

## Expert Review: Narrabri Gas Project, Terrestrial Ecology

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### Summary

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Following review of the terrestrial ecology components of the Narrabri Gas Project (NGP) Environmental Impact Statement (EIS), a number of serious omissions within the assessment are evident, and several questions regarding the adequacy of the assessment remain unresolved, in particular:

- The adequacy of the methodology used to describe direct impacts is questionable. The lack of a development footprint by which impact could be measured according to 'whole of government' guidelines gives uncertainty to the ecological outcomes.
- Levels of indirect impact have been significantly under-estimated. Using fox predation as a measure, pre-mitigation levels of indirect impact should be at least doubled in magnitude, based on available evidence.
- Survey effort for some key fauna species appears to be deficient and would have adversely affected the ability of the EIS to adequately account for some species.
- A NSW and Commonwealth-listed threatened ecological community *White Box Blakely's Red Gum-Yellow Box Woodland (and derived native grassland)* has been mis-identified and presumed to be not present in the study area. New data confirms its presence along Bohena Creek.
- The description of important habitat for a number of key fauna species, such as the Regent Honeyeater, Pilliga Mouse, Koala, Black-striped Wallaby and Five-clawed Worm-skink is not accurate.
- New information regarding the presence of the Koala in the study area discounts the assertion made in the EIS that it is not currently present.
- Due to deficiencies in the survey and assessment for two 'matters for further consideration' (Regent Honeyeater and Five-clawed Worm-skink), the Secretary's Requirements and requirements under the NSW Biodiversity Offset Policy have not been met. The Black-striped Wallaby also meets the requirements of being a MFFC.
- Direct impacts upon Bragalow Park State Conservation Area remains uncertain as do the magnitude of indirect impacts upon the adjacent Nature Reserve and existing biodiversity corridors.
- A Biodiversity Offset Strategy does not provide any surety for how well it will 'retire' the impact of the Project because the strategy provided in the EIS does not provide any like-or-like land-based offsets apart from an unproven rehabilitation plan and rests on the hypothetical efficacy of a feral animal control proposal. The suitability of the offset package with respect to the statutory requirements under the NSW Biodiversity Offset Policy is poor. The offset proposal is also not consistent with the requirements of the Commonwealth Offset Policy.

Based on these findings, this part of the Project assessment should be rejected as being data-deficient in relation to the Secretary's Requirements, and inadequate under the terms of NSW and

Commonwealth Biodiversity Offset Policies. The matters outlined above should be addressed by the proponent before any further assessment is undertaken.

## **Review of Methodology**

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### ***Database and literature review***

These are essential components of any EIS particularly for investigations in relation to biodiversity and threatened species. The key databases are BioNet, the Commonwealth's Protected Matters Search Tool, the VIS database for plant communities, and the relevant state and Commonwealth listings of threatened ecological communities which are available on the departmental websites. Searches which are conducted some time prior to the submission of the documentation, should be updated prior to submission to take account of recent additions and changes to the databases, e.g. some species may be listed or new records made public between the time the report is written and when it is submitted. Any due diligence review should update the findings in the report, particularly if new information regarding key species in the EIS warrants consideration. Failure to do so may lead to misleading information in the documentation when it is submitted to the consent authority. There are a number of important data omissions in the EIS. These will be highlighted in the relevant sections of this report.

Similarly, any literature review should include up to date searches of the scientific and relevant 'grey' literature. There are a number of instances where key scientific information has not been acknowledged in the NGP EIS. This is a failure of due diligence. Any scientific inquiry should acknowledge all relevant facts, particularly in relation to key issues. These failures are also highlighted throughout this report.

### ***Field Surveys***

Field surveys conducted by consultants EcoLogical Australia (ELA) on the whole seem to be consistent with state and Commonwealth guidelines, though a number of survey shortcomings are documented in the EIS.

For targeted threatened flora surveys, surveys were undertaken between 2010 and 2014, mostly in the spring time which suits a majority of flowering times for key threatened flora, though the information provided in the EIS does not show which species were surveyed and when, or the effort undertaken for each species. Often some species such as orchids flower more profusely following rain, though no account is given on how weather influenced the timing of surveys.

Fauna surveys were generally undertaken at appropriate times to maximise detection of key fauna species, though the effort and timing of surveys is not sufficient or is inappropriate for some key species.

For the critically endangered Regent Honeyeater *Anthochaera phrygia*, only one survey (October 2012) appears to have been undertaken over the five years of the field survey period prior to the submission of the EIS. Commonwealth guidelines (DEWSaP 2010) recommend surveys take into account eucalypt flowering events and should amount to at least 20 hours over five days. This has clearly not been accounted for in the EIS. Similarly, surveys for the Swift Parrot *Lathamus discolor*, with only one survey conducted, in July 2013, should also be linked to flowering events for 20 hours over eight days.

81 'trap nights' were used for a 'Song Meter' to record birdcalls, supposedly targeting the Regent Honeyeater, though without appropriate call playback, this method is unlikely to yield results. The

large amounts of data this methodology creates would need a Regent Honeyeater song algorithm (a digital call signature), from local animals in order to be able to maximise the detection of this species.

Targeted surveys for the endangered Five-clawed Worm Skink *Anomalopus mackayi* were undertaken in April 2014. The Commonwealth guidelines (DEWSaP 2011) for this species state that,

*“Peak activity is likely to be late spring and early summer under warm but not overly dry conditions. Not active on the ground surface by day and would only be active between sheltering sites at night.”*

Surveys should be conducted at this time of year. The methods used should meet the following requirements:

*“Appropriate survey methodology for detecting the presence of the long-legged worm skink is searching sheltering sites in combination with pitfall trapping at a time of year when the species is most likely to be active. If the survey is a targeted search for this species, a series of pitfall trap lines each comprising six 10 litre buckets spread along a 15 metre fence could be employed, however the species is more likely to burrow between the soil and the bucket. A successful technique has been to deploy artificial structures, such as bales of hay of different thicknesses, over a long period (over 6 months) and periodically check underneath.”*

Table 15-5 shows that 57.1 hours of ‘reptile surveys’ were undertaken for this species. If undertaken at the wrong time of year, the efforts are bound to be fruitless, even if taken after a ‘significant rainfall event’ (Table 15-6). A map of the survey effort however shows that only 12 of the 30 reptile surveys were conducted in areas north of the forest more likely to support habitat for this species (Figure 9, Appendix J1). So less than half of the total effort in reptile surveys could have targeted this species, although p. 74 of Appendix J1 states only three sites had habitat potentially suitable for the Five-clawed Worm-skink, R21, R27, R31.

Within the project area, the EIS states that survey effort for the Koala *Phascolarctos cinereus* between 2011 and 2014 include call playback (27 person hours), nocturnal surveys (31 person hours) and scat searches (38 plots) in Table 15-6. However, Figure 12 of Appendix J1 only shows four Scat Assessment Technique survey locations, three of which are clustered. Koala habitat in the project area amounts to some 30,000 ha according to the EIS if the ‘secondary’ habitat is taken into account. Minimum survey effort as outlined in the NSW threatened species survey guidelines (DEC 2006) has not been met. There are currently no Commonwealth guidelines on how Koalas should be surveyed.

A ‘Regional survey’ for the Koala was undertaken in April/May of 2014. Effort shown in Table 15-6 states that sites were selected using information from a recent Koala survey in the Pilliga and that 1,654 ha of koala habitat was searched over 112 km. However, information provided in Appendix J1 (within Appendix F7 thereof) has a lack of detail with regard to the effort expended in the project area compared to the effort outside.

### ***Ecological sensitivity analysis***

An ecological sensitivity analysis protocol tries to avoid areas where threatened ecological communities, threatened species habitat and riparian areas are located. A combination of mapping, models of habitat, and riparian buffer zones have been used. Given the first two require field verification and the latter does not automatically protect all threatened ecological communities or threatened species habitat which are associated with drainage lines, there are limits to how well modelled products can reduce impact.

As stated in the EIS, pipelines will still have to be built across creeks and given the uncertainty around the location of well sites and tracks, there is still great uncertainty as to what future impacts may look like.

### ***Direct Impact Assessment***

While approximately 1,000 ha of native vegetation is estimated to be directly affected by the development of the project area over time, my main concern with the assessment provided in the EIS, is the level of impact on the various ecological communities and threatened species habitat. The Secretary's Requirements state in relation to the impact assessment:

*“an assessment of the likely biodiversity impacts of the development, in accordance with the Framework for Biodiversity Assessment (OEH, 2014), unless otherwise agreed by OEH, and having regard to the OEH's and DPI's requirements (see Attachments 3A and 3B)”*

As stated throughout the EIS, due to the nature of the necessary exploration and appraisal that is required prior to production, a development footprint has not been identified at the time of the lodgement of the EIS as it is not 'practical'. An 'indicative footprint' has been provided but the sites carry no locational information. It seems Santos has left the gate open with regard to future location of the footprint. This has a number of consequences for assessing the impact on biodiversity:

- (a) The location, type and area of ecological communities and their habitats affected by the project cannot be accurately determined, making assessment of impact difficult,
- (b) The quantum of biodiversity credits (both ecosystem and species credits) cannot be accurately determined affecting the ability of the EIS to predict credit liability,
- (c) No opportunity exists for any kind of field verification of the communities affected by the development, and
- (d) The actual impact assessment will be left until after any consent for the project has been given.

The EIS states it has utilised a 'modelled development footprint' to determine the extent and types of biodiversity credits that the project will need to retire to meet the requirements of the FBA and the conditions of consent. How the total quantum of impact upon each vegetation community was achieved in the EIS was by use of a 'probabilistic' methodology which used a geographic grid overlay with an algorithm to determine 'maximum probable disturbance' and an ameliorated probable disturbance. This is detailed in Appendix F3 of Appendix J2. How well this algorithm works however is not entirely clear.

The methodology was developed by an American academic, apparently to deal with diffuse impacts such as gas fields in the United States. Professor Small is also a reviewer of the methodology used for this project as outlined in Appendix F3. The other reviewer is also an environmental engineer with a career in the petroleum sector.

Whatever the merits of the modelled approach to describe the impacts and biodiversity credit liability of the NGP, given the uncertainty around what actually may be impacted by the NGP and despite the site avoidance methodology proposed by Santos, it may be that the actual extent of impact upon vegetation communities may be very different to what has been outlined in the EIS.

The impact assessment approach has some issues, particularly in the context of its consistency with the Framework for Biodiversity Assessment (FBA) which states that the Biodiversity Assessment Report (BAR) requires a site map and a location map which shows the 'boundary of the development site' as well as maps showing the intersection of the site boundaries with the mapped vegetation

communities. This allows accurate assessment of the actual impact because it takes into consideration differences with mapped aerial extent of vegetation communities and variations in condition, all of which can affect biodiversity credit liability.

In my opinion, Santos have not met the SEARs by not providing a BAR which meets the requirements of the FBA. ELA did undertake biometric vegetation plots as per the methodology within each of the vegetation communities but this was undertaken across the project area and may not actually contain any sites which form part of the development footprint.

Once consent is given, it is proposed that the main way that impact is to be minimised is by the utilisation of a post-approval 'field development protocol' in conjunction with a 'ecological scouting framework', designed to signal on-the-ground issues which warrant avoidance. It is assumed that well and pipeline placement has some flexibility and some sensitive matters may be avoided by minor adjustment of the site location. But this may not always be the case and limits may occur as to how much particular pipe routes, exploration and appraisal well sites can be moved to avoid, for example, Pilliga Mouse habitat. But given the placement of the well sites is uncertain anyway, this protocol does not offer much re-assurance in terms of how well avoidance can be achieved.

There is also the issue that given Santos apparently don't know exactly where the wells are best located, it may be that some pilot, 'appraisal', wells will be unproductive, leading to a need to increase in the total number of sites being established to meet production targets over time. Currently 2 out of 5 well sites in the Pilliga have been capped due to their unproductiveness. Future incremental changes to the development footprint will only add to the post-approval impact.

Instead of proposing modelled 'upper disturbance limits' for each community and habitat type, a more transparent approach which could have been adopted by Santos and given better surety to the extent of possible impact and if those impacts could be managed, would have been to create a 'worst case scenario' that uses actual sites with locations. If those sites proved to be in the wrong location, then additional sites could be found which have a similar or less level of impact through a protocol that has additional regulatory oversight.

### ***Indirect Impact***

It is claimed in the EIS that indirect impacts, which take into account a range of offsite and flow-on effects on local ecological communities, have been accommodated in the impact modelling. There are two key issues with this assessment.

Santos are proposing a 50 or 20m 'buffer' around all infrastructure to accommodate off-site impacts such as site noise, traffic movements, light and dust pollution, gaseous emissions and increased impact of feral predators. Buffers are important when infrastructure is placed near sensitive ecological areas, such as streams, threatened species habitat and reserve boundaries.

In the EIS, streams will have buffers, but the EIS gives no surety that buffer zones will exclude areas of important habitat, particularly where subsequent location of wells impinges on habitat identified as being important for certain species. But most importantly, there is no evidence provided verifying the likely spatial extent of most of these offsite impacts in the EIS. 50m seems hardly adequate to cater for airborne pollutants, dust, light and noise and potential impacts on wildlife and ecosystems. This is particularly relevant for the Brigalow Park Nature Reserve, and State Conservation Area, the latter included within the project area.

While a 50m buffer is proposed around well sites and pipelines, ELA have calculated what the indirect impacts means in terms of additional biodiversity credit liability. It is stated in the EIS that

unmitigated offsite impacts only affect, on average, a 12m metre distance around the infrastructure and with mitigation actions the affected zone will be reduced by five metres for well pads and only 1m for tracks. Only this 1-5m indirect impact area has been added to the direct impact and biodiversity credit liability.

There is no literature review of these types of impacts provided in the EIS and it is not intended to provide one here. However, if we look at just one type of impact, feral animal (fox) predation, it will be realised that modelled assertions made in the EIS are questionable. Foraging patterns of foxes were studied in Jervis Bay:

*“As in other studies, roads, beaches and creeks were used by foxes as thoroughfares and boundaries to their territories ... Foxes were recorded within 15 m of roads on 33% of all fixes. Similarly, many European studies have found home-range boundaries of foxes to be defined by man-made features such as roads, playing fields and railway lines (Macdonald 1981; Kolb 1984; Doncaster and Macdonald 1991; Saunders et al. 1993)”* (Meek and Saunders 2000).

Studies have shown that roads are good predictors of local fox activity, they use them to mark their boundaries, and as hunting routes;

*“On nightfall foxes would increase their activity and begin to use the roads to patrol their home range.”* (Meek and Saunders 2000)

Foxes do not confine their activity to the road itself but stay close, within 15 m to the road, which seems to act as a maker for their foraging bouts. The fact that foxes spend a third of their total foraging time within close proximity to a road is probably for several reasons, most likely to do with ease of movement and visual amenity to detect prey. Additional roading, well pads and pipeline easements are going to add to the hunting success for the fox and may allow greater density of foxes to persist in the area because adding new cleared strips is effectively adding more hunting space.

As well as strong visual abilities, foxes have acute olfactory and auditory senses (Peterson *et al.* 1969; Malkemper *et al.* 2015). Using sound clues, a Red Fox can detect earthworms under the ground surface (MacDonald 1980) and rodents under feet of snow with relative ease and with precision (Cervený *et al.* 2011). An individual moving at a distance of 15m from a road or track would have the ability to hear animals moving for some distance into the bush away from the road. Exactly how far is not certain, though a 10m distance would not be far for a fox to detect a small vertebrate using sound clues. So, to account for the effective ‘indirect’ impact that new infrastructure would realistically have in relation to fox activity prior to mitigation would be a distance of 20-30m, particularly for tracks.

To claim that impacts like noise, air pollution and increased levels of feral predator predation could be mitigated to an area of 1-5m from infrastructure sites is unrealistic in my view and has not been supported by any strong evidence. To mitigate fox predation, Santos have proposed a ‘regional feral predator control program’ though key details that would add weight to the assertion has not been provided.

### ***Assessments of Significance***

These are outlined in Appendix J of Appendix J1 for the ‘seven-part test’ under the EPA Act and Appendix K for Commonwealth assessments of significance. Given the uncertainties outlined above regarding the accuracy of the direct and indirect impacts on particular matters, these assessments should be treated with caution by the consent authorities.

## Identified plant and threatened ecological communities

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There are 22 plant communities and four threatened ecological communities identified within the project area, all of which may suffer some direct and indirect impact. A number of plant communities in the project area which are threatened ecological communities (TECs) have not been adequately taken into account in the EIS.

### **Brigalow woodlands**

There are 6,695 ha of Brigalow dominant woodlands in the project area (Plant Community Type (PCT) ID 35), though only 2,268 ha have been classified as being consistent with the definition of the state and commonwealth-listed threatened ecological communities (TEC).

ELA have stated that further areas of this community which contain regrowth 'may' be considered to be part of this listed ecological community but that this has not been confirmed by field assessments, rather an approach was taken whereby any site cleared less than 15 years ago was classified as being 'regrowth' under the *Native Vegetation Act 2003*. However, if adequate field surveys or cross-checking with recent satellite imagery were not possible within time and access-constraints, a precautionary approach should have been adopted to include this larger area under the category of the TEC both at the state and federal levels as many of these areas may contain regrowth which met the definition of this community, despite a poor condition.

Brigalow is an Acacia, and despite its size and longevity, is capable of growing to a significant size within ten years following clearing.

### **Riparian red gum/Angophora/Callitris woodlands**

There are over 1,000 ha of the riparian redgum /angophora community in the project area, which is described as being dominated by Blakely's Red Gum *Eucalyptus blakelyi* and Rough-barked Angophora, *Angophora floribunda*. This community in the EIS is given as PCT ID 399 *Red gum - Rough-barked Apple +/- tea tree sandy creek woodland (wetland) in the Pilliga - Goonoo sandstone forests, Brigalow Belt South Bioregion*, with the Biometric Vegetation Type (BVT) for this community given as NA197 *Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion*, a grassy woodland.

Field verification surveys conducted by Ethical Ecology (EE) along Bohena Creek show this community (see Appendix 1) is a grassy woodland which best suits the plant community type, PCT ID 544:

(<http://www.environment.nsw.gov.au/NSWVCA20PRapp/DataEntry/PlantCommunity.aspx?M=E&PID=544>)

- (a) Verification surveys within the community mapped by ELA as being PCT ID 399 along the length of Bohena Creek show it meets the criteria of the Keith Formation of 'Grassy Woodlands'. The riparian woodland in question was found generally to contain a low overstorey height of 10-20 m, an open understorey with relatively little mid-storey (0-15%) or understorey shrub cover (5-30% cover), a lack of sclerophyllous shrubs, and having a high litter cover with groundcover dominated by grasses and forb species.
- (b) The species composition of this community was found to be more consistent with the grassy woodland PCT ID544, always containing White Cypress Pine *Callitris glaucophylla* and sometimes Yellow Box *Eucalyptus melliodora* in the overstorey; a mid-storey dominated by

the soft-leaved wattle *Acacia deanii* with only scattered sclerophyllous species, such as *Persoonia*; a low shrub cover mostly dominated by *Lomandra longifolia*; sometimes aquatic plants are present, eg, *Juncus* and *Cyperus*, though never dominant in the understorey; and a groundstorey containing species typically found in North-west Slopes and New England grassy woodlands, such as *Dichondra repens*, *Chrysocephalum*, *Glycine*, *Wahlenburgia*, *Chielianthes*, *Austrostipa*, *Micloeana* and *Aristida* grass spp. In the spring, this community typically contains high numbers of greenhood *Pterostylis* and *Diuris* orchids, while in autumn providing habitat for the lily *Crinium flaccidum*.

PCT ID 399 is present in the project area and it seems this type was specifically created to take into account riparian communities in the Pilliga region (Benson *et al.* 2010). However, while the sclerophyllous shrubs, Tea-tree *Leptospermum polygalifolium*, Bottle-brush *Callistemon linearis* are common along the creek systems in the Pilliga, along the greater part of the extent of Bohena Creek (a 5<sup>th</sup> order stream) these species are mostly restricted to the creek-bed itself and along a thin margin bound by the bank of the creek, if present at all.

Field surveys conducted by EE took into account the presence of these species by setting transects (n=16) with one edge along the top of the creekbank. A methodology consistent with the FBA was adopted, taking into account the contribution of all mid-storey species in the vegetation cover within the site assessments, including the tea-tree and bottlebrush. Of note is that the description of the riparian woodland community in question provided by the consultants in the EIS (p.151, Appendix J2) is not that different to that provided by EE, in Appendix 1.

ELA conducted 20 survey plots and found this community to have an overstorey cover of 2-18%, midstorey cover of 0-10%, grass cover of 0-50%, other ground vegetation cover of 8-30%, understorey shrub cover of 0-6%, litter cover of 9-55% and bare ground cover of 2-38%. Plots undertaken by EE tended to have a lower grass and groundstorey veg cover, a higher litter cover, and a higher understorey shrub cover (up to 30% at some sites), though generally data fell within the range of error provided by ELA for their sites.

The PCT description of the two communities in question is given below using an extract from the VIS database.

#### 1. PCT ID 399



Figure 1(a) Sandy Creek spring, in project area (b) Groundwater seepage zone, Flaggy Creek

Considerable ground-truthing in the project area by Ethical Ecology has shown that PCT ID 399 is present, generally found to be associated with lower order streams where the banks are less developed or absent. This describes the majority of streams in the Pilliga forests. Tea-tree and



bottlebrush seem to grow as dominant parts of the understorey where there are relatively high levels of surface or shallow groundwater flow (hence its description as a 'wetland' in the VIS database). Some areas of the creekbed, particularly containing waterholes, conform to this community, though most of Bohena Creek has little aquatic vegetation, except on within creek 'islands'.

## 2. PCT ID 544

This community was found at all but one of the transects (n=15) surveyed by EE. It is characterised as being found along the length of Bohena Creek, on flat or gently sloping ground (creek terrace) restricted on the creek edge by a distinct bank, which generally was not very high. While some doubt could be raised to the classification of this community, which typically occurs in the New England Tablelands and Nandewar bioregions, it is not uncommon to use PCTs from neighbouring regions to classify communities on the ground. The EIS also uses PCTs from neighbouring bioregions, such as the description of this same community as being in BVT NA 197 *Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion* in some parts of the EIS. Apart from a lack of the Native Olive, *Notolaea microcarpa*, all the species listed as being typical of PCT ID 544 matches the species composition found in the field.



Figure 2 (a) Near Oil Well Road

(b) Near Garlands Crossing

While Benson *et al.* (2010) identified PCT ID 399 as the predominate riparian community in the Pilliga Forests, it simply does not describe the grassy woodland and creek terrace structure encountered along Bohena Creek. From my own observations over 25 years, the other major Pilliga creeks, Baradine and Etoo, also support the same community.

### **Correspondence with TEC definitions for Box Gum Woodland**

This grassy riparian woodland community (PCT ID 544, BVT equivalent of NA342) is considered to meet the requirements of both the *Threatened Species Conservation Act 1997* (TSC Act)-listed and the EPBC Act-listed threatened ecological community *White Box Blakely's Red Gum-Yellow Box Woodland (and derived native grassland)* according to the VIS database, while PCT ID 399 does not as it belongs to the 'dry sclerophyll forest' Keith Formation.

But the real test as to whether this community matches the description of Box Gum Woodland is to compare the field data with the definitions provided in the listings for this TEC, both at state and commonwealth levels.

## 1. TSC Act listing

The White Box Yellow Box Blakely's Red Gum Woodland endangered ecological community (TSC Act) is described below via the OEH website:

<http://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10837>

This community is present in the Pilliga sub-regions according to the OEH database. Criteria which define this community are summarised as being:

- *Characterised by the presence or prior occurrence of White Box, Yellow Box and/or Blakely's Red Gum.*
- *The trees may occur as pure stands, mixtures of the three species or in mixtures with other trees, including wattles.*
- *Commonly co-occurring eucalypts include Apple Box (*E. bridgesiana*), Red Box (*E. polyanthemos*), Candlebark (*E. rubida*), Snow Gum (*E. pauciflora*), Argyle Apple (*E. cinerea*), Brittle Gum (*E. mannifera*), Red Stringybark (*E. macrorhyncha*), Grey Box (*E. microcarpa*), Cabbage Gum (*E. amplifolia*) and others.*
- *The understorey in intact sites is characterised by native grasses and a high diversity of herbs; the most commonly encountered include Kangaroo Grass (*Themeda australis*), Poa Tussock (*Poa sieberiana*), wallaby grasses (*Austrodanthonia* spp.), spear-grasses (*Austrostipa* spp.), Common Everlasting (*Chrysocephalum apiculatum*), Scrambled Eggs (*Goodenia pinnatifida*), Small St John's Wort (*Hypericum gramineum*), Narrow-leafed New Holland Daisy (*Vittadinia muelleri*) and blue-bells (*Wahlenbergia* spp.).*
- *Shrubs are generally sparse or absent, though they may be locally common.*
- *Remnants generally occur on fertile lower parts of the landscape where resources such as water and nutrients are abundant.*
- *Sites with particular characteristics, including varying age classes in the trees, patches of regrowth, old trees with hollows and fallen timber on the ground are very important as wildlife habitat.*
- *Sites in the lowest parts of the landscape often support very large trees which have leafy crowns and reliable nectar flows - sites important for insectivorous and nectar feeding birds.*

ELA test the correspondence of site values they encountered with the above criteria in Appendix F1 of Appendix J1. They found enough lack of correspondence to not regard the community as conforming to Box Gum Woodland. These points are addressed below.

The ecological community is either dominated by *Eucalyptus blakelyi* or has it a canopy co-dominant. It does not matter if the either species Yellow Box or White Box are present or not. In fact, Yellow Box is present at a low density, ELA just failed to detect it. The lack of the other occasional co-dominants within the community does not negate it being the endangered ecological community (EEC). Likewise, the presence of Rough-barked Apple and White Cypress Pine do not negate the community being an EEC.

The understorey in this community was found to be dominated by native grasses and forbs, though with usually high levels of leaf litter. Diversity at the transects showed some variance, with poorer condition areas with low diversity and higher levels of weed cover. Total diversity of native understorey showed 14 common grasses and 27 forbs and herbs. Levels of species correspondence for the listed 'characteristic species' in the scientific determination found of the 69 species identified in this study as being part of the riparian woodland community, 25 (36.7%) of these are listed as characteristic species under the Box Gum Woodland NSW Scientific Committee determination. Of the 94 characteristic species listed in the determination, 28 (28.7%) were found within the targeted

riparian community. In both regards this measure of correspondence with the scientific determination is high, supporting the notion that the dominant community described here matches the listing of Box Gum Woodland under the TSC Act.

In contrast, ELA found only a 5-12% correspondence with the characteristic species. This seems difficult to understand, given most of the same species were identified in the two surveys. If ELA were checking only each set of site data against the determination this result may be achieved. However, a more accurate community comparison against the determination should have used the full list of species found in this community. This information is not easily gleaned from the EIS because the different plant communities are not linked with the site floristic data in Appendix J1.

In contrast, the understorey shrub layer was species poor, mostly dominated by *Lomandra longifolia*, *Gahnia aspera* and occasionally rushes. The mid-storey was also species poor, dominated by *Acacia deanii* and sometimes Tea tree and Bottlebrush. In both cases, the cover by these layers was found to be generally sparse to common in patches.

ELA state that a chief reason why the community is not the EEC is because it does not have 'relatively fertile soils'. Soils in this habitat are said to be sands and sandy loams. The soils on which this community survives, while some sand wash can occur over the creek-terraces during times of high flow, are better described as being 'sandy loams', often with humic layers promoted by the high levels of leaf litter and clayey B horizons which retain moisture. This community is part of an alluvial system where the nutrients in the landscape are highest, certainly relative to the rest of the landscape. ELA may contend these areas are nutrient poor, but they have enough nutrient to support relatively high densities of large apple, box and gum trees. Other studies have shown that the density of large trees is highest in the 'gully' zones in the Pilliga (Date and Paull 2000) and that these sites supported the greatest diversity of birds, favoured by nectivorous species (Date et al 2002).

All sites supported old growth features such as high level of hollow development and large logs. The canopy was generally of a mixed age with regrowth locally common.

The ecological community dominated by Blakely's Red Gum – Rough-barked Apple - White Cypress Pine, a 'riparian woodland' described here as PCT ID 544, matches strongly the criteria above and should be regarded as being consistent with the definition of this EEC.

## 2. EPBC Act listing

The description of the EPBC-listed *White Box - Yellow Box - Blakely's Red Gum Grassy Woodlands and Derived Native Grasslands* is found at the Commonwealth website below.

<http://www.environment.gov.au/biodiversity/threatened/conservation-advice/white-box-yellow-box-blakelys-red-gum-grassy-woodlands-derived-native-grasslands>

The advice to the Minister states that, "In its pre-1750 state, this ecological community was characterised by:

- a ground layer dominated by tussock grasses;
- an overstorey dominated or co-dominated by White Box, Yellow Box or Blakely's Red Gum, or Grey Box in the Nandewar bioregion; and,
- a sparse or patchy shrub layer.

*“Associated, and occasionally co-dominant, trees include, but are not restricted to: Grey Box (Eucalyptus microcarpa), Fuzzy Box (E. conica), Apple Box (E. bridgesiana), Red Box (E. polyanthemos), Red Stringybark (E. macrorhyncha), White Cypress Pine (Callitris glaucophylla), Black Cypress Pine (C. enderlicheri), Long-leaved Box (E. gonicalyx), New England Stringybark (E. calignosa), Brittle Gum (E. mannifera), Candlebark (E. rubida), Argyle Apple (E. cinerea), Kurrajong (Brachychiton populneus) and Drooping She-oak (Allocasuarina verticillata) (Austin et al. 2002; Beadle 1981; Fischer et al. 2004; NSW National Parks & Wildlife Service 2002; Prober & Thiele in press). This ecological community occurs in areas where rainfall is between 400 and 1200 mm per annum, on moderate to highly fertile soils at altitudes of 170 metres to 1200 metres (NSW Scientific Committee 2002).*

*“Shrubs can occur naturally in grassy woodlands, and can form an important part of the Box – Gum Grassy Woodland and Derived Grassland ecological community... In shrubby woodlands, the dominance of native tussock grasses in the ground layer of vegetation is lost. Therefore, a remnant with a continuous shrub layer, in which the shrub cover is greater than 30%, is considered to be a shrubby woodland and so is not part of the listed ecological community. Remnant attributes, such as shrubbiness, should be measured on a scale of 0.1 hectares or greater.*

*“The size and life-form of understorey species are such that viable populations can exist in very small areas (Prober & Thiele 1993). Therefore, in order to be the listed ecological community, an understorey patch, in the absence of overstorey trees, must have a high level of native floral species diversity, but only needs to be 0.1 hectares or greater in size. A patch in which the perennial vegetation of the ground layer is dominated by native species, and which contains at least 12 native, non-grass understorey species (such as forbs, shrubs, ferns, grasses and sedges) is considered to have a sufficiently high level of native diversity to be the listed ecological community.*

*“At least one of the understorey species should be an important species (e.g. grazing-sensitive, regionally significant or uncommon species; such as Kangaroo Grass or orchids) in order to indicate a reasonable condition. Areas with both an overstorey and understorey present are also considered of sufficiently good condition to be part of the listed ecological community if the understorey meets any of the conditions above, or if they have a predominantly native understorey, are two hectares or above in size, and have either natural regeneration of the overstorey species or 20 or more mature trees per hectare.”*

In Table 2, Appendix F1 of Appendix J1, ELA provide an assessment on how well the community in question meets the definition criteria of the EPBC Box Gum Woodland CEEC. My responses to their comments are below:

Some importance is placed on the contention that the groundlayer is not “dominated by tussock grasses.” Many of the grasses present in this community such as wire grasses, wallaby grass, spear grass are regarded as ‘tussock grasses’. While the overall cover of these grasses does not constitute a majority of cover, the groundcover may be described as a mixture of forbs, grasses and leaf litter. The tussock grasses are the dominant type of cover in the groundlayer in that they are taller and more conspicuous. Other species such as Bladey Grass *Imperata* and Reed Grass *Arundinella nepalensis* occurred in patches, though were not present at all sites. Other grasses present at most sites were the damp loving species Couch and Weeping Grass. ELA also include the species *Lomandra longifolia* and *Gahnia aspera* as groundcover, though I regarded them as a low shrub for the analysis in this study, due to their large size (up to a metre).

*“Tree cover in the subject plots range from discontinuous on the larger creeks like Bohena Creek and continuous on the smaller tributaries.”* This statement by ELA confirms the notion that the plant

community along Bohena Creek is a woodland and is different to that on the smaller creeks which support PCT ID 399.

ELA again contend the soils are not 'moderate to highly fertile soils' as defined in the EPBC determination, but rather more on the 'low to moderate' scale. This is debatable as to whether the definition under the EPBC Act does not include soils which have a 'low to moderate' fertility.

The project area being outside the zone mapped by Prober and Thiel (1995) by itself does not constitute a reason why the community here should not be regarded as the CEEC, nor should presence or absence of White Box.

ELA have confused the term 'eastern slopes' with the slopes east of the divide. This was not the intention of this term which is referring to the slopes on the eastern side of the distribution of this community, ie. the north-west slopes. The Pilliga is regarded as being partially within the general 'slopes' region.

The discussion in the EPBC determination about Kangaroo Grass and Snow Grass is made in the context of their grazing susceptibility. It clearly states in the determination that these species were, *"originally the dominant grasses across a large part of the ecological community's range"* not the whole range of where this community is found. There should be no expectation from ELA that these species are found in this community in the project area.

With an understorey diversity ranging from 20 to 35 species per plot, these are not species-poor habitats, though some variation in condition was encountered by EE, with a number of plots lacking sufficient diversity to meet the conditions in the EPBC definition. The soils this community occurs on is alluvial in nature, relatively deep, have clay zones which trap water and high levels of leaf litter promoting humic conditions. As ELA have conceded the level of shrub cover in this community is only sparse to patchy. None of these matters supports the contention that this community is not the CEEC.

Due to the variation in the condition of this community along Bohena Creek, only 8 of the 16 sites sampled meets the EPBC criteria in terms of structure, species composition and species diversity. Beside the one site found on the eastern bank of Bohena Creek at Site 5 which was a shrubby woodland (PCT ID 408), the other transects failed to meet the definition of the EPBC Box Gum woodland due to their poor groundstorey condition and lack of forb and herb species (<12 as required in the definition above).

Interestingly, the Commonwealth flagged the possible presence of Box Gum Woodland CEEC in the study area in their response to the referral submitted 2014. But in the SEARs, the OEH have removed this community as a 'matter for further consideration' on the basis that it was presumably thought not to be present.

Despite the variation in condition and based on the information above, the community identified here as PCT ID 544 should be regarded as being consistent with the definition of this critically endangered ecological community.

#### *PCT ID 401*

There is actually very little difference in the structure and species composition of this community and the PCT ID 544 (see p. 152, Appendix J2), except the red gum in this community is said to be *E. chloroclada* in the EIS and the absence of Yellow Box and Kurrajong. But as this community also contains *E. blakelyi* and given the recognised extent of hybridisation in the Pilliga forests among red

gums (Benson *et al.* 2010), the distinction between the two may not be so clear. Observations of this community type (PCT ID 401) in the field, suggest it could be lumped with the previously discussed PCT ID 544. In fact ELA has assigned these two communities the same Biometric Vegetation Type, *NA 197 Rough-barked Apple riparian forb/grass open forest of the Nandewar Bioregion*, a grassy woodland.

This similarity was acknowledged in the EIS, as Appendix B of Appendix F2 of Appendix J1 states, “*ID 399 and ID 401 generally occur adjacent to one another and intergrade along riparian corridors ... These communities are relatively similar and it was often difficult to delineate the boundary between these two communities.*”

However, without any independent verification, it is not possible to confirm whether or not PCT ID 401 should include all the red gum – rough barked apple communities in the study area and how much of this combined type also conforms to the state and Commonwealth-listed ecological community. Further verification should be required to clarify this issue.

### **Identified Threatened flora**

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Appendix F4 of Appendix J1 (Flora Modelling Technical Report) details much of the rationale, effort and results for the targeted threatened flora surveys. The models used to estimate population size seem appropriate and the estimates given appear to be the best possible given the limited data available in some instances.

Nonetheless, the margin of error in the estimates is considerable, up to 100%, which does not provide great certainty as to the predictive accuracy of some of these models, necessary for accurate impact assessment.

### **Identified Threatened fauna**

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*“In the study area, 16 birds, 10 mammals and one reptile listed as threatened under the TSC Act, three mammals one bird listed under the EPBC Act and five birds listed as migratory under the EPBC Act were recorded during this assessment.”* (Appendix J1, p. 105).

A review of statements made of the habitat preferences and distribution of some of the key species for this EIS is provided below. Species identified by the Secretary as being “matters for further consideration” within the SEARs are discussed separately.

#### **Pilliga Mouse**

Habitat preferences of the Pilliga Mouse and habitat modelling undertaken for this species is discussed in Appendices F5 and F6. The most accurate statement about the habitat preferences of the Pilliga Mouse is provide on p.15 of Appendix F6;

*“Consistent characteristics of Pilliga Mouse habitat include a high cover and diversity of low shrubs as well as a sandy soil substrate in woodland and forest communities.”*

Except that the Pilliga Mouse is not restricted to woodland habitats and also occurs in treeless heaths when suitable conditions arise. The most detailed habitat descriptions of this species are contained within Paull (2009) and Paull *et al.* (2014) who describe a number of statistically significant relationships:

- In mature habitats in the central parts of the Pilliga, Pilliga Mice prefer a high ground cover of litter and ground-plants, while in fire affected sites prefer a low shrub cover of over 30% with burrow sites located in patches of high leaf litter cover. This trend for selection of a dense low shrub cover was recorded again in breeding habitat in the eastern Pilliga.
- In the central Pilliga, Pilliga Mice strongly avoided areas with a dense mid-storey cover 2 m or greater in height. Breeding sites in the eastern Pilliga also did not support this kind of mid-storey.
- Tree cover was not found to be a factor affecting Pilliga Mouse presence in the central Pilliga, with highest numbers recorded from treeless areas. However, in the eastern Pilliga, all breeding sites were found within woodland habitats. Therefore tree cover is not a predictive factor.
- A preference for a relatively deep (at least 30cm) sandy substrate was recorded across all sites.

The Canopy Height Model proposed by ELA identified five categories of habitat (Appendix F5 of Appendix J1). CAT 1 (Dense Heath) and CAT 2 (open heathy woodland) are regarded as 'primary'. Three others require further field verification and are regarded as 'secondary'.

From observations made by Paull *et al.* (2014), based on over 30 captures in the eastern Pilliga, important habitat for the Pilliga Mouse may also be found in 'woodland' as opposed to 'open woodland'. Whether the LIDAR-based Canopy Height Model employed by ELA can detect a low shrub cover under this density of canopy appears unlikely.

Pilliga Mice have also been trapped in riparian woodlands (RACD 2001), again, type of use by Pilliga Mice is likely to be dependent on suitability of local ground and understorey conditions.

ELA don't regard Broombush scrub as habitat for the Pilliga Mouse, citing shallow clay layer as a barrier to burrowing. This is despite the clear preference for this community type in the central Pilliga (Paull 2009) where a clay layer is present though deep enough below the sandy A horizon to allow burrows to be constructed. The 'clay dome' which underlies most areas which are treeless and prone to water-logging can vary in depth below the surface, though to exclude the Broombush community in its entirety from the habitat model as 'primary habitat' would not be prudent in relation to the conservation of this species.

For the purpose of the both the EPBC and TSC Acts, the species listed as *Pseudomys pilligaensis* in the list of threatened species is currently treated as a valid taxon and so conjecture regarding its taxonomic status in the EIS is a moot point.

In fact, despite a recent move to have the Pilliga Mouse de-listed as a threatened species due to this question regarding its taxonomic status, the Pilliga Mouse has been retained on the Commonwealth listing and the current position of the current Commonwealth Threatened Species Scientific Committee with regards to this issue is given below from the Commonwealth website.

*"The available genetic evidence (i.e. presence of mitochondrial DNA similar to both P. delicatulus and P. novahollandiae in specimens of P. pilligaensis) indicates that P. pilligaensis is either a stabilised natural hybrid or a hybridised population of P. delicatulus or P. novahollandiae (Eldridge 2015, pers. comm.). This evidence has led some authorities to treat the Pilliga Mouse as a southern population of the non-significant Delicate Mouse (Pseudomys delicatulus) (AFD 2015; Breed & Ford 2007; Van Dyck & Strahan 2008; Woinarski et al. 2014). The Australian Museum, however, argues that the current data is insufficient to distinguish amongst these options and that a more detailed study is required to resolve the matter (Eldridge 2015, pers. comm.)."*



This is re-iterated by the IUCN who have listed this species as Data Deficient in view of recent doubts as to its taxonomic validity. This summarises the current scientific position on this issue. That is, while the work of Ford (2003) raised questions about the taxonomic status of the Pilliga Mouse, he did not resolve them.

Further, the Red List states, *“should this taxonomic issue be resolved such that P. pilligaensis is again widely accepted as a full species, it would need to be reassessed. At present, it may be considered Endangered under this scenario because its extent of occurrence is less than 5,000 km<sup>2</sup>, its distribution may be severely fragmented, and there is continuing decline in the quality of habitat due to mining and logging.”*

<http://www.iucnredlist.org/details/full/18555/0>

At no time has the NSW Scientific Committee considered removal of the species from its listing under the TSC Act, recognising the genetic uniqueness of the population, having more than one haplotype within its gene pool. Even if at some time the population becomes regarded as a Delicate Mouse after further taxonomic investigation that uses genome testing rather than a mitochondrial analysis, this is still a threatened species under the TSC Act.

### **Koala**

*“Note that Koala has been included in this list as Koala scats (Landmark Ecological Services and Wilderness Society 2012) and a Koala skull was recorded during survey for this assessment in 2011. Due to the similarity between Brushtail Possum and Koala scats, and the fact that no Koala sightings in the study area can support these records, the current evidence does not indicate presence of a current population in the study area.”* (Appendix J1, p. 105).

Brushtail Possum scats and Koala scats may be similar in some respect, but there is no doubting the accuracy of a trained sniffer dog and sightings of animals. Both types of detection of Koalas have been made within the study area in the last year. New evidence is provided here (reports attached) which show 5 records of Koalas in the study area and nearby in the period 2013-2016.

OWAD Environmental conducted a Koala scat trained detection dog survey in 2016. Two ‘hits’ were made. One on Crow Road of scats in an area of Narrow-leaf Ironbark (*E. crebra*) and another near the study area southern boundary on Bohena Creek Road in Red Gum and Yellow Box woodland, but the scats here was not located. More recently, a male individual was observed on Dog Proof Fence Road within the western boundary of the study area. He was located in a Red Gum, near Bundock Creek in November 2016. This stream is surrounded by Pilliga Box woodland, with more scats found to the south of the Project area on Borah Creek.

Prior to this, Koala scats were observed on Bohena Creek (Lunney *et. al.* submitted to Pacific Conservation Biology) another individual was observed in August 2014 near Cocoboy 2 Dam, in the Pilliga East SCA. All these records have been submitted to the NSW Wildlife Atlas.

The record contained in Lunney *et al.* (submitted) was part of an Environmental Trust funded project to replicate historical surveys conducted by teams of experts who had surveyed Koalas previously in the Pilliga. The findings of this study along with the work conducted by Niche (Appendix F7 of Appendix J1) show that the Koala distribution and abundance has declined significantly since times of peak numbers in the 1990s (Kavanagh and Barrott 2001). Niche found 14 animals in the Etoo and Baradine Creek drainages across an area where perhaps hundreds were resident 20 years ago.



There have been other recent records of the Koala in the northern Pilliga, with more than one detected from the Australian Wildlife Conservancy (AWC) lands (R. Kavanagh, pers. com.) last year. In this light, the recent observation on Bundock Creek should not be a surprise, given there is more or less continuous habitat for the Koala from the AWC area to the eastern side of the Newell Hwy, if the preferred food tree Pilliga Box *Eucalypts pilligaensis* is taken into account (see below).

In summary, the current status of the Koala in the study area (and throughout the Pilliga) is dire with numbers desperately low. Any records of where Koalas are currently should be treated with the highest priority. While presence of the Koala in the Bohena Creek area is uncertain, records from the northern Pilliga suggest very low numbers are still persisting this area. Considerably more monitoring needs to be undertaken of Koalas in the project area and beyond to ascertain if current trends of decline will continue and what actions need to be done to ensure the local and regional Koala's survival.

The EIS claims to have modelled 'primary' and secondary' habitat for the Koala in the project area by reference to the NSW Koala Recovery Plan (2008) which identifies a number of primary and secondary species. However, it is widely accepted, and based on scientific evidence, that this list does not accurately reflect feed preferences from the Pilliga and the Liverpool Plains.

Work by Kavanagh *et al.* (2007) clearly show that the preferred feed species of the Pilliga koalas at a time of high population density were Blakely's Red Gum and Pilliga Box. This was re-iterated within the EIS itself within Appendix F7 of Appendix J1. Areas dominated by preferred feed species should constitute primary habitat as defined under Callaghan (cited in DECC 2008), that is, all areas dominated by Blakely's Red Gum, Pilliga Box and River Red Gum would constitute primary habitat or habitat critical to the survival of the koala.

Despite this, the EIS identifies only 10.5 ha of primary habitat, River Red Forest in the vicinity of Yarrie Lake. By adding the areal extent covered by the communities identified as 'secondary' in the EIS, (29,942.5 ha), the total area of Koala habitat in the study area covers 29,953 ha. However, if the approach outlined in the Commonwealth guidelines or that outlined in the NSW Recovery Plan is used, primary habitat in the study area could cover at least 7,050.6 ha. Most of the records in the study area from the BioNet database are from the northern Pilliga Box woodlands as mapped by ELA.

While it has been common practice among ecological consultants in NSW to use the now defunct Recovery Plan's (DECC 2008-13) regional categories of tree preference provided in the Plan as scientific proof, any guidelines such as these should be subject to scientific scrutiny. The approach taken by ELA ignores common scientific practice of reviewing the relevant literature. After all, ecology is a science, not just a tick-the-box exercise.

ELA goes on to state that there is no 'core' Koala habitat in the study area using the definitions provided in the SEPP44 – Koala Habitat guidelines. SEPP44 outlines an 'activity-based' approach to determining koala use of land parcels. The use of these guidelines is only appropriate and has statutory meaning for developments where local government is the consent authority and where developments are local in scale. It is certainly not appropriate to use this approach for regional scale developments where local populations may be at very low densities, such as in the Pilliga forests. The survey intensity of scat assessments in the EIS is certainly of not enough quantity to cover all of the extent of koala habitat in the study area (4 mapped plots over 30,000 ha) and the Secretary of the Environment should disregard any statements using definitions under the SEPP44.

### ***Black-striped Wallaby***

ELA recorded this endangered species at 12 locations, however, the importance of the affected population to this species and the potential impact on it from the gas field is understated in the EIS. This is despite the fact that:

- Seven records in the EIS are from the Pilliga forests effectively doubling the number of times this species has been recorded from the Pilliga.
- The current distribution of this species is wholly within the project area.
- This population is spread between two areas, one centered around Brigalow Park Nature Reserve and State Conservation Area and the Pilliga Forests. Connecting vegetation is found along Bundock Creek. These important areas may be surrounded by gas wells, degrading habitat conditions and hindering dispersal or movement of this species.
- The Black-striped wallaby is endangered in NSW. The western slopes population is isolated from other populations on the eastern seaboard. Arguably this species should have been identified as a 'matter for further consideration' under the FBA due to potential impacts upon landscape features or significant reductions in population viability in the IBRA subregion (s. 9.2.1.3 of the FBA).

Appendix A5 of Appendix J1 describes the habitat preferences of this species as being wide, selecting all habitats except for heath. However, in Appendix I of Appendix J1, the habitat requirements of the Black-striped Wallaby in the study area is described as:

*"Preferred habitat is characterised as dense woody or shrubby vegetation within 3 m of the ground. This dense vegetation must occur near a more open, grassy area to provide suitable feeding habitat. On the north-west slopes it is associated with dense vegetation including brigalow, ooline and semi-evergreen vine thicket."*

These are quite specific requirements as compared to a more general one, which raising questions about the accuracy of the impact assessment on this species. Key to this is that this assessment ignores this species' presence in the Pilliga, which does not contain the vegetation communities mentioned in Appendix I, but does have areas of forest with thick understorey vegetation. This wallaby is most well-known from Brigalow Park Nature Reserve (NR) and State Conservation Area (SCA) about 20 km to the north of the Pilliga forest, these areas are dominated by Brigalow, small remnants of the 5% of this community which remains in NSW. Normally, this wallaby occupies territories of over 90 ha, though it is capable of longer distance movements (Evans 1996). There is only limited space the very small reserves to the north of the Pilliga forest can afford the Black-striped Wallaby which it shares with other macropods, such as the Red-necked Wallaby.

Recent evidence has shown that in fact this population is regularly using the northern sections of the Pilliga forest and are particularly using a corridor running along Bundock Creek. Besides records from Landmark Ecological Services (2012) and the data provided in this EIS, survey by the North West Local Land Service has recorded dozens of images of Black-striped Wallabies at the state forest northern boundary using holes in the wire fence to gain access (Reegan Walker, NW LLS pers. comm.). Much emphasis is often placed on the forging requirement of 'open, grassy areas' as needed by this species, though the Pilliga forest itself has significant grass cover, and supports thousands of kangaroos.

In the EIS there has been no attempt to describe the locations or habitat use of this endangered species, in what seems like a considerate oversight. But from what we know, an initial habitat model would include the following.

- Forest with high canopy cover – consistent with its preference for ‘denser forest’.
- Forest on heavier soils – records from the Pilliga suggest this species is restricted by heavier soils associated with box/ironbark vegetation in the north of the forest, these areas are characterised by a clay soil horizon.
- Refuge sites containing areas of dense understorey up to 3m – Pilliga has much cypress and bull oak regrowth, as well as dense patches of wattle.
- Some records suggest wallabies are also grazing along creeks, with a record in the EIS from near Bohena Creek.

Given the very inaccurate characterisation of the habitat of this species, the poor assessment of indirect impacts and the general lack of consideration in the EIS, the Secretary should disregard any impact assessment undertaken on this species as being an accurate account.

Special consideration should be given to this species under the terms of s.9.2.5.2 of the FBA.

### **Impact assessment**

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It is stated in the EIS that there will be 1,701.51 ha of cumulative impact on native vegetation (including derived native grasslands) – 1.79% of the study area. The modelled impact assessment also found that there would be less than 3% of fauna habitat for all threatened fauna and less than 2% of threatened flora individuals affected by the gas field.

What is remarkable about the predicted impacts is the evenness of impact that the probabilistic modelling creates. For example, nearly all modelled impacts on threatened flora species predicts an impact of around 1.57% for direct impacts. This is despite very different levels of occupancy and density exhibited by the different species. Similar patterns also exist for fauna habitat and vegetation communities, exhibiting a high level of similarity of magnitude of impact within the model.

Is this an artefact of the type of modelling that has been undertaken? Or just a remarkable coincidence.

Similarly, the assessments of significance of impact as per the tests in the EPA and EPBC Acts suffer from a lack of transparency due to questions regarding the modelled impact.

### **Matters of further consideration**

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The SEARs identify three ‘matters for further consideration’ and require particular assessment approach as detailed at s.9.2.5.2 of the FBA. Consideration has to be given as to whether the matter under consideration is ‘directly and/or indirectly impacted by the development’.

The EIS has called this the ‘disturbance site’ which is the area contained within the ‘disturbance boundary’, including buffer zones, but in reality these remain hypothetical.

Reference in Appendix D of the Biodiversity Assessment Report (Appendix J2) refers to expected impacts which may arise as a result of the development. Some reliance seems to have been made as to whether or not the two fauna species in question have 'breeding habitat' in the 'study area' but this assessment is primarily based how much this habitat overlaps with the likelihood of it being affected by an imaginary footprint based on the 'probabilistic' methodology described in Appendix F3.

It should be viewed by the Secretary that as the proponent has not identified a development footprint, the requirements of s.9.2.5.2 have not been met and that statements made in the EIS such as 'outside the disturbance area' should not be taken literally.

### **Regent Honeyeater *Anthochaera phrygia***

The EIS states that there is no breeding habitat for the Regent Honeyeater within the study area, but there must be some doubt as to the accuracy of this assertion. Bohena, Borah and Yaminbah Creeks all support grassy woodland containing red gums, Yellow Box and Mugga Ironbark and it is not necessary that breeding habitat contain River Oak *Casuarina cunninghamiana*. Areas close to the main streams in the Bohena Creek system also contain box and ironbark woodlands. Previous records of this species from the Pilliga and Warrumbungles were from riparian habitats (Dr Liz Huxtable, pers. comm.).

The National Recovery Plan for the Regent Honeyeater states that:

*"... riparian habitat is also selected as breeding habitat in some years (Geering and French, 1998; Oliver et al., 1998; Oliver et al., 1999). Often this is adjacent to box-ironbark woodland. Remnant stands of timber, roadside reserves, travelling stock routes and street trees also provide important habitat for regent honeyeaters at certain times (Franklin et al., 1987, 1989; Ley & Williams, 1992; Webster & Menkhorst, 1992; Oliver, 1998)."*

Mugga (or Red) Ironbark, *Eucalyptus sideroxylon* and Yellow Box are identified as key tree species for the Regent Honeyeater. Both are present in the study area. The Recovery Plan states that 'habitat critical to the survival of the Regent Honeyeater' includes:

- *Any breeding or foraging habitat in areas where the species is likely to occur; and*
- *Any newly discovered breeding or foraging locations.*

While there are no records of this critically endangered bird in the study area, the red gum angophora woodlands of the Bohena Creek (which contains Yellow Box) and adjacent areas of Mugga Ironbark could potentially be 'habitat critical to the survival'.

*"Key areas include the Bundarra-Barraba, Pilliga Woodlands, Mudgee-Wollar and the Capertee Valley and Hunter Valley areas in New South Wales, and the Chiltern and Lurg-Benalla regions of north-east Victoria."* The National Recovery Plan (DoE 2016) regards the Pilliga as a breeding area for the Regent Honeyeater.

Given the confusion about the definition of breeding habitat for this species and, as discussed previously, a lack of sufficient effort to detect this species, the Secretary should determine that specific assessment conditions outlined in s.9.2.5.2 have not been adhered to.

### **Five-clawed Worm-skink *Anomalopus mackayi***

There are two important aspects for the impact assessment undertaken on this species which have been overlooked by ELA. A summary by ELA on the ecology and presence of this species in the project area is as follows:

*“The Five-clawed Worm-skink is known to occur on the floodplains of the Namoi River, and its likely distribution within the Namoi Catchment extends to just north of the study area (North-west Ecological Services 2010). Its preferred habitat on deep cracking clay soils is not present in the study area. The northern portion of the study area supports limited potential habitat in closed forest habitat”.* (p. 112, Appendix J1).

A due diligence assessment of the known information on this skink shows it is not restricted to ‘deep cracking clay soils’. The Queensland Government’s description of this species states the following:

*“The habitat of the long-legged worm-skink is eucalypt open woodland and low open grassland. Three specimens have been found beneath logs on red-black to black clay-loam soils in a gently sloping open paddock with even, low (approximately 5-10 cm) grass cover and scattered eucalypts.”*

[https://www.ehp.qld.gov.au/wildlife/animals-az/longlegged\\_wormskink.html](https://www.ehp.qld.gov.au/wildlife/animals-az/longlegged_wormskink.html)

The study undertaken by North-west Ecological Services (2010) on this species within the Namoi and Gwydir floodplain also found one specimen on ‘basaltic soils’ within box woodland.

There is also a record of a specimen found just outside the study area in 2015. ELA deal with this by stating that the location was someone’s ‘property’ and the location is not certain. A review of the circumstances of this record show it was found dead on a road and handed to NPWS for verification. A check of the BioNet database shows that location data has been provided (Figure 3).

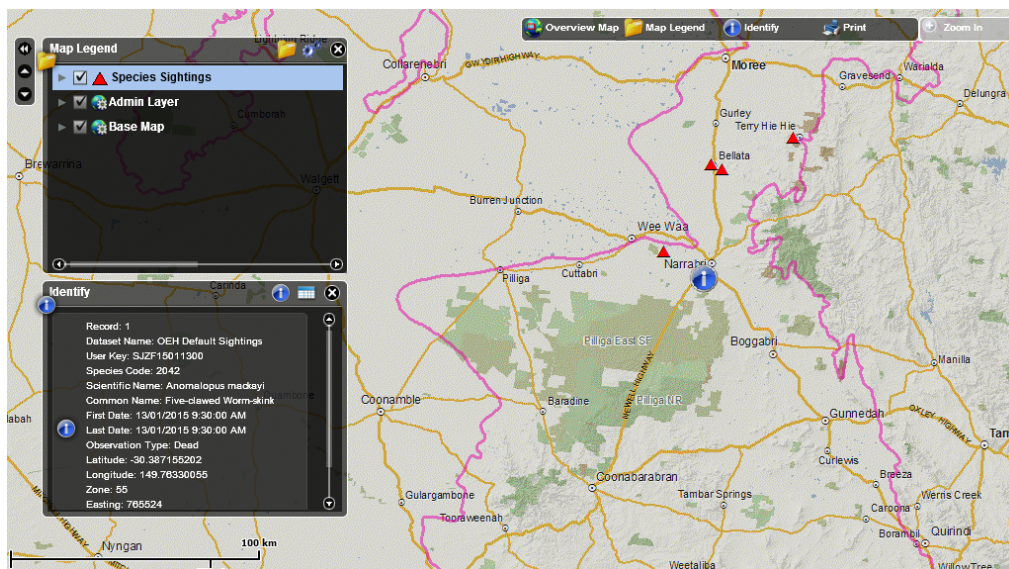


Figure 3. Records of *A. mackayi* from the BioNet database (accessed March 2017). The ‘i’ is the record from 2015 near the study area boundary

While ELA have dismissed any closer examination of this record, if the latest soil type mapping from Geoscience Australia is overlain, the record provides some indication of the soil types associated with it. The specimen was found in an area of Grey Brown Podzols/Earthy Sands. The extent of the heavy ‘Black Earths’ is shown as medium grey to the north and west of the location. Its distribution is well into the study area.

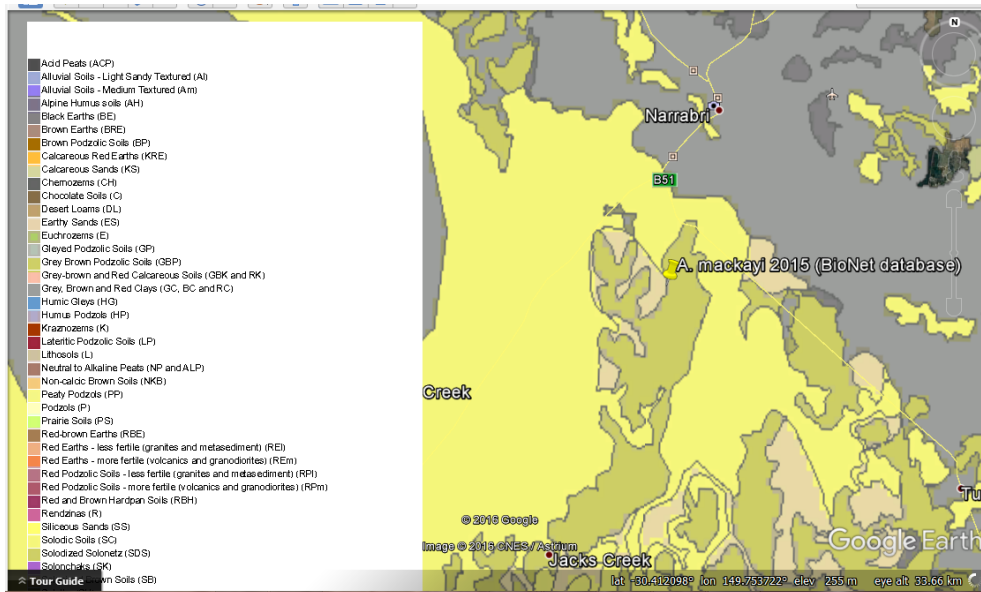


Figure 4. 2015 location with Soil type mapping from GeoScience Australia

The Black Earths can be found all the way through the study area, to include the heavy gilgaed (Brigalow) soils. The category of ‘cracking clays’ is not used in the latest soils mapping as the inclusive category ‘Black Earth’ include a variety of types, all with a similar physical properties, including cracking. What is clear is that statements made by ELA that there is no preferred habitat in the study area cannot be supported by the available evidence. Assessments of the site suitability for this species during field surveys in fact identified three sites which were thought to be suitable for this species.

Given the confusion about the habitat for this species, an unwillingness to consider key data and, as discussed previously, a lack of sufficient effort to detect this species, the Secretary should determine that specific assessment conditions outlined in s.9.2.5.2 have not been adhered to.

## Impacts on NPWS estate

While Santos has proposed a ‘no drill zone’ within the Brigalow Park State Conservation Area (SCA), this does not carry any regulatory restriction as gas exploration activities are allowed in State Conservation Areas. In addition, the Brigalow Park Nature Reserve and the Brigalow Park SCA – (both sections) may be completely surrounded by gas infrastructure as a result of the NGP. As both these reserves are small, impacts such as additional noise and light pollution, increased traffic, fencing, infrastructure and habitat removal are likely to decrease the habitat value within these areas, increasing levels of ‘edge-effect’. This is particularly significant for the endangered Black-striped Wallaby, a species barely mentioned in the EIS itself. These reserves are two of the last refuges for this endangered animal, and NPWS conduct routine surveys to check on numbers.

However, if the construction of gas infrastructure occurs in the vicinity of the reserves or Bundock Creek, the safe refuge and dispersal of this wallaby may be hindered and the current conditions which promote the relatively safe and quiet conditions around the reserves may be compromised.

But again, without knowing the location of the infrastructure, it is impossible to provide an accurate assessment of the magnitude of indirect impacts on these reserves. And given the very poor

modelling of indirect impact to 5 effective metres, the EIS does not take into account the effects of lighting, dust etc.

## Environmental Risk Assessment

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The proposed limits to indirect impact will be further explained within a Biodiversity Management Plan and a Significant Species Management Plan, but these are currently not available. Given the mitigating actions proposed in Table 15-22 in Chapter 15, there are only three which could minimise the risk of impact offsite, the Dark Sky Planning Guidelines, 'minimisation' of driving when it's dark and a proposed regional feral predator control program.

Foxes are notoriously difficult to control, neither baiting or shooting has been shown to be effective in the long-term if animals are allowed to re-colonise controlled areas (Newsome et al. 2014). This is particularly true for large scale feral animal control programs as gaps in baiting events and lack of coverage in adjacent areas will lead to ongoing fox dispersal into the study area. The potential impact in the most biodiverse sections of the project area are mostly restricted to state forest. No level of 'integration' can ignore the fact that this is large area is managed by one agency (Forests NSW). This also has to be placed within the context of the high risk of the project increasing levels of feral animal predation (particularly the fox) within the state forest. Fox numbers in the Pilliga are already high, a camera trap survey using 90 cameras throughout the Pilliga detected foxes at over 50% of cameras (D. Paull unpubl. data). No details of the control program are given in the EIS except for a number of objectives.

The Dark Sky Planning Guidelines will reduce onsite lighting at some facilities by aiming the light fixtures towards the ground, though flares are exempt under the guidelines. Placing rows of trees around the flare sites will reduce some light cover in time, if the flare stacks are low enough, though will not reduce total penetration of light.

Minimising vehicle movements at night may help reduce off-site impacts, though little detail is available as to what this really means in terms of number of vehicle movements. The fact remains that increased truck movements will result in a net increase in overall impact.

The mitigating actions with respect to direct impacts are conventional measures and the clearing protocol for example may save some individuals, but the impact itself cannot be avoided.

The field scoping protocol for sites may also assist in reducing local impact on a limited number or amount of listed matters, but there are limits to avoidability in the field due to issues relating to the necessity of the particular location and the extent of sensitive matters in the local area. Undertaking desktop searches prior to construction may identify some threatened species records, though to assume that they will for all threatened species in the location is not justified. Issues with some of the habitat mapping noted above reduce the reliability of this approach.

A number of the risks were given a 'High' rating, (impacts of clearing for example). It is unclear how this could be reduced to a medium risk given the above considerations. The risk posed by increased feral predation is also said to be mitigated by site rehabilitation measures. However, at present there is no evidence that site rehabilitation measures offer any protection from feral predators at sites already cleared across the Pilliga. These are generally still largely bare, or mulched with some grass and scattered low shrub cover (including Galvanised Burr) and sites with stands of Mudgee Wattle *Acacia spectabilis*. Many of these have been established for over 10 years. The predation risk at these sites should be regarded as 'High' and this rating would not have changed in this time.

Weed control measures have been poor at existing well sites, even with rehabilitation plans, with noxious weeds present at some. Weeds may provide some habitat use for native fauna, but in terms of restoring natural landscapes become a hindrance. In general, there is little surety that stated objectives in the Rehabilitation Plan (Appendix V) can be achieved (see below).

There is no bushfire risk management plan for the public to see or any assessment of the bushfire risk of the development.

## **Biodiversity Offset Strategy**

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Perhaps the biggest failure of the terrestrial ecology assessment is the lack of a credible offset strategy. In fact, p. 15-54 states that there has been no investigation of the merits of the different offset proposals provided in the EIS and that these issues would be sorted out post-approval.

All Biodiversity Assessment Reports need to follow the FBA under the current NSW Biodiversity Offset Policy for Major Projects (the Policy). This requires proponents to provide a transparent retirement of biodiversity credits using offsets showing how many credits each action will generate. Only estimations have been provided. The SEARs for this project states the following must be provided;

*“... a strategy to offset any residual impacts of the development in accordance with the NSW Biodiversity Offsets Policy for Major Projects (OEH, 2014), unless otherwise agreed by OEH.”*

Appendix J2 states that over 56,000 ecosystem credits will require retirement, similarly, about 115,000 fauna species credits and about 340,000 flora species credits.

Offset packages can have a range of measures under the Policy and in the past have focussed on land-based outcomes, such as transferral of land to the National Park estate or setting up of conservation agreements over land parcels. However, no land parcels for offsets have been identified in this EIS (which would demonstrate the adequacy of the proposal in terms of both ecosystem and species credits), instead the offset strategy states it will adopt a mixture of approaches:

- Like-for-like land based offsets (including an extensive rehabilitation program),
- Supplementary measures (Feral predator control program),
- Compensatory measure (Koala Research),
- Contribution to the Biodiversity Fund.

While Santos have not provided any clear actions to implement their offset strategy, the EIS emphasises two main offset measures; a site rehabilitation program (said to account for 50% of the credit liability) and a ‘regional’ feral animal control program, accounting for 30% the credit liability from the impacts of the project.

### ***Rehabilitation program***

Of the nearly 1,000 ha of direct impact expected to occur as result of the NGP, Santos intends to rehabilitate approximately half of this area. This is because legacy well sites will still need to be maintained and well-pads and other infrastructure will remain following the project’s completion.

With this 500 ha of rehabilitation Santos claims to be able to offset half of its credit liability in upfront credits of the project (by generating 23,500 credits). The current Policy allows for mine



rehabilitation with upfront and delayed credits, the latter can be enacted following the return of the original bond to the proponent. Rehabilitation cannot generate species credits without specific actions.

*“Under the policy, proponents will need to return a recognisable plant community to the site in order to generate biodiversity credits. The method for calculating the contribution of rehabilitation to an offset requirement recognises that full ecological restoration of a site may not be possible. It also recognises that biodiversity gain achieved through rehabilitation often occurs much more slowly than biodiversity gain at an offset site.” (NSW Biodiversity Offset Policy).*

But statements made about the certainty of the outcomes for the rehabilitation program as outlined in Appendix V seem far-fetched given the current record of such actions in PEL238.

Currently, most sites have large areas of bare ground or mulched surface, some with some ground cover of grasses and scattered low shrubs. A high proportion of the shrubs are weeds, particularly Galvanised Burr is common across the sites. The areas of natural regeneration including some young trees and wattles, particularly *Acacia deanii* and *A. spectabilis* (Mudgee Wattle). Mudgee Wattle is a poor condition site specialist, favoured for mine rehabilitation by industry and is one species which has regenerated at the sites, sometimes in dense stands.

About 20 sites have had some sort of identified spillage from past operations that has left the well site, it is fair to say that most existing well sites would have some localised spillage during the course of operations as current water control measures are only designed to prevent spillage leaving the site. A look at the two large spill zones, at Bibblewindi and Bohena 2 show poor level of natural regeneration 5 and 16 years following the spill respectively.



Figure 5. Bibblewindi spill zone (5<sup>th</sup> April 2017)



*Figure 6. Bohena 2 spill zone (5 April 2017)*

A key issue at the well sites are the high levels of background alkalinity in the soil (up to a pH of 10 at Bibblewindi spill zone, Golder and Associates 2012, attached), most likely arising from presence of groundwater spillage at the sites. The application of high levels of carbonates in the form of gypsum, as is current practice at the spill sites, has the potential to exacerbate this situation.

Surface soils in the Pilliga are generally acidic in nature (Appendix I) and species of Cypress Pine in particular prefer acidic soil conditions (pH 5-7, Lacey 1973). The legacy sites in the Pilliga are without any cypress pine regeneration, along with most species present in the surrounding vegetation.

The prospects of achieving a native vegetation community that could be regarded as 'like-for-like' at present seem low. The actions proposed in Appendix V do not address some of the key issues in relation to soil conditions identified here as being a key constraint.

### ***'Regional' feral animal control program***

Despite the NSW Offset Policy stating that *"Supplementary measures can only be used in lieu of offsets when offsets are not feasible and other options are needed"*, Santos have highlighted one such measure without any evidence of effort demonstrated to obtain land-based offsets, a regional predator control program.

There is little detail about this program or how it will meet specific recovery plan objectives for different species, just some objectives in the EIS. It is assumed that this action will reduce the biodiversity credit liability by about 30%.

But there are two levels of predator intensity to be considered, the pre-impact (current) intensity, which is high, and the post impact intensity which will see an extensive increase in net fox foraging area, particularly within the state forest itself, a large area managed by one agency. The question is will the action proposed be able to deal with the increase in fox forage area and activity? If not, the fox program proposed may not see any net benefit to the ecosystem in its current level of disturbance.

Will it result in a reduction in overall impact of the project by 30%? Given the shortcomings in the indirect impact assessment, lack of detail about the program itself including the chances of success, this proposition is not supported by available evidence.

### ***Biodiversity credits***

With the 1 and 5m effective indirect areas modelled by ELA the total area of indirect impact has been calculated to be 181 ha. However as demonstrated here, the unmitigated impact from foxes alone should be twice the size of what the EIS estimates, giving a total impact area of 724 ha – 1,086 ha. It is questionable, as outlined above, if fox impacts could be mitigated to pre-impact levels with the increase in fox foraging quality throughout the study area. Given the extent of other unmitigated impacts, the effective impact areas of 1 and 5m should be considered well short of what an indirect impact would look like in the study area as a result of the project. As such the biodiversity credit liability detailed in the EIS has been under-estimated.

With the commitment to pay into the Biodiversity Fund to finalise their offset commitment, which is not yet in place, it seems Santos is taking an approach which seems to rely on its rehabilitation and feral predator control programs. Given the lack of certainty for the effectiveness of the outcomes in these two measures proposed, a lack of measurable land-based outcomes, no actions proposed to retire the flora species credits liability, and a lack of any evaluation of contingency actions, the offset package as proposed falls short of meeting the requirements of the current NSW Biodiversity Offset Policy and the Secretary's Requirements for this project, unless of course agreed to by the Office and Environment and Heritage (OEH).

This discretionary power to OEH in the SEARs to be able to disregard the statutory guidelines, after 10 years of development to achieve a 'whole-of-government' set of assessment methodologies, flies in the face of a transparent biodiversity outcome for this and future major projects.

### ***Commonwealth requirements***

Appendix 3 of the EPBC Act Environmental Requirements for the NGP outlines the information requirements for EPBC Act offset proposals. The offset strategy outlined in the EIS has a low level of compliance with these requirements, as it does not provide any detail regarding the following for the Bilateral approval:

- i. the location of any offsets as the location of well sites is not known, though it is estimated that each well pad will be 2 ha in size. The only land-based offsets Santos have provided are the rehabilitation undertaken at the well-pads.
- ii. maps for each offset site are not available.
- iii. confirmed records of presence (or otherwise) of relevant protected matter(s) on the offset site(s) cannot be determined nor can details of studies and surveys used to confirm the presence of individuals and or likely habitat within offset site(s). The quality of habitat cannot be assessed.
- iv. information and justification regarding how the offsets package will deliver a conservation outcome that will maintain or improve the viability of the protected matter(s) consistent with the EPBC Act Environmental Offsets Policy (October 2012) has not been undertaken other than via a rehabilitation methodology provided by the NSW Government.
- v. the risk of damage, degradation or destruction to any proposed offset site(s) in the absence of any formal protection mechanism is high considering the risks posed by ongoing mining leases and

future development applications in the area. State Forests are open to mining and gas activities in NSW and no formal protection measures have been proposed for rehabilitation sites.

vi. it is unclear whether the rehabilitation of mine sites be regarded as being 'additional' to existing requirements by the Commonwealth. Such activities are usually obligations contained within a Mine Plan, though now the NSW Government has determined that rehabilitation on mine sites can generate biodiversity credits.

vii. no costings of the proposed offsets package in the EIS.

Considerably more information is required by the Commonwealth before any decision can be made about the efficacy of the offset package.

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## Attachments

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1. Ethical Ecology (2017). Survey of Bohena Creek riparian plant communities. Report for Upper Mooki Landcare Inc
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