

Section 4B.4.6 describes the management measures to minimise the impacts on corridor function and Section 4B.4.7 evaluates the residual impact on the 37 threatened fauna species potentially affected (in accordance with Step 3 of Part 3A Guidelines).

4B.4.5.5 Fish Passage

The development of access roads and power line corridors over the Mine Site would require the crossing of Kurrajong and Pine Creeks and their tributaries. While Ecotone (2009) did not identify aquatic or fish habitat, nor consider the occurrence of aquatic or fish habitat to be likely (see Section 4B.4.4.2), the disturbance associated with the development and operation of these corridors could result in fish passage being blocked. Subsidence related changes to drainage line structure could also result in blockage or restriction of fish passage.

While the presence of aquatic or fish habitat has not been identified on the Mine Site, precluding any impacts on fish passage, Section 4B.4.6 describes the management measures that would be implemented to identify and manage fish passage over the life of the mine.

4B.4.5.6 Groundwater Dependent Ecosystems

Changes to groundwater levels associated with in-flow to the underground workings could potentially impact on any vegetation which is reliant on the impacted groundwater. It is also possible that surface cracking may impact on shallow groundwater aquifers such as the perched systems that exist at the base of the weathered zone (see Section 4B 2.5.9).

4B.4.5.7 Subsidence

Section 4B.1.6 assessed the impacts of subsidence on the land surface. The impacts most likely to affect the flora and fauna of the Mine Site are as follows.

- **Surface Cracking.** Small terrestrial fauna may fall into cracks formed at surface and may perish as a consequence. Cracking may also affect surface drainage with the potential, although considered unlikely, for surface flows to be re-routed underground. This could in turn impact on the habitat value of the drainage features of the Mine Site, ie. Community 3.
- **Sub-surface Cracking.** Should cracks develop between the geological strata, especially near surface strata, vertical flow of groundwater may be accelerated. This may in turn reduce the availability of water within groundwater required by some vegetation communities to maintain floristic diversity and vegetation structure, ie. Groundwater Dependent Ecosystems (GDEs).
- **Ponding.** As a result of the differential height of subsidence along the drainage lines of the Mine Site, ponds may form at various points along these. This could affect vegetation structure and therefore habitat value at these points.
- **Erosion.** Accelerated erosion may impact on the habitat value of affected areas of the Mine Site.



Section 4B.4.6 describes the management measures to minimise the impacts of subsidence and Section 4B.4.7 evaluates the residual impact on the 40 threatened species potentially affected (in accordance with Step 3 of Part 3A Guidelines).

4B.4.5.8 Discharge of Raffinate to the Namoi River

The volume of water to be discharged to the Namoi River is predicted to commence after 7 years of operations, peaking in Year 20 at approximately 2.1ML/day before gradually reducing throughout the remaining life of the Longwall Project (see **Table 4B.19**). This discharge is likely to have some small but positive impacts on the water quality and flow rate within the Namoi River, which in turn may benefit aquatic or riparian habitat and the flora and fauna that depend on these. Further discussion regarding the discharge to the Namoi River is presented in Section 4B.7.7.

4B.4.6 Ecological Management

4B.4.6.1 General Management Measures

The following management measures relate to the proposed general management of flora and fauna on the Mine Site.

- The Mine Site layout has been designed to minimise the clearing of native vegetation, particularly with the additional disturbance within the Pit Top Area and Reject Emplacement Area located within Community 7 (see **Table 4B.25**). Importantly, the vegetation of Community 3 along Kurrajong Creek Tributary 1, would not be disturbed by the proposed surface disturbing activities within and surrounding the Pit Top Area.
- The boundaries of all areas to be disturbed would be clearly marked for the machinery operators to minimise the extent of clearing. No clearing would occur outside these boundaries.
- During operations, the sediment dams and evaporation / storage ponds would be regularly inspected for fauna during the course of regular maintenance and operational inspections.
- Any cleared native vegetation would be dispersed whole or mechanically reduced and spread outside the perimeter bund around the ventilation shaft to provide habitat, increase the seed bank and to provide a mulch material for nutrient cycling and water retention purposes.
- A weed management strategy would be implemented, to be developed in consultation with the Livestock Health and Pest Authority and the Narrabri Shire Council weeds officer, for the retained or rehabilitated natural vegetation within the Mine Site. All noxious weeds would be treated in accordance with their weed Class as per the *Noxious Weeds Act 1993*.
- A feral animal management program would be implemented as part of the Landscape Management Plan for the Proponent to lower the predator impact upon small terrestrial native species, and would be reviewed on an annual basis throughout the life of the mine.



- The facilities within the Pit Top Area and the Reject Emplacement Area would be decommissioned and the area rehabilitated on completion of the Longwall Project to re-instate a final land use of agriculture and native vegetation in accordance with that detailed in Section 2.13.2.

4B.4.6.2 Management of Progressive Surface Disturbance

As the Longwall Project is developed, disturbance associated with construction of gas drainage sites (both pre-drainage and goaf gas drainage), ventilation sites and access roads and power line corridors to these sites would be progressively undertaken. Whilst the general area of disturbance for these activities can be identified (see **Figure 4B.29**) a degree of flexibility in the exact location of these sites of disturbance is required as this would be dictated by underground and mining conditions at the time. In order to accommodate the fact that the exact location of disturbance cannot be nominated, the Proponent has committed to the following management measures.

- Once the location of the surface disturbance is nominated, a qualified ecologist would be commissioned to complete a pre-clearance survey to identify whether any threatened species, population or community or their habitat is present. In particular, the survey would target threatened species known or potentially occurring in the area and identify habitat within the clearing areas, particularly substantial habitat trees. The Proponent has committed to retain all substantial habitat trees, wherever possible.
- The pre-clearance survey would also include an assessment of whether aquatic or fish habitat is present within the drainage features to be traversed by the access road and/or power line corridors.
- In the event that an EEC or threatened species or population is identified, alternate locations or orientations of the disturbance area would be considered and confirmed, if practicable.
- If the relocation or re-orientation of the area to be disturbed is not practicable (for reasons of mine / operational safety), the consultant ecologist would relocate any fauna species residing within the area to be cleared.
- Any tree-felling required would be undertaken in accordance with a Tree Felling Protocol to be developed and implemented by the Proponent. The Tree Felling Protocol would be developed by a qualified ecologist with previous experience supervising the felling of trees and would include, but not necessarily be limited to a description of:
 - the best time of the year for felling (which depends on the likely species to be affected);
 - pre-felling mapping of habitat trees;
 - inspections of trees on the day of felling;
 - procedures for the safe removal of fauna species from trees prior and post felling;
 - a relocation/release protocol; and
 - a protocol for the assessment and salvaging of tree hollows.



- Where trees are to be felled, an assessment of distribution of tree hollows surrounding the area to be cleared would be undertaken by the commissioned ecologist. The ecologist would determine the need for local supplementing of tree hollows (using salvaged tree hollows or nest boxes) based on the number of hollows lost during felling and the surrounding distribution of remaining natural hollows.
- As far as practicable, the more significant areas of surface disturbance associated with ventilation and gas drainage would be located away from the riparian corridors of Community 3.
- The location of access tracks would be determined in conjunction with an ecologist after inspecting each proposed route and determining the path with least impact on environmental values.
- In the event that fish habitat is identified, the crossing of the drainage feature would be constructed in accordance with the Policy and Guideline document of DPI-NSW Fisheries “*Why do Fish need to Cross the Road? Fish Passage Requirements for Waterway Crossings.*”
- All earthworks would be undertaken in accordance with an Erosion and Sediment Control Plan to be prepared for each activity, eg. gas pre-drainage sites, ventilation shaft sites, access roads, etc. particular emphasis would be placed on surface disturbing activities where runoff could flow directly into the drainage features of the Mine Site.
- To prevent the importation of root-rot fungus (*Phytophthora cinnamomi*) to the vegetation of the Mine Site, imported machinery would be required to be certified as being free of the disease prior to entry onto the Mine Site.
- As disturbed areas are no longer required for ongoing operational activities, these would be rehabilitated to re-establish either agricultural land or native vegetation as described in Section 2.13.3.

As noted in Section 4B.4.5.1 and **Table 4B.27**, the progressive disturbance associated with the Longwall Project would require the disturbance of approximately 210.5ha of native vegetation (predominantly that of Community 1). While this land would ultimately be rehabilitated to re-establish the vegetation of Community 3, a biodiversity offset strategy has been developed by the Proponent to compensate for this temporary disturbance to the biodiversity values of the Mine Site. Section 4B.4.6.4 provides a description of the proposed biodiversity offset strategy.

4B.4.6.3 Management of Subsidence-related Disturbance

As noted in Section 4B.4.5.7, subsidence could potentially impact on Mine Site ecology through surface cracking, ponding and erosion. The Proponent proposes to manage these potential impacts as follows.



Surface Cracking

As described in Section 4B.1.6.1, the potential cracking zones of each longwall panel would be regularly inspected and any cracking identified and filled in either by natural processes or through minor earthworks.

Ponding and Other Hydrological Changes

Changes to surface drainage would be monitored and any stream re-direction or modification works would be undertaken after consultation with an appropriately qualified hydrological professional and/or the Department of Environment, Climate Change and Water – Office of Water.

The Proponent would also regularly inspect the drainage lines of the Mine Site and should the variable subsidence result in the blockage of any identified fish or aquatic habitat (noting that Ecotone (2009) found no evidence of this habitat within the drainage features of the Mine Site), earthworks would be undertaken in accordance with “*Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings.*”

Erosion

To minimise the potential impacts of erosion and steeply eroded creek banks toppling the Proponent would:

- monitor surface slope displacement along subsidence cross lines;
- in-fill cracks as they appear;
- regrade or revegetate areas significantly affected by erosion; and
- regularly review and appraise any significant changes to surface slopes after each longwall is extracted.

4B.4.6.4 Management of Groundwater Dependent Ecosystems

The former DWE was consulted to identify the location of any known Groundwater Dependent Ecosystems (GDEs) on, or in the vicinity of the Mine Site. Two groundwater dependent ecosystems, identified as Hardys Spring and Eather Spring, have been recorded approximately 6km and 7km south of the Mine Site respectively. Groundwater investigation undertaken by Aquaterra (2009) identified a third GDE approximately 1.2km from the southern boundary of the Mine Site on the “Mayfield” property (referred to hereafter as the Mayfield Spring). The locations of the three springs are displayed on **Figure 4B.10**. This spring, which discharges at a very low rate (<0.1 L/s), appears to coincide with a topographic sub-crop of the Purlawaugh Formation and emanates within a low lying topographical area within a valley which acts as a drainage pathway.

Should significant changes to the floristics or structure of the GDE become evident, remedial measures which could include the provision of supplementary water to the vegetation would be undertaken. Any remedial measures would be developed in consultation with a suitably qualified ecologist and the DECCW-NOW.



4B.4.6.5 Biodiversity Offset Strategy

The Proponent would implement an offset strategy to compensate for the loss of woodland communities across the Mine Site. While the exact component areas and activities of the offset strategy have yet to be finalised, the Proponent is committed to implementing these within 3 years of commencement of the Longwall Project, or prior to surface disturbing activities above LW4, whichever occurs first. This approach to establishing and implementing the offset strategy will allow the Proponent to more accurately determine the exact areas of vegetation that will be disturbed. The Proponent notes that it is likely that gas pre-drainage activities will revert to conventional in-seam underground methods once the initial longwall panels are established, as well as obtaining more detailed information on the impact of subsidence on the local landform. Consequently, the potential removal of up to 101.4ha of native vegetation for the surface to in-seam drilling may be reduced substantially. In the interim, the Proponent has identified two parcels of land, namely Lots 64 and 65, DP757114, in the northwestern section of the Mine Site (**Figure 4B.30**) that are to be protected under a covenant under Section 88B of the *Conveyancing Act 1919* or similar. **Table 4B.28** details the area of each vegetation community that would be removed for mining activities (across the entire Mine Site), the area of each community in the proposed Biodiversity Offset Area, and the resulting offset ratio.

Table 4B.28
Calculated Biodiversity Offset Ratio for the Longwall Project

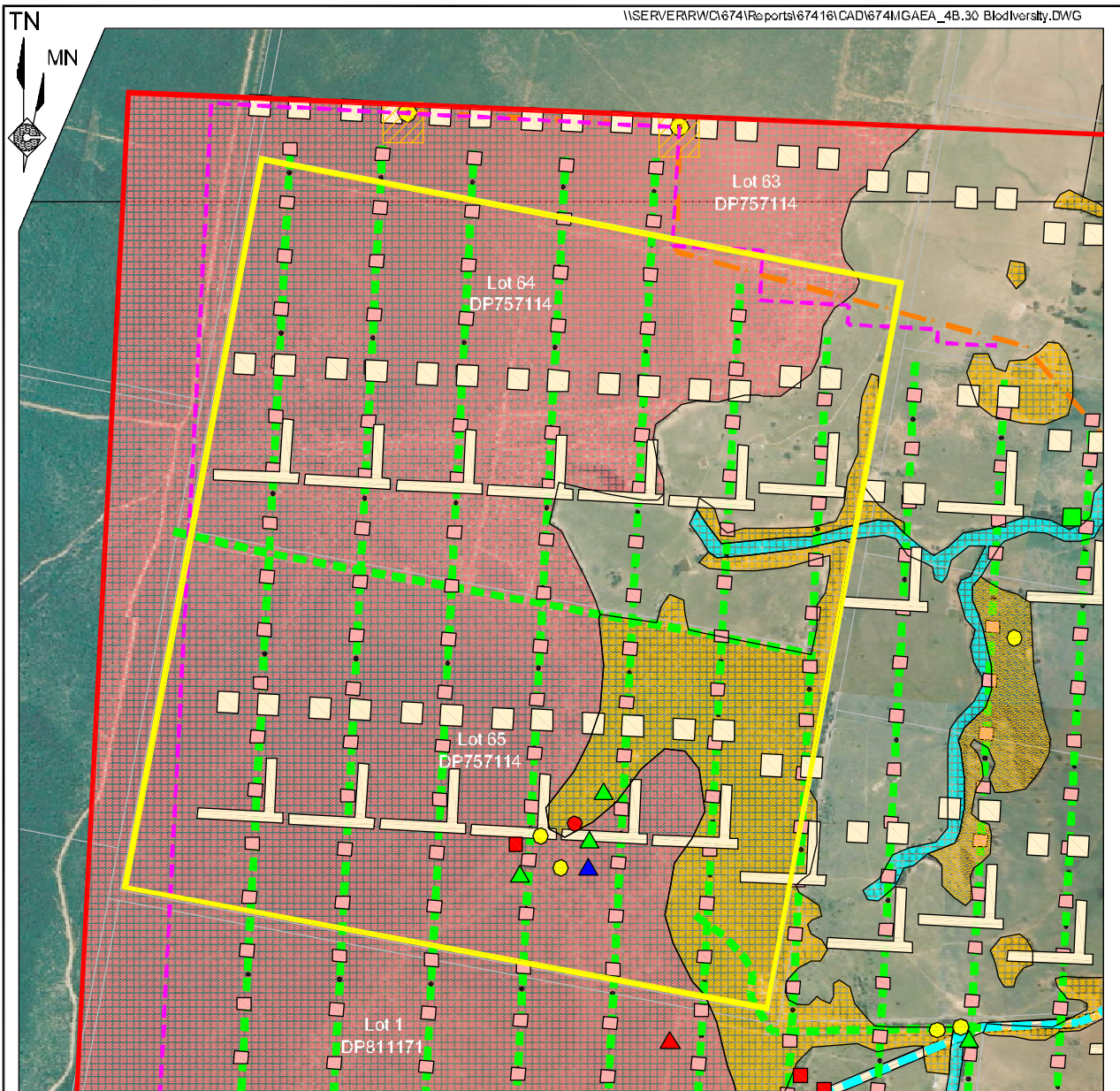
| Vegetation Community | Area on the Mine Site | Area to be Disturbed* | Area to be Conserved | Offset Ratio (Area Conserved : Area Disturbed) |
|--|-----------------------|-----------------------|----------------------|--|
| Community 1 | 2058 | 178.9 | 465.7 | 2.6 : 1 |
| Community 2 | 318 | 24.8 | 78.7 | 3.2 : 1 |
| Community 3 | 98 | 4.1 | 2.9 | 0.7 : 1 |
| Community 4 | 20 | 2.7 | 0 | -- |
| Community 6 | 0.3 | 0.0 | 0 | -- |
| Total | 2494.3 | 210.5 | 547.3 | 2.6 : 1 |
| * This area nominated is a maximum as a substantial proportion of the native vegetation nominated to be cleared for the surface to in-seam drilling may not eventuate. | | | | |
| Source: Modified after Ecotone (2009) - Table 13 | | | | |

The Proponent would implement the following management measures during the life of the Longwall Project and while ever the Proponent continues to own the relevant land.

- Stock would be excluded from the Biodiversity Offset Area.
- Wildlife-friendly boundary fences would be maintained to prevent stock from surrounding properties entering the Biodiversity Offset Area.
- Ongoing pest control programs would be implemented, including for rabbits, European Red Foxes and feral cats.
- Ongoing implementation of weed control programs, including for noxious weeds such as Bathurst burr, Creeping oxalis, Mother of millions, Noogoora burr, Prickly pear and Spiny burr grass.

Should the Proponent donate the land covered by the Biodiversity Offset Area to a public authority, an appropriate arrangement for the ongoing management of the land would be negotiated with the appropriate government agency prior to the land being transferred.





REFERENCE

- Mine Site Boundary
- Cadastral Boundary
- Creek / Drainage Line
- Boundary of Biodiversity Offset Area (offset for clarity)
- Indicative Limit of Underground Workings
- Proposed Stage 2 All Weather Unsealed Access Road
- Proposed Stage 2 Power Line
- Proposed Stage 2 Power Line Advancing with Mine
- Proposed Stage 2 Access for Goaf Drainage
- Proposed Stage 2 Rear of Panel Ventilation Shaft
- Proposed Goaf Drainage Borehole Site
- Proposed Gas Production Site
- Community 1 - Brown Bloodwood / Pilliga Box Woodland
- Community 2 - Inland Grey Box Woodland
- Community 3 - Riparian Forest
- Community 4 - Callitris Forest
- Community 5 - River Red Gum
- Community 6 - Weeping Myall Endangered Ecological Community

- Delicate mouse
- Glossy-black cockatoo
- ▲ Greater long-eared bat
- ▲ Grey-crowned babbler
- ▲ Pale-headed snake
- Speckled warbler

| Vegetation Community | Biodiversity Offset Area | |
|----------------------|--------------------------|---------------------------|
| | Total Area (ha) | Area to be Disturbed (ha) |
| 1 | 520 | 54.3 |
| 2 | 88.1 | 9.4 |
| 3 | 3.2 | 0.3 |
| 4 | 0 | 0 |
| 5 | 0 | 0 |
| Cleared | 76.1 | 11.0 |
| Total | 687.4 | 75.0 |

SCALE 1:25 000

250 0 250 500 750 1000 1250 m

Base Photo Source: Geo-spectrum (Australia) Pty Ltd - Date of Photo: 5 December 2005

Figure 4B.30
 BIODIVERSITY OFFSET AREA



It is noted that a number of access tracks, pre-drainage and goaf boreholes and gas production sites would be located within the Biodiversity Offset Area. The areas that would be disturbed by each of these have not been incorporated within the area calculation for the Biodiversity Offset Area and would be rehabilitated as soon as practicable once they are no longer required for gas drainage and production purposes.

4B.4.7 Assessment of Ecological Impacts

4B.4.7.1 Threatened Flora and Fauna of the TSC Act

This section draws on the evaluation of impact on the EECs and threatened species and populations either identified on, or considered as potentially occurring on the Mine Site completed by Ecotone (2009) in accordance with Step 3 of the Part 3A Guidelines. Discussion of the evaluation of impacts with respect to Steps 4 and 5 of the Part 3A Guidelines is also provided.

Evaluation of Impact on Threatened Flora Species and EECs (Step 3 of the Part 3A Guidelines)

(a) *How is the proposal likely to affect the lifecycle of a threatened species and/or population?*

Of the three threatened flora species identified as potentially occurring on the Mine Site, Ecotone (2009) concludes the following.

- *Bertya opposens*. If occurring on the Mine Site, any individuals are likely to represent the outer fringe of the substantial known population in Jacks Creek State Forest. Given the known presence of this nearby extensive source of propagules, the lifecycle of the locally occurring population of *Coolabah bertya* is unlikely to be significantly affected, even if individual plants happen to be removed or disturbed.
- *Cadellia pentastylis* and *Lepidium aschersonii*. In both cases, the potential habitat for these species occur across the Mine Site (with it being most likely to be present over the flat plains area of the eastern part of the Mine Site). Therefore, given the generally wide distribution regionally of both species, it is unlikely that any removal of, or disturbance to individuals of the species within the Mine Site would affect the lifecycle of either species on a regional basis.

(b) *How is the proposal likely to affect the habitat of a threatened species, population or ecological community?*

Threatened flora species

- *Bertya opposens*. Potential habitat occurs within the pilliga vegetation of Community 1. Limited areas of potential habitat would be disturbed by the proposed surface disturbance, as well as any changes resultant from subsidence, eg. changes to local drainage. Notably, a significant occupied area of habitat occurs to the west in Jacks Creek State Forest, where a large population is known to occur.



- ***Cadellia pentastylis* and *Lepidium aschersonii***: While potential habitat may be disturbed by the proposed surface disturbance, as well as any changes resultant from subsidence, the majority of the potential habitat on the flat plains area of the eastern part of the Mine Site would remain unaffected by the Longwall Project.

Threatened Ecological Communities

- ***Inland Grey Box Woodland***: Patches of known occupied habitat occur on the flat plains area in the eastern part of the Mine Site (Community 2). Parts of this habitat could be affected by subsidence and the associated changes in hydrology and drainage.
 - ***Brigalow***: Patches of marginal occupied habitat occur in the undulating pilliga community (Community 1) in the western part of the Mine Site. This area could be affected by subsidence and the associated changes in hydrology and drainage.
 - ***Myall Woodland***: At least one small disturbed remnant of the community occurs along a dirt road in the south-eastern part of the Mine Site (see **Figure 4B.27**). This area of the Mine Site would not be disturbed.
- (c) ***Does the proposal affect any threatened species or populations that are at the limit of its known distribution?***
- All three species would be at the limit of their currently known distribution.
- ***Bertya opposens*** would occur at the eastern limit of the Jacks Creek State Forest sub-population.
 - ***Cadellia pentastylis*** would be at the western limit of its known distribution.
 - ***Lepidium aschersonii*** would be at the eastern limit of its known distribution.
- (d) ***How is the proposal likely to affect current disturbance regimes?***
- Current disturbance regimes within the study area include stock grazing, fire, weed invasion and human presence. Of these disturbance regimes, stock grazing and fire are likely to remain unchanged or decrease over the life of the mine. The area and level of weed invasion may increase due to the increased human activity on the Mine Site.
- (e) ***How is the proposal likely to affect habitat connectivity?***
- The proposed northern power line corridor would split Community 1 roughly in half and may fragment habitat for potential threatened flora species and the marginal occurrence of the brigalow EEC. Minor fragmentation of the Inland Grey Box Woodland EEC (Community 2) and riparian habitat (Community 3) would also occur further to the east. Further minor fragmentation would occur as roads are developed to enable access to the gas drainage and ventilation infrastructure required by the Longwall Project, although these are not expected to result in significant fragmentation of habitat.
- (f) ***How is the proposal likely to affect critical habitat?***
- No areas of critical habitat proclaimed occur in the vicinity of the study area.



Conclusion

The proposed Longwall Project may directly or indirectly impact on one or more threatened flora species with potential to occur. However, any impact would be minimal given the known distributions and abundances of the species elsewhere.

The proposed Longwall Project may also have minor direct impact on the Inland Grey Box Woodland and Brigalow EECs as a result of proposed surface disturbance as well as a minor indirect impact associated with subsidence and consequent hydrological changes. Ecotone (2009) concludes that any impact would be adequately mitigated by the proposed measures described in Section 4B.4.6.

Evaluation of Impact on Threatened Fauna Species (Step 3 of the Part 3A Guidelines)

- (a) ***How is the proposal likely to affect the lifecycle of a threatened species and/or population?***

Threatened Population

- **Australian brush-turkey (Endangered Population under the TSC Act).** The Australian brush-turkey was not recorded on the Mine Site, however, 10 records for the species occur within a 10km radius. While no evidence of habitation by the species was identified, Community 1 of the Mine Site was considered to be potential habitat. Should the species occur on the Mine Site the lifecycle of the species may be affected by the proposed longwall mining. Cracking resulting from subsidence may damage the species nest mounds and reduce the reproductive output of some pairs and reduce the overall reproductive output of any local population.

Threatened Species

- **Magpie goose and Black-necked stork**

Neither species was identified on the Mine Site although they may on rare occasions utilise farm dams and nearby grassland habitats within the Mine Site. While surface cracking following subsidence may drain farm dams and reduce the available habitat for the magpie goose and black-necked stork, the highly mobile nature of the two species and the likely infrequency of visits to the subject site suggest that the life cycles of the magpie goose and black-necked stork are unlikely to be significantly affected by the proposed longwall mine.

- **Black-breasted buzzard and Little eagle**

Neither species were recorded on the Mine Site, however, they may utilise habitat areas across the Mine Site on an occasional or rare basis. There is no suitable breeding habitat for the black-breasted buzzard (timbered water courses) and both species are only likely to visit the Mine Site on an occasional or rare basis. Given all trees to be felled would be inspected for fauna prior to disturbance and no tree-fall is expected as a result of subsidence the proposed longwall mine is unlikely to significantly affect the life cycle of either species.



- **Hollow dependent woodland bird species⁸**

The Glossy-black cockatoo and Superb parrot were recorded during field surveys. The Little lorikeet, Turquoise parrot, Swift parrot, Masked owl and Barking owl were not recorded during field surveys, however, suitable habitat is present for each species. These woodland bird species require tree hollows for breeding and either woodland areas or woodland/grassland areas for foraging. Areas of this habitat would be cleared as part of the progressive disturbance associated with gas drainage and mine ventilation activities. Notably, all clearing activities would be undertaken according to a tree clearing protocol to avoid direct disturbance to nesting birds. Additional tree losses due to subsidence are unlikely as tree fall is not predicted to occur.

The loss of potential foraging and nesting trees during clearing activities is therefore unlikely to affect the lifecycle of the above hollow dependent bird species due to the small area of vegetation to be removed relative to the area to be conserved as part of the proposed biodiversity offset area.

- **Non-hollow dependent woodland bird species⁹**

The Speckled warbler, Grey-crowned babbler, Varied sittella and Diamond firetail were recorded during field surveys. The Black-chinned honeyeater, Regent honeyeater and Hooded robin were not recorded during field surveys, however, suitable habitat is present for each species. Areas of this habitat would be cleared as part of the progressive disturbance associated with gas drainage and mine ventilation activities. Notably, all clearing activities would be undertaken according to a tree clearing protocol to avoid direct disturbance to nesting birds.

The loss of potential foraging and nesting trees during clearing activities is therefore unlikely to affect the lifecycle of the above hollow dependent bird species due to the small area of vegetation to be removed relative to the area to be conserved as part of the proposed biodiversity offset area.

- **Spotted-tailed quoll**

The spotted-tailed quoll was not recorded during field surveys, however suitable habitat is present. Areas of this habitat would be cleared as part of the progressive disturbance associated with gas drainage and mine ventilation activities. Notably, hollow bearing habitat trees would be avoided as far as practicable with additional tree fall as a consequence of subsidence not predicted. Surface cracks may result in the death or injury of some prey species of the Spotted-tailed quoll, although the species preys on a large range of species and so this is unlikely to have any significant impact.

The loss of some woodland areas during clearing activities and impacts on some prey species is unlikely to affect the lifecycle of the spotted-tailed quoll due to the small area of vegetation to be removed relative to the area to be conserved as part of the proposed biodiversity offset area.

⁸ Glossy black-cockatoo, Little lorikeet, Turquoise parrot, Swift parrot, Superb parrot, Masked owl, Barking owl
⁹ Speckled warbler, Black-chinned honeyeater, Regent honeyeater, Hooded robin, Grey-crowned babbler, Varied sittella, Diamond firetail.

- **Koala**

A single scat sample was identified on the Mine Site. Areas of Koala habitat would be cleared as part of the progressive disturbance associated with gas drainage and mine ventilation activities. Notably, all clearing activities would be undertaken according to a tree clearing protocol to avoid direct disturbance to resident Koalas.

The loss of some woodland areas during clearing activities is unlikely to affect the lifecycle of the Koala due to the small area of vegetation to be removed relative to the area to be conserved as part of the proposed biodiversity offset area.

- **Eastern pygmy-possum**

The eastern pygmy-possum was recorded on the Mine Site. Areas of woodland habitat would be cleared and due to their small size individual pygmy possums may not be detected during felling and individuals may perish or become injured during the clearing process. Additionally, as the home range of this species is limited to 0.68ha for adult males and 0.35ha for adult females, the proposed disturbance has the potential to affect, through removal or fragmentation, significant portions of individual possums home ranges. The life-cycle of the Eastern pygmy possum may also be affected by surface cracking if individuals fall into cracks while moving between trees. This would be partially mitigated by the Proponent's commitment to identify and fill in cracks as they develop on the Mine Site.

It is noted, however, that large areas of similar woodland exist to the west and south of the Mine Site and it is likely that the population of eastern pygmy possums extends into these areas. Therefore, it is considered unlikely that the possible loss of some individuals and potential fragmentation of part of the Mine Site population are unlikely to significantly impact on the life cycle of the species.

- **Squirrel glider**

The squirrel glider was not recorded during field surveys, however suitable habitat was identified and the species may occur. Areas of potential habitat would be cleared as part of the progressive disturbance associated with gas drainage and mine ventilation activities. Notably, all clearing activities would be undertaken according to a tree clearing protocol to avoid direct disturbance to resident gliders.

The loss of potential foraging and nesting trees during clearing activities is unlikely to affect the lifecycle of the squirrel glider due to the small area of vegetation to be removed relative to the area to be conserved as part of the proposed biodiversity offset area.

- **Black-striped wallaby**

The Black-striped wallaby was recorded from a single hair tube sample. Areas of wallaby habitat would be cleared as part of the progressive disturbance associated with gas drainage and mine ventilation activities. Surface cracking has the potential to result in injury to individuals, although this risk is considered unlikely by Ecotone (2009). This risk would be further minimised by the commitment of the Proponent to fill in cracks as they develop.



The loss of some woodland areas during clearing activities and impacts on some prey species is unlikely to affect the lifecycle of the Black-striped wallaby due to the small area of vegetation to be removed relative to the area to be conserved as part of the proposed biodiversity offset area.

- **Hollow roosting bat species¹⁰**

The Yellow-bellied sheath-tail-bat, Little pied bat¹¹ and Eastern long-eared bat were recorded during field surveys. Potential roosting and breeding trees and foraging area would be cleared as part of the progressive disturbance associated with gas drainage and mine ventilation activities. Notably, all clearing activities would be undertaken according to a tree clearing protocol to avoid breeding periods and the felling of trees while bats may be roosting.

The loss of habitat is unlikely to affect the lifecycle of the hollow roosting bats due to the small area of vegetation to be removed relative to the area to be conserved as part of the proposed biodiversity offset area.

- **Cave roosting bat species¹²**

The Little pied bat¹¹ was recorded on the Mine Site. The large-eared pied bat was not recorded, however, suitable habitat is present. Notably no caves or mine shafts for roosting were identified by Ecotone (2009) and it is unlikely that any occur in areas not covered during the survey. Foraging habitat would, however, be cleared as part of the progressive disturbance associated with gas drainage and mine ventilation activities.

The loss of foraging habitat is unlikely to affect the lifecycle of the hollow roosting bats due to the small area of vegetation to be removed relative to the area to be conserved as part of the proposed biodiversity offset area.

- **Delicate mouse**

The Delicate mouse was recorded on the Mine Site. Areas of woodland habitat would be cleared and due to their small size individual Delicate mice may not be detected during felling and individuals may perish or become injured during the clearing process. Additionally, the proposed northern power line corridor may fragment parts of the existing population if individuals are unable or unwilling to cross the cleared power-line easement. The life-cycle of the Delicate mouse may also be affected by surface cracking if individuals fall into cracks while foraging. This would be partially mitigated by the Proponent's commitment to identify and fill in cracks as they develop on the Mine Site.

It is noted, however, that large areas of similar woodland exist to the west and south of the Mine Site and it is likely that the population of Delicate mouse extends into these areas. Therefore, it is considered unlikely that the possible loss of some individuals and potential fragmentation of part of the Mine Site population are unlikely to significantly impact on the life cycle of the species.

¹⁰ Yellow-bellied sheath-tail-bat, Eastern long-eared bat, Little pied bat.

¹¹ Little Pied Bat uses both caves and tree hollows for roosting.

¹² Large-eared pied bat, Little pied bat.



- **Pale-headed snake**

The Pale-headed snake was recorded on the Mine Site. Pale-headed snakes utilise hollows and the tree canopy for nesting and foraging which would be cleared as part of the progressive disturbance associated with gas drainage and mine ventilation activities. Notably, all clearing activities would be undertaken according to a tree clearing protocol to minimise the felling of trees while snakes may remain in hollows or the tree canopy. The life-cycle of the pale-headed snake may also be affected by surface cracking during subsidence as individual snakes, particularly smaller juveniles, may be injured or perish if falling into the cracks. This would be partially mitigated by the Proponent's commitment to identify and fill in cracks as they develop on the Mine Site.

Due to the potential for harm to individuals during clearing, including possible home range reductions, and the occurrence of surface cracking across what may be limited home ranges of the snake, the life-cycle of the pale-headed snake may be negatively affected by the proposed longwall mine.

(b) ***How is the proposal likely to affect the habitat of a threatened species, endangered population or endangered ecological community?***

Habitat for the 37 threatened fauna species would be cleared as part of the progressive disturbance associated with gas drainage and mine ventilation activities. Notably, all clearing activities would be undertaken according to a tree clearing protocol to avoid breeding periods and the felling of trees while individual species may be resident. The risk of tree fall as a result of subsidence is considered minimal and therefore unlikely to impact on threatened species habitat.

The proposed clearing would be unlikely to impact on the habitat of 34 of the 37 threatened species, however, may affect species with small home range areas such as the Eastern pygmy-possum, Delicate mouse, and Pale-headed snake. It is noted, however, that large areas of similar habitat exist to the west and south of the Mine Site and it is likely that the populations of these three species extend into these areas. Therefore, due to the small area of habitat to be removed relative to the area to be conserved (as part of the proposed biodiversity offset area, as well as off the Mine Site) it is considered unlikely that the possible loss of habitat would significantly impact on any of the above species.

(c) ***Does the proposal affect any threatened species or endangered population that are at the limit of its known distribution?***

The Mine Site is at the limit of the southern distribution of the Delicate mouse. The identification of the delicate mouse extends its southern most record by approximately 210km to the southeast. As noted above, individual Delicate mice may be injured or perish by falling into surface cracks, however, it is unlikely that species would be significantly impacted by the proposed longwall mine.



(d) ***How is the proposal likely to affect current disturbance regimes?***

Current disturbance regimes within the study area include stock grazing, fire, weed invasion and human presence. Of these disturbance regimes, stock grazing and fire are likely to remain unchanged or decrease over the life of the mine. The area and level of weed invasion may increase due to the increased human activity on the Mine Site.

(e) ***How is the proposal likely to affect habitat connectivity?***

The northern power line corridor would split the habitat of Community 1 roughly in half and may create a barrier to movement for species wary of open areas, eg. Delicate mouse and Eastern pygmy possum. Further minor fragmentation would occur as roads are developed to enable access to the gas drainage and ventilation infrastructure required by the Longwall Project, although these are not expected to result in significant fragmentation of habitat.

(f) ***How is the proposal likely to affect critical habitat?***

No areas of critical habitat proclaimed occur in the vicinity of the study area.

Conclusion

The proposed Longwall Project may directly or indirectly impact on one or more threatened fauna species which either have been identified or have the potential to occur on the Mine Site. In most cases, the proposed mitigation measures described in Section 4B.4.6 would be sufficient to reduce the potential impact on the identified threatened species such that any significant impact on the life cycle or habitat is considered by Ecotone (2009) to be unlikely (given the known distributions and abundances of the species elsewhere).

As a consequence of the reduction in habitat and surface cracking, the proposed Longwall Project could possibly impact on the life cycle, home ranges or habitat connectivity of a limited number of threatened fauna including the Delicate mouse, Eastern pygmy possum and Pale-headed snake.

Avoid, Mitigate, Offset Impacts (Step 4 of the Part 3A Guidelines)

As noted in Section 4B.4.6, prior to disturbance related to the development of gas drainage and mine ventilation infrastructure, the Proponent would commission an assessment of the proposed area to be disturbed and advise of any recommended relocation of activities to avoid impacts on identified threatened species, populations or EECs. If the proposed relocation of activities would not compromise the safety of underground operations, eg. as a result of reduced efficiency of gas drainage or mine ventilation, the Proponent would revise the proposed location of disturbance as recommended.

It is also noteworthy that the Proponent has located all surface facilities, including the Reject Emplacement Area over the already cleared agricultural land of Community 7. All activities have been set back from the riparian areas of Community 3, with appropriate management measures in place to ensure no indirect impacts on this vegetation.



However, despite these commitments, the clearing of up to 210.5ha of native vegetation, including habitat for up to 40 threatened species and possibly one EEC would be unavoidable. Some impact on threatened species and their habitats has also been predicted as a consequence of surface cracking associated with mine subsidence. Sections 4B.4.6.1 to 4B.4.6.4 describe the measures proposed to mitigate these unavoidable impacts. In summary, these include the following measures.

- The filling in of surface cracks as they are identified. The filling would be allowed to occur naturally for small cracks but would be undertaken manually by the Proponent for larger or persisting cracks.
- Changes to surface drainage would be monitored and remedial works undertaken to maintain current drainage patterns and riparian corridors in consultation with an appropriately qualified hydrological professional and the DECCW-OW.
- To minimize the potential impacts of erosion and steeply eroded creek banks toppling the Proponent would:
 - monitor surface slope displacement along subsidence cross lines;
 - fill in cracks as they appear;
 - re-grade or revegetate areas significantly affected by erosion; and
 - regularly review and appraise any significant changes to surface slopes after each longwall is completed.
- Native vegetation to be cleared would be inspected by an ecologist for threatened flora species and roosting or nesting fauna prior to clearing. Any identified fauna would be relocated prior to disturbance.
- The location of access tracks would be influenced by an ecologist after inspecting each proposed route and determining the path with least impact on environmental values.
- A flora and fauna management plan and monitoring program would be developed to ensure regular reassessment of the ecological values of disturbed and natural areas.

The Proponent acknowledges that these measures cannot completely mitigate the impacts resultant from the activities of the proposed Longwall Project. Therefore to compensate for the residual impacts, the Proponent has proposed the establishment of a Biodiversity Offset Area on the Mine Site (see Section 4B.4.6.5). The biodiversity offset area would include approximately 466ha of Community 1, 79ha of Community 2 and 3ha of Community 3, the condition of which has been described as “almost pristine” in places by the consulting ecologist, and linked to Jacks Creek State Forest to the west which in turn is linked to Pilliga East State Forest to the south.

Assessment of Impacts Against Key Thresholds (Step 5 of the Part 3A Guidelines)

Ecotone (2009) completed an assessment of the residual impacts of the proposed Longwall Project on threatened species, with the results summarised as follows.



- Whether or not the proposal, including actions to avoid or mitigate impacts or compensate to prevent unavoidable impacts would maintain or improve biodiversity values.

Given the loss of approximately 210.5ha of native vegetation would be offset by the conservation of 547.3ha of equivalent vegetation, with all disturbance to be rehabilitated to re-establish the original vegetation community, the Longwall Project would maintain overall biodiversity values.

- Whether or not the proposal is likely to reduce the long-term viability of a local population of the species, population or ecological community.

The Longwall Project would be unlikely to reduce the long-term viability of any local population of flora or fauna species.

- Whether or not the proposal is likely to accelerate the extinction of the species, population or ecological community or place it at risk of extinction

The Longwall Project would not accelerate the extinction of, or place any species, population or ecological community at risk of extinction.

- Whether or not the proposal would adversely affect critical habitat.

The Longwall Project would not affect any areas of identified critical habitat.

4B.4.7.2 Koala Habitat Assessment (SEPP 44)

A single Koala scat was identified during the site survey on the Mine Site, however, no further evidence of a resident Koala population was identified. On this basis, and as the only food tree species identified on the Mine Site *Eucalyptus albens* was found at densities of <15% within the woodland areas, it could not be determined whether the Mine Site represents “Core Koala Habitat” as defined by SEPP 44.

The above notwithstanding, Ecotone (2009) concludes that even in the event of a resident population being identified, the loss of some woodland areas during clearing activities is unlikely to affect the lifecycle of the Koala due to the small area of vegetation to be removed relative to the area to be conserved as part of the proposed biodiversity offset area and that within the adjoining State Forest and private property. The possible impact would be further mitigated by the proposed pre-clearing surveys to be undertaken prior to each clearing campaign.

4B.4.7.3 Matters of National Environmental Significance of the EPBC Act

The EPBC Act focuses Commonwealth interests on matters of national environmental significance (NES) including integrated biodiversity conservation and the management of important protected areas. With regard to flora and fauna, the only matters of NES relevant to the proposed Longwall Project are:

- nationally listed threatened species;
- nationally listed threatened ecological communities; and
- nationally listed threatened migratory species.



Ecotone (2009) considered the impact of the proposed Longwall Project on each matter of NES and concluded the following.

Nationally Listed Threatened Species

- Due to the small area of vegetation to be removed, and the proposed mitigation of surface cracking, the proposed longwall mine is unlikely to lead to a long-term decrease in the size of any populations of the threatened flora or fauna.
- The clearing of vegetation associated with the proposed Longwall Project is unlikely to have a significant impact on occupancy of these species on the Mine Site.
- There is the potential for the disturbance associated with the northern power line to fragment populations of the Delicate mouse, Border thick-tailed gecko and Five-clawed worm skink corridor, however, given the large area of equivalent habitat on and surrounding the Mine Site, the impact of this fragmentation would be significantly reduced. No other populations of threatened species are likely to suffer significant fragmentation.
- The proposed Longwall Project would not adversely affect habitat critical to the survival of any threatened species.
- Due to the retention of significant areas of equivalent habitat to that to be disturbed, the proposed Longwall Project is considered unlikely to affect the breeding cycle of any threatened species.
- The proposed Longwall Project would not modify, destroy, remove or isolate or decrease the availability or quality of habitat for any threatened species to the extent that any would be likely to decline.
- The proposed Longwall Project is highly unlikely to result in an invasive species harmful to the identified threatened species from becoming established within the study area.
- With the adoption of appropriate equipment certification to confirm appropriate decontamination, the risk of introducing plant disease or pathogens such as *Phytophthora cinnamomi* would be significantly reduced. The proposed Longwall Project is highly unlikely to result in the introduction of a disease that would cause threatened fauna species to decline.
- While the proposed Longwall Project would result in the loss of some potential habitat for the identified threatened species, this would not interfere significantly with the recovery of these species.

Nationally Listed Threatened Ecological Communities

- The limited surface disturbance proposed is unlikely to significantly reduce the extent of the two endangered ecological communities, Brigalow and Weeping Myall, on the Mine Site.
- Some fragmentation of the Brigalow community may occur as a result of the northern power line corridor, however, other populations would remain intact. The Weeping Myall EEC is already highly fragmented and would not be affected by the proposed disturbance of the Longwall Project.



- No habitat critical to the survival of either EEC occurs within the Mine Site.
- Although some hydrological changes could occur within the Mine Site as a consequence of subsidence, neither EEC is critically dependent on strict maintenance of the current hydrological regime for survival.
- No substantial changes in the species composition of either EEC are expected as a direct or indirect result of the longwall Project.
- Assuming the implementation of a weed management strategy, the risk of invasive weeds and disease would be reduced so as unlikely to have a major impact.

Nationally Listed Threatened Migratory Species

Given the small area of vegetation to be removed relative to the area to be conserved as part of the proposed biodiversity offset area and on land to the south, west and north of the Mine Site, the proposed Longwall Project would not have any significant impact on the life cycle, habitat or survival of nationally listed migratory species.

4B.4.7.4 Impacts on Non-listed Species and Communities

The Mine Site contains a high diversity of flora species, but none of those recorded were listed on the Rare or Threatened Australian Plants (ROTAP) database (Briggs & Leigh, 1996) or were otherwise locally or regionally significant. In the event that one or more ROTAP species do occur, Ecotone (2009) concludes that the minor level of removal or temporary disturbance is unlikely to place their local populations at risk of extinction.

A total of 140 non-listed native fauna species were recorded during the field survey. The loss of habitat associated with the proposed Longwall Project would decrease the extent of fauna habitat available, however, given the small area of habitat to be removed relative to the area to be conserved as part of the proposed biodiversity offset area and on land to the south, west and north of the Mine Site, Ecotone (2009) concludes that this would be unlikely to greatly impact any of these fauna species.

4B.4.7.5 Impacts on Riparian Zones

The riparian vegetation (Community 3) on the Mine Site may suffer very minor direct impact as a result of clearing required to develop access roads to the sites of gas drainage and mine ventilation. The impacts would be avoided where possible, ie. by crossing the various drainage features of the Mine Site where there is no remnant riparian vegetation, and minimised by limiting disturbance to the minimum area in consultation with an ecologist commissioned to advise on the alignment of Mine Site access roads. If aquatic or fish habitat is identified, then the crossing would be designed and constructed so as not obstruct fish passage. As noted in Section 4B.4.6.5, unavoidable disturbance to the riparian vegetation would be offset by the inclusion of approximately 3ha of Community 3 within the proposed biodiversity offset strategy of the Proponent. Assuming the implementation of the avoidance, mitigation and offset measures, the direct impact of the proposed Longwall Project on the Mine Site would be relatively minor.



A potentially more significant impact on the riparian vegetation of the Mine Site would be that resultant from ponding within Kurrajong and Pine Creeks and their tributaries caused by subsidence. Subsidence predictions of DGS (2009) determine that the net fall across the Mine Site would provide for surface drainage to continue un-impeded, thereby maintaining the water supply to the riparian vegetation. However, ponding of 0.5m and 1.5m could occur, extending beyond the banks of the drainage features and potentially ‘drown’ areas of remnant riparian and surrounding vegetation.

The exact magnitude and impacts of ponding cannot be accurately predicted and it is proposed to monitor and manage ponding events on a case by case basis. Following the identification of ponding, the affected area would be inspected by a suitably qualified ecologist and hydrologist who would advise on the most appropriate management strategy. This could include earthworks to re-open the drainage line, however, in some cases this may be more harmful to the flora and fauna species of the riparian zone, in which case alternative management methods such as pumping or leaving the affected area alone would be implemented.

While adverse impacts on the riparian vegetation of Kurrajong and Pine Creeks and their tributaries cannot be ruled out, it is assessed that by following the recommendations of suitably qualified ecology / hydrology specialists, the impact of ponding on riparian vegetation could be minimised.

4B.4.7.6 Impacts on Groundwater Dependent Ecosystems

The groundwater modelling of Aquaterra (2009) predicts that the impacts of groundwater depressurisation of the underlying Permian coal measures would have minimal (Mayfield Spring) or nil (Hardys Spring and Eather Spring) impact on the groundwater level and therefore flows within these springs. All three GDEs are also located outside the zone of potential surface cracking (see **Figure 4B.5**). As such, it is unlikely that the proposed Longwall Project would significantly impact on these GDEs. This notwithstanding, groundwater levels, as well as the health and condition of the vegetation of Mayfield Spring would be monitored by the Proponent.

It is possible that deep rooted vegetation, reliant on groundwater, may be present on the Mine Site and could potentially be impacted by the drawdown in groundwater levels. However, the groundwater modelling of Aquaterra (2009) predicts almost no drawdown in the upper geological strata (Namoi Alluvium and Pilliga Sandstone) from which this vegetation would draw groundwater, with the Purlawaugh Formation insulating the shallow groundwater accessed by this vegetation from any impacts of groundwater depressurisation of the underlying Permian coal measures due to mining activities. Therefore it is anticipated that there would be no impact to deep rooted vegetation GDEs should they be present on the Mine Site or surrounds.

4B.4.7.7 Impacts Associated with Discharge to the Namoi River

It is predicted that the Longwall Project would result in a discharge of up to approximately 2.1ML/day into the Namoi River, which typically (>70% of the time) carries a flow of 100ML/day or greater (WRM, 2009). This increase in flow <3% is unlikely to have any significant impact on aquatic or riparian habitats. The discharged water quality would comply



with the water quality criteria nominated in **Table 4B.15** and would be of equivalent or lower salinity to historic concentrations measured for average to low flows (river salinity levels (total dissolved solids) may be less than the discharged 500mg/L during high flow periods) (see **Figure 4B.23**).

Whilst a detailed assessment of hydrologic impacts of this additional flow has not been undertaken, Ecotone (2009) suggests that this discharge into the Namoi River would contribute to improved health of aquatic and riparian habitats by increasing environmental flows. Some level of seasonal variation in discharge volume may be appropriate and could be accommodated if such seasonal flow variations occur naturally in the Namoi River system as seasonal flow variations are known to initiate breeding in some inland fish species and may be important for other aquatic and riparian biota.

4B.4.7.8 Impacts on State Forests

The Mine Site includes portions of the Jacks Creek and Pilliga East State Forests which may be affected by clearing and/or subsidence. The impact of this disturbance on the state forests is considered as follows.

Clearing of Vegetation

Of the native vegetation to be cleared on the Mine Site, none would be required within Jacks Creek State Forest with clearing within Pilliga East State Forest limited to approximately 20ha (associated with pre-drainage and goaf gas drainage sites and associated tracks). This represents approximately 0.0125% of Pilliga East State Forest (which covers approximately 160 000ha) and is therefore unlikely to have any impact on the ecological or forestry value of the forest. The impact of native vegetation clearing is therefore deemed to be negligible.

Subsidence

Portions of both Jacks Creek and Pilliga East State Forests occur within areas of the Mine Site that would be affected by subsidence in the manner described in Section 4B.1.5.2. Any impacts would, however, be mitigated by the management measures proposed by the Proponent (see Section 4B.1.6). In addition, the affected areas of both state forests represent less than 0.1% of the total area of each (Pilliga East State Forest = 160 000ha, Jacks Creek State Forest = 4 600ha). Based on the relatively small area of impact (compared to the total area of each state forest) and the implementation of the proposed mitigation measures, the impact of subsidence on the ecological or forestry value of the forests is deemed to be negligible.

4B.4.7.9 Assessment of the Biodiversity Offset Strategy

Ecotone (2009) provides an assessment of the proposed Biodiversity Offset Strategy against:

- the offset selection priority criteria used to identify potential offset areas across the available properties (owned by the Proponent) within the Mine Site; and
- the principals identified in Principles for the use of Biodiversity Offsets in NSW presented as Appendix II of the document Guidelines for Biodiversity Certification of Environmental Planning Instruments – Working Draft published by the Department of Environment and Climate Change in April 2007.



Offset Selection Priority Criteria

Priority 1. Areas should be selected on a like-for-like basis.

- a) *Areas should be selected that contain the same vegetation communities as those areas to be impacted;*
- b) *Areas should be selected that contain, as much as possible, the same fauna species that are present in the areas are to be impacted.*

The vegetation communities with the Biodiversity Offset Area and the areas proposed to be disturbed are the same, with Communities 1 and 2 dominating both areas. In addition, Ecotone (2009) states that as the vegetation communities are the same, the fauna species that utilise the Biodiversity Offset Area would be the same as the fauna species that utilise other woodland areas within the Mine Site.

Priority 2. Areas should be selected that contain known locations of threatened species, populations and/or ecological communities;

- a) *Where possible an appropriate radius (generally 100m or more) around each known location of a threatened species should be included in the Biodiversity Offset Area.*
- b) *Where possible the entire area of a threatened population or ecological community should be included in the offset area.*

Ecotone (2009) notes that 10 of the 16 locations where threatened fauna species were observed within the Mine Site were recorded within the Biodiversity Offset Area. In addition, all 16 threatened fauna species were recorded in either Community 1, 2 or 3, each of which would be preserved within the Biodiversity Offset Area.

Priority 3. Areas should be selected to protect threatened species, populations or ecological communities that may be impacted by the proposal.

Ecotone (2009) notes that the Biodiversity Offset Area has been selected to incorporate as many of the locations where threatened species have been observed as possible. In addition, the offset area has been selected to incorporate areas of vegetation that are equivalent to the areas that would be disturbed.

Priority 4. Areas should be selected that minimize the level of landscape fragmentation of the vegetation community.

- a) *Areas within large existing patches should be selected over isolated small patches.*
- b) *Areas within existing patches or nearby existing patches should be selected in preference to patches distant from other patches.*

The proposed Biodiversity Offset Area comprises one of the larger patches of relatively undisturbed vegetation within the Mine Site. In addition, the Biodiversity Offset Area is location adjacent to an area of the regional Pilliga forest area within the Jacks Creek and Pilliga East State Forest.

Priority 5. Areas should be selected that minimize the level of landscape isolation of the vegetation community.

Vegetation within the proposed Biodiversity Offset Area is well connected to surrounding woodland habitat.



Priority 6. Areas should be selected that minimize edge effects:

- a) *Areas within existing patches should be selected in preference to entire patches with edges;*
- b) *Patches with high area to circumference ratios (circular or block shaped patches) should be selected over patches with low area to circumference ratios (thin linear patches).*

Ecotone (2009) notes that with the exception of the east where it is bordered by agricultural grazing land, the Biodiversity Offset Area is contiguous with neighbouring habitat on all sides. The offset strategy also maximises the area to circumference ratio of the woodland areas.

Priority 7. Areas of high diversity (flora and/or fauna) should be selected over less diverse areas.

- a) *Riparian vegetation should be selected in preference to mid slope or ridge line vegetation to conserve a likely higher diversity of fauna species.*

Vegetation Communities 1, 2 and 3 are the most species diverse communities recorded within the Mine Site. All three vegetation communities contain diverse canopy, mid-storey and ground cover flora species which support a diverse range of fauna species.

Priority 8. Areas should be selected that are the least disturbed of the available areas.

The Biodiversity Offset Area is dominated by a large area of woodland with little disturbance.

Principles for the Use of Biodiversity Offsets in NSW

Principle 1 Impacts must be avoided first by using prevention and mitigation measures.

Offsets are then used to address remaining impacts. This may include modifying the proposal to avoid an area of biodiversity value or putting in place measures to prevent offsite impacts.

The Proponent has, to the greatest extent possible, minimised the area of disturbance associated with the Longwall Project. This has been achieved through location of those components of the Longwall Project with the most concentrated level of disturbance, namely the Pit Top and Reject Emplacement Areas within areas of low conservation significance, namely within cleared areas previously used for agricultural activities (Community 7).

Principle 2 All regulatory requirements must be met.

Offsets cannot be used to satisfy approvals or assessments under other legislation, e.g. assessment requirements for Aboriginal heritage sites, pollution or other environmental impacts (unless specifically provided for by legislation or additional approvals).

The Proponent would meet all regulatory requirements related to the construction, operation and rehabilitation of the Longwall Project.



Principle 3 Offsets must never reward ongoing poor performance.

Offset schemes should not encourage landholders to deliberately degrade or mismanage offset areas in order to increase the value from the offset.

The Proponent has not deliberately degraded or mismanaged any land under its control. Ecotone (2009) report that the lands of the Mine Site are currently being managed for conservation (woodland areas to the west) or grazing at low stocking rates (scattered woodland and open pasture paddocks in the eastern two thirds of the Mine Site). Both management strategies represent appropriate environmental management of the proponents land within the Mine Site.

Principle 4 Offsets will complement other government programs.

A range of tools is required to achieve the NSW Government's conservation objectives, including the establishment and management of new national parks, nature reserves, state conservation areas and regional parks and incentives for private landholders.

The establishment of the Biodiversity Offset Area would increase the total area of conservation lands within the region and complement other nearby conservation areas such as Mount Kaputar National Park (to the northeast) and Pilliga Nature Reserve (to the southwest).

Principle 5 Offsets must be underpinned by sound ecological principles.

They must:

- include the consideration of structure, function and compositional elements of biodiversity, including threatened species;
- enhance biodiversity at a range of scales;
- consider the conservation status of ecological communities; and
- ensure the long-term viability and functionality of biodiversity.

Biodiversity management actions, such as enhancement of existing habitat and securing and managing land of conservation value for biodiversity, can be suitable offsets. Reconstruction of ecological communities involves high risks and uncertainties for biodiversity outcomes and is generally less preferable than other management strategies, such as enhancing existing habitat.

Ecotone (2009) identify that the proposed Biodiversity Offset Strategy comprises the conservation of existing habitat and the promotion of natural regeneration. It is a commonly understood ecological principle that the conservation of existing habitats is preferred to the reconstruction of habitat in disturbed areas. In addition, the proposed Biodiversity Offset Area was selected based on numerous sound ecological principals identified previously, including:

- incorporating areas of similar vegetation, including areas of known threatened species, population and ecological community habitat;
- conserving areas of high landscape value;
- conserving areas of high flora and fauna diversity;
- maximising the area to circumference ratio; and
- maximising the linkages between areas of vegetation within the Mine Site and areas surrounding the Mine Site.



Principle 6 Offsets should aim to result in a net improvement in biodiversity over time.

Enhancement of biodiversity in offset areas should be equal to or greater than the loss in biodiversity from the impact site.

Setting aside areas for biodiversity conservation without additional management or increased security is generally not sufficient to offset against the loss of biodiversity. Factors to consider include protection of existing biodiversity (removal of threats), time-lag effects, and the uncertainties and risks associated with actions such as revegetation.

Offsets may include enhancing habitat, reconstructing habitat in strategic areas to link areas of conservation value, or increasing buffer zones around areas of conservation value and removal of threats by conservation agreements or reservation.

The implementation and management of the proposed Biodiversity Offset Area would be likely to result in a net improvement in biodiversity over time through the removal of threats to the vegetation communities and the encouragement of natural regeneration. This would include protection from grazing, tree harvesting, firewood collection, track creation and other possible detrimental land management actions. The removal of such threats, combined with management to encourage natural regeneration, would be likely to result in an increase in the area of Communities 1 to 3 over time and, as a result, a net improvement in biodiversity within the Mine Site.

Principle 7 Offsets must be enduring – they must offset the impact of the development for the period that the impact occurs.

As impacts on biodiversity are likely to be permanent, the offset should also be permanent and secured by a conservation agreement or reservation and management for biodiversity. Where land is donated to a public authority or a private conservation organisation and managed as a biodiversity offset, it should be accompanied by resources for its management. Offsetting should only proceed if an appropriate legal mechanism or instrument is used to secure the required actions.

The Proponent would secure the Biodiversity Offset Area through an enduring covenant or restriction on the use of the land under Section 88B of the *Conveyancing Act 1919* or similar arrangement, to the satisfaction of the Department of Planning and the Department of Environment, Climate Change and Water – Environment Protection and Regulatory Group. The purpose of such an arrangement would be to restrict the use of the Biodiversity Offset Area for the purposes of native vegetation conservation in perpetuity. In addition, the Proponent would undertake to manage the Biodiversity Offset Area for the purpose of native vegetation and fauna conservation during the life of the Longwall Project and while ever the Proponent continues to own the relevant land. In the event that the land is donated to a public authority, the Proponent would negotiate an appropriate arrangement with the relevant government agency for the ongoing management of the land prior to the transfer of control of the land.

Principle 8 Offsets should be agreed prior to the impact occurring.

Offsets should minimise ecological risks from time-lags. The feasibility and in-principle agreements to the necessary offset actions should be demonstrated prior to the approval of the impact. Legal commitments to the offset actions should be entered into prior to the commencement of works under approval.

The Biodiversity Offset Area and a timeframe for putting the appropriate legal arrangements and management strategies in place would be agreed with the relevant government agencies prior to Longwall Project-related disturbance occurring.

Principle 9 Offsets must be quantifiable – the impacts and benefits must be reliably estimated.

Offsets should be based on quantitative assessment of the loss in biodiversity from the clearing or other development and the gain in biodiversity from the offset. The methodology must be based on the best available science, be reliable and used for calculating both the loss from the development and the gain from the offset. The methodology should include:

- the area of impact;
- the types of ecological communities and habitat/species affected;
- connectivity with other areas of habitat/corridors;
- the condition of habitat;
- the conservation status and/or scarcity/rarity of ecological communities;
- management actions; and
- level of security afforded to the offset site.

The best available information/data should be used when assessing impacts of biodiversity loss and gains from offsets. Offsets will be of greater value where:

- they protect land with high conservation significance;
- management actions have greater benefits for biodiversity;
- the offset areas are not isolated or fragmented; and
- the management for biodiversity is in perpetuity (eg. secured through a conservation agreement).

Management actions must be deliverable and enforceable.

The following factors are relevant when considering whether the proposed Biodiversity Offset Strategy complies with the requirements of this principle.

- The area of Communities 1 and 2 that would be preserved within the Biodiversity Offset Area are approximately 2.5 and 3.6 times the area that would be disturbed respectively.
- The area of Communities 3 and 4 would be marginally less than the areas that would be disturbed.



- The floristic characteristics and habitat values of those areas to be disturbed are similar to those areas to be preserved.
- The Biodiversity Offset Area would have a low area to circumference ratio and is located adjacent to very large areas of habitat within the Jacks Creek and Pilliga East State Forests.

Principle 10 Offsets must be targeted.

They must offset impacts on the basis of like-for-like or better conservation outcome. Offsets should be targeted according to biodiversity priorities in the area, based on the conservation status of the ecological community, the presence of threatened species or their habitat, connectivity and the potential to enhance condition by management actions and the removal of threats. Only ecological communities that are equal or greater in conservation status to the type of ecological community lost can be used for offsets. One type of environmental benefit cannot be traded for another: for example, biodiversity offsets may also result in improvements in water quality or salinity but these benefits do not reduce the biodiversity offset requirements.

The Biodiversity Offset Area would preserve areas of Communities 1 and 2 that are 2.5 and 3.6 times the area that would be disturbed respectively. In addition, as highlighted previously, the Biodiversity Offset Area was carefully selected to preserve the maximum number of locations where threatened fauna were observed, maximise the area to circumference ratio and the linkages with surrounding vegetation and habitat areas.

Principle 11 Offsets must be located appropriately.

Wherever possible, offsets should be located in areas that have the same or similar ecological characteristics as the area affected by the development.

The Biodiversity Offset Area is located adjacent to the areas of proposed disturbance. In addition, the offset area is also located adjacent to Jacks Creek and Pilliga State Forests and the large areas of native vegetation and habitat associated with those areas of forest.

Principle 12 Offsets must be supplementary.

They must be beyond existing requirements and not already funded under another scheme. Areas that have received incentive funds cannot be used for offsets. Existing protected areas on private land cannot be used for offsets unless additional security or management actions are implemented. Areas already managed by the government, such as national parks, flora reserves and public open space cannot be used as offsets.

The Biodiversity Offset Area is supplementary to rehabilitation activities and commitments that apply to the Stage 1 operation and the commitments made in this *Environmental Assessment*. In addition, the proposed area is not the subject of any other biodiversity management program or incentive scheme.



Principle 13 Offsets and their actions must be enforceable through development consent conditions, licence conditions, conservation agreements or a contract.

Offsets must be audited to ensure that the actions have been carried out, and monitored to determine that the actions are leading to positive biodiversity outcomes.

It is envisaged that the proposed Biodiversity Offset Area and related commitments made in this document would be incorporated into the conditions associated with project approval, should it be granted. In addition, it is anticipated that the conditions to any project approval would include a requirement for the Proponent to undertake an independent compliance audit of the Longwall Project against the conditions of the project approval. It would also be expected that an independent audit would be required of the offset area to ratify its condition and value over time.

4B.4.8 Flora and Fauna Monitoring

A Flora and Fauna Monitoring Program would be developed to assess impacts of the proposed Longwall Project. The monitoring program would be developed in conjunction with a qualified ecologist and would place particular emphasis on the following elements.

Monitoring the populations of the Delicate mouse, Eastern pygmy possum and Pale-headed snake to ensure that these species are not negatively affected by the progressive disturbance associated with the gas drainage and mine ventilation of the mine and surface cracks caused by subsidence. The monitoring program would commence prior to the initiation of longwall mining to establish baseline population levels. The monitoring program would involve, as a minimum, a large number of permanently established pitfall and funnel traps across unaffected and mined areas.

In accordance with the recommendations of the *Impacts of Underground Mining on Natural Features in the Southern Coalfield* (DoP, 2008), flora and fauna monitoring would (to the extent practicable) follow the Before, After, Control, Impact (BACI) method. This would enable more detailed statistical analyses of the impacts of subsidence on Mine Site flora and fauna to be included in the analysis of monitoring data.

4B.5 ABORIGINAL HERITAGE

The Aboriginal heritage assessment was undertaken by Archaeological Surveys & Reports Pty Ltd. The full assessment is presented in Volume 2, Part 5 of the Specialist Consultant Studies Compendium, with the relevant information from the assessment summarised in the following subsections. The full assessment is referred to as AS&R (2009a) throughout this document.

4B.5.1 Introduction

Based on the risk analysis undertaken for the proposed Longwall Project (see Section 3.3 and **Table 3.5**), the potential environmental impacts related to Aboriginal heritage requiring assessment and their unmitigated risk rating are as follows.

- Impact on identified sites and/or artefacts of Aboriginal cultural heritage as a result of the proposed construction and mining activities and without the permission of LALC or DECCW (high risk).



- Impact on unidentified sites and/or artefacts of Aboriginal cultural heritage as a result of subsidence and without the permission of LALC or DECCW (high risk).

In addition, the Director-General's Requirements issued by DoP require that the assessment of Aboriginal heritage refer to the draft *Guidelines of Aboriginal Cultural Heritage Assessment and Community Consultation* (Department of Environment and Conservation).

The following subsections present the method of assessment, review the results of an Aboriginal heritage survey undertaken, provide the proposed management of identified sites and assess the significance of any impact on these. The assessment was undertaken in consultation with the Narrabri Local Aboriginal Land Council (Narrabri LALC) and Narrabri Gomeroi Traditional Owner Group (Gomeroi), and with reference to the comments provided by DECCW on the requirements of an assessment of impacts on Aboriginal cultural heritage values.

4B.5.2 Method of Investigation

4B.5.2.1 Introduction

In order to identify the nature and extent of impacts on Aboriginal cultural heritage values across the Mine Site, Archaeological Surveys & Reports Pty Ltd (AS&R, 2009a) considered the existing archaeological record, consulted with the local Aboriginal community, undertook a field survey of the areas likely to be disturbed on the Mine Site (as well as a proposed water pipeline corridor between the Mine Site and the Namoi River), considered the significance of identified sites on the Mine Site and on this basis assessed the significance of any impact(s).

The potential impacts of the proposed Longwall Project were also considered within a regional context to enable the cumulative impact of proposed and approved developments to be assessed.

The following subsections provide a summary of the key elements of the Aboriginal heritage investigation undertaken by AS&R (2009a).

4B.5.2.2 Review of the Archaeological Record

Initially, a search of the Aboriginal Sites Register (Aboriginal Heritage Information Management System – AHIMS) was completed by AS&R (2009a) over a 256km² search area centred on the Mine Site to identify the type and frequency of sites recorded in the local and regional area.

One previous archaeological investigation has been completed on the Stage 1 Pit Top Area within the Mine Site (AASC, 2007), focussing on the Pit Top Area and initial Ventilation Shaft Area, and this was reviewed by AS&R (2009a) to provide an indication of the type of sites that may be encountered over the rest of the Mine Site. AS&R (2009a) also considered the archaeological potential of the Mine Site based on the presence or absence of resources such as vegetation, water and stone.



4B.5.2.3 Consultation

The following consultation has been undertaken as part of the preparation of AS&R (2009a).

- An advertisement was placed in the *Narrabri Courier* on 26 August 2008 (in accordance with the *Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* – DEC, 2005). Representatives of Narrabri LALC and Gomeroi responded to the advertisement registering their interest.
- Representatives of both Narrabri LALC and Gomeroi were subsequently contacted to arrange a date for the field investigation of the Mine Site.
- After agreement over the survey of the Mine Site could not be reached with Gomeroi, a copy of the proposed survey strategy of the Mine Site was provided to both Narrabri LALC and Gomeroi. A copy of this proposed survey strategy has been appended to AS&R (2009a).
- Following a protracted period of consultation between AS&R (on behalf of the Proponent), Narrabri LALC and Gomeroi, agreement over the survey strategy for the areas above LW1 to LW7 (“the Panels 1 to 7 Survey Area”) was reached.
- At the completion of the field survey (see Section 4B.5.2.4), a listing of all sites recorded during the investigation was forwarded to both Narrabri LALC and Gomeroi, and a request made for each stakeholder to provide their comments and/or recommendations in relation to the results of the field survey to the Proponent. Correspondence from both stakeholders was received confirming their participation in the surveys, agreeing to the completion of further survey over the Mine Site (Panels 8 to 26) and, in the case of Narrabri LALC on 20 April 2009, providing recommendations as to the management of the identified sites.
- Following the completion of the Panels 1 to 7 Survey, a representative of the Proponent met with representatives of Gomeroi to discuss the completion of field survey over the remaining areas of the Mine Site that could be affected by the proposed Longwall Project (“the Panels 8 to 26 Survey Area”). Mutual agreement over a proposed approach to the field survey of the Panels 8 to 26 Survey Area was reached and the survey was completed between 6 and 14 July 2009. Similar to the process followed following the completion of the field survey of the Panels 1 to 7 Survey Area, a listing of all sites recorded during the investigation was forwarded to both Narrabri LALC and Gomeroi and a request made for each stakeholder to provide their comments and/or recommendations in relation to the identified sites.
- Prior to the receipt of any correspondence from the Aboriginal stakeholder groups, the Proponent identified that additional land on the Mine Site would need to be disturbed to enable the construction of the Brine Storage Area and a pipeline between the Mine Site and the Namoi River installed. The Aboriginal stakeholder groups were again contacted by the archaeologist and invited to take part in field surveys of the Brine Storage Area and Water Pipeline Route. Both Aboriginal stakeholder groups accepted the invitation and provided a representative to take part in the field surveys on the 29 and 30 July.



- Following the completion of these surveys, the Proponent finalised a Statement of Commitments in relation to the management of the identified Aboriginal sites and Aboriginal cultural heritage on the Mine Site in general. Meetings between representatives of the Proponent and both Narrabri LALC (6 August 2009) and Gomeroi (13 August 2009) were convened in which the Statement of Commitments was explained and a request for written comment on the proposed site management made. Both Aboriginal stakeholder groups agreed to provide formal correspondence to the Proponent commenting on the proposed management of the identified Aboriginal sites and Aboriginal cultural heritage on the Mine Site.

Importantly, all consultation meets the requirements of the DECC guideline document *Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (DEC, 2005).

4B.5.2.4 Development of a Predictive Model and Field Survey

In order to design an investigative strategy, it is firstly necessary to develop a predictive model for site location. The objective of the predictive model is not to determine where the investigation should be conducted, rather to establish a theoretical model for the distribution of archaeological material against which the effectiveness and subsequent analysis of the survey results can be tested, compared and reasoned. The predictive model developed by AS&R (2009) considers the existing archaeological record, resource availability, knowledge of the habitation and land use patterns of the Aboriginal people of the region (and generally) and factors affecting identification.

Considering the above, AS&R (2009a) proposed the following model for site distribution for the Mine Site, in which there was no reliable water source, few exposures of sandstone bedrock, and no rock overhangs, and which in the absence of both water and shelter, there were unlikely to be any places of potential archaeological deposits (PADs).

- Isolated artefacts may be present and visible within erosion features.
- Low-density artefact scatters may be present and visible in erosion features, but it is unlikely that any debitage would be visible.
- There is potential for trees more than 150 years old to exhibit scarred surfaces.
- There is potential for any trees more than 150 years old to exhibit carved surfaces.
- There are unlikely to be any engravings, and/or grinding grooves.
- There are unlikely to be any PADs.
- In the absence of shelters or overhangs there is little potential for shelters to exist and therefore no potential for art sites, and therefore no potential for undisturbed occupation deposits.
- There would be no Aboriginal stone quarries.
- There would be no shell middens.



- There would be no visible evidence of burials.
- There would be no surviving Bora rings.
- There would be no stone arrangements.
- There are no known cultural associations with the area.

4B.5.2.5 Field Surveys

Four separate field surveys have been completed as part of the Aboriginal heritage assessment for the Longwall Project as follows.

1. A detailed survey of the proposed disturbance areas of the Mining Area above longwall panels LW1 to LW7, referred to hereafter as the “Panels 1 to 7 Survey”. The primary objective of this survey was to identify all Aboriginal sites and artefacts that could be impacted by the proposed layout of the surface disturbing activities (over the first 7 years of the Longwall Project) and to develop measures to manage these. A secondary objective was to validate the predictive model for site location such that a more general field survey of the remaining Mining Area could be undertaken.
2. A reconnaissance field survey of those locations and environmental features of the Mining Area above LW8 to LW26 considered as having higher potential for Aboriginal site occurrence and identification. Referred to hereafter as the “Panels 8 to 26 Survey”, the objective of this survey was to provide a basis for assessing the likely cumulative impact of the Longwall Project on the Aboriginal archaeological record.
3. A detailed field survey of the Pit Top Area where the proposed Brine Storage Area would be located. Referred to hereafter as the Brine Storage Area Survey, the objective of this survey was to identify all Aboriginal sites and artefacts that could be impacted by the proposed layout of the Brine Storage Area and develop measures to manage these.
4. A detailed field survey of the route of the proposed water pipeline between the Mine Site and the Namoi River. Referred to hereafter as the Water Pipeline Route Survey, the objective of this survey was to identify all Aboriginal sites such that the alignment of the proposed pipeline could avoid these (as far as practicable).

The following provides a summary of the survey methodology and effort for each of the four surveys.

Panels 1 to 7 Survey

In accordance with the agreed survey strategy (see Section 4B.5.2.3), a field survey of the Panels 1 to 7 Survey Area was undertaken by Mr John Appleton (of AS&R) between 30 March and 1 April, and 7 and 8 April. Ms Kristie Toomey (Sites Officer of Narrabri LALC) and Mr Mick Trindall (Sites Officer of Gomeroi) were present for all five days of the field survey with Mr Craig Trindall of Gomeroi taking part on the morning of 30 March 2009 (and assisting in the identification and recording of the first two sites).



The survey was undertaken on foot, in dry conditions, in light ideal for observing any artefactual material present and observable. The survey route followed the alignment of the likely location of gas drainage and ventilation infrastructure as well as local creeks and drainage lines (all ephemeral) along which sites would be most likely to be found. **Figure 4B.31** identifies the area included in the Panels 1 to 7 Survey. Both prior to and during the survey, the potential for particular site types to be present, and the particular environments in which they might occur was discussed. At the conclusion of the survey the results were discussed, as were the possible outcomes in view of the potential impacts from the proposed gas drainage and ventilation boreholes, and access roads.

Panels 8 to 26 Survey

In order that a more definitive statement could be made as to the likely site numbers and distribution within the Mining Area a field ‘reconnaissance’ survey was made targeting those locations in which it was predicted from the results of the survey of the Panels 1 to 7 Survey, sites were most likely to occur. As the Mining Area over LW8 to LW26 is unlikely to be disturbed for at least seven years, AS&R (2009a) considers it probable that many of the sites recorded during a survey in 2009 would become covered in 7 years time (or sooner) and similarly, other sites which are currently not exposed or visible would become exposed over this 7 year period. The survey was undertaken, therefore, not for the purpose of recording every site, but to provide a firmer basis on which to assess the cumulative impact of disturbing or salvaging sites within the Panels 1 to 7 Survey. At the conclusion of the survey, the results were discussed, as were the possible outcomes in view of the potential impacts from the proposed gas drainage and ventilation boreholes and access roads.

The investigation was undertaken over 7 days, from 6 to 14 July, by Mr John Appleton (of AS&R) with Matt Trindall and Tahnesha Trindall - on different days (of Narrabri LALC) and Mick Trindall and Patrick Sevil (of Gomeroi) present during all stages of the 7 day investigation. Both prior to and during the survey, discussions were held regarding the potential for particular site types to be present, and the particular environments in which they might occur. The survey strategy and results were considered and discussed throughout the survey and at the completion of each survey unit.

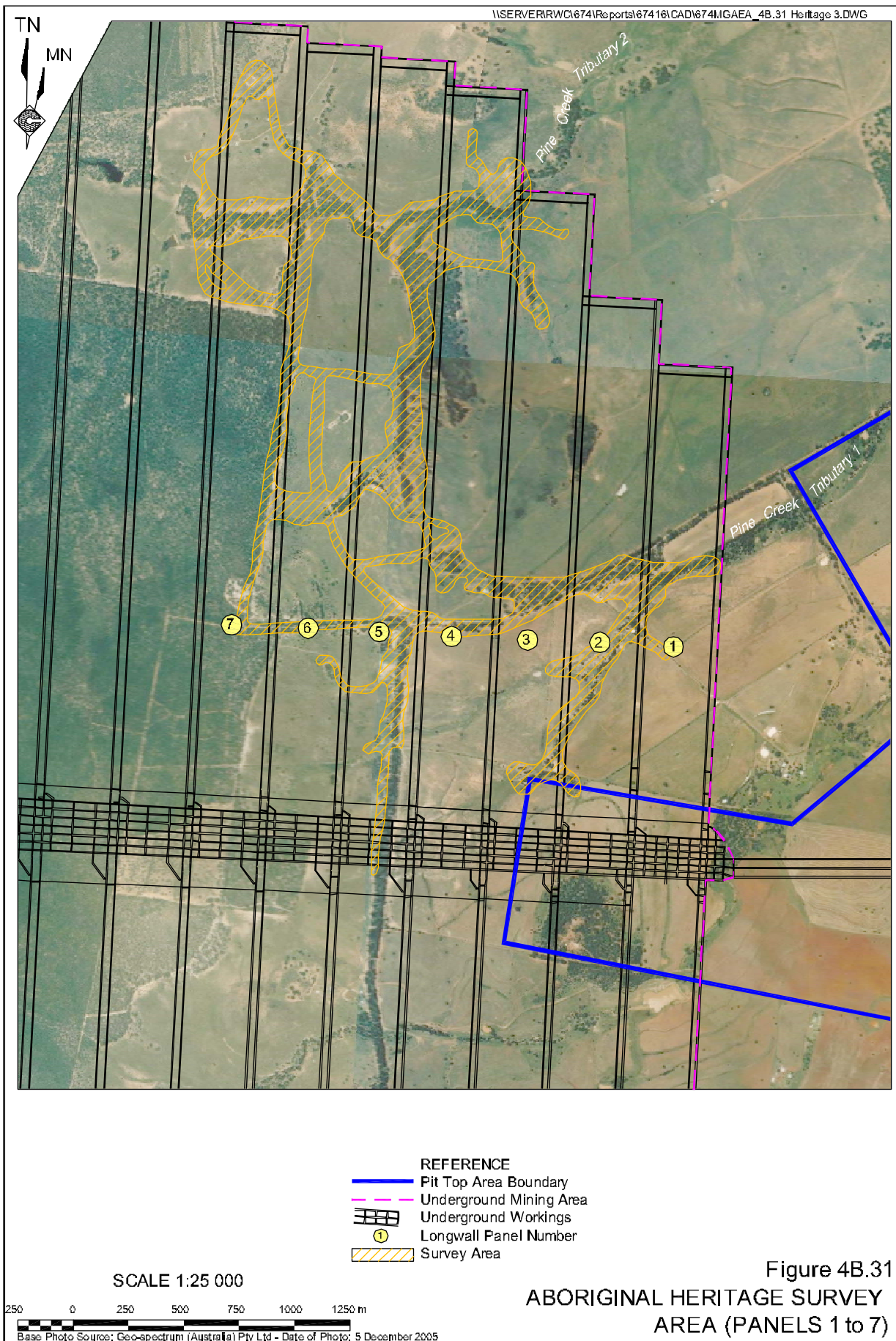
Brine Storage Area Survey

A pedestrian survey of the entire Brine Storage Area was completed on 29 July 2009 by Mr John Appleton (of AS&R), accompanied by Matt Trindall (of Narrabri LALC) and Mick Trindall and Patrick Sevil (of Gomeroi), targeting any ground surface exposures and in particular the elevated areas overlooking flooding zones of Kurrajong Creek Tributary 1.

Water Pipeline Survey

A pedestrian survey of the entire Water Pipeline Route was completed on 30 July 2009 by Mr John Appleton (of AS&R), accompanied by Matt Trindall (of Narrabri LALC) and Mick Trindall and Patrick Sevil (of Gomeroi). Mature trees and ground exposures within the road and rail easements were inspected.





4B.5.2.6 Review of Predicted Subsidence

The impacts of subsidence on Aboriginal sites may occur as a result of the following.

- The differential lowering of the ground surface over large areas.
- Surface cracking which may occur along the margins of the subsidence (above the line of longwall panels), and where differential tilting of the surface may occur.

The Subsidence Assessment prepared for the proposed Longwall Project was subsequently reviewed to identify the area and magnitude of the likely subsidence and surface cracking.

4B.5.2.7 Consideration of Cultural and Research Potential and Assessment of Impact(s)

The Aboriginal or cultural significance of an Aboriginal artefact, relic or site can only be assessed by the Aboriginal community, and in particular, the Elders. As noted in Section 4B.5.2.3, the results of the field survey were provided to both Narrabri LALC and Gomeroi for comment on the cultural significance of the identified sites and to provide recommendations for management of these sites.

The research potential has been considered based on the type, condition and location of any identified sites.

On the basis of the cultural significance and research potential, and management measures developed in consultation with the Aboriginal community, AS&R (2009a) assessed the significance of any impact on identified Aboriginal sites. The assessment of impacts considers both the impact on any affected site, but also the cumulative impact on the regional archaeological record.

4B.5.3 Summary of Results

4B.5.3.1 The Archaeological Record

Only a single record was identified within the 256km² search area of the Aboriginal Sites Register. This site, Site #19-3-0010 is identified as a scarred tree at “Laluba: Bunda Wallah Waterhole” nearly 4km to the north of the Mine Site. This lack of registered sites should not be interpreted as representing the frequency or distribution of sites in the area, rather a reflection of the lack of survey for Aboriginal heritage sites in the region.

Supporting the conclusion that the lack of recorded sites does not reflect the actual archaeological record is the results of AASC (2007). This study identified seven archaeological sites recorded (including a Wild Orange Tree of no known direct cultural association), none of which are currently recorded on the Aboriginal Sites Register. Of the six archaeological sites, two were described as isolated artefacts, two were described as artefact scatters and two scarred trees were identified. All artefactual material is currently being managed in accordance with an Aboriginal Cultural Heritage Management Plan, prepared in consultation with Gomeroi and Narrabri LALC.



4B.5.3.2 Field Survey

Panels 1 to 7 Survey

43 sites were recorded during the Panels 1 to 7 Survey, with all but one recorded within 50m of a creek or drainage line. **Figure 4B.32** illustrates the location of these sites, including site groupings likely to represent locations visited regularly or periodically by Aboriginal inhabitants.

Of the 43 sites, 28 were identified as open artefact scatters of which 19 contained 5 artefacts or less. Seven open artefact scatter sites contained 10 or more artefacts, with only one believed to contain more than 100 artefacts. A single set of axe grinding grooves, a scarred tree and a fireplace were also identified. AS&R (2009a) identifies sites 10b (axe grinding grooves) and 39 (a large open scatter of in excess of 100 artefacts) as being of greatest significance.

On first viewing, the archaeological record appears to be represented predominantly by many very low density sites. However, by considering groupings of sites based on proximity and environmental setting, evidence of more regularly visited or occupation sites is provided. AS&R (2009a) suggests the following site groupings as representative of locations of multiple visits, occupation and use (see **Figure 4B.32**).

- Sites 16, 17, 18, 19, 22 and 23 containing at least 38 artefacts.
- Sites 38 and 39 containing in excess of 113 artefacts.

Sites 11, 12 and 13; Sites 32, 33 and 34; and Sites 1, 4, and 7, could also be grouped together demonstrating more frequent historic use of certain areas.

Panels 8 to 26 Survey

As a result of the Panels 8 to 26 Survey, an additional 69 sites were recorded. With the exception of three sites at the southern end of LW 23 (Sites 107, 111 and 112), all of the additional sites were either isolated artefacts (14 sites), or low density scatters (52 sites). **Figure 4B.32** provides the locations of all sites identified on the Mine Site, ie. as part of the Panels 1 to 7, Panels 8 to 26 and Brine Storage Pond Surveys.

Brine Storage Area Survey

A total of nine sites were identified as part of the Brine Storage Area Survey, comprising three isolated artefacts, two sites of 2 artefacts, two sites of 3 artefacts, and two sites of 5 artefacts.

Water Pipeline Route

No sites were identified during the survey of the Water Pipeline Route.

Summary

Considering the results of the four surveys, AS&R (2009) reports that of the 121 sites recorded, 97 (81.51%) contained 1 to 5 artefacts, 13 (10.92%) contained 6 to 10 artefacts, 5 (4.20%) contain 11 to 20 artefacts, and 4 sites (3.37%) contained in excess of 20 artefacts. In simple terms four in every five sites will contain 5 artefacts or less, and only 4 in 121 sites will contain more than 20 artefacts.

