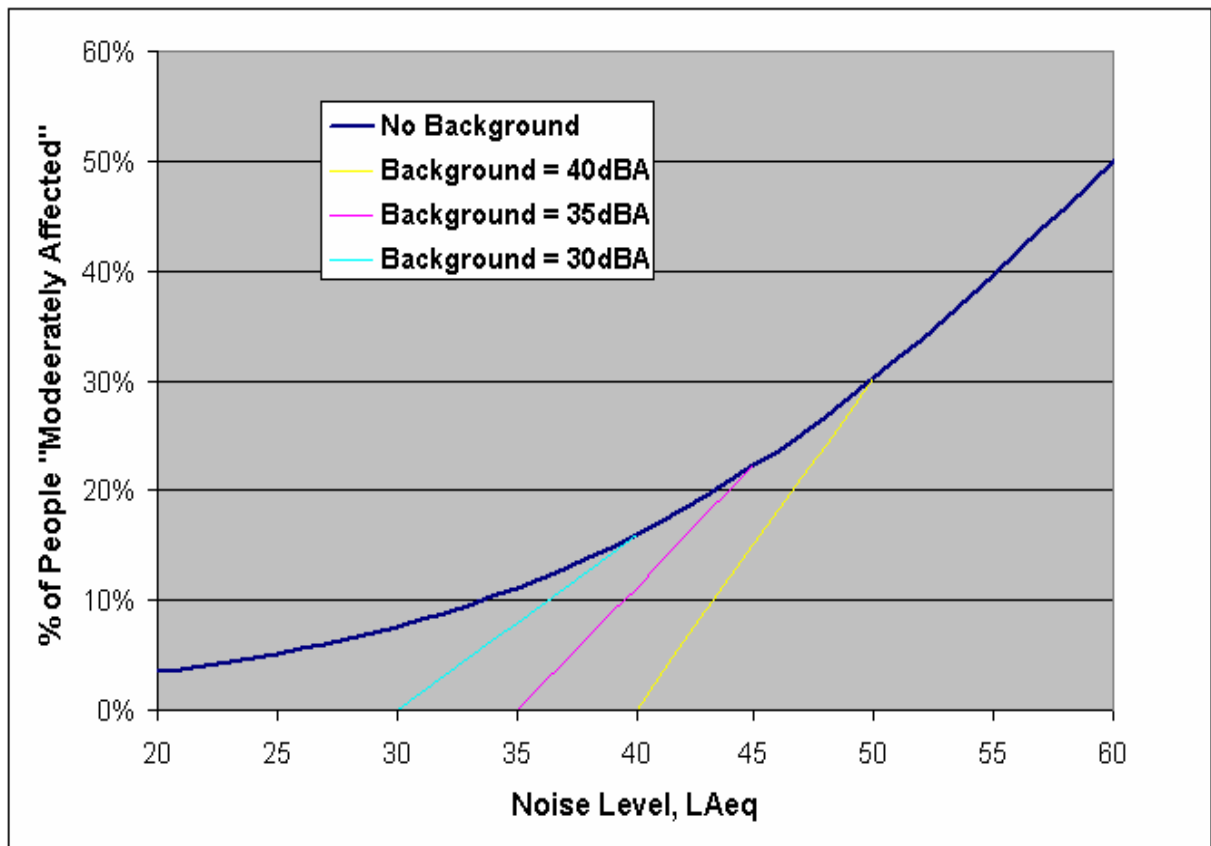
In summary, Wilkinson Murray believe evidence exists that there is a lower limiting noise level, below which the impact of noise from a specific source would not be significant, even if background noise levels are very low. Above this limit, the “background plus 5 dB” rule would apply. Wilkinson Murray also believe that a reasonable estimate of this lower limiting noise level is approximately 35 dBA, which is consistent with the criterion arising from the procedures in the INP.

This view is clearly shared by the DEC, which endorses the use of 30 dBA as a “cut-off” value for background noise in this specific project.



GRAPH 3.1

Typical Dose-Response Relationship for Reaction to Aircraft Noise  
(exposure units expressed as LAeq, using an approximate translation)



GRAPH 3.2

Conceptual Model of the Effect of  
Background Noise Level on Reaction to Noise



- 4. The EA main report and the Noise and Blasting Assessment Working Paper (Appendix 12), fail to provide suitable noise mitigation measures for properties that are identified as exceeding the ‘acquisition criteria’ but their owners do not want to sell their properties. According to the EA, such properties would not be offered alternative measures. This is a major short-fall in the assessment presented.**

Points 4, 9 and 14 all indicate that eligibility and procedures for providing sound attenuation to individual residences should be defined within the noise assessment, while point 13 makes the same comment with respect to a dilapidation survey.

In response, the eligibility of residences for sound attenuation would be defined in approval conditions for the project (if approval is granted). Sound attenuation is one measure which has been provided for potentially-affected residences in the past, and may be provided again. However, it is considered premature to pre-judge the outcome of the assessment by defining exactly which residences are proposed to lie within an area which would be subject to such conditions, if only because the expectations of residents may be inappropriately raised. In the case of property acquisition, the consistency of previous judgements gives reason to believe that a criterion of 40 dBA would be set as the boundary of this region, but for sound attenuation the approach is traditionally more site-specific. The purpose of a noise assessment is to provide sufficient information for decision-makers to determine what noise control measures, if any, should be applied in different areas, and Wilkinson Murray believe the Anvil Hill assessment fulfils this purpose.

In relation to the dilapidation surveys, Centennial propose that all private residents within 2 kilometres of the open cut mine boundary will be offered the opportunity for a structural survey of their residence prior to commencement of mining. This ensures that adequate base-line data is available from which to effectively and efficiently resolve any issues relating to blast impacts on residences, as the mine proceeds.

With respect to the actual attenuation measures to be applied at individual residences, once again criteria would be set in approval conditions. It is clearly far too early to provide details of specific control measures on a residence-by-residence basis. However, typical measures would include provision of air-conditioning or mechanical ventilation, to allow windows to be kept closed if desired, and in some cases upgrading of the construction of windows, using thicker glazing or double-glazing.

- 5. The ENM noise model used in the noise assessment, does not take into account the effect of sound reflections and amplification due to geological structures. In this case, noise amplification from the surrounding hills and escarpment and its effect on noise impacts, does not appear to have been accounted for in the noise modelling and is not well defined in the EA.**

This point discusses the presence of large reflecting surfaces as part of the topography of the surrounding area, and indicates that reflections from these surfaces would not have been taken into account in noise modelling.

In response, it is true that the model used did not include the effect of such reflections. To determine its importance, an absolute worst-case condition was considered, and the effect of these reflections was calculated under very conservative assumptions. The case considered was for receiver 66 (located just outside the “acquisition” boundary) in year 10, daytime. It was assumed that in this scenario, receiver 66 may experience direct reflection of noise from operations on both the Main Pit and North Pit overburden areas simultaneously, from both Anvil Hill and Wallaby Rocks. Reflected sound from these sources was reduced compared with direct sound by:

- geometric spreading corresponding to the additional distance travelled; and
- an additional 3 dB loss due to scattering. This is considered very conservative given the nature of the reflecting surfaces at this point – a more realistic reduction would be 5-10 dBA.

Reflected sound was added to the direct sound from these and all other sources affecting this location. The results indicated an enhancement of:

- 1.5 dBA in noise from the Main Pit only;
- 0.7 dBA in noise from the North Pit only; and
- 0.4 dBA in total noise from the mine.

Given the conservative and worst-case nature of the above calculations, the impact of reflections on calculated noise levels is considered negligible.

**6. The Working Paper however, does not provide details of validation tests, nor does it provide any information on validation of the noise model used for this assessment.**

In response, a number of validation studies have been performed and presented, including by Renzo Tonin and Associates (Acoustics Australia 25(2), 75-79). (The model was in fact developed by RTA Technology, a company associated with Renzo Tonin and Associates.) These studies confirm the validity of the model in circumstances similar to those in this project. The Anvil Hill noise assessment referred briefly to some more recent studies by Wilkinson Murray, the detailed results of which are not publicly available, but which support the generally-held conclusion that ENM's predictions are reliable on a statistical basis and for moderate wind speeds and temperature gradients.

**7. This point requests statistical properties of temperature inversion strength, or else a "sensitivity analysis" of noise level against inversion strength.**

In response:

- The requested probabilities are not considered useful as the analysis conducted for the Anvil Hill Project is based on alternative procedures (endorsed by the DEC) which do not require them.
- A "sensitivity analysis" shows noise levels with a 6°/100 metre inversion would be 2-3 dBA higher than with a 4°/100 metre inversion. However, given other conservative assumptions in modelling it is not considered appropriate to add further "safety factors", which seems to be the implication of this request.

**8. The Working Paper discusses the use of adverse meteorological conditions in the noise modelling however the details of the noise modelling remain unclear. For example it is unclear whether a drainage wind has been incorporated with the temperature inversions in the noise modelling, as is described in the INP.**

This point queries whether drainage wind was included in addition to inversions in all calculations.

In response, it was.

9. **Appendix C of the Working Paper shows there to be some very large exceedances of the set noise criteria at many noise sensitive receivers. Where noise impacted properties are not acquired by the mine, either because their owners do not wish to be bought out or the properties do not qualify for acquisition, it is unclear in the EA what noise mitigation measures are actually being proposed.**

See response to point 4.

10. **The traffic noise algorithm used to predict traffic noise levels and impacts along the two local roads, namely Wybong Road and Bengalla Link Road, is the CoRTN algorithm. This algorithm is typically used to calculate traffic noise from roads with free-flowing and steady traffic conditions. It is normally not suited for use in calculating traffic noise where traffic flows are intermittent and sporadic as is the case on local roads. The EA does not provide sufficient justification for the use of the CoRTN algorithms in this case. Alternative traffic noise calculation algorithms are available, but have not been used in the EA.**

11. **The traffic noise algorithm used in this EA has not been validated with site measurements and therefore the accuracy of its results are in question.**

These points relate to the accuracy of the CoRTN algorithm used in traffic noise calculations, and in particular its use in “low flow” conditions.

In response:

- The model was used for situations defined as “low flow rate” in CoRTN documentation. However, the “low flow” corrections specified relate to calculation of  $L_{A10}$  noise levels. In calculating  $L_{Aeq}$ , no correction for flow rate is necessary.
  - The alternative FHWA model was used to calculate  $L_{Aeq}$  levels for the closest receivers, under the same assumptions of speed, road surface, etc. (The CoRTN assumption of 50% “soft” ground is taken as equivalent to the FHWA “soft ground” algorithm.) Results are in agreement with CoRTN to within 1 dBA in all cases.
12. **This point requests details of proposed traffic monitoring procedures, and whether cumulative traffic noise impacts from Mount Pleasant and Anvil Hill will be considered.**

In response, once again both these issues would need to be addressed in consent conditions. In the case of cumulative impacts, as always this issue is difficult to address, as it requires apportioning of noise impacts between two sources.

The assessment provided considers the impact of traffic from Anvil Hill, either in the absence of traffic from Mount Pleasant in the same shift-change hour, or in its presence, in which case traffic from Mount Pleasant is considered as an existing noise source. The assessment does not adopt an approach in which both projects are considered as if they were a single project opening at one time, with all traffic from both projects constituting new noise imposed on the existing background in the same hour. If this approach were adopted there would be a small number of additional residences – certainly less than five - for which noise criteria would not be exceeded due to traffic from either project alone, but would be exceeded due to the total new traffic.

Attempts to determine any such cumulative traffic noise impacts in detail at this stage are considered premature. Information on operations at Mount Pleasant is based on an Environmental Impact Statement which is approximately eight years old, and is not sufficiently detailed to provide clear estimates of traffic volumes on relevant roads. Even for Anvil Hill, in some cases very conservative assumptions were made in estimating total traffic volumes.

If it happens that shift change times from both projects coincide, and if monitoring indicates that the cumulative impact of traffic noise exceeds relevant criteria at some residences, while impacts from either project alone do not, then some procedure for determining appropriate mitigation would need to be devised for the small number of affected residences.

- 13. Where noise impacted buildings from blasting are not acquired by the mine, either because their owners do not wish to be bought out or the properties do not qualify for acquisition, it is unclear in the EA if dilapidation surveys are proposed for such buildings.**

See response to point 4.

- 14. The rail traffic noise assessment conducted on the Muswellbrook to Ulan line indicates that an extra two residences are modelled to have noise levels that would exceed the ARTC noise criteria. It is unclear what noise mitigation measures are proposed for these residences.**

Whilst the EA assessed the rail traffic noise implications arising from the project, it should be noted that noise control on the Muswellbrook to Ulan line is the responsibility of ARTC.

### **3.2.2 Other Community Submissions**

Many of the community submissions raised concerns regarding the extent of predicted noise impact at their residence or more broadly in the general area. As noted in the DEC submission, the method and approach to determining these impacts is considered adequate. Centennial's suggested approach to managing such impacts is outlined in **Section 3.1.1.2**, and there is a strong commitment to purchasing or reaching agreement with the majority of Significantly Affected Residents as soon as possible. Ultimately, the Minister for Planning will consider the merit of the project, weighing up the social, environmental and economic benefits and costs of the projects, including the extent of proposed noise impact.

**Low-frequency vibration is stated to be associated with washeries, stacker reclaimers and rail loading facilities.**

In response, the occurrence of perceptible vibration due to such sources appears to be a very rare event, associated with specific properties of the local ground, or perhaps the vibrating structures. A criterion has been proposed in the noise and vibration assessment which would allow objective determination of whether such a problem exists. If it does, although the exact cause of such issues is unclear at this point, there appears to be no reason why the source could not be identified in any particular instance and mitigation measures introduced to ensure that the criterion is met.

**A number of submissions raise concerns related to the existing low background noise in the area.**

The impact of new noise from a mine in an area with low existing background levels is discussed above.

**Outdoor noise levels at Residences**

One submission indicates that treatment of residences does not provide a solution for noise experienced outdoors. In response, this is certainly true, but it is often effective in reducing sleep disturbance, which for many people is the most important noise impact.

**Noise Impacts on Horses**

This issue was not specifically addressed in the noise assessment. However, studies such as Bell, Jnl Acoust Soc Am, 51(2) 758 ("Animal Response to Sonic Booms") indicate that the threshold for perceptible noise impacts on animals is significantly higher than the threshold of annoyance for humans, and hence if residential amenity criteria are met, impacts on horses can be considered minimal.

**Noise from Off-Site Transport**

Several submissions mention an increase in noise from off-site road and/or rail traffic. In each case, the size of the projected increase is documented in the noise assessment. Some residences are predicted to experience an increase in noise which is above relevant limits, and if this is confirmed by monitoring, appropriate mitigation measures would be put in place.



## 4.0 Air Quality

### 4.1 Government Agency Submissions

#### 4.1.1 Department of Environment and Conservation

The main concerns expressed by the DEC (in its submission referenced as DOC06/52579 273196A1) relate to the possibility that the background PM<sub>10</sub> levels may be underestimated and that the calibration factor used to determine 24-hour PM<sub>10</sub> concentrations may cause 24-hour PM<sub>10</sub> concentrations to be underestimated, and that PM<sub>10</sub> concentrations have not been included in the predictions of 24-hour average PM<sub>10</sub> concentration. The DEC believes that an additional 13 residences, outside those with which Centennial has agreements, could be affected.

To deal with the matters the DEC recommends *“approval for the project be subject to a commitment from Centennial to the acquisition of any additionally identified dust affected residences and the implementation of a real-time dust monitoring program to supplement the proposed air quality monitoring program”*.

Prior to dealing with the technical aspects raised in the DEC submission, it should be noted that most of the potential additional dust affected private residences referred to by DEC are all either now owned by Centennial, or Centennial has reached agreement for purchase of such properties, or such residences fall within the area Significantly Affected by noise impacts and therefore are expected to be subject to a requirement for Centennial to acquire or reach agreement with such private landholders, at the request of the individual landholders. Further, Centennial is prepared to commit to acquisition of any additional dust affected residences (defined by exceedance of the relevant DEC criteria noted in the EA) that may be identified by future dust monitoring. In addition, Centennial also commits to the conduct of real-time dust monitoring to assist with pro-active dust control for the Project.

The remainder of this section provides the Holmes Air Sciences response to the technical air quality assessment issues raised by DEC.

#### **Annual average PM<sub>10</sub> concentration**

The DEC notes that the maximum of the rolling annual average PM<sub>10</sub> concentration (in the data used in the EA) was 17 µg/m<sup>3</sup> and not 15 µg/m<sup>3</sup> as used in the assessment. The 15 µg/m<sup>3</sup> was derived from block averages. There is no firm guidance from the DEC in its Approved Methods (DEC, 2005) as to how annual average background concentrations should be determined (i.e. whether running averages or block averages should be used). However, it is relevant to note that for air pollutants that have an annual average standard, the National Environment Protection Measures require that the concentrations are measured over a calendar year and when routine compliance reports are prepared these make use of block averages i.e. over a calendar year or financial year. Generally, the block annual average and rolling values will be similar, as they are in the current case (15 compared with 17 µg/m<sup>3</sup>). The 2 µg/m<sup>3</sup> difference represents 7% of the assessment criterion. The block averages and rolling averages are likely to be close to one another provided no biases are introduced by missing data or extraordinary events.

Currently available data is from 5 September 2004 to 26 August 2006. The following summarises the data as calculated in a number of different ways.

	PM10-1 (McLane)	PM10-2 (Porter)
Average over all data	17.1	14.6 $\mu\text{g}/\text{m}^3$
Average 2005 Calendar	17.3	13.8 $\mu\text{g}/\text{m}^3$
Average 30 June 2004 to 1 July 2005	15.2	13.4 $\mu\text{g}/\text{m}^3$ .

The attached **Figure 4.1** shows all the currently available data at this time in graphical form.

It is clear that the question as to what the background level will be during any particular year of mining is unknown. It will depend on seasonal conditions, rainfall, plant cover, the intensity and extent of bushfires etc. It is relevant to point out that the most recent data correspond to unusually dry conditions over most of NSW.

Finally, it may be useful to consider the following information taken from a response provided to the Moolarben IHAP concerning the performance of the ISC model.

It is difficult to find many cases where model predictions can be compared with actual measurements. However in the preparation of the Mt Owen EIS, predictions of annual average  $\text{PM}_{10}$  concentrations were made using the unmodified ISC model at two locations (HV1 and HV2) (see Figure 1 in the Mt Owen EIS). The model results applied for Year 1 were also provided in the EIS. Year 1 can be approximately related to the situation that would apply at Mt Owen in the 2003/04 period.

Monitoring data for HV1 and HV2 are presented in the EIS for the twelve month period leading up to 29 September. At HV1, only TSP data were available, but at HV2 TSP data were available from 28 September 2002 to 2 April 2003 and  $\text{PM}_{10}$  measurements were available from 2 April 2003 to 26 September 2003. While the data set is not an ideal, it does provide some indication of the expected performance of the unmodified ISC model when used in EIS assessments.

To use the monitoring data it is necessary to convert the TSP measurements into  $\text{PM}_{10}$  concentrations. This can be done by noting that typically 40% of the TSP is in the  $\text{PM}_{10}$  size range. At HV2 there is a limited period (2 April 2002 to 26 September 2003 including 54 measurements of the 24-hour concentration) where both TSP and  $\text{PM}_{10}$  samples were collected. The  $\text{PM}_{10}$ :TSP ratio for this period was 34:100 and assuming that the value is 40:100 will be conservative for the current discussion. (The factor of 0.4 appears to apply reasonably reliably in the Hunter Valley in areas where mining sources contribute a significant fraction of the dust in the air. It does not apply in urban areas where the percentage of finer particles is higher). If the TSP concentration at HV1 is converted (assuming a  $\text{PM}_{10}$ :TSP ratio of 40:100) to an annual average  $\text{PM}_{10}$  concentration the value is  $32 \mu\text{g}/\text{m}^3$ . If the same approach is adopted to convert the TSP data at HV2 and this is averaged with the direct measurements of  $\text{PM}_{10}$  that are available at HV2 then the estimated measured annual average  $\text{PM}_{10}$  concentration at HV2 is  $21 \mu\text{g}/\text{m}^3$ .

The predicted and measured concentrations are shown below:

Monitor	predicted annual average $\text{PM}_{10}$	Measured annual average $\text{PM}_{10}$
HV1	$36 \mu\text{g}/\text{m}^3$	$32 \mu\text{g}/\text{m}^3$
HV2	$22 \mu\text{g}/\text{m}^3$	$21 \mu\text{g}/\text{m}^3$

In both cases, the predicted values were higher than the measured values, by 12% at HV1 and 5% at HV2. If the actual ratio  $\text{PM}_{10}$ :TSP, as measured at HV2 of 34:100 was used, then the measured concentrations would be even lower and the over prediction of the model would be greater. Instead of inferring an annual average of concentration of  $32 \mu\text{g}/\text{m}^3$  at HV1 the value would be  $27 \mu\text{g}/\text{m}^3$  and the value at HV2 would be  $20 \mu\text{g}/\text{m}^3$ . The over prediction at HV1 and HV2 would be 33% and 10% respectively.

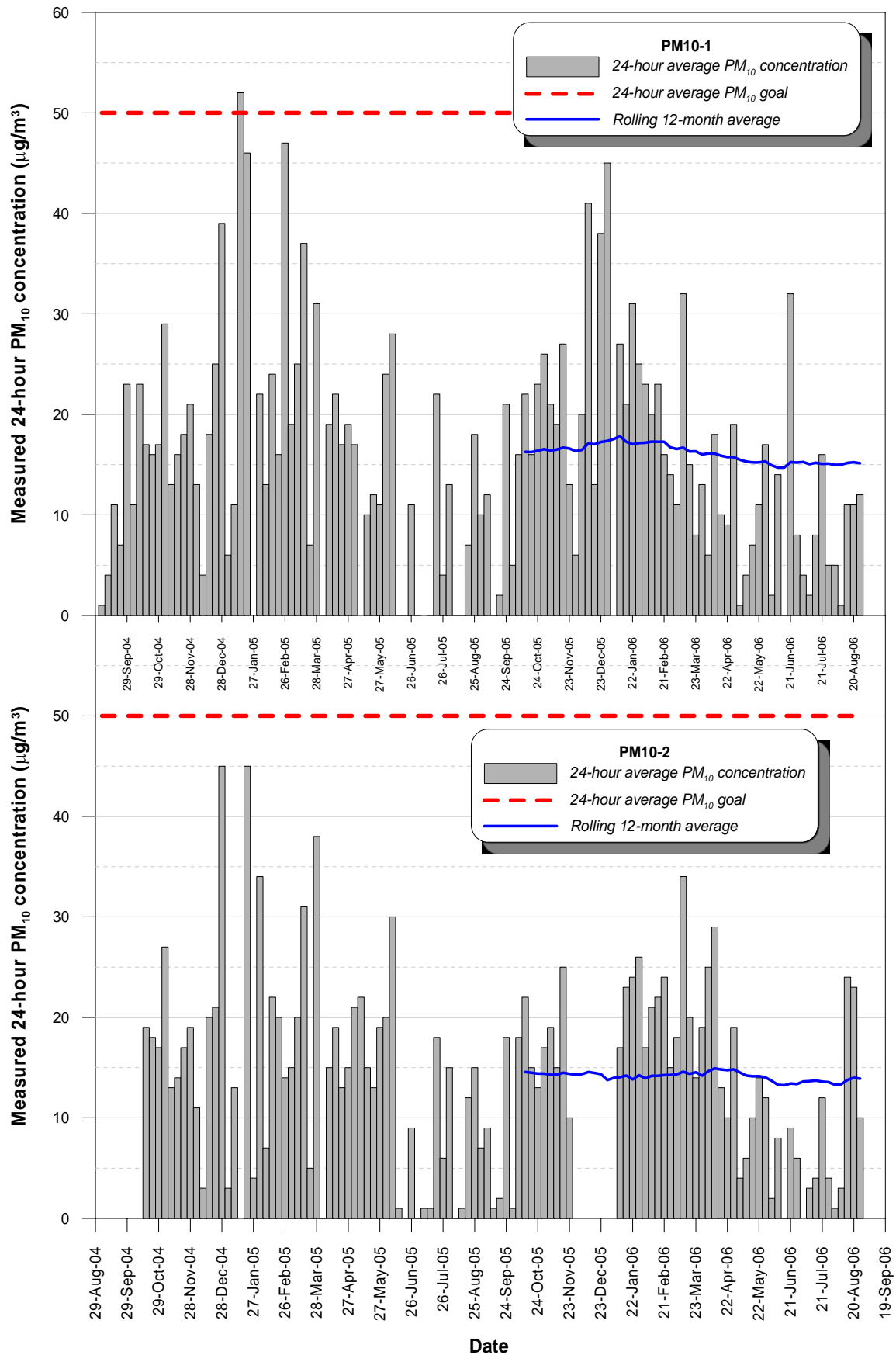


FIGURE 4.1

Measured PM<sub>10</sub> Concentrations in the Study Area

Thus there is reasonable evidence that the ISC model over predicts annual average PM<sub>10</sub> concentrations (as well as 24-hour PM<sub>10</sub> concentrations – see later).

We suggest that the Centennial's commitment to acquire properties on request should measured annual average PM<sub>10</sub> concentrations exceed the 30 µg/m<sup>3</sup> will provide protection for the community should the model predictions prove to have been too optimistic.

### **The PM10 24 hour calibration factor**

The DEC submission explores what would happen to the number of affected properties if the calibration factor for 24-hour predictions was less than 1.6, for example if it was appropriate to use no calibration factor i.e. if calibration factor was 1.0. As with the previous point, this is essentially a sensitivity test. There is however, very strong evidence that some form of calibration adjustment is required. In fact, Section 234 of the US Clean Air Amendment Act specifically directed US EPA to examine available emission factors and dispersion models to address the potential overestimation of air quality impacts of surface coal mines. The focus of the work appears to have been on refining the emission factors, which were not changed significantly as a result, but some refinements to the ISC model have been introduced (including a scheme for including pit retention). No major changes have been made to the model. Thus, the conclusion remains that the model predictions (which involve both the way in which emissions are calculated and the way that the model simulates dispersion) are higher than they should be. Holmes Air Sciences have been careful in selection of the calibration factor and have done additional work since setting its value at 1.6 for this project. The additional work suggests that the factor of 1.6 is realistic and likely to be on the conservative side for most receptors.

### **Lack of a cumulative assessment for 24-hour PM<sub>10</sub> concentrations**

The assessment of short-term (24-hour average PM<sub>10</sub>) impacts has always been difficult. The approach Holmes Air Sciences have used is the same as that applied for all projects assessed since the first version of the DEC modelling guidelines were produced in 2000. The approach has been accepted by DEC on previous occasions and was developed in consultation with them over a number of years. The approach is also consistent with approvals given for other mining projects in the Hunter Valley, see for example the conditions of consent for the Bulga open cut mine (DoP, DA376-8-2003 Section 23). This consent provides a useful model for the acquisition of land affected by dust emissions from mining.

The DEC's Approved Methods (DEC, 2005) suggests several approaches to the problem of combining the effect emissions from a proposal with the existing background levels. These are broadly summarised below.

1. Take the highest measured background level and add this to all predictions; or
2. Develop a daily background file and add the daily predicted level to the daily background and show:
  - a) The project does not cause any exceedances
  - b) The project does not cause any additional exceedances.

The first approach does not work in this case because the highest background level is 52 µg/m<sup>3</sup> (see PM10-1 on 15 January 2005) which is already above the assessment criterion and this is in the absence of the mine. The second approach cannot be used because it relies on having a computer compatible file containing daily PM<sub>10</sub> data and contemporaneous meteorological data. The database does not exist for the Anvil Hill area and in fact, suitable databases are difficult to find for the Sydney metropolitan area. Further, if a complete data

set did exist it would contain the  $52 \mu\text{g}/\text{m}^3$   $\text{PM}_{10}$  concentrations that occurred on 15 January 2005. Thus option 2(a) could not be used. Option 2(b) is problematical in that relies on finding a time-series of concentration measurement that suit the project. The second highest measured concentration is  $47 \mu\text{g}/\text{m}^3$ . An exceedance would be caused by a  $4 \mu\text{g}/\text{m}^3$  increase in 24-hour average  $\text{PM}_{10}$  concentrations. An increase in 24-hour  $\text{PM}_{10}$  concentrations of  $4 \mu\text{g}/\text{m}^3$  would be very small and unnoticeable in an environment where the background was  $47 \mu\text{g}/\text{m}^3$ .

Holmes Air Sciences notes that if real time dust monitoring and proactive management is in place then it is possible to manage emissions from the mine in such a way as to ensure that they do not contribute significantly to exceedances when background levels are high or when they exceed the criterion. Experience at Bengalla shows this to be the case.

Finally, it is relevant to note that other jurisdictions allow more relaxed 24-hour  $\text{PM}_{10}$  criteria. For example, the US EPA 24-hour  $\text{PM}_{10}$  standard (used in the Bulga Consent) is  $150 \mu\text{g}/\text{m}^3$  and the recently published Draft Protocol for Environmental Management for Mining and Extractive Industries in Victoria (Victorian EPA, 2006) introduces a 24-hour  $\text{PM}_{10}$  concentration of  $60 \mu\text{g}/\text{m}^3$  in recognition of the special problems that face these industries. Indeed the agricultural sector and rural transport on unsealed roads would face the same problems if they were regulated with the same instruments.

## 4.2 Interest Groups and Community Submissions

### **Air pollution from extra uncovered rail wagons not addressed in EA – coal dust from open trains**

Coal dust from open, uncovered rail wagons will form an insignificant fraction of the overall dust emissions from the Project. Coal exported from the site will be washed and be low in fines and with a moisture level around 10% and will therefore have only a low potential for dust generation.

To quantify this, consider a hypothetical train with 100 wagons, each wagon 10 metres by 3 metres, then the total exposed area of the uncover coal will be  $3000 \text{ m}^2$ . Assuming a wind erosion loss of  $0.4 \text{ kg}/\text{ha}/\text{h}$  and that the train is in place for an entire year (which will of course overstate the period of time the train would spend at any one location), this will amount to an annual dust emission of approximately 1051 kg. This would form an insignificant fraction of the annual dust emissions presented in the air quality assessment. There will be no change to the model predictions or conclusions of the assessment on this basis.

Nevertheless, it will be important for the train operators to ensure they manage dust emissions from rail wagons effectively. This in practice means ensuring that wagons are not overloaded. This will minimise the potential for short-term air quality impacts to be observed as trains pass by residential properties.

### **Data from Jerrys Plains irrelevant as it is a long way from Anvil Hill in an area that will not be affected**

Climatic data collected by the Bureau of Meteorology (BoM) from Jerrys Plains were presented in the Air Quality Assessment to provide an overview of weather conditions for the study area. This is the closest BoM operated station to the Project site.



For the quantitative air quality assessment, the number of raindays was the only parameter that was used from the Jerrys Plains information. The number of raindays was used to estimate annual dust emissions due to wind erosion. A higher number of raindays will result in a lower estimate of annual dust emissions due to wind erosion. Conversely, a lower number of raindays will result in a higher estimate of annual dust emissions due to wind erosion.

At Jerrys Plains the average number of raindays per year is 86. At Scone, the average number of raindays is 93 and at Singleton, 113. There will be some variability in rainfall for different parts of the Hunter Valley however, since the number of raindays at Jerrys Plains is slightly lower than at other locations (Scone and Singleton), there may be some element of conservatism in the dust emission calculations – that is, the estimated emissions will be higher than if rainfall data from either Singleton or Scone were used.

### **Diesel emissions**

Particulate matter due to diesel emissions were accounted for in the air quality assessment.

Particulate matter (dust) emissions were estimated using emission factors for each dust generating activity. For example, a typical emission factor for a bulldozer stripping topsoil is 14 kilograms per hour (kg/h). This emission factor takes into account all sources of particulate matter arising from the operation of the bulldozer, including exhaust emissions generated through diesel combustion.

### **Dust impact on pasture for grazing animals**

The air quality impact of the Project was assessed by comparing estimates of dust concentrations and deposition levels with DEC air quality criteria. The air quality criteria have been set for the protection of human health and to minimise nuisance impacts. The air quality criteria would also be expected to protect the health and amenity of other mammals.

Andrews and Sriskandarajah (1992) conducted two research trials to investigate the effects of coal mine dust on dairy farms in the Hunter Valley. The results of their study suggested that coal mine dust, at levels much higher than would be experienced in practice, had no effect on the production of dairy cows. Also, the amount of soil ingested by dairy animals for typical grazing behaviour far outweighs the quantity of dust ingested by consumption of deposited dust on the pasture.

### **Dust impact on vineyards**

A recent study title "Airborne Particulates and vegetation: Review of Physical Interactions" (Doley, 2006) examined the physical effects of dust on vegetation. The study noted that the effects may be associated with a "reduction in light reaching the photosynthesis apparatus of the leaf" and an increase in leaf temperature. A relevant conclusion from the study suggested that there is no discernible affect on the most sensitive plant functions with dust loads of less than 8 g/m<sup>2</sup> on the leaf surface during growth.

Air quality impacts of the Anvil Hill Project were assessed against a dust fallout criteria of 4 g/m<sup>2</sup>/month. All vineyards in the area are located outside the zone where deposition levels of more than 4 g/m<sup>2</sup>/month are predicted due to proposed mining operations. Thus, the impact of dust emissions on vineyards is considered to be negligible.

## Dust impacts on surface water

Dust emissions will ultimately be deposited to the ground where they will become part of the soil. The particles will pose no greater risk to surface waters than the particles already in the soil.

## Dust size and large particulate matter omitted from EA - will be a major problem

The air quality impact assessment considered a range of particulate matter sizes. These included total suspended particulates (TSP) and particulate matter with particle size less than 10 micrometres ( $\mu\text{m}$ ) in diameter. TSP includes all particles that can be suspended in the air.

The assessment provided estimates of the impact zone from the Project, based on predictions of TSP concentrations. All particles capable of transport through the atmosphere were considered in the assessment.

## Dust, with cumulative effects from other mines

Cumulative effects of the Project with other mining operations were considered in the air quality assessment. Most of these relevant mines are already in operation at this time and so their effects were included in the monitoring data. However, emissions from Mt Pleasant were discussed explicitly (see Section 8 "Cumulative Impacts").

Predictions of the impact zone of the Project, based on air quality, considered the cumulative effects of other mining operations.

**EA acknowledges that ultrafine<sup>1</sup> dust particles ( $\text{PM}_{2.5}$ ) represent greatest health hazard, but does not include an assessment of this size of particle. It appears that the only reason they do not is that they are not required to.**

It is relevant to note that the creation of fine particles from rocks and other crustal materials requires the input of mechanical energy to break the larger material into smaller particles. The energy required is proportional to the surface area created. In practice, it is not possible to create ultra fine particles by mechanical means. Ultra fine particle and indeed much of the mass in the  $\text{PM}_{2.5}$  size range is created via chemical processes, e.g. combustion or chemical reactions involving the gases produced in combustion. Thus, mining does not cause the generation of much dust in the ultra fine or even the  $\text{PM}_{2.5}$  size range. Typically, only 4 to 5% of the particles generated by mining operations are in the  $\text{PM}_{2.5}$  size range.

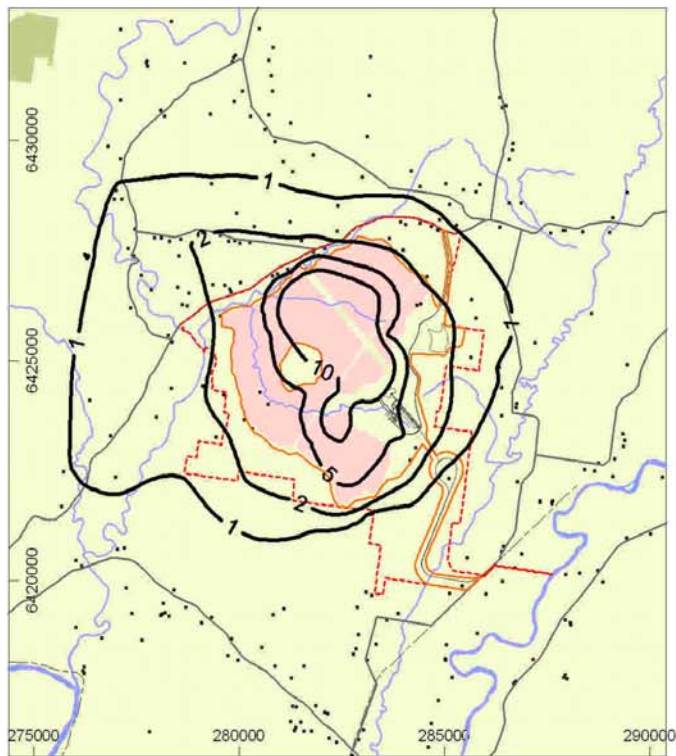
Epidemiological studies indicate that it is the finer particles, that is those below  $2.5 \mu\text{m}$  in equivalent aerodynamic diameter and referred to as  $\text{PM}_{2.5}$ , that are the particles that are most implicated in causing health impacts, as these particles can be taken deeper into the lung.

Results for  $\text{PM}_{2.5}$  were reviewed as part of the assessment but were not included in the impact assessment report, since the DEC does not, as yet, have ambient goal for  $\text{PM}_{2.5}$  applied on a project basis.

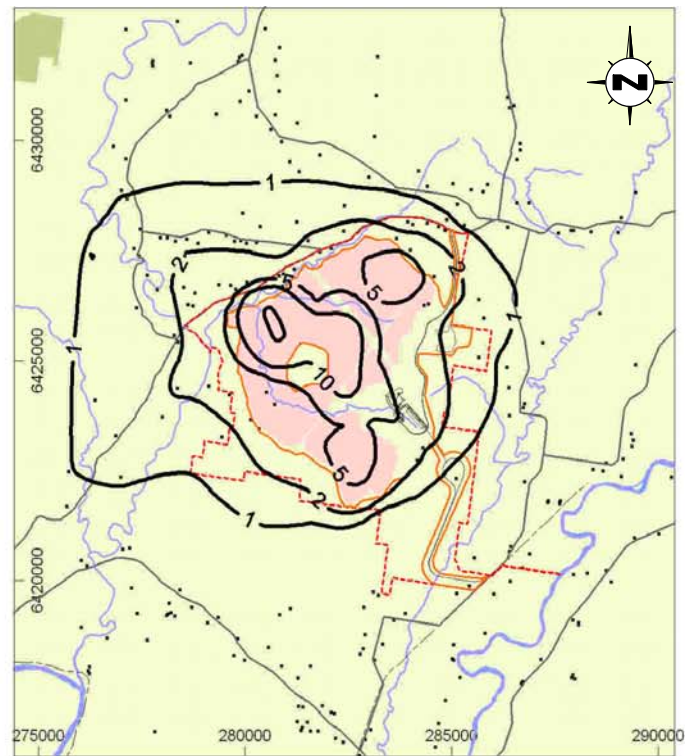
Dispersion model results for  $\text{PM}_{2.5}$  were however, presented during the IHAP hearing and compared with the advisory  $\text{PM}_{2.5}$  standards listed by the National Environmental Protection Council (NEPC). For convenience, the figures presented at the IHAP hearing are represented are provided as **Figures 4.1, 4.2 and 4.3.**

---

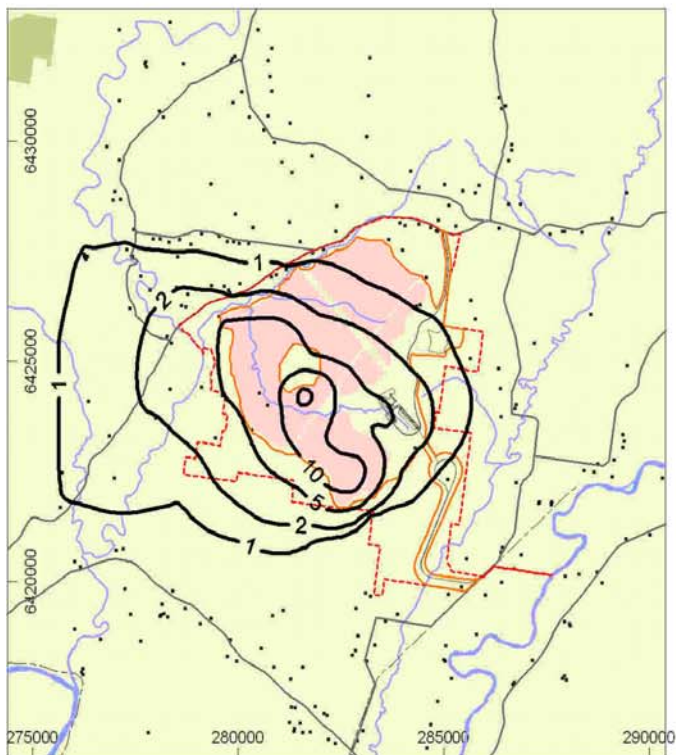
<sup>1</sup> Please note that technically, the term ultrafine particles refers to particle with equivalent aerodynamic diameters of  $0.1 \mu\text{m}$ .



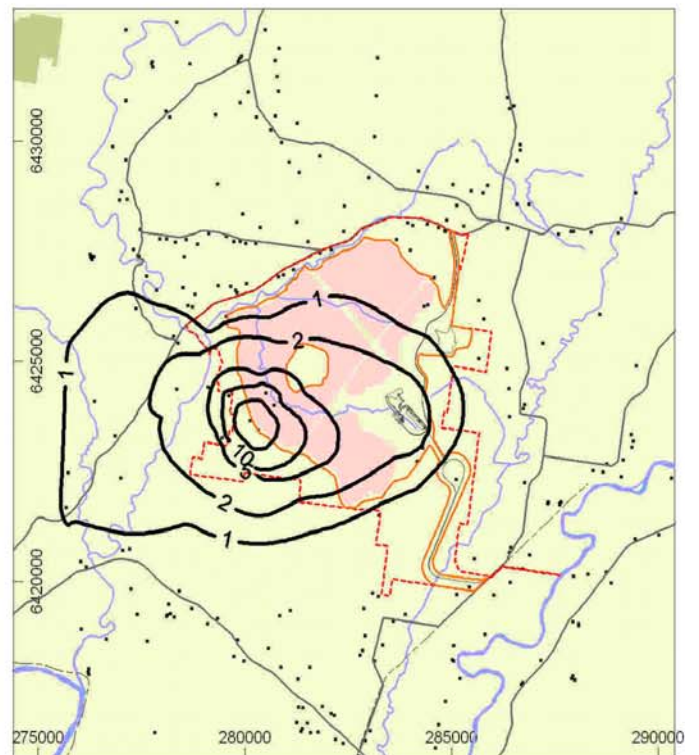
**Year 5**



**Year 10**



**Year 15**



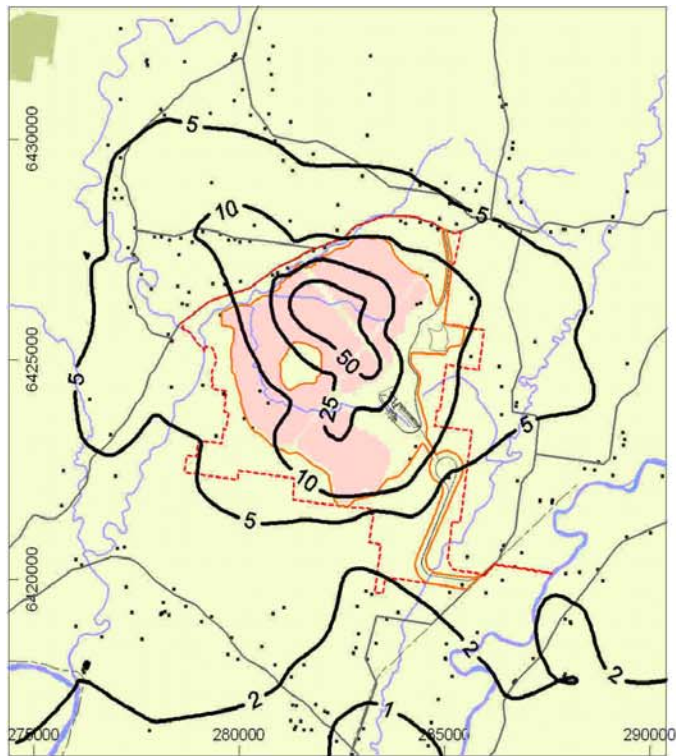
**Year 20**

Source: Holmes Air Sciences (2006)

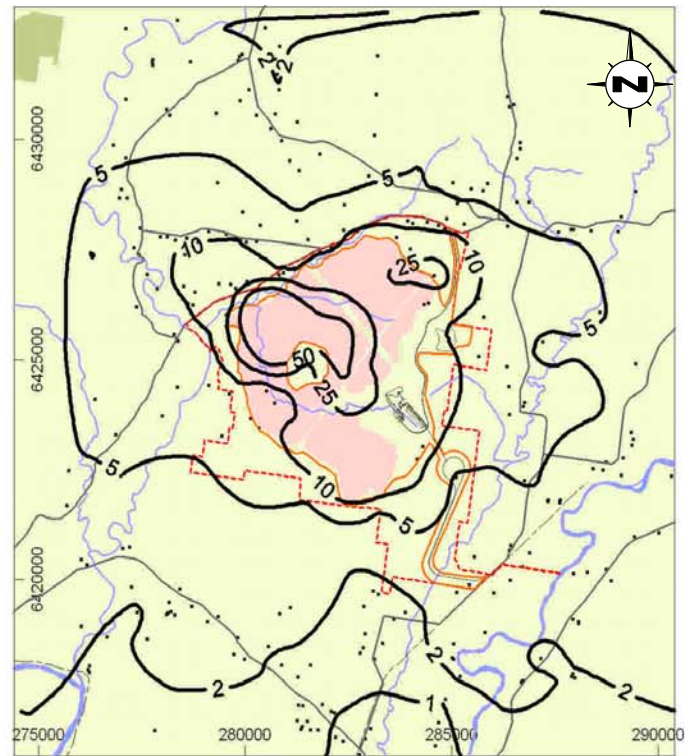
**FIGURE 4.2**

**Predicted annual average PM<sub>2.5</sub> concentrations - µg/m<sup>3</sup>**

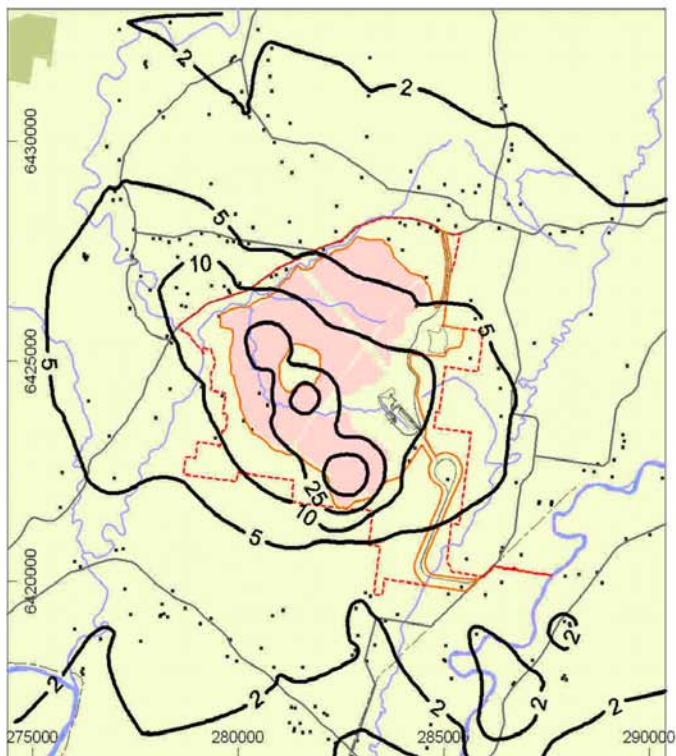




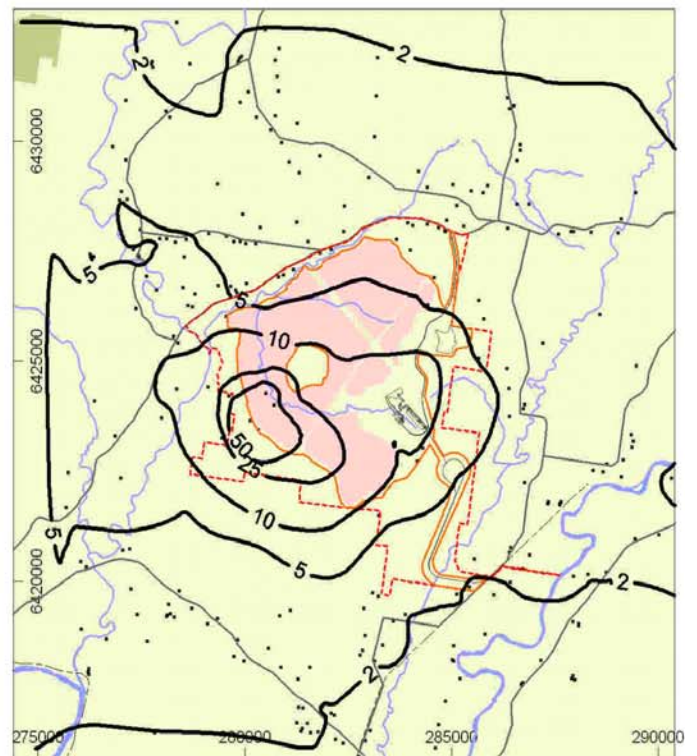
**Year 5**



**Year 10**



**Year 15**



**Year 20**

Source: Holmes Air Sciences (2006)

**FIGURE 4.3**

**Predicted maximum 24-hour average  $PM_{2.5}$  concentrations -  $\mu g/m^3$**

The impact zone of PM<sub>2.5</sub>, defined by comparing annual PM<sub>2.5</sub> predictions with the NEPC standard was found to be very similar to the impact zone of PM<sub>10</sub>. Therefore, it was concluded that areas where compliance with the PM<sub>10</sub> criteria was predicted would also be predicted to comply with the NEPC advisory standard for PM<sub>2.5</sub>. In addition the panel was provided with the PM<sub>2.5</sub> monitoring results in Muswellbrook (collected by the Muswellbrook Council) which showed PM<sub>2.5</sub> concentrations generally complied with the NEPC standards and the only exceptions were when bushfire smoke was affecting air quality. The Muswellbrook Council's data would of course include the effects of emissions from all existing mines including Bengalla, Mt Arthur, Muswellbrook Coal, Drayton and others further away.

### **Fence deterioration from air pollution**

Fence deterioration may arise from acid gases and particles that deposit on the fence, resulting in corrosion. These acid gases will be largely due to combustion-related emissions and not from dust emitted from the disturbance of overburden and coal during mining operations. The level of combustion related emissions (i.e. diesel exhaust and blasting emissions) from the project is not sufficient to cause such effects.

**Foals and yearlings will be compromised with respiratory ailments. Rattles is a disease that can be fatal in horse breeding industry - aggravated by dusty conditions. Treatment is expensive and permanent damage to the respiratory system is common, seriously compromising the racing career of the horse in question. Huge increases in airborne dust is a serious issue for horse breeders.**

The air quality impact of the Project was assessed by comparing estimates of dust concentrations and deposition levels with DEC air quality criteria. The air quality criteria have been set for the protection of human health and to minimise nuisance impacts. The air quality criteria would also be expected to protect the health and amenity of other mammals, including horses. Horses and other mammals are kept and raced in Sydney and other cities where PM<sub>10</sub> concentrations will be similar and in many cases higher than will be experienced outside the area that the EA has identified as impacted by the mine. For example the DEC's Action for Air publication shows that the annual average PM<sub>10</sub> concentration over all the monitoring sites in the Sydney region was in the range 18 to 29 µg/m<sup>3</sup> (DEC, 1998) for the period 1988 to 1996. Horse racing and stabling are successfully conducted in the Sydney environment.

**Impacts on human health, including increase in diseases like asthma, and nearby residents would suffer health impacts.**

The air quality impact of the Project was assessed by comparing estimates of dust concentrations and deposition levels with the DEC air quality criteria. The air quality criteria have been set for the protection of human health and to minimise nuisance impacts. The criteria are derived from epidemiological studies which assess pollutant concentrations against health effects, including asthma.

**Increased dust will severely affect drinking water quality with residue from roofs washing into fresh water tanks.**

Any area predicted to experience cumulative annual average dust deposition levels at or above 4 g/m<sup>2</sup>/month is considered in the assessment process to be impacted. If it is assumed that all the deposited dust on a 100 m<sup>2</sup> roof is washed into a rain water tank then the annual average quantity of dust entering the rain water tank would be approximately 5 kg. This material will settle to the bottom of the tank and will need to be cleaned out every



10 to 20 years. Much of the accumulation of particulate matter could be avoided via the use of simple systems that prevent the first flush from the roof entering the tank.

Even though predicted dust deposition levels are below the relevant criteria well within a few kilometres of the proposed mining boundary, Centennial recognises that potential dust effects on drinking water is a sensitive community issue. For this reason, Centennial is volunteering to install first flush systems at the request of private residents located within 4 kilometres of the proposed mining boundary.

### **No data collected from north-east or south-west corners of the project**

Dust deposition was measured at 20 locations around the Project site, including in the north-east and south-west of the site. These data showed that the north-east and south-west corners of the Project site do not experience dust fallout levels significantly different from other parts of the study area.

Dust concentration data were collected to the north-west and south-east of the Project site. The data showed that PM<sub>10</sub> concentrations were very similar at the two locations. It should be noted that the locations chosen for the dust concentration measurements were representative of the locations where the highest air quality impacts were predicted.

### **No detailed study on SO<sub>2</sub>, NO<sub>x</sub> and CO emissions**

The sulfur content of Australian diesel is too low and mining equipment is too widely dispersed over mine sites to cause sulfur dioxide goals to be exceeded even in mines that use large quantities of diesel. For this reason, no detailed study of SO<sub>2</sub> emissions from the mine has been undertaken. For the same reason, NO<sub>x</sub> and CO emissions have not undergone a detailed modelling assessment. The issues have been addressed in other EAs and Commissions of Inquiry and have been shown not to be matters that need to be investigated in detail.

### **Odours**

Emissions of odours can occur if self-heating of the coal is allowed to occur without proper control. Self-heating of coal occurs at different rates depending on the composition of the coal and how it is managed. Self-heating that gives rise to smoldering fires in stockpiles can lead to significant emissions of smoke and odour, but these would be able to be brought under control rapidly.

Self-heating of the coal in the product stockpiles would be reduced through the use of water sprays and prudent stockpile management. The potential for odour generation is therefore considered to be low and it follows that the frequency of odour events would also be low. Given the sporadic nature of such events, the odours from the Project are difficult to quantify, however, with proper management, the potential for adverse odour impacts to be observed at the nearest residential properties is considered to be negligible.

### **Only have to drive into Muswellbrook to see modelling dust impacts to be incorrect.**

Dust dispersion modelling is a tool for predicting the air quality impacts of a Project. In the case of the Anvil Hill Project, the dispersion modelling provided a best estimate of the impact zone due to dust emissions arising from the proposed operations.

Air quality monitoring is carried out in Muswellbrook which shows that particulate matter concentrations are below current DEC air quality criteria.

In 2005, TSP monitoring in Muswellbrook showed that concentrations were  $42 \mu\text{g}/\text{m}^3$  – well below the current DEC criteria of  $90 \mu\text{g}/\text{m}^3$ .  $\text{PM}_{10}$  concentrations in 2005 were  $22 \mu\text{g}/\text{m}^3$  which is below the DEC's criteria of  $30 \mu\text{g}/\text{m}^3$ .

**Residence is in direct line of dominant south-east air currents that will carry dust off the mine site. Topography gives double dip effect. EA shows their property will not be impacted by dust - just outside the magic line.**

The air quality assessment provided a best estimate of the impact zone due to dust emissions arising from the proposed operations. These estimates took into consideration all meteorological conditions that have been measured in the study area, including the south-east winds that prevail in the summer months. Detailed topographic information was included in the calculations.

### Silica

- **Rock to be mined contains high silica component - will be in the air.**
- **Silica will be a major component of dust**
- **Silica will be one of the  $\text{PM}_{2.5}$  that will enter household drinking water tanks along with other heavy metals and contaminants from diesel, e.g. cadmium, aluminium, flouride.**

Silicosis is a lung disease that can result from exposure to dust containing high concentrations of respirable crystalline silica. It is usually confined to individuals who have experienced exposures as a result of their occupation. The occupations involved are typically those that involve cutting and grinding rocks high in crystalline silica, sandblasting and so on. These are usually the only people who are exposed to sufficiently high concentrations. The environment of underground coal miners is subject to monitoring to ensure that exposures are maintained at safe levels, but the risk for surface workers (i.e. those in open cut mines) is usually too low to require routine monitoring. The exposures for residents neighbouring open cut mines would be much lower concentrations than for the workforce and therefore the risks would be correspondingly lower. For these reasons a specific assessment is not normally undertaken as part of an EA. However it is relevant to note that the Victorian EPA has recently published<sup>2</sup> an assessment criterion for respirable crystalline silica for the general community residing around mines/quarries. The criterion is  $3 \mu\text{g}/\text{m}^3$  (annual average) and for these purposes respirable is taken to be  $\text{PM}_{2.5}$  particles (Victorian EPA, 2006).

The figures showing the annual average predicted  $\text{PM}_{2.5}$  concentrations presented **Figures 4.2 and 4.3** discussed above, may therefore be used to assess the significance of exposure to crystalline silica. If it is assumed that current background levels are low and that 100% of the  $\text{PM}_{2.5}$  is crystalline silica then points inside the  $3 \mu\text{g}/\text{m}^3$  would be the area where the Victorian EPA criterion would be exceeded. This is clearly a conservative assumption because background levels are likely to be low but there is no chance that 100% of the  $\text{PM}_{2.5}$  would be crystalline silica. Examination of the relevant figures shows that the area affected would lie within the criteria for DEC's assessment criteria for  $\text{PM}_{10}$ .

In addition it is relevant to note that opponents to the Anvil Hill proposal have presented material which alleged the prevalence of the disease silicosis is increasing and also questioned the silica content of the rock at the Anvil Hill Project.

<sup>2</sup> Victorian EPA (2006) "Draft Protocol for Environmental Management – Mining and Extractive Industry" EPA Victoria, 40 City Road, Southbank, Victoria, 3006.

It is noted that in a letter dated 13 October 2005 from Anvil Hill Project Watch Association Inc to the Senate Community Affairs References Committee, there is reference to silica dust arising from Hunter Valley open cut coal mines and, with particular reference to the Anvil Hill Project, it is stated:

Example 2 The Anvil Hill Open Cut Coal Mine Proposal in an area of known high crystalline quartz silica sand soil profiles being amongst sandstone and conglomerate outcrops. The Project Manager has commented that Silica capping on the sandstone will cause issues with blasting.

Some clarification on the geology at Anvil Hill and occurrence of silica is provided below.

As sedimentary deposits, the coal seams and surrounding rocks at the Project are similar to other coal bearing strata occurring elsewhere the Hunter Valley. The major rock units associated with the coal seams are:

- conglomerate (pebbly material in a matrix of finer sandstone/claystone material)
- sandstone
- tuffs (fine grained material derived from volcanic ash falls) and tuffaceous claystones (tuffs which have been altered over time)

Such materials do contain variable amounts of silica. However, there is no evidence of any above normal concentration of silica in the Project area compared to that typically to be expected.

As an example, results from mineralogical analysis of 34 samples of the Awaba Tuff and claystone units at the Anvil Hill Project indicate quartz contents ranging from 1.1% to 64.9%. Quartz is the most common form of crystalline silica.

While the Project Manager recalls that at an Anvil Hill Community Consultative Committee meeting he commented on the formation of silicified caprock as a geological phenomenon, this is not relevant at the Anvil Hill Project. There is no evidence of formation of such capping in the Project Area. It is not a phenomenon generally found in the Hunter Valley geological setting.

Finally, it is not clear what the specific concern with fluoride, cadmium, aluminium and heavy metals is. These elements will of course be present in the overburden and even in the coal in small amounts and so will be present in the dust derived from the overburden coal. However, the elements are not present in bio-available forms and the dust from mining will pose no greater risk to exposure to heavy metals than would road dust from an unsealed road or from a paddock being ploughed.

**Table 9 of Air Quality Assessment shows a predicted maximum 24 hour average PM<sub>10</sub> at our residence. This shows we are consistently above the 30 ug/m<sup>3</sup> goal and at least once above the 50 ug/m<sup>3</sup> goal.**

The air quality impact assessment adopted the approach that if a dispersion model prediction for a particular property was above relevant air quality criteria, then that property was taken to be adversely affected by dust emissions from the proposed operations. It should be noted that the criteria are:

Annual average PM<sub>10</sub> – 30 µg/m<sup>3</sup>

Annual average TSP – 90 µg/m<sup>3</sup>

Annual average deposition (insoluble solids) 2 g/m<sup>2</sup>/month (increment) 4 g/m<sup>2</sup>/month (total).

The 24-hour PM<sub>10</sub> prediction would not necessarily trigger acquisition since it would be unreasonable to acquire a property on the basis of what might be a single exceedance of a PM<sub>10</sub> concentrations level that is known will be exceeded even if the mine were not to proceed.

Centennial would need to consult with the occupants of properties where exceedances of the DEC air quality criteria were predicted for at least part of the Project life.

### **Gases and fumes from blasting**

Dust emissions from blasting were estimated in the air quality impact assessment. These data formed part of the process to estimate the air quality impacts of the Project. Blasting will also result in emissions of NO<sub>x</sub> however air quality goals for NO<sub>x</sub> would not be exceeded off-site at the distances from the blast locations to the nearest residences.

Controls on blasting, to ensure that wind conditions were not such that dust and fume would be blown towards neighbouring properties, would ensure that this is the case.

The air quality impacts of the Project will be dominated by particulate matter emissions. Thus, the focus of the impact assessment was on the potential effects of particulate matter (PM).

### **Increase in 'acid rains' which plague the area**

Acid rain occurs because of man-made sources that include emissions of sulfur dioxide (SO<sub>2</sub>) and nitrogen oxides (NO<sub>x</sub>). SO<sub>2</sub> and NO<sub>x</sub> in the Hunter Valley result primarily from fossil fuel combustion. Some acid rain formation is driven by natural sources, such as decaying vegetation.

Dust emissions will be the main air quality issue from the Project. The proposed mining activities will therefore not increase "acid rains".

### **Dust from the coal handling plant, and cumulative dust from other mines**

Dust emissions from the coal handling plant were estimated in the air quality impact assessment. These data formed part of the process to estimate the air quality impacts of the Project.

Cumulative effects of the Project with other mining operations were considered in the air quality assessment. Section 8 ("Cumulative Impacts") discussed this in detail.

Predictions of the impact zone of the Project, based on air quality, considered the cumulative effects of other mining operations.

### **Visual range and dust**

At the IHAP hearing an offer was made to present some additional material on the effects of particulate matter on visibility and visual range. This material is provided below.

As light from a distant target object travels through the atmosphere towards an observer some of the light will be absorbed and some will be scattered out of the beam. The

cumulative effect of these two mechanisms is referred to as extinction. In addition, the same processes that scatter light out of the beam will scatter light from other parts of the atmosphere, not along the line of sight, into the line of sight. This effect will cause a dark object on the horizon to become lighter and a light object to become darker. In both cases, the contrast of the object will decrease and it will become less sharp and less easy to distinguish against the horizon.

To calculate the scattering or absorption of light by a plume requires information on the particle concentration and the size distribution of the particles and the optical properties of the particles. The most important particles from the perspective of visual impacts are those with sizes of the same order as the wavelength of visible light, which is in the range approximately 0.4 to 0.7  $\mu\text{m}$ . For this reason, it is appropriate to focus on the concentration of fine particles in the sub-2.5 micron range. The US EPA suggests that for fine particles (particles less than 2.5  $\mu\text{m}$  in diameter) the extinction coefficient ( $b_{\text{ext}}$ ) is  $0.004 \text{ km}^{-1}/\mu\text{g}/\text{m}^3$ . The extinction coefficient due to scattering by the molecules of the gaseous constituents of the atmosphere has a value of  $0.012 \text{ km}^{-1}$ .

Using this information it is possible to explore the likely visual effects of particulate matter on visibility in general. These basic principles are explored below.

If the initial contrast ( $C_o$ ) is defined as the ratio of the target brightness minus the horizon brightness divided by the horizon brightness, then the perceived contrast ( $C$ ) can be written as (see US EPA, 1979):

$$C = C_o \frac{B_T e^{-x \cdot b_{\text{ext}}}}{B_o}$$

where,

$C$  = the apparent contrast at the distance of the observer,

$C_o$  = the initial contrast of the object,

$\frac{B_T}{B_o}$  = the ratio of sky brightness at the target object to that at observer (taken as 1 for distances of 50 to 100 km,

$b_{\text{ext}}$  = extinction coefficient

$x$  = observer to object distance (km).

Equation 1

If equation 1 is manipulated it may re-written as follows:

$$x = \frac{\ln\left(\frac{C}{C_o} \frac{B_o}{B_T}\right)}{b_{\text{ext}}}$$

Equation 2

The extinction coefficient is a quantitative measure of the proportion of light scattered and absorbed as light passes through a kilometre<sup>3</sup> of air. Since light is scattered and absorbed by both molecules of air and particles, the extinction coefficient is made up of a number of terms, representing scattering by molecules that make up the gases in the atmosphere,

<sup>3</sup> In the analysis presented here the units of backscatter have been taken to be  $\text{km}^{-1}$  (i.e. 1/km). Backscatter could equally well be expressed in terms of  $\text{m}^{-1}$ , or  $\text{miles}^{-1}$ .



absorption by air molecules, scattering by particles and absorption by particles. Mathematically we can write:

$$b_{\text{ext}} = b_{\text{Rg}} + b_{\text{ag}} + b_{\text{scat}} + b_{\text{ap}},$$

where,

- $b_{\text{Rg}}$  is a term called Rayleigh scattering due to scattering by air molecules;
- $b_{\text{ag}}$  is absorption due to air molecules which can be taken to be zero unless pollutant gases such as  $\text{NO}_2$  etc are present;
- $b_{\text{scat}}$  is scattering due to particles, and;
- $b_{\text{ap}}$  is absorption due to particles.

Equation 2 can be used to calculate the maximum theoretical visual range for perfectly clean atmosphere where the only scattering is due to the molecules of the gases that make up the atmosphere. In this case  $b_{\text{scat}} = b_{\text{Rg}} = 0.012 \text{ km}^{-1}$ . If the minimum detectable contrast is 2% and the ratio of  $B_{\text{T}}/B_0$  is taken to be 1 then the maximum visual range  $x_{\text{max}}$  is  $\ln(0.02)/0.012$  km, i.e 326 km. This range is sometimes realised in desert areas, such as the south-western US and inland Australia in the winter at times when particulate matter concentrations are low. Of course, the curvature of the earth is significant over 326 km and the effect of the earth's curvature would often impose a limit to visual range that is much less than this unless the viewing point is elevated or the target object is elevated. For example, the limit imposed by the earth's curvature is observed at sea.

Typically, the  $b_{\text{scat}}$  ratio for fine particles is  $0.004 \text{ km}^{-1}/\mu\text{g}/\text{m}^3$  (US EPA, 1979). The addition of  $1 \mu\text{g}/\text{m}^3$  of dust in the fine particle size range along the viewing path, in an otherwise pristine area, would make  $b_{\text{scat}}$  take a value of  $0.016 \text{ km}^{-1}$  [ $0.012 \text{ km}^{-1} + 0.004 \text{ km}^{-1}$ ]. This would reduce the visual range from the theoretical limit of 326 km to 245 km. The presence of fine particles at a concentration of  $8 \mu\text{g}/\text{m}^3$  (the NEPM annual average reporting standard for fine particles ( $\text{PM}_{2.5}$ )) would reduce visual range to 89 km. The NEPM 24-hour reporting standard for fine particles is  $25 \mu\text{g}/\text{m}^3$  and this would cause the visual range to be 35 km.

These calculations highlight an important point, namely that the visibility of a plume or cloud of dust will depend on the concentration of fine particles already present from other sources. The greater this background concentration the less visible will be the plume from a specific source.

The important point in determining whether the plume of fine particles from a specific source is visible, or not, will be the integrated concentration along the line of sight through the plume to a target object behind the plume compared with a line of sight that does not pass through the plume. If presence of the plume causes a contrast change of more than two percent then the plume or cloud of dust would be visible.

## 5.0 References

- Andrews A and Sriskandarajah N, 1992. *Coal Mine Dust & Dairy Farming – The Answers* School of Agriculture, University of Western Sydney, Hawkesbury, Bourke Street, NSW 2753.
- Bell WB Jnl Acoust Soc Am 51(2), 758, 1972. *Animal response to sonic booms.*
- Chaston K and Doley D, 2006. *Mineral particulates an vegetation: Effects of coal dust, overburden and flyash on light interceptions and leaf temperature* Clean Air and Environmental Quality, Volume 40, Number 1, 40-44.
- Doley D, 2006. *Airborne particulates and vegetation: Review of physical interactions* Clean Air and Environmental Quality, Volume 41, Number 2, 36-41.
- Fields JM and Walker JG J Snd Vbn 85, 197, 1982. *The response to railway noise in residential areas in Great Britain.*
- NSW DEC, 2005. *Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in NSW*, Department of Environment and Conservation, 59-61, Goulburn Street, Sydney, NSW 2000.
- Taylor SM, Hall FL and Birnie SE J Snd Vbn 71, 261, 1980. *Effect of background levels on community response to aircraft noise.*
- Tonin R Acoustics Australia 25(2), 75, 1997. *Validation of Environmental Noise Model (ENM Windows)*
- US EPA, 1979. *Protecting Visibility: An EPA Report to Congress* Prepared by US EPA, Office of Air, Noise and Radiation, Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina 27711
- Victorian EPA, 2006. *Draft Protocol for Environmental Management Mining and Extractive Industry* EPA Victoria, 40 City Road, Southbank, Victoria 3006

## **APPENDIX 1**

### **Bird Species Sighted by Peter Hogan at Anvil Hill**

## BIRD SPECIES SIGHTED BY PETER HOGAN AT ANVIL HILL

Scientific Name	Common Name	Conservation		Last sighting and other notes
		TSC Act	EPBC Act	
<b>Lassianidae</b>				
<i>Coturnix pectoralis</i>	stubble quail		MAR	2006
<b>Anatidae</b>				
<i>Dendrocygna eytoni</i>	plumed whistling-duck		MIG	1977
<i>Cygnus atratus</i>	black swan		MIG	2003 – more common outside property
<i>Chenonetta jubata</i>	Australian wood duck			June 2006 - nest
<i>Anas superciliosa</i>	Pacific black duck			June 2006 - nest
<i>Anas gracilis</i>	grey teal			June 2006
<b>Podicipedidae</b>				
<i>Tachybaptus novaehollandiae</i>	Australasian grebe			June 2006
<b>Phalacrocoracidae</b>				
<i>Phalacrocorax melanoleucos</i>	little pied cormorant			2005 –looking for water
<i>Phalacrocorax varius</i>	pied cormorant			2005 – looking for water
<i>Phalacrocorax sulcirostris</i>	little black cormorant			2004 – looking for water
<b>Pelecanidae</b>				
<i>Pelecanus conspicillatus</i>	Australian pelican		MAR	2005
<b>Ardeidae</b>				
<i>Egretta novaehollandiae</i>	white-faced heron			June 2006
<i>Ardea pacifica</i>	white-necked heron			June 2006
<i>Ardea ibis</i>	cattle egret		MAR	June 2006
<i>Nycticorax caledonicus</i>	nankeen night heron		MAR	June 2006
<b>Threskiornithidae</b>				
<i>Threskiornis molucca</i>	Australian white ibis		MAR	2005 – drought affected
<i>Threskiornis spinicollis</i>	straw-necked ibis		MAR	2005 – drought affected
<i>Platylea regia</i>	royal spoonbill			2000 – drought affected
<i>Platylea flavipes</i>	yellow-billed spoonbill			2005 – drought affected
<b>Accipitridae</b>				
<i>Pandion haliaetus</i>	osprey	V	MAR & MIG	1976
<i>Elanus notatus</i>	black-shouldered kite			2005
<i>Milvus migrans</i>	black kite		MIG	early 1970s
<i>Haliastur sphenurus</i>	whistling kite		MAR	2006
<i>Haliaeetus leucogaster</i>	white-bellied sea-eagle		MAR & MIG	early 1980s – short visits
<i>Circus assimilis</i>	spotted harrier		MIG	2005
<i>Circus approximans</i>	swamp harrier		MAR & MIG	1990s
<i>Accipiter fasciatus</i>	brown goshawk			2006
<i>Aquila audax</i>	wedge-tailed eagle			2006 - nest
<b>Falconidae</b>				
<i>Falco berigora</i>	brown falcon			2006 - nest
<i>Falco longipennis</i>	Australian hobby			June 2006
<i>Falco hypoleucos</i>	grey falcon	V	MIG	1984

Scientific Name	Common Name	Conservation		Last sighting and other notes
		TSC Act	EPBC Act	
<i>Falco peregrinus</i>	peregrine falcon			June 2006
<i>Falco cenchroides</i>	nankeen kestrel		MAR	2006
<b>Rallidae</b>				
<i>Porphyrio porphyrio</i>	purple swamphen			2006 – drought affected
<i>Gallinula tenebrosa</i>	dusky moorhen			2006 – drought affected
<i>Fulica atra</i>	Eurasian coot			2006 – drought affected
<b>Otididae</b>				
<i>Ardeotis australis</i>	<b>Australian bustard</b>	<b>E</b>		<b>1970s - doubt will see another</b>
<b>Turnicidae</b>				
<i>Turnix varia</i>	painted button-quail			1990
<b>Burhinidae</b>				
<i>Burhinus grallarius</i>	<b>bush stone-curlew</b>	<b>E</b>		<b>1970s - doubt will see another</b>
<b>Charadriidae</b>				
<i>Elseya melanops</i>	black-fronted dotterel			2004 – drought affected
<i>Vanellus tricolor</i>	banded lapwing		MIG	2000
<i>Vanellus miles</i>	masked lapwing			2006 - next
<b>Columbidae</b>				
<i>Streptopelia chinensis</i>	spotted turtle-dove			June 2006
<i>Phaps chalcoptera</i>	common bronzewing			June 2006
<i>Phaps elegans</i>	brush bronzewing			1980s
<i>Ocyphaps lophotes</i>	crested pigeon			June 2006 - nest
<i>Geopelia striata</i>	peaceful dove			January 2006
<b>Cacatuidae</b>				
<i>Calyptorhynchus banksii graptogyne</i>	<b>red-tailed black-cockatoo</b>	<b>V</b>	<b>MIG &amp; E</b>	<b>1970s</b>
<i>Calyptorhynchus lathami</i>	<b>glossy black-cockatoo</b>	<b>V</b>		<b>June 2006 – three pair</b>
<i>Calyptorhynchus funereus</i>	yellow-tailed black-cockatoo			June 2006 – one pair
<i>Cacatua roseicapilla</i>	galah			June 2006 - nest
<i>Cacatua sanguinea</i>	little corella			2006
<i>Cacatua galerita</i>	sulphur-crested cockatoo			June 2006
<i>Nymphicus hollandicus</i>	cockatiel			1990s
<b>Psittacidae</b>				
<i>Alisterus scapularis</i>	Australian king-parrot			June 2006 – at my feet as I write - nest
<i>Platycercus eximius</i>	eastern rosella			June 2006 - nest
<i>Psephotus haematonotus</i>	red-rumped parrot			June 2006 - nest
<b>Cuculidae</b>				
<i>Cuculus pallidus</i>	pallid cuckoo		MAR	2006
<i>Cacomantis flabelliformis</i>	fan-tailed cuckoo		MAR	2006
<i>Chrysococcyx basalis</i>	Horsfield's bronze-cuckoo		MAR	20060
<i>Scythrops novaehollandiae</i>	channel-billed cuckoo		MAR	2006 – nest (Ravens')
<b>Strigidae</b>				
<i>Ninox novaeseelandiae</i>	southern boobook		MAR	1980s



Scientific Name	Common Name	Conservation		Last sighting and other notes
		TSC Act	EPBC Act	
<i>Ninox strenua</i>	powerful owl	V		1980s
<b>Tytonidae</b>				
<i>Tyto alba</i>	barn owl			2005
<b>Podargidae</b>				
<i>Podargus strigoides</i>	tawny frogmouth			June 2006
<b>Aegothelidae</b>				
<i>Aegotheles cristatus</i>	Australian owllet-nightjar			2005
<b>Apodidae</b>				
<i>Hirundapus caudacutus</i>	white-throated needletail		MAR & MIG	
<b>Alcedinidae</b>				
<i>Ceyx azurea</i>	azure kingfisher			2006
<b>Halcyonidae</b>				
<i>Dacelo novaeguineae</i>	laughing kookaburra			June 2006
<i>Todiramphus sanctus</i>	sacred kingfisher		MAR	2006
<b>Meropidae</b>				
<i>Merops ornatus</i>	rainbow bee-eater		MAR & MIG	2006
<b>Coraciidae</b>				
<i>Eurystomus orientalis</i>	dollarbird		MAR	2006
<b>Climacteridae</b>				
<i>Corombates leucophaeus</i>	white-throated treecreeper			June 2006
<i>Climacteris picumnus</i>	brown treecreeper	V		2006
<b>Maluridae</b>				
<i>Malurus cyaneus</i>	superb fairy-wren			June 2006 - nest
<b>Pardalotidae</b>				
<i>Pardalotus punctatus</i>	spotted pardalote			2006
<i>Pardalotus striatus</i>	striated pardalote			2006
<i>Origma solitaria</i>	rockwarbler			2006
<i>Pyrrholaemus sagittata</i>	speckled warbler	V		June 2006
<i>Gerygone fusca</i>	western gerygone			1970s
<i>Acanthiza chrysorrhoa</i>	yellow-rumped thornbill			June 2006 - nest
<i>Acanthiza nana</i>	yellow thornbill			2006
<i>Acanthiza lineata</i>	striated thornbill			1980s
<i>Aphelocephala leucopsis</i>	southern whiteface			June 2006 - nest
<b>Meliphagidae</b>				
<i>Anthochaera carunculata</i>	red wattlebird			2005
<i>Acanthagenys rufogularis</i>	spiny-cheeked honeyeater			June 2006
<i>Plectorhyncha lanceolata</i>	striped honeyeater			1990s
<i>Philemon corniculatus</i>	noisy friarbird			June 2006 - nest
<i>Entomyzon cyanotis</i>	blue-faced honeyeater			1980s, Muswellbrook 2006
<i>Manorina melanocephala</i>	noisy miner			June 2006
<i>Meliphaga lewinii</i>	Lewin's Honeyeater			1970s
<i>Lichenostomus chrysops</i>	yellow-faced honeyeater			June 2006
<i>Lichenostomus leucotis</i>	white-eared honeyeater			2006

Scientific Name	Common Name	Conservation		Last sighting and other notes
		TSC Act	EPBC Act	
<i>Lichenostomus penicillatus</i>	white-plumed honeyeater			June 2006 - nest
<i>Acanthorhynchus tenuirostris</i>	eastern spinebill			1980s
<i>Myzomela sanguinolenta</i>	scarlet honeyeater			2005 – one-off visit
<b>Petroicidae</b>				
<i>Microeca leucophaea</i>	jacky winter			
<i>Petroica multicolor</i>	scarlet robin			June 2006
<i>Petroica goodenovii</i>	red-capped robin			June 2006
<b><i>Melanodryas cucullata cucullata</i></b>	<b>hooded robin (south-eastern form)</b>	<b>V</b>		<b>June 2006</b>
<i>Eopsaltria australis</i>	eastern yellow robin			June 2006
<b>Pomatostomidae</b>				
<b><i>Pomatostomus temporalis temporalis</i></b>	<b>grey-crowned babbler (eastern subspecies)</b>	<b>V</b>		<b>June 2006 - nest</b>
<b>Neosittidae</b>				
<i>Daphoenositta chrysoptera</i>	varied sittella			
<i>Pachycephala pectoralis</i>	golden whistler			2005 – only a male
<i>Pachycephala rufiventris</i>	rufous whistler			June 2006
<i>Colluricincla harmonica</i>	grey shrike-thrush			June 2006 - nest
<i>Myiagra inquieta</i>	restless flycatcher			June 2006
<i>Grallina cyanoleuca</i>	magpie-lark		MAR	2006 - nest
<i>Rhipidura fuliginosa</i>	grey fantail			June 2006 - nest
<i>Rhipidura leucophrys</i>	willie wagtail			June 2006 - nest
<i>Dicrurus hottentottus</i>	spangled drongo		MAR	2005
<b>Pachycephalidae</b>				
<i>Falcunculus frontatus</i>	crested shrike-tit			1970s – I fear its gone for good
<b>Campephagidae</b>				
<i>Coracina novaehollandiae</i>	black-faced cuckoo-shrike		MAR	2006
<i>Coracina maxima</i>	ground cuckoo-shrike			1990
<i>Lalage sueurii</i>	white-winged triller			2006
<b>Artamidae</b>				
<i>Artamus superciliosus</i>	white-browed woodswallow			2006
<i>Artamus cinereus</i>	black-faced woodswallow			
<i>Artamus cyanopterus</i>	dusky woodswallow			June 2006
<i>Cracticus torquatus</i>	grey butcherbird			June 2006 - nest
<i>Cracticus nigrogularis</i>	pied butcherbird			
<i>Gymnorhina tibicen</i>	Australian magpie			June 2006 - nest
<i>Strepera graculina</i>	pied currawong			June 2006
<b>Corvidae</b>				
<i>Corvus coronoides</i>	Australian raven			June 2006 - nest
<b>Corcoracidae</b>				
<i>Corcorax melanorhamphos</i>	white-winged chough			June 2006 – nest - grand marshall of the feed bins
<i>Struthidea cinerea</i>	apostlebird			Late 1990s

Scientific Name	Common Name	Conservation		Last sighting and other notes
		TSC Act	EPBC Act	
<b>Ptilonorhynchidae</b>				
<i>Ptilonorhynchus violaceus</i>	satin bowerbird			June 2006 – mainly females
<b>Motacilidae</b>				
<i>Anthus novaeseelandiae</i>	Richard's pipit		MAR	June 2006
<b>Passeridae</b>				
<i>Passer domesticus</i>	house sparrow			June 2006
<i>Taeniopygia guttata</i>	zebra finch			2006
<i>Taeniopygia bichenovii</i>	double-barred finch			June 2006 – nest on table as I write
<i>Neochmia temporalis</i>	red-browed finch			2006
<b><i>Stagonopleura guttata</i></b>	<b>diamond firetail</b>	<b>V</b>		<b>2006</b>
<b>Dicaeidae</b>				
<i>Dicaeum hirundinaceum</i>	mistletoebird			2006
<b>Hirundinidae</b>				
<i>Cheramoeca leucosternum</i>	white-backed swallow			1980s
<i>Hirundo neoxena</i>	welcome swallow		MAR	June 2006 - nest
<i>Hirundo nigricans</i>	tree martin		MAR	1980s
<i>Hirundo ariel</i>	fairy martin			2006 - nest
<b>Sylviidae</b>				
<i>Cincloramphus mathewsi</i>	rufous songlark			1980s
<i>Cincloramphus cruralis</i>	brown songlark		MIG	2000
<b>Zosteropidae</b>				
<i>Zosterops lateralis</i>	silveryeye		MAR	2005
<b>Muscicapidae</b>				
<i>Turdus merula</i>	common blackbird		MIG	June 2006
<b>Sturnidae</b>				
<i>Sturnus vulgaris</i> *	common starling			June 2006 – send them back
<b>Sturnidae</b>				
<i>Acridotheres tristis</i> *	common myna			June 2006 – too many!