8 IMPACTS, MANAGEMENT AND MITIGATION

This section provides a summary of predicted environmental and social impacts from the Project and discusses management and mitigation measures as appropriate. The issues have been prioritised in accordance with the EARs and the risk assessment process in **Section 7**.

8.1 AIR QUALITY AND GREENHOUSE GAS

PAE Holmes has conducted an air quality and greenhouse gas impact assessment for the Project which is presented in full in **Appendix G** and includes:

- Meteorological and climatic conditions and the existing air quality conditions;
- Applicable air quality criteria relevant to the Project;
- Methods used to estimate dust emissions from the Project for future years;
- Predicted dust dispersion patterns due to emissions from the Project and other sources;
- Comparison between the predicted dust concentration and deposition levels with DECCWs assessment criteria; and
- Estimation of the greenhouse gas emissions resulting from the Project.

The assessment has been completed using dispersion modelling, following the procedures outlined in the DECCW *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (DEC, 2005).

Figure 4 and **Table 3** illustrate landownership surrounding the Project and allocates each an identification number and indicates whether a receiver is located on the property and should be read in conjunction with this section.

A summary of the assessment is provided below.

8.1.1 Methodology

Predicted ground-level dust concentrations and deposition levels in the vicinity of the Project were assessed using a computer-based dispersion model (ISCMOD). To assess the impact that dust emissions will have on existing air quality, the dispersion model predictions from four indicative worst case modelled years (Year 1, Year 5, Year 10 and Year 21) have been compared with relevant air quality criteria.

To determine the potential 24 hour average PM_{10} concentrations on a cumulative basis, a detailed analysis of existing environmental monitoring data in the vicinity of Boggabri was completed. The most representative monitoring data were determined to be those collected by HVAS's in the area. A limitation of these data is that they are only collected every six days, rather than on a continuous basis.

Therefore, in addition to completing the assessment in accordance with the methodology provided within the Approved Methods, PAE Holmes completed a "*Probability*" approach to complement the assessment which enabled the examination across the full dataset. This involved the consideration of the statistical probability of dust contributions at each receiver from the Project coinciding with a background concentration that would result in cumulative levels greater than the 50 $\mu g/m^3$ 24 hour average criteria. Further discussion on the cumulative impact assessment is provided in **Appendix G**.

Construction of the rail spur and rail loop in Year 5 was also considered in the modelling scenario when the maximum production capacity is achieved. The dragline scenario was not modelled as a preliminary assessment identified that the introduction of a dragline would reduce dust emissions from the site by approximately 3%. The five modelled scenarios represent stages of the Project that have been assessed to have the potential for worst case air quality impacts on receivers surrounding the Project Boundary.

Meteorological Data

A summary of the meteorological data used for modelling air quality for the Project is summarised in **Section 2.1**.

Existing Air Quality

Air quality is monitored by Boggabri Coal in the vicinity of the Project, as shown in **Figure 6**, and includes:

- Dust deposition levels at 15 sites; and
- Particulate matter less than 10 microns (PM_{10}) measured every sixth day at one site using HVAS.

A detailed review of existing monitoring data was completed for the Project and is provided in **Appendix G**. The review concluded:

- There were three elevated readings of the 24-hour average goal of 50 µg/m^3 between August 2005 and July 2009. Two of these elevated readings coincided with strong winds reported in Narrabri, 60 km north-west of Boggabri;
- Annual average PM_{10} concentrations monitored by Boggabri Coal are below relevant air quality criteria; and
- The dust deposition levels measured by the Boggabri Coal air quality monitoring network vary significantly across sites with annual average levels ranging from 0.7 g/m^2/month to 4.0 g/m^2/month, however all were below the relevant air quality criteria.

In order to assess the air quality impacts due to the Project, background concentrations of PM_{10} and Total Suspended Particulates (TSP) and also dust deposition levels need to be incorporated into the predicted results. The approach recommended by DECCW is to add dispersion model predictions to existing background levels.

The background air quality was calculated in this assessment by determining the difference between the cumulative impacts of the Project and other sources and PM_{10} and dust deposition measurements made in the Project area for a given period.

The results are then compared with the relevant air quality criteria as provided in **Table 18** and **Table 19**.

Assessment Criteria

Table 18 provides a summary of the relevant DECCW air quality criteria applicable to the Project. Generally these air quality criteria relate to the total dust burden in the air and not just the dust generated by the Project. Consideration of background levels needs to be made when using these criteria to assess impacts.

In addition to health impacts, airborne dust also has the potential to cause nuisance impacts by depositing on surfaces. **Table 19** shows the maximum acceptable increase in dust deposition over the existing dust levels. The criteria for dust fallout levels are set to protect against nuisance impacts and considers cumulative impacts from all dust sources (DEC, 2005).

Greenhouse Gas

The procedure specified in *National Greenhouse Accounts* (NGA) *Factors* (2009) published by the Department of Climate Change and Energy Efficiency has been adopted for this assessment and is consistent with internationally applied methods. The procedure nominates the following greenhouse gases:

- Carbon dioxide (CO_2);
- Methane (CH_4);
- Nitrous oxide (N_2O); and
- Synthetic gases (HFCs, SF_6, CF_4, C_2F_6).

Emission factors are standardised and expressed as a carbon dioxide equivalent (CO2-e) which is calculated by multiplying the individual gas emission factor by the respective Global Warming Potential (GWP).

Dust Modelling

This assessment has been completed following the procedures outlined in the DECCWs *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (DEC, 2005). The model used for the assessment was a modified version of the US EPA ISCST3 model (ISCMOD) to predict dust concentration and deposition levels due to the Project. Indicative Years 1, 5, 10 and 21 of operations were modelled to represent the possible worst case impacts as a result of the Project.

Table 18
TSP and PM_{10} Assessment Criteria

Pollutant	Criteria ($\mu g/m^3$)	Averaging Period	Agency
Total Suspended Particulates (TSP)	90	Annual mean	National Health & Medical Research Council
PM_{10}	50	24-hour maximum	DECCW
	30	Annual mean	DECCW long-term reporting goal

Source: DEC, 2005

Table 19
Dust Deposition Assessment Criteria

Pollutant	Averaging period	Maximum Increase in Deposited Dust Levels (g/m^2/month)	Maximum Total Deposited Dust Levels (g/m^2/month)
Deposited Dust	Annual mean	2	4

Source: DEC, 2005

Emissions inventories have been developed for each year using information provided by Boggabri Coal to determine haul road distances and routes, the location of stockpile and pit areas, activity operating hours, truck sizes and other details that are necessary to predict dust emissions. This information has been used with meteorological data from the Boggabri MDS to predict the maximum 24-hour PM_{10}, annual average PM_{10}, annual average TSP and annual average dust deposition (insoluble solids) for four representative years of the Project.

Contributions of particulate matter from other mines (Tarrawonga Mine) have been included in this assessment. Under its current approval Tarrawonga Mine operations are set to cease by Year 6 of the Project and hence have only been included in Year 1 and Year 5 of the assessment.

Dust Modelling Criteria

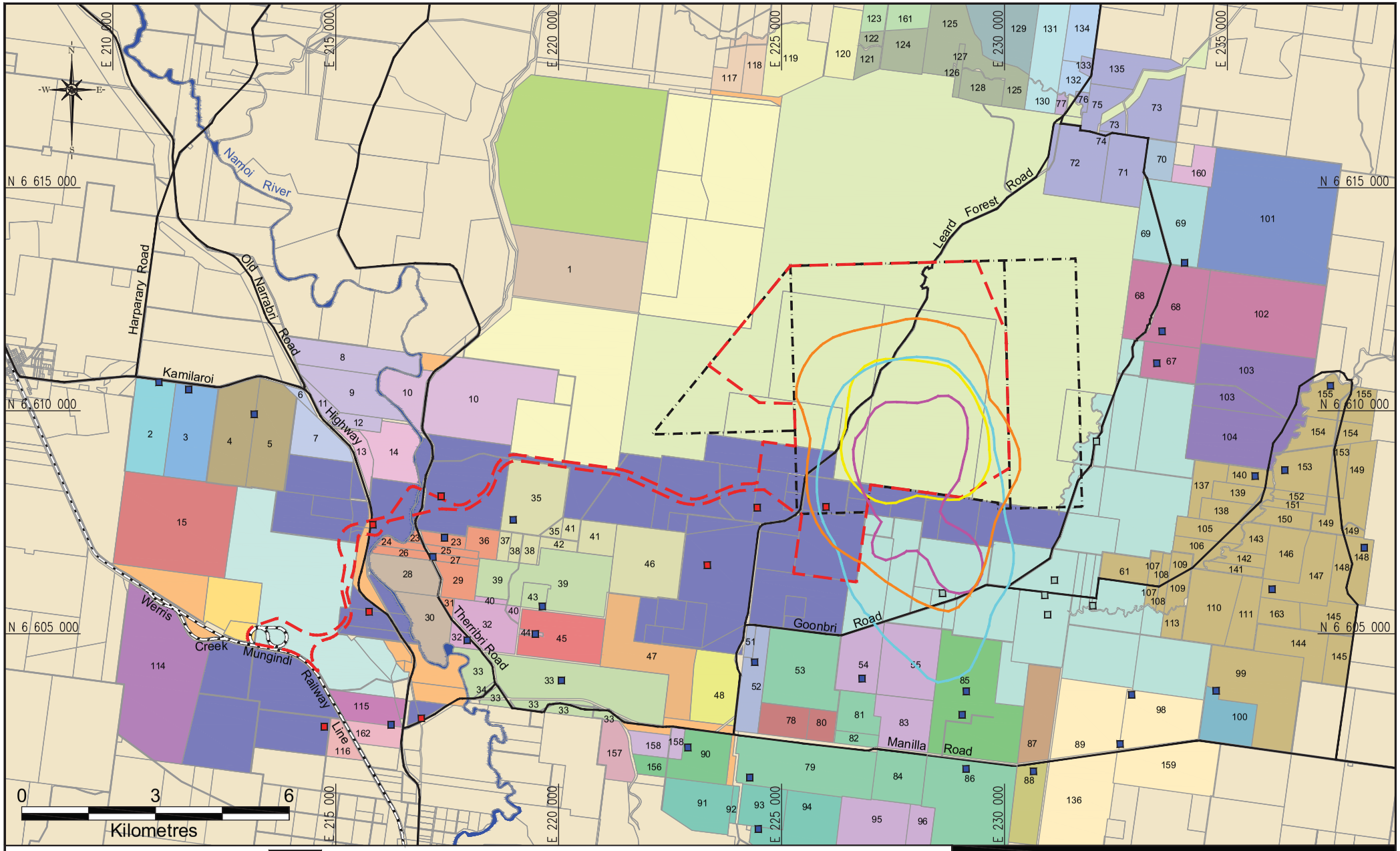
The relevant air quality criteria are those specified in DECCWs modelling guidelines and those specified by DoP in recent Conditions of Consent for open cut coal mines and include:

- 50 $\mu g/m^3$ for 24-hour PM_{10}. The DoP acquisition criteria for 24-hour PM_{10} is the 98.6th percentile due to the Project alone (i.e. the criterion is not to be exceeded more than five days per year);
- 30 $\mu g/m^3$ for annual average cumulative PM_{10} due to the Project and the effects of other sources;
- 90 $\mu g/m^3$ for annual average TSP concentrations due to the Project and the effects of other sources;
- 2 g/m^2/month for annual average deposition (insoluble solids) due to the Project considered alone; and
- 4 g/m^2/month for annual average cumulative deposition (insoluble solids) due to the Project and the effects of other sources.

8.1.2 Impact Assessment

The greatest potential impacts of the Project will occur in Year 1 and Year 5 as mining operations will be at the closest proximity to receivers during the early stages of the operation. Year 1 and Year 5 of the modelled scenarios contour plots showing the predicted annual average total suspended solids (TSP) concentrations, predicted annual average PM_{10} concentrations, and the predicted annual average (insoluble solids) dust deposition rate in relation to private receivers are provided in **Figure 14**, **Figure 15, Figure 16** and **Figure 17**.

The predicted dispersion pattern of particulate matter, due to the Project in isolation and combined with other sources, indicate that there are two receivers that may experience exceedances of the air quality criteria. These predicted exceedances are summarised in **Table 20**. At all other receivers, no exceedances of the criteria have been predicted.



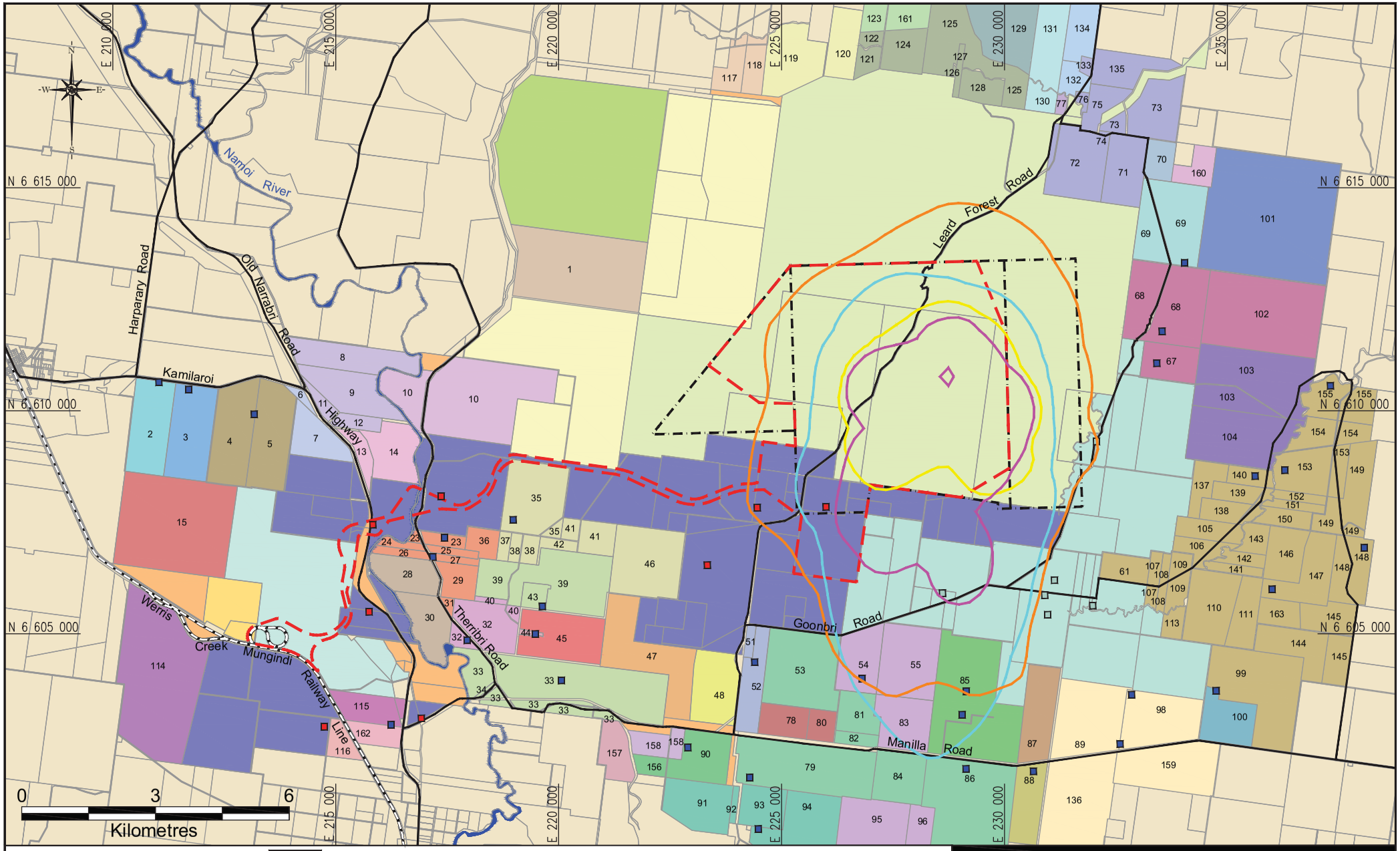
- Project Boundary
- Boggabri Mining Tenements
- Boggabri Coal
- Whitehaven Coal Mining
- Aston Resources
- Not Searched
- Crown
- Crown - Special Lease
- NSW State Forest
- Leard State Conservation Area
- Mining Joint Ownership
- Private Freehold Receiver
- Boggabri Coal Owned Receiver
- Other Mine Owned Receiver
- TSP DECC Criteria (90 µg/m³)
- PM_{10} DECC Annual Average Criteria (30 µg/m³)
- Dust Deposition DECC Criteria (2g/m²/month)
- PM_{10} 24 hr DECCW Criteria(50 µg/m³)

Source: PAE Holme 2010
Land Searches LPI 2009/2010
Co-ordinate System: MGA 94 Zone 56

BOGGABRI COAL MINE

Air Quality Contours Year 1

Cad File: 06085E.dwg	Date: 14.10.2010	Drawn: CP	Figure 14



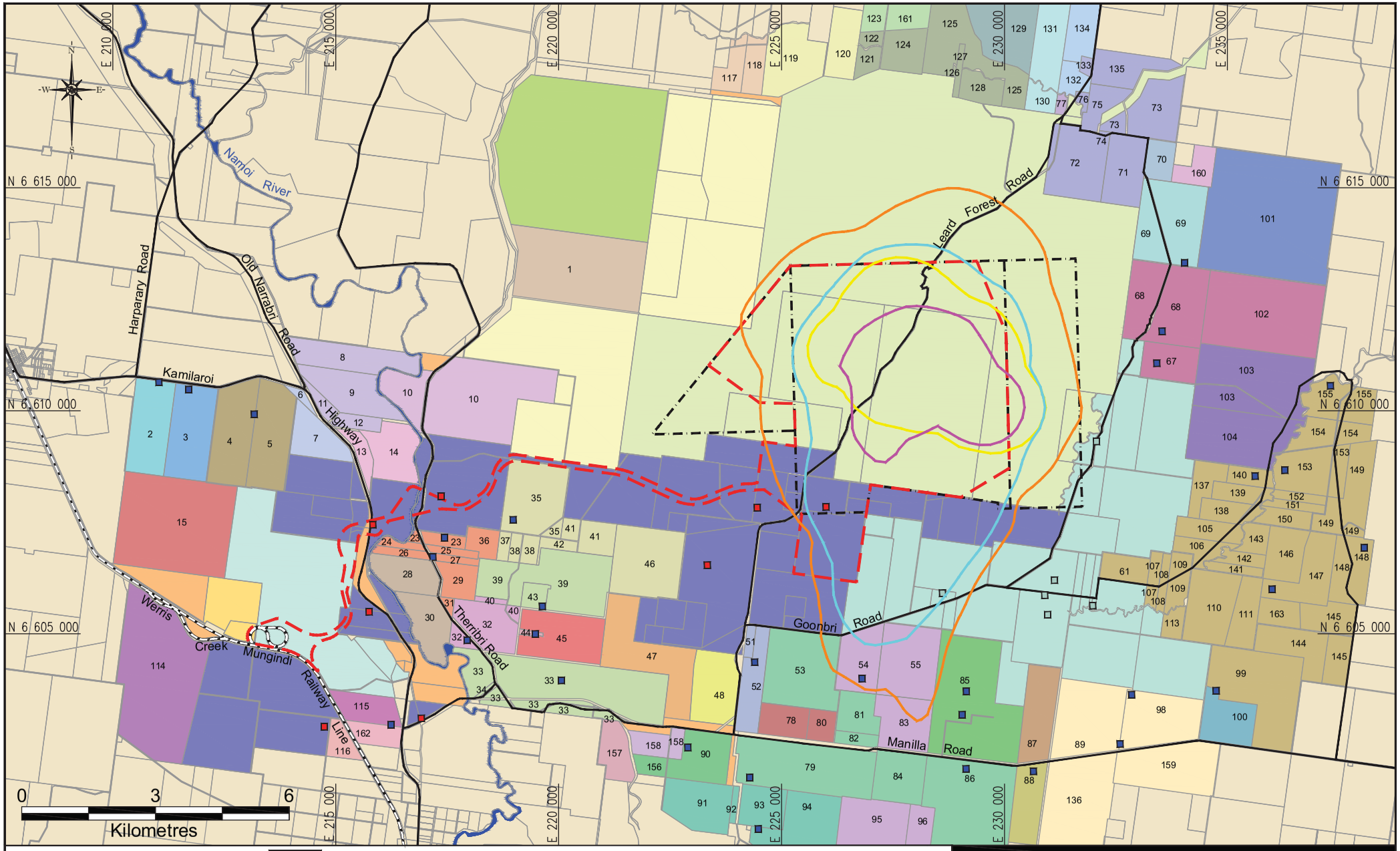
- Project Boundary
- Boggabri Mining Tenements
- Boggabri Coal
- Whitehaven Coal Mining
- Aston Resources
- Not Searched
- Crown
- Crown - Special Lease
- NSW State Forest
- Leard State Conservation Area
- Mining Joint Ownership
- Private Freehold Receiver
- Boggabri Coal Owned Receiver
- Other Mine Owned Receiver
- TSP DECC Criteria (90 µg/m³)
- PM_{10} DECC Annual Average Criteria (30 µg/m³)
- Dust Deposition DECC Criteria (2g/m²/month)
- PM_{10} 24 hr DECCW Criteria(50 µg/m³)

Land Searches LPI 2009/2010
Co-ordinate System: MGA 94 Zone 56

BOGGABRI COAL MINE

Air Quality Contours Year 5

Cad File: 06086G.dwg	Date: 14.10.2010	Drawn: CP	Figure 15



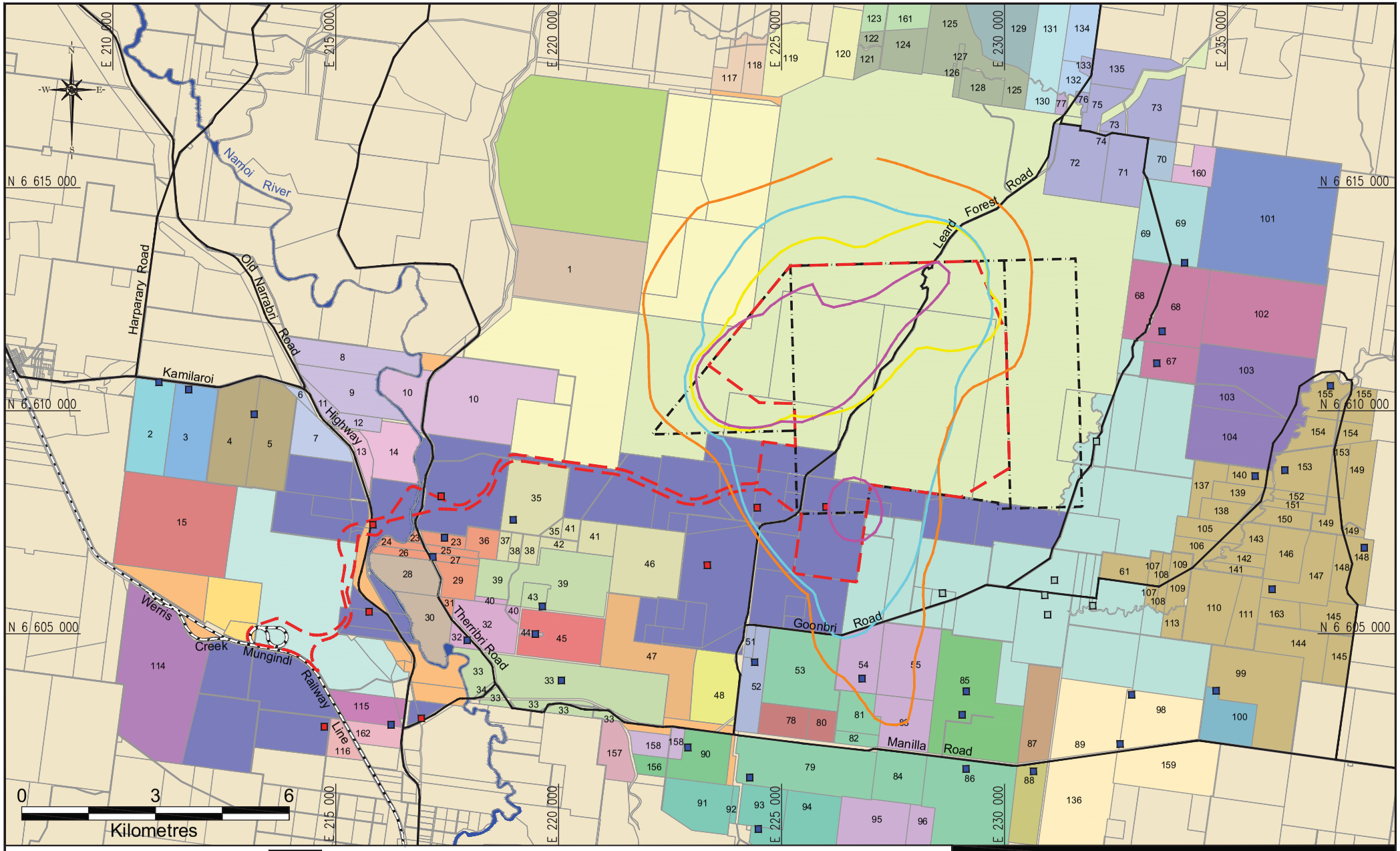
- Project Boundary
- Boggabri Mining Tenements
- Boggabri Coal
- Whitehaven Coal Mining
- Aston Resources
- Not Searched
- Crown
- Crown - Special Lease
- NSW State Forest
- Leard State Conservation Area
- Mining Joint Ownership
- Private Freehold Receiver
- Boggabri Coal Owned Receiver
- Other Mine Owned Receiver
- TSP DECC Criteria (90 µg/m³)
- PM_{10} DECC Annual Average Criteria (30 µg/m³)
- Dust Deposition DECC Criteria (2g/m²/month)
- PM_{10} 24 hr DECCW Criteria(50 µg/m³)

Source: PAE Holme 2010
Land Searches LPI 2009/2010
Co-ordinate System: MGA 94 Zone 56

BOGGABRI COAL MINE

Air Quality Contours Year 10

Cad File: 06087E.dwg	Date: 14.10.2010	Drawn: CP	Figure 16



- Project Boundary
- Boggabri Mining Tenements
- Boggabri Coal
- Whitehaven Coal Mining
- Aston Resources
- Not Searched
- Crown
- Crown - Special Lease
- NSW State Forest
- Leard State Conservation Area
- Mining Joint Ownership
- Private Freehold Receiver
- Boggabri Coal Owned Receiver
- Other Mine Owned Receiver
- TSP DECC Criteria (90 µg/m³)
- PM_{10} DECC Annual Average Criteria (30 µg/m³)
- Dust Deposition DECC Criteria (2g/m²/month)
- PM_{10} 24 hr DECCW Criteria(50 µg/m³)

Source: PAE Holme 2010
Land Searches LPI 2009/2010
Co-ordinate System: MGA 94 Zone 56

BOGGABRI COAL MINE

Air Quality Contours Year 21

Cad File: 06088E.dwg	Date: 14.10.2010	Drawn: CP	Figure 17

Further results of detailed air quality impact predictions for all receivers are presented in **Appendix G**. Predicted TSP and dust deposition levels were below the DECCW assessment criteria at all existing receivers as shown in **Table 20**.

Impacts at two privately owned properties (receivers 54 and 85) are predicted to exceed the 24-hr average PM_{10} criterion of 50 µg/m³. However, the number of days of exceedance is less than the DoP criterion for acquisition.

When considering the cumulative 24-hour average PM_{10} impacts, residences to the south of the mine may be impacted.

The Tarrawonga and Ambardo properties are predicted to experience dust impacts on greater than 25% of their land area. No other properties were identified as receiving dust impacts over more than 25% of their property area.

The same two properties are also predicted to experience exceedances of the annual average PM_{10} criterion of 30 µg/m³ during Year 5 and under the modelled rail spur scenario.

Therefore it can be concluded that two receivers are anticipated to be impacted by dust levels exceeding the relevant criteria. The construction of a rail spur and rail loop to transport Product coal to the Werris Creek Mungindi Railway Line will not result in a significant reduction of dust impacts. The alternative dragline scenario for Year 5 is predicted to decrease emissions by 3%.

Greenhouse Gas Assessment

The main sources of greenhouse gas emissions from the Project have been identified as resulting from electricity consumption, fugitive emissions of CO_2 and CH_4, diesel usage, explosives usage, and the transport and end use of the product coal.

The emissions from these sources have been calculated based on the ROM coal extraction rate for each year of the Project and are summarised in **Table 21**.

The Project will not significantly affect ambient sulphur dioxide (SO_2) concentrations due to the low sulphur content of Australian diesel and the fact that mining equipment for the Project will be widely dispersed over the site.

Similarly, while NO_x and CO emissions from the Project activities were considered, these were deemed to be too small and too widely dispersed to enable or require a detailed modelling assessment.

The total emissions CO_2-$_e$ are estimated to be 374.8 Mt over the 21-year lifetime of the Project with an annual average of approximately 16.9 Mtpa.

At any point in time, it would be reasonably simple to compare the estimated emission of CO_2-$_e$ from the Project with the 3,000 Gt of CO_2-$_e$ currently estimated to be stored in the atmosphere.

A comparison of the annual average emissions of 16.9 Mtpa CO_2-$_e$ indicates that the average annual emissions over the lifetime of the Project from the mining and burning of coal (including transportation) produced from the Project are estimated to contribute approximately 0.012% of the current global CO_2–$_e$ atmospheric load.

Based on the Intergovernmental Panel on Climate Change estimate that a doubling of the CO_2-$_e$ concentration in the atmosphere would lead to a 2.5°C increase in global average temperature and that the current global CO_2–$_e$ load is approximately 3,000 Gt, it can be estimated that the annual average emissions (Scope 1, 2 and 3) during the life of Project (including mining, transporting the coal to the Port of Newcastle and overseas and usage of the coal) could lead to an annual increase in global temperature of 0.000014°C.

The emissions generated from the Project will not have any significant impact on global warming. Applying the principles of ESD, it is considered that there will be no increase or measureable impact on climate change as a result of the Project.

Table 20
Predicted Air Quality Exceedances at Private Receivers

ID	PM_{10} (µg/m³)		TSP (µg/m³)	Dust Deposition (g/m²/month)	
	24-hour	Annual	Annual	Annual	
	Project Alone	Project and Other Sources	Project and Other Sources	Project Alone	Project and Other Sources
54 (Tarrawonga)	**2 Days above criteria** (Year 10) **1 Day above criteria** (Year 21)	**32 µg/m³** (Year 5) **31 µg/m³** (Year 5 – rail spur)	No exceedance	No exceedance	No exceedance
85 (Ambado)	**1 Day above criteria** (Year 5 – rail spur)	**35 µg/m³** (Year 5) **35 µg/m³** (Year 5 – rail spur)	No exceedance	No exceedance	No exceedance

Table 21
Total Greenhouse Gas Emission Predictions

Activity	Emissions (kt CO_{2-e})
Diesel usage	2,920.2
Electricity consumption	77.0
Explosives	84.3
Fugitive emissions	6,537.5
Transport of coal (rail and sea)	39,594.8
End use of coal	325,571.0
Total	**374,784.8**

8.1.3 Mitigation and Management

As the Project is predicted to generate a substantive quantity of suspended particulates, a number of controls have been recommended to ensure "leading practice" methodology in order to minimise dust emissions. Boggabri Coal will develop an Air Quality Management Plan (AQMP) considering the existing Air Quality EMP for the site to incorporate practical management measures which may be implemented as required to ensure dust emissions are minimised and regulatory criteria are met at the majority of private receivers, these include:

- A review of the existing air quality monitoring program and EMP;
- Minimising overburden and ROM coal haul road distances;
- The use of water sprays;
- The use of dust suppressant product (or other comparable effective alternatives) on all active coal and overburden haul roads where necessary;
- Maintain a bitumen sealed product coal haul road to the Boggabri Coal Terminal;
- Enclosing conveyer systems and or to transport the ROM coal from the hopper to the CPP installation of automatically triggered dust suppression sprays to conveyors;
- Revegetate disturbed areas as soon as practical including rehabilitation areas and obsolete haul roads when these are no longer needed;

- Install a Tapered Element Oscillating Microbalance (TEOM) air quality monitoring unit(s); and
- Install a real time meteorological monitoring system with predictive software capabilities.

Boggabri Coal will continue to monitor greenhouse gas emissions to ensure that these emissions are kept to the minimum practicable level.

Through the ongoing review of greenhouse gas emissions and the investigation of practical options for greater energy efficiency, Boggabri Coal will attempt to keep the ratio of greenhouse gas emissions per tonne of coal produced as low as possible. This may be achieved through:

- Review of equipment purchases with a view to keeping energy efficiency levels high;
- Ongoing scheduled and preventative maintenance to ensure that diesel and electrically powered plant operate efficiently;
- Consideration of the use of alternative fuels (e.g. biodiesel, solar panels and solar hot water systems) where economically and practically feasible;
- Review of mining practices to minimise double handling of materials and ensuring that coal and overburden haulage is undertaken using the most efficient routes; and
- Ensuring that lighting and heating are only used when required.

Since the inception of mining, there has been no incidence of spontaneous combustion within the mine. Further analysis of the materials indicates that there is a low potential for spontaneous combustion within the target coal seams for the Project.

8.2 ACOUSTICS

8.2.1 Background

A noise and blasting impact assessment for the Project was completed by Bridges Acoustics and is presented in full in **Appendix H**.

The assessment includes consideration of operational mining noise, construction noise, road and rail noise, sleep disturbance, low frequency noise and blasting issues. The noise assessment is summarised below and has been undertaken in accordance with the following policies and guidelines:

- The *NSW Industrial Noise Policy* (INP) (EPA, 2000) for operational and construction noise;
- The *Environmental Noise Control Manual* (ENCM) (EPA, 1985), specifically Chapter 19 related to sleep disturbance criteria;
- The *Environmental Criteria for Road Traffic Noise* (ECRTN) (EPA, 1999) for road traffic noise;
- The *Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration, Australian and New Zealand Environment Council* (ANZEC, 1990) for ground vibration and overpressure limits and time restrictions for blasting;
- *Assessing Vibration – a Technical Guide* (DEC, 2006) for assessing construction vibration; and
- *Interim Guideline for the Assessment of Noise from Rail Infrastructure Projects* (DECC, 2007) for noise from train movements on the Werris Creek to Mungindi Railway.

Figure 4 along with **Table 3** illustrate landownership surrounding the Project and allocates an identification number to each privately owned property. It also indicates whether a receiver is located on the property and should be read in conjunction with this section.

8.2.2 Methodology

Introduction

Predicted noise levels at receivers for operations in Year 1, Year 5 Year 10 and Year 21 of the Project were calculated using RTA Technology's Environmental Noise Model (ENM). ENM is considered the most appropriate choice for situations involving complex terrain, a large number of noise sources and where a detailed assessment of the effect of weather conditions on noise propagation is required. It has previously been endorsed by DECCW for assessing noise from Projects of this type.

The ENM model included operating scenarios for the four representative years which were chosen to represent reasonable worst case noise levels to all receivers around the Project Boundary. All operating scenarios included noise from coal trucks on the private haul road to the Boggabri Coal Terminal, operation of the rail loadout facility and locomotives operating at idle speed on the loading loop to represent worst case project noise levels.

Additional model scenarios were used to determine construction, rail spur and sleep disturbance noise levels to ensure these issues were comprehensively assessed.

Background Noise Levels

The Project is located in a quiet rural area at some distance from major sources of background noise such as arterial roads or other industrial developments. The Tarrawonga Mine is located adjacent the Project Boundary. Previous noise monitoring completed for the existing Boggabri Coal Mine has indicated background levels regularly fall to 30 dBA or below during all time periods at all monitoring locations.

The INP recommends background noise levels below 30 dBA be considered to be 30 dBA for the purposes of determining noise criteria, a Rating Background Level (RBL) of 30 dBA was adopted for all receivers and time periods for this assessment. No further noise monitoring to determine the background noise level was therefore required.

Noise Criteria

Operational Noise

The INP recommends two separate noise criteria be applied to operational noise, including an intrusive criterion 5 dBA above the background noise level and amenity criteria which depend on the nature of the receiver area and the existing level of industrial and mining noise in each time period. Adopted noise criteria for all receiver properties are shown in **Table 22**.

Noise amenity criteria in **Table 22** considers cumulative noise impacts from other industrial or mining developments.

The operational noise criteria apply to within 30 m of a residence or at the property boundary where the boundary is closer than 30 m from a residence. The Interim Construction Noise Guideline (DECC, 2009) states it does not apply to construction work associated with coal mining developments. Construction noise criteria are therefore identical to the criteria shown in **Table 22**.

Sleep Disturbance

Sleep disturbance can occur when a short, sharp noise is clearly audible over the background noise level.

The DECCW recommends a conservative sleep disturbance criterion of 15 dBA above the background noise level, which for the Project would be 45 LA1-1 min. The sleep disturbance criterion applies at a point 1 m outside a bedroom window during the night period.

Road Traffic Noise

The principle access route to the Project will be via Manilla Road and Leard Forest Road, both of which are considered 'local' roads for the purpose of the noise assessment.

Relevant traffic noise criteria are listed in **Table 22** in the ECRTN. Noise criteria for Situation 13 "Land use developments with the potential to create additional traffic on local roads" are 55 $L_{Aeq,1hr}$ during the day and 50 $L_{Aeq,1\ hr}$ during the night and apply to all traffic on the road including vehicles associated with the Project. Noise criteria in the ECRTN only apply to residential receivers.

The $L_{Aeq,1\ hr}$ parameter refers to the average traffic noise level in the loudest 10% of the hours in a day or night. As it is difficult to determine the loudest 10% hour during the day and night, this assessment conservatively considers the loudest hour during a 24 hour period.

Low Frequency Noise

Generally low frequency noise includes frequencies in the range from 20Hz up to 80Hz. Section 4 of the INP recommends low frequency noise levels be considered in the normal operational noise criteria by the addition of a 'modifying factor' to either a source sound power level or a received noise level.

Table 22
Operational Noise Criteria

Time Period	RBL ($L_{A90,15min}$)	Intrusive Criteria ($L_{Aeq,15min}$)	Amenity Criteria, Rural Category ($L_{Aeq,period}$)	Other Industrial Sources ($L_{Aeq,period}$)
Day	30	35	50	33
Evening	30	35	45	33
Night	30	35	40	32

Any modifying factors that are relevant to the assessment have been applied to the adopted sound power levels for mining and transportation equipment. In addition, the Queensland EPAs draft guideline for the assessment of low frequency noise suggests an internal criterion of 50 dBL for this frequency range to minimise the potential for impacts on noise sensitive receivers, while experience near other NSW coal mines indicates a received level of 80 dBL is unlikely to be noticed by receivers.

Noise levels expressed in dBL are unweighted decibels, without the usual A-weighting correction that is normally applied to approximate the frequency response of an average human ear. The suggested dBL criteria cannot be directly translated to equivalent criteria in dBA. The Project is not anticipated to generate deleterious low frequency noise impacts on adjacent residents. Boggabri Coal will investigate any issues raised in regards to low frequency noise vibration impacts and implement management strategies as required.

Blast Overpressure and Vibration

Current noise and vibration criteria are recommended in the Australian and New Zealand Environment Council (ANZEC) publication *"Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration"*.

Recommended noise and vibration limits in the guideline are:

- Overpressure - 115 dBL; and
- Ground vibration - 5 mm/s Peak Particle Velocity (PPV).

The guideline recognises blast effects cannot always be controlled accurately and allows higher limits of 120 dBL and 10 mm/s PPV for up to 5% of the total number of blasts on a site in a 12 month period. Recommended blasting criteria apply during the hours 9:00 am to 5:00 pm Monday to Saturday, excluding public holidays.

8.2.3 Impact Assessment

Weather Conditions

Weather conditions, in particular winds and temperature inversions, can have a significant effect on noise levels at a distance from a noise source. A detailed review of weather conditions was undertaken according to INP guidelines as part of this assessment. The INP suggests potentially noise enhancing weather conditions should be considered in the assessment if they occur for more than 30% of the time in any season or time period.

Analysis of winds during the day indicates a prevailing southerly wind occurs for up to 32% of the time in autumn. The evening and night periods are very similar in terms of wind direction and indicate a dominant northerly wind can occur for approximately 50% of the time during these periods. As the Project site is located in a natural basin that drains to the south, the evening and night northerly wind represents a cold air drainage flow from the basin past the weather station towards the Namoi River floodplain.

Cold air reaching the floodplain would then follow the river valley to the north, creating a southerly wind in this area. The result would be a northerly wind over the mine site, a southerly wind along the Namoi River floodplain and a northerly wind in the area of the rail loadout facility during the evening and night.

This complex wind situation has been considered by modelling mining operations and the rail loadout facility with a northerly wind, the coal haul road with a southerly wind, then combining the two sets of noise contours into one. **Table 23** shows the weather conditions adopted for this assessment.

Table 23
Assessment Weather Conditions

Atmospheric Parameter	Day		Evening and Night		
	Neutral	Prevailing	Neutral	Inversion No Wind	Inversion And Wind
Temperature (°C)	20	20	15	10	10
Relative Humidity (%)	70	70	80	90	90
Wind Speed (m/s)	0	3	0	0	2
Wind Direction	-	South	-	-	North (mine, rail loadout) South (haul road)
Temp Gradient (°/100m)	-1	-1	0	3	3
Equiv. Inversion (°/100m)	-1	6.5	0	3	8

Winds and temperature inversions tend to increase noise levels for downwind receivers and the effects are cumulative. A 3°/100 m temperature inversion with a 2 m/s wind from source to receiver is, according to ENM, equivalent to a very strong 8°/100 m temperature inversion.

The assessment weather conditions shown in **Table 23** therefore represent strong noise enhancing conditions and would cause increased noise levels at downwind receivers compared to a 3°/100 m temperature inversion alone.

Operational Noise Levels

Figure 18 to **Figure 21** show predicted received noise levels for Year 1, Year 5, Year 10 and Year 21, respectively. Each figure includes the outer envelope, or maximum noise level, from all assessed weather conditions shown in **Table 23**. Operational key assumptions used for the purposes of modelling and detailed predicted noise levels for all receivers are presented in **Appendix H**.

Predicted noise levels for operational activities and construction of infrastructure modifications include proposed mitigation measures and represent the worst case scenario with all equipment operating under noise enhancing weather conditions. While this situation may occur occasionally, noise levels will generally be lower than the predicted noise levels.

Table 24 shows properties and receivers expected to receive 5 dBA or more over the intrusive criterion which would be considered a significant noise impact for these receivers.

Table 25 shows properties and receivers expected to receive noise levels less than 5 dBA over the intrusive criterion, which would be considered a minor to mild noise impact at these receivers. Other properties and receivers that have not been identified in **Table 24** or **Table 25** are expected to receive noise levels generated by the Project within the intrusive criterion under all assessed weather conditions.

Dragline Option

Predicted noise levels in **Figure 18** to **Figure 21** and **Table 24** and **Table 25** assume a mining operation including an excavator or shovel and fleet of trucks. It is proposed a dragline will be introduced as required in the later years of the Project. The dragline will replace either a shovel or excavator and an associated fleet of six to eight overburden trucks.

The total sound power level of an excavator and a fleet of six trucks would be approximately 126 dBA, while the proposed dragline would produce a sound power level of approximately 118 dBA. The proposed dragline is therefore 8 dBA quieter than the equipment it would replace. No further detailed noise modelling of the dragline operation was undertaken as the worst case scenario for the Project regarding noise generation will be Year 5 using an excavator or shovel and a fleet of trucks.

Rail Spur Option

Predicted noise levels in **Figure 18** to **Figure 21** and **Table 24** and **Table 25** assume up to seven coal haul trucks would operate on the private product coal haul road from Boggabri Coal Mine to the Boggabri Coal Terminal.

Table 24
Mining Noise - Summary of Noise Affected Residences, Lots and Properties

Residences	25% of Separate Lot Area	25% of Entire Property Area
Belleview, Jeralong Tarrawonga, Ambardo	14, 24, 26, 28, 35, 41, 46, 51, 52, 53, 54, 55, 61,81, 83, 85	Horse Shoe Northam

Table 25
Mining Noise - Summary of Moderate and Mild Noise Impacts

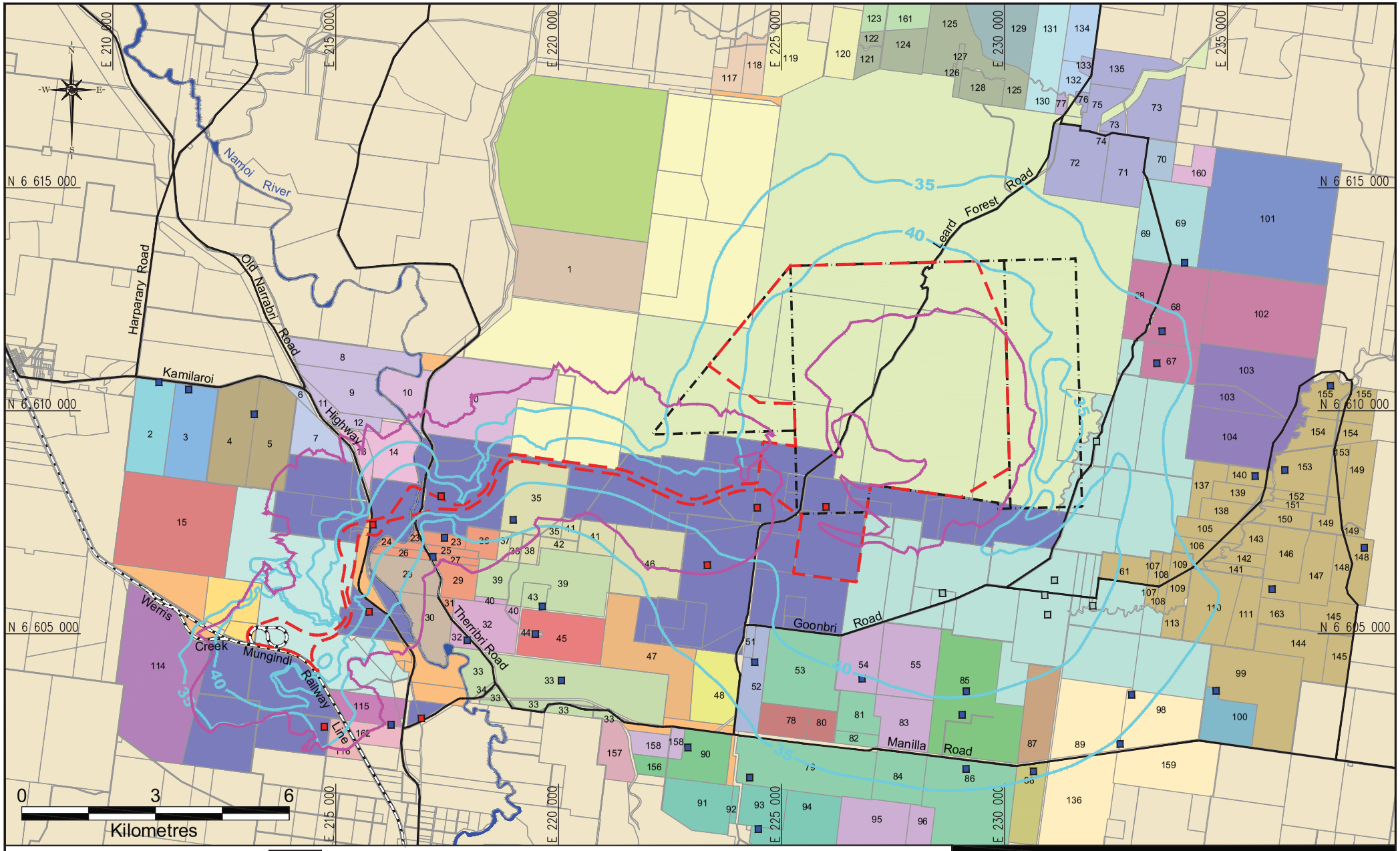
Residences	25% of Separate Lot Area	25% of Entire Property Area	Predicted Noise Level, LAeq,15min	
			Day	Evening / Night
-	36	-	38	Less than 40
-	37	-	37	
-	38	-	36	
Goonbri	42, 67, 80, 107	87 Templemore	35 or below	
-		Cooboobindi	37	39
-	39, 68, 78, 82, 108	Roma BJ Crosby 48 Wilboroi East	35 or below	
-	72	-	39	38
-	13	-	38	
-	23	Bullock Paddock	37	
Cooboobindi	25, 27	-	36	
-	43, 79, 84, 89, 102, 109	47 Wilboroi	35 or below	
Roma Glenhope Pine Grove Flixton	29, 30, 31, 103, 110	10 Kelso Billabong 44 Glenhope	35 or below	37
Billabong Northam Barbers Lagoon	90, 93, 98, 106	PM MI Mainey Brighton 45 DV RJ Gillham 88 Pine Grove 116 RA CM Collyer 158 KL Grover	35 or below	36
-	126, 127, 128, 130	-	37	35 or below
-	121, 122, 124, 125	CM RRF Morse	36	
Brighton	111, 118, 120, 123, 131, 132, 136	92 94 Callandar PD LA Finlay	35 or below	

The coal haul trucks may ultimately be replaced by a rail spur and loop as and when required. Both the coal haul trucks and the rail spur options have been modelled in the absence of mining operations to indicate the relative noise contribution produced by both transport methods, these are described in more detail in **Appendix H**.

When assessing noise levels over a 15 minute period as required by the INP and assuming a train on the rail spur would travel the full length of the spur during a 15 minute period, the rail spur option is approximately 1 or 2 dBA louder than the road option.

However, it should be noted that the truck fleet will be required to operate for much of the day to transport up to 7 Mtpa of product coal while only two to three trains per day would transport the same amount of coal.

The rail option is therefore slightly louder than the truck option in a 15 minute period, but would only produce noise for approximately 6% (1.5 hrs) of a 24 hour period. For this reason the rail spur option for product coal haulage is considered to be a slightly better option from an environmental noise perspective.



Project Boundary
Boggabri Mining Tenements
Boggabri Coal
Whitehaven Coal Mining
Aston Resources
Not Searched

Crown
Crown - Special Lease
NSW State Forest
Leard State Conservation Area
Mining Joint Ownership
Private Freehold Receiver

Boggabri Coal Owned Receiver
Other Mine Owned Receiver
Noise Contours LAeq (15 min)
Sleep Disturbance Contour (45 dBA)

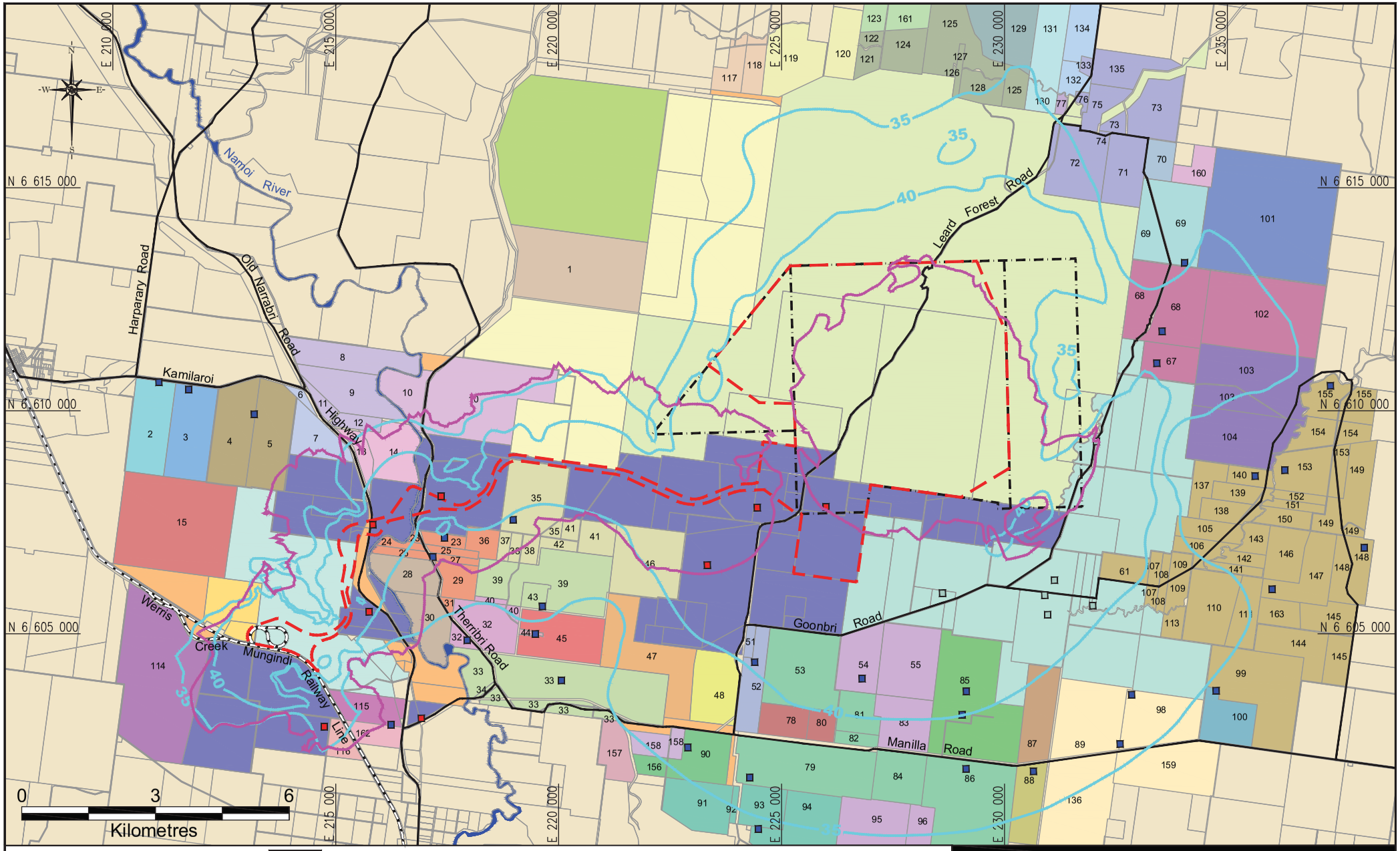
Source: Bridges Acoustics
Land Searches LPI 2009/2010
Co-ordinate System: MGA 94 Zone 56

Hansen Bailey

BOGGABRI COAL MINE

Indicative Noise Contours Year 1

Cad File: 06089D.dwg	Date: 14.10.2010	Drawn: CP	Figure 18



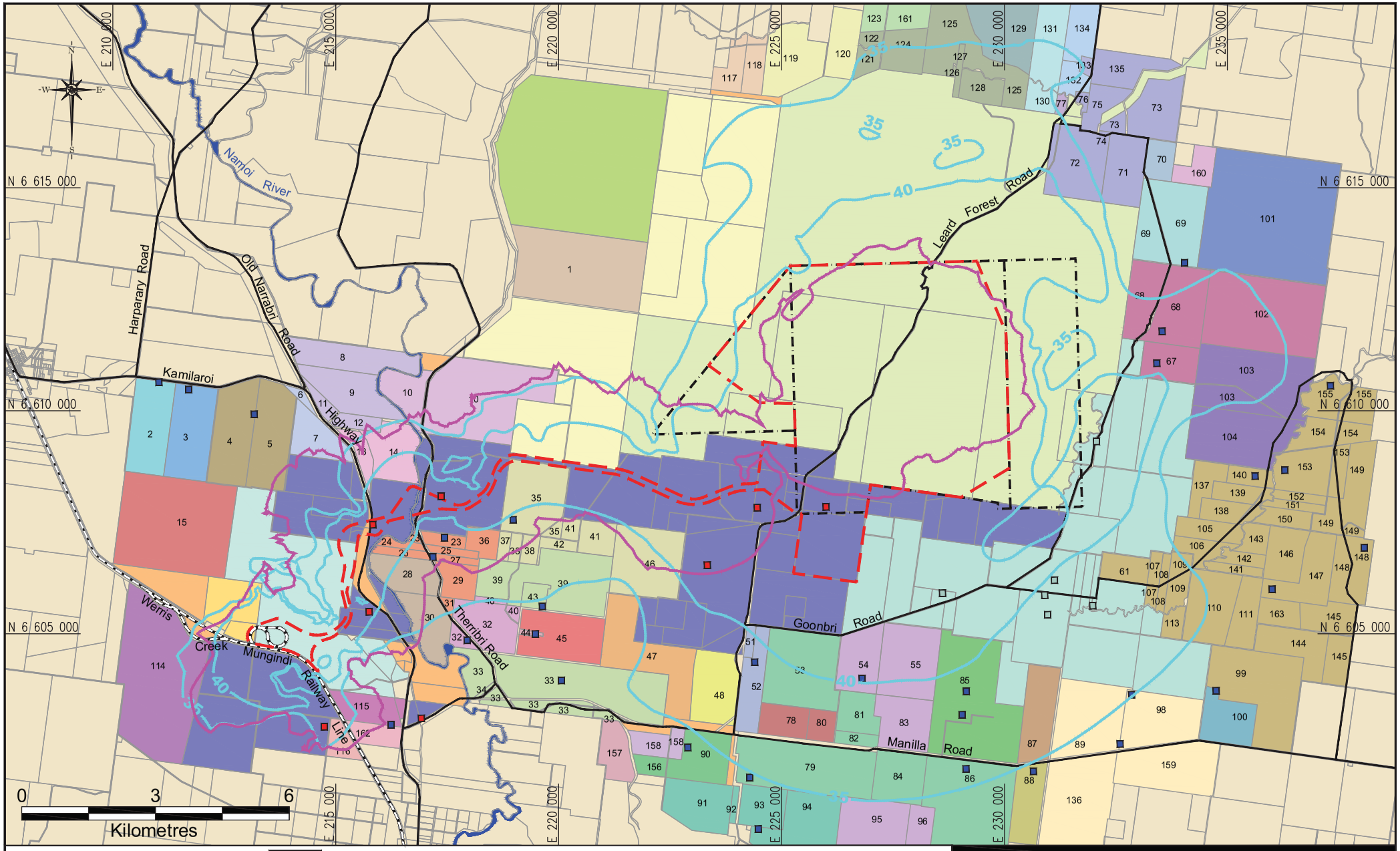
- Project Boundary
- Boggabri Mining Tenements
- Boggabri Coal
- Whitehaven Coal Mining
- Aston Resources
- Not Searched
- Crown
- Crown - Special Lease
- NSW State Forest
- Leard State Conservation Area
- Mining Joint Ownership
- Private Freehold Receiver
- Boggabri Coal Owned Receiver
- Other Mine Owned Receiver
- Noise Contours LAeq (15 min)
- Sleep Disturbance Contour (45 dBA)

Land Searches LPI 2009/2010
Co-ordinate System: MGA 94 Zone 56

BOGGABRI COAL MINE

Indicative Noise Contours Year 5

Cad File: 06091F.dwg	Date: 14.10.2010	Drawn: CP	Figure 19



Project Boundary
Boggabri Mining Tenements
Boggabri Coal
Whitehaven Coal Mining
Aston Resources
Not Searched

Crown
Crown - Special Lease
NSW State Forest
Leard State Conservation Area
Mining Joint Ownership
Private Freehold Receiver

Boggabri Coal Owned Receiver
Other Mine Owned Receiver
Noise Contours LAeq (15 min)
Sleep Disturbance Contour (45 dBA)

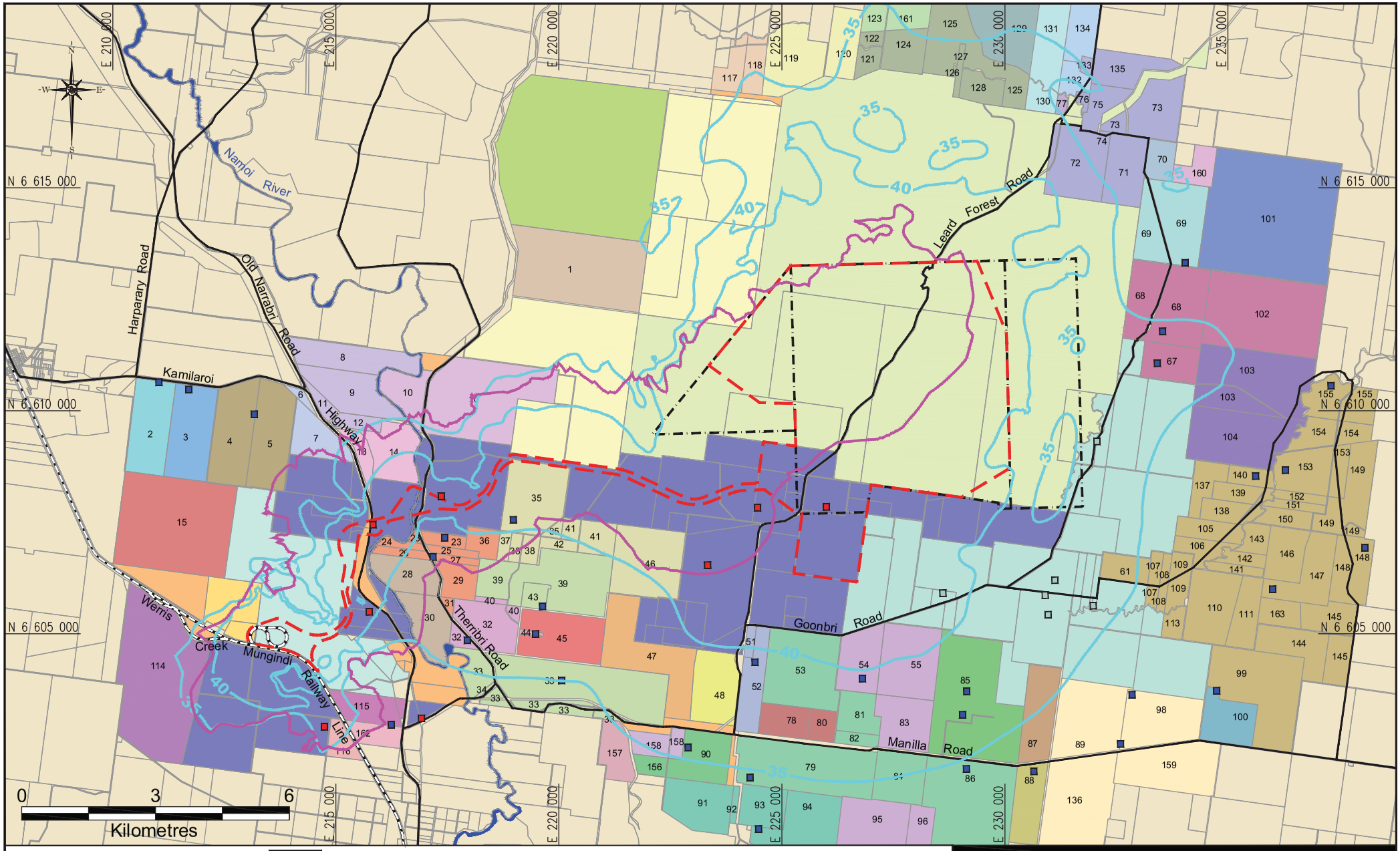
Source: Bridges Acoustics
Land Searches LPI 2009/2010
Co-ordinate System: MGA 94 Zone 56

Hansen Bailey

BOGGABRI COAL MINE

Indicative Noise Contours Year 10

Cad File: 06092Ddwg	Date: 14.10.2010	Drawn: CP	Figure 20



- Project Boundary
- Boggabri Mining Tenements
- Boggabri Coal
- Whitehaven Coal Mining
- Aston Resources
- Not Searched
- Crown
- Crown - Special Lease
- NSW State Forest
- Leard State Conservation Area
- Mining Joint Ownership
- Private Freehold Receiver
- Boggabri Coal Owned Receiver
- Other Mine Owned Receiver
- Noise Contours LAeq (15 min)
- Sleep Disturbance Contour (45 dBA)

Source: Bridges Acoustics
Land Searches LPI 2009/2010
Co-ordinate System: MGA 94 Zone 56

BOGGABRI COAL MINE

Indicative Noise Contours Year 21

Cad File: 06093D.dwg	Date: 14.10.2010	Drawn: CP	Figure 21

Construction Noise

Dragline Construction

The dragline will be assembled onsite over a period of approximately 12 months. The dragline construction pad will be located in close proximity to the CPP and would therefore be at least 4.8 km from the nearest receiver. A construction sound power level of approximately 120 dBA would produce less than 35 dBA at any receiver adjacent the Project. No further assessment was required as this was well within acceptable amenity criteria.

Rail Spur Construction

Construction work on the rail spur would produce a maximum sound power level of approximately 128 dBA during the earthmoving phase, excluding pile driving for the Namoi River bridge foundations which was assessed separately.

Modelling shows noise levels produced by rail spur work would be similar to noise levels produced by mining operations and would therefore produce similar noise levels as shown in **Table 24** and **Table 25** above. Construction of the rail spur would take approximately 6 months.

Rail Bridge Construction

Construction works on the Namoi River rail bridge would require an impact pile driver for a period of two to three months.

The pile driver would operate adjacent to the river and along the rail spur route over the floodplain and, based on previous noise measurements, would produce a sound power level of approximately 125 dBA plus either an impulsive or tonal penalty for a maximum effective sound power level of 130 dBA.

The pile driver would therefore produce a maximum noise level of approximately 50 dBA at closest Residences 27 and 35. Residence 23 would be effectively shielded from the closest pile driver operation by a small hill and would receive less than 45 dBA from this source.

Given the temporary nature of construction work, predicted noise levels are not necessarily considered unacceptable.

A construction noise management plan for the rail spur works will be developed to ensure all feasible and reasonable noise management and mitigation measures are implemented during the work.

Haul Road Widening

Construction work associated with the widening of the private product coal haul road would be approximately 7 dBA quieter than operational noise levels and would not create any adverse noise impacts.

CPP and Facilities Upgrade

Construction work associated with the CPP and infrastructure upgrade works would produce less than 35 dBA at any receiver and would not create any adverse noise impacts.

Sleep Disturbance

Mining Noise

The loudest sources of noise associated with mining operations are typically a shovel gate or dozer tracks, followed by train wheel squeal.

Figure 18 to **Figure 21** for years 1, 5, 10 and 21 include a 45 LAmax contour for combined mining and rail spur noise levels and show potential sleep disturbance effects at Residences 23, 27 and 35. Further investigation shows a train movement on the rail spur is the dominant source of maximum noise levels at these residences. Maximum noise levels from mining equipment would meet the sleep disturbance criterion at all receiver locations.

Rail Spur

A train produces a sound power level of approximately 126 dBA when travelling at 50 km/h on the rail spur, assuming some unavoidable wheel squeal occurs. **Figure 18** to **Figure 21** for years 1, 5, 10 and 21 include a 45 LA_{max} contour for combined mining and rail spur noise levels and show potential sleep disturbance effects at Residences 23, 27 and 35.

Residence 35 is expected to receive significant operational noise impacts and is included in **Table 24**.

Residences 23 and 27 are expected to receive 51 and 48 $LA_{1\text{-}1min}$ respectively from train movements on the rail spur assuming some unavoidable wheel squeal occurs.

These three residences are expected to receive mild noise impacts from mining operations and are included in **Table 25**.

Noise levels from train movements on the rail spur will be slightly higher than the truck movements, however, the average daily noise level produced by trucks is significantly greater than the average daily noise level produced by trains.

This is because trucks would need to operate 24 hours per day to transport up to 7 Mtpa product coal whereas three to four trains per day could potentially transport the same volume of product coal and would only need to operate for much shorter periods during the day.

The rail spur will be designed, where possible, with large radius corners and an optimum track alignment to minimise wheel squeal and other potentially intrusive noise sources.

Road Traffic Noise

Operational road traffic accessing the Project, including staff cars and delivery trucks, would predominantly travel from the Kamilaroi Highway via Manilla Road and Leard Forest Road. Residences 33, 52 and 90 are the closest to this route. Traffic noise levels are estimated to reach 43.2 dBA at Residence 52 with slightly lower noise levels at the other two receivers. Predicted operational traffic noise levels are below the noise criteria (55 dBA day and 50 dBA night) and as such no further assessment was required.

Construction related traffic would include additional trucks and generate slightly higher noise levels compared to the operational workforce. Therefore operational traffic noise levels for the Project should remain well within relevant criteria.

Rail Traffic Noise

Noise produced by train movements on the Mungindi to Werris Creek Railway is assessed separate to noise from trains on the private rail spur. Additional trains required to transport up to 7 Mtpa of coal would represent an increase of less than 10% of average daily train movements on the Werris Creek Railway and would produce a noise level increase of up to 0.3 LAeq 15 hour day and 0.3 LAeq 9 hour night. Maximum pass by noise levels would not change assuming all trains produce a similar maximum noise level.

A 0.3 dBA increase in average train noise levels at all potentially affected residences near the Werris Creek Railway represents a very minor noise impact and is therefore considered acceptable.

Low Frequency Noise

A modifying factor of 5 dBA has been applied to modelled mining and transportation sources where relevant therefore no further analysis of low frequency noise levels is required under the INP.

CPP Sources

Based on experience from other operating coal mines, sources of low frequency noise include crushers, vibrating screens and centrifuges. Noise is typically produced in the 14 Hz to 25 Hz frequency range, corresponding to machine operating speeds.

Noise model results indicate a received noise level of up to 50 dBL at the closest receivers, including noise enhancement due to temperature inversions and excluding topographic shielding to represent the worst case. Predicted noise levels are acceptable compared to adopted criteria.

Train Movements

Coal train movements are a source of low frequency noise, with locomotives and empty coal wagons being the most common sources. Sound frequencies in the range 25 Hz to 63 Hz are typically produced by these sources. Model results indicate a noise level of up to 65 dBA is expected at a distance of 1 km from the rail spur.

This result indicates low frequency noise levels from train movements on the rail spur are likely to remain within the 80 dBL level that has previously been found to be acceptable near other coal mines in NSW, but would exceed Queensland's 50 dBL Interim Low Frequency Criterion.

It is noted that the Queensland criterion is intended to apply to constant sources of noise such as industrial plants, not to transient sources such as train movements. The rail spur would be designed and constructed to minimise low frequency noise impacts.

Blast Overpressure and Vibration

Ground Vibration

Historic blast monitoring results for the Boggabri Coal Mine indicates 46 blast events occurred in 2009 and a maximum ground vibration level of 0.75 mm/s was recorded (2009 AEMR) at the nearest receiver. Extrapolation of these results, considering distances to closest receivers and the Project schedule and proposed blast design and frequency, indicates that blasts would produce up to 1.3 mm/s compared to the 10 mm/s criterion.

This result indicates ground vibration levels would remain well within acceptable limits and have no adverse impacts on adjacent receivers, private property or livestock in the vicinity of the Project.

The ground vibration criterion is intended to protect residential amenity. Vibration criteria to protect buildings and other structures from cosmetic or structural damage are significantly higher and predicted vibration levels would remain well below even the most conservative criteria. Building damage as a result of blasting is therefore highly unlikely to occur.

Overpressure

The 2009 AEMR indicates a maximum overpressure level of 114 dBL occurred at a distance of approximately 4 km from the blast site. With closest receivers located a minimum of 3.9 km from future blasts, overpressure levels up to 114.2 dBL are predicted compared to the 120 dBL criterion.

As predicted overpressure levels are approaching the criterion, ongoing blast monitoring will be undertaken to ensure future overpressure levels remain within acceptable limits. The increase in annual production up to 7 Mtpa product coal will result in more frequent blasts rather than larger blasts.

The Project will potentially include up to 300 blast events per year at full production. More frequent smaller blasts will ensure relevant ground vibration and overpressure criterion are achieved. Blast events will continue to be coordinated with the adjacent Tarrawonga Mine and any other future mining operations in the area to avoid any potential cumulative impacts.

8.2.4 Mitigation and Management

A combination of the following noise control measures will be incorporated into the Project to ensure predictions are met and minimise potential adverse noise impacts on receivers and reduce the Project's area of affectation:

- Mining trucks would be fitted with best practise exhaust silencers;
- The overburden fleet would be directed to higher, exposed emplacement areas during favourable weather conditions (generally during the day) and to lower, more shielded emplacement areas where possible during noise enhancing weather conditions (generally during the evening and night);
- Additional trucks purchased for the transport of Coal to the Boggabri Coal Terminal would achieve sound power levels of 108 dBA or less. That is the same noise level as a standard on-road truck and lower than the existing truck fleet;
- The existing three product haul trucks would be operated at a speed of 90 km/h during the day and during favourable weather conditions, and at a speed of 50 km/h during noise enhancing weather conditions in the evening and night;
- Vehicle reverse alarms, horns, start alarms and other audible warning devices would be selected, installed and adjusted to produce the lowest possible noise levels consistent with relevant safety standards;
- Mobile and coal handling equipment would be maintained in good condition to minimise unnecessary noise;
- The proposed rail spur would include noise control measures to minimise noise impacts where practical;
- A real time noise monitoring system will be installed if requested by residents; and
- Monitoring of blast events to ensure ground vibration and overpressure amenity levels are achieved.

A Real Time Noise Monitoring System will be installed to assist in the management of noise emissions on a daily basis. Boggabri Coal will:

- Further consult with adjacent affected landowners and establish Noise Management Agreements where possible;
- Offer sound suppression to the residences of immediate neighbours where modelling results exceed 35 dB(A);
- Install a permanent directional noise monitoring system (such as the Barn-Owl system) at a representative sensitive receiver location(s) and review the monitoring location on a regular basis to confirm it remains appropriate as the mine progresses;
- Correlate real time noise monitoring results with the mine's meteorological monitoring station for comparative analysis to assist in determining appropriate responses to noise issues;
- Develop an automatic warning system to notify site personnel when noise levels from mining activities are approaching the noise goals. This will also include a predictive capability linked to meteorological data to provide an estimate of likely future noise impacts from mining operations;
- Modify operations as required to ensure noise goals are achieved, which may include:
    - Relocate the dominant source(s) to a more shielded area of the mine;
    - Substitute alternative and quieter operating methods or machines. This may include operating equipment at lower speeds and / or adopting new technologies to reduce potential noise emissions; and
    - Cease operating equipment that is identified as the dominant noise source(s) until weather conditions are more favourable; and
    - Continue to review results from the noise monitoring system to confirm the adopted action is effective in achieving the criteria.

Preliminary noise modelling in the absence of the proposed noise control measures has indicated the proposed measures would achieve a significant noise reduction at all property and receiver locations.

Boggabri Coal's existing noise monitoring program will be reviewed and enhanced to ensure the Project achieves the predicted noise emissions targets. The monitoring network will include a combination of attended and unattended monitoring.

8.3 VISUAL AND LIGHTING

Integral Landscape Architecture and Visual Planning was commissioned to complete a visual and lighting assessment of the potential impacts of the Project.

This assessment was designed and undertaken to identify the character of the visual landscape surrounding the Boggabri Coal Mine and provide management and mitigation measures for visual impacts found to be associated with the Project. A summary of this assessment is provided below and included in full in **Appendix I**.

8.3.1 Methodology

Consideration was given to the existing visual environment surrounding the Project Boundary, including the determination of existing landscape settings and how they are seen from various viewing locations. In this way, the existing visual character of the landscape and the visual sensitivity of the various viewing locations assessed for the Project were determined. The visual effect of the Project was then determined by considering the visual characteristics of its various components in the context of the landscape in which the Boggabri Coal Mine will be located.

An integrated assessment of visual sensitivity and visual effects (and interactions between these two factors) was used to determine overall impacts of the Project and provide direction on the mitigation strategies required. The overall method of visual assessment of the existing landscape and the Project in the context of the surrounding landscape is outlined in **Table 26**.

Visual Effect

Visual effect relates to the level of visual contrast and integration of a development (i.e. the Project) with the existing landscape. Each landscape has certain visual characteristics expressed through the visual elements including form, shape, pattern, line, colour and texture with the relative contrast and integration between each element determining visual effect.

A mining development such as the Project has different visual characteristics that will create contrast with the existing landscape. However, in this case the approved Boggabri Coal Mine and Tarrawonga Mine are already part of the existing landscape, so to an extent the visual effects of the Project borrow visual character from these operations, reducing visual effects.

The magnitude of the visual effect of the Project was determined by a balanced consideration of the following:

- The level of contrast and integration of the Project with its surrounding landscape. Project elements as expressed through the visual expression elements (i.e. form, shape, pattern, line and colour with minor consideration in relation to texture) contrast to varying degrees with the surrounding landscape and will also integrate with it to some extent; and
- The proportion of a view (known as the Primary View Zone) from a location that is occupied by the Project. The level of Primary View Zone is occupied by an arc created by sight lines from the eye radiating out vertically and horizontally at angles of 30 degrees around a centre view line.

Visual Sensitivity

Visual sensitivity is a measure of how critically a change to the existing landscape is viewed by people from different land use areas in the vicinity of a development. In this regard, residential, tourist and / or recreation areas generally have a higher visual sensitivity than other land use areas, including industrial, agricultural or transport corridors.

Residential areas may use the scenic amenity values of the surrounding landscape as part of a leisure experience over extended viewing periods increasing the visual sensitivity. **Table 26** indicates the levels of visual sensitivity associated with the Project. The visual sensitivity of individual receivers may range from high to low, depending on the following additional factors:

- Screening effects of any intervening topography, buildings or vegetation. Receivers with well screened views of the Project will have a lower visual sensitivity than those with open views;
- Viewing distance from the receiver to visible areas of the Project. The longer the viewing distances, the lower the visual sensitivity; and
- General orientation of receivers to landscape areas affected by the Project. Those receivers with strong visual orientation towards the Project (i.e. those with areas such as living rooms and / or verandas orientated towards it) will have a higher visual sensitivity than those not orientated towards the Project, and which do not make use of the views toward the Project.

For any area to be given a sensitivity score, it must have visibility to the Project. The assessment of visibility for the purpose of scoring visual sensitivity was assessed based on field assessments, the evaluation of topographic and vegetation data and the computer assessment of those two parameters.

Visual Impact

The visual impact of the Project has been determined by considering both visual effect and visual sensitivity, which when considered together determine impact levels. The way in which the visual parameters of visual sensitivity and visual effect are cross referenced and resultant impacts is shown in **Table 26**.

Lighting Impact

The lighting impacts associated with the Project have been assessed by considering both the proposed mining operations, the relative levels at which the various viewing locations are situated and the presence of any screening features such as topography or vegetation.

Table 26
Visual Impact Assessment Matrix

		Visual Effect			
Visual Sensitivity		High	Moderate	Low	Very Low
	High	High Impact	High Impact	Moderate Impact	Low Impact
	Mod	High Impact	Moderate Impact	Low Impact	Low Impact
	Low	Moderate Impact	Low Impact	Low Impact	Low Impact

Project Mine Planning and Final Landform

The assessment of the existing visual environment undertaken for the areas surrounding the Project Boundary was used to enhance the development of the conceptual mine and final landform development plans for the Project.

In considering the effects and sensitivities predicted for each primary viewing sector throughout the life of the Project, a conceptual final landform was able to be developed that minimises visual impacts where possible and provides the most acceptable result for surrounding receivers.

The mine plan landform has also been modified to improve visual amenity, including the development of undulating, free-draining OEAs.

The development of the conceptual mine plans and final landform for the Project are discussed further in **Section 4** and **Section 8.16** respectively.

8.3.2 Impact Assessment

The visibility of the Project's mining operation is very limited. The Project Boundary to the north, east and west is screened by the forested ridges of the Willow Tree Range. A number of prominent topographical features help screen the Project Boundary to the south-east and south-west.

There are some limited views of the Project from the Kamilaroi Highway, roadside rest area at Gins Leap, rural residents and some views from local roads. The mining void will not be visible to external views except from the sky.

A review of the Project mine plans in conjunction with aerial photography determined that visual impacts will be created predominantly by the establishment of the southern OEA. Only the outer slopes of the southern OEA are visible to some southern viewing locations with progressive rehabilitation reducing the visual effect. The rail spur and bridge crossing of the Kamilaroi Highway will initially have a high visual effect however this will be reduced to low following rehabilitation of the earthwork batters.

The visual effect is created by the progressive introduction of a new landform into the landscape and the variable shapes, lines and colour that are generated by these elements. The visual effect of the southern OEA is for the greater part of four stages, depending on the progression of rehabilitation:

- Overburden that has strong colour and form contrast to the existing landscape, creating a high visual effect;
- Shaped overburden to create the final landform. This, to varying degrees, removes form contrast reducing visual effect towards moderate;
- Land stabilisation with grass planting which restores colour values and reduces contrast with the existing grassland landscape which reduces visual effect to moderate / low; and
- The reintroduction of tree cover to re-establish the patterns of the landscape and assist in reducing the regular form of OEAs in the landscape which will reduce the visual effect to low.

In terms of the above, it can be seen that the visual effect on receivers will eventually be reduced to low. The southern OEA will be completed over approximately the first five years of the mine life.

During this period exposed areas of pre-rehabilitated OEA will have high contrast and low integration however will not exceed 2.5% of the primary view resulting in a moderate visual effect.

If this level is exceeded a high visual effect will temporarily occur until rehabilitation is complete and the visual effect will reduce to low.

The OEA will reach an RL of 395 m, an increase of 45 m from that originally approved. This is not considered visually significant due to its proximity to sensitive receptors and shielding from surrounding topography.

South Eastern Sector Sensitivity

The Namoi River floodplain forms part of the south-eastern view corridor that incorporates lands on the floodplain and adjoining foothills of the Vickery and Kelvin State Forests to the east of the river and adjoining rural lands.

A number of minor roads are located in this sector including the Manilla, Goonbri, Braymont and Dripping Rock Roads.

The south-eastern sector contains a number of private rural residences within a 7.5 km radius that may have views of the Project.

The following visual sensitivities will be experienced from the viewing locations assessed for this sector:

- Rural Residences – Ranging from moderate to high sensitivity dependent on the topographical features, distance from the Project, localised viewing restrictions and view orientation; and
- Local Roads – Low sensitivity rating at distances greater than 2.5 km.

South-Western Sector Sensitivity

Located south-west of the Project mining area is the Namoi River floodplain that is adjoined by the rolling hills of the western foothills. This sector contains the township of Boggabri as well as several rural residences.

The sector also supports segments of the Kamilaroi Highway, the Werris Creek Mungindi Railway and small local roads including the Manilla Road, Therribri Road and Leard forest Road.

The following visual sensitivities will be experienced from the viewing locations assessed for this sector:

- Boggabri Township – Low sensitivity due to the distance from the Project being over 15 km and localised viewing restrictions;
- Kamilaroi Highway – Ranging from low to high sensitivity due to the location from the Project being approximately 10 km and topographical elements. The immediate area associated with the rail spur overpass and power line of the Kamilaroi Highway results in a high sensitivity rating;
- Rural Residences – Ranging from moderate to high sensitivity dependant on the distance to the Project, proximity to the rail spur, topographical features, localised visual restrictions and receiver orientation; and
- Local Roads – Moderate sensitivity dependent on proximity to the Project.

North, East and West Sector Sensitivity

Residences and roads in these sectors are screened from view by the Willow Tree Range so they will not experience any visual impacts from the Project.

Visual Impact Summary

The visual impacts of the Project will vary according to the visual effects created, its visibility and the visual sensitivity of areas from which it is seen.

As discussed above, the visibility of the Project's mining operation is very limited with the sensitive viewing locations (receivers) surrounding the Project Boundary.

The Project to the north, east and west is completely screened by the forested ridges of the Willow Tree Range. In addition, a number of prominent topographical features help screen the Project Boundary to the south-east and south-west.

There are some limited views of the Project from the Kamilaroi Highway, roadside rest area at Gins Leap, rural residents and some views from local roads. Results from the visual impact assessment undertaken indicate that the high levels of impacts to receivers associated with the Project are predominantly created by views of the OEAs.

The rail spur and bridge over the Kamilaroi Highway, while visible, will not create adverse impacts following the rehabilitation of earthworks.

Lighting Impact Summary

The effect of lighting surrounding the Project Boundary will vary depending on the location of mining operations, the relative level at which the viewing location is situated, and the presence of any topographical features and / or vegetation. The level of impacts from lighting is generally dependent on the two types of lighting effects that could be experienced from the Project, being:

- Direct light, where the light source is directly visible and will be experienced if there is a direct line of sight between a viewing location and the light source; and
- General night-glow (diffuse light) that results from light of sufficient strength being reflected into the atmosphere. This type of effect will create a strong local focal point and the effect will vary with distance and atmospheric conditions such as fog, low cloud and / or dust particles which all reflect light.

Generally direct lighting as a result of the Project will be screened by topography, vegetation and eventually the OEA. During the construction of the OEA the night lighting from dump trucks and other machinery working on the outer faces of the OEA will project lighting effects outside the Project Boundary.

The other form of direct lighting effects will be created by train movements along the rail spur and product coal haul trucks however, it is not expected that rural residents would be affected by such light. Direct lighting from stationary infrastructure including the CPP, workshop and Boggabri Coal Terminal will not have adverse direct lighting impacts on receivers.

The existing Boggabri Coal Mine and Tarrawonga Mine already contribute to diffuse lighting effects into the night sky. The diffuse night lighting effect of the Project is expected to be similar to that which is currently experienced however this may increase slightly as a result of increased operational activities. Depending on the proximity to the viewing zone, light glow may result around the Project Boundary however this will not create a significant visual effect.

Further, the influence of the surrounding mining operations and associated lighting activities will reduce the visual impact of diffuse light generated by the Project.

The Siding Spring observatory is located 125 km south-west of the Project and only 20 km west of Coonabarabran. The Siding Springs observatory is managed in accordance with the Orana Regional Environmental Plan (OREP) No.1 Siding Springs. This plan applies to all land within the Shires of Coonabarabran, Coonamble, Gilgandra and the City of Dubbo. The Project is located outside of the area covered by the OREP. Diffuse lighting from the Project is not expected to adversely affect the observatory.

The Narrabri Observatory is located 65 km north-west of the Project and only 20 km west of Narrabri and 25 km south-east of Wee Waa. The Narrabri Township is located between the Project and the Narrabri Observatory. Diffuse lighting from the Project is not expected to adversely affect the observatory.

8.3.3 Mitigation and Management

Mitigation and management measures to reduce the visual impacts from the Project include onsite treatments and are discussed below.

Offsite treatments at viewer locations are considered unlikely and would only be considered if a high impact is experienced at a residence for a substantial period.

The following practical mitigation measures are proposed for the Project:

- Infrastructure will be constructed in forest tones (i.e. green, grey, cream) to blend with the surrounding natural environment as far as practical;
- A continuation of existing rehabilitation programs;
- Implementation of already completed landform design of the eastern and southern OEAs and associated drainage structures;
- Establishment of visual and ecological forest planting patterns to achieve landscape patterns that emulate existing forest colour and texture continuums in the landscape;
- Within the established rail and road easements rehabilitate earthwork batters and carry out tree plantings to provide vertical scale to balance and integrate, but not necessarily screen, overhead rail gantries and bridges, especially in relation to views from the Kamilaroi Highway and Therribri Road; and
- Where possible and consistent with health and safety requirements, lights will be hooded or directed away from sensitive receivers to avoid direct light spillage from the site.

8.4 ECOLOGY

Parsons Brinckerhoff has completed an ecological assessment for the Project which is included in **Appendix J**.

It examines the terrestrial and aquatic flora and fauna assemblages and their habitats within the Project Boundary and determines the biological impacts of the construction and operation of the Project.

The assessment describes the ecological values within the Project Boundary in consideration of the regional context in which it lies, and assesses the impacts of the Project on flora and fauna, particularly Threatened species and communities listed under the *Threatened Species Conservation Act 1995* (TSC Act). The assessment also addresses impacts on MNES as listed under the EPBC Act.

Assessments have been undertaken in accordance with relevant NSW legislation and planning policies relevant to the protection of biodiversity and are discussed further in **Section 5**.

8.4.1 Methodology

Background

The Project Boundary has been previously surveyed as part of the original Boggabri Coal Project. The Boggabri EIS included a detailed report on the Botany, Wildlife and Ecology of the Leard State Forest (James B. Croft and Associates, 1983). This study included detailed flora sampling and vegetation mapping, mist netting, terrestrial and arboreal trapping of three seasonal sessions and opportunistic surveys.

More recently the NSW National Parks & Wildlife Service have undertaken fauna survey work within the Leard State Forest (Pennay, 2001). These surveys included, harp trapping, terrestrial and arboreal trapping, pitfall trapping, targeted bird surveys and opportunistic surveys.

In addition to these previous surveys, Parson Brinckerhoff has completed annual ecological monitoring surveys within the Leard State Forest and locality of the Project over the last five years. These surveys consisted of Invertebrate sampling, flora transects, diurnal bird surveys and Microchiropteran bat surveys using anabat echolocation recordings.

All of these assessments were reviewed for the Project so that existing information on the flora and fauna assemblages of the Project Boundary could be built upon through investigation and further field survey. In addition to these previous ecological surveys, the Project is located within an area covered by the broad scale vegetation mapping completed by Department of Land & Water Conservation (2002).

Records of Threatened plants and animals documented previously, or predicted to occur, in the Project Boundary or region, were obtained from various database resources.

These databases included DECCW BioBanking Threatened Species Database, DECCW Atlas of NSW Wildlife, DECCW Threatened Species, Populations and Community's Database, Bionet, Birds Australia Database and the DEHWA Protected Matters Search Tool.

A review of the background studies and database searches revealed that due to the broad-scale and age of the previous survey work completed within the Project Boundary a more detailed contemporary flora and fauna survey effort was required to complement this.

The design of the additionally required ecological assessment considered the *Draft Survey Guidelines for Fauna Surveys in the Western Zone of New South Wales* (Ellis, M. 1998; Ellis, W. A. *et al.* 2000) and were undertaken in accordance with the *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* (*Working Draft*) (Department of Environment & Conservation, 2004).

Survey Definitions

For this report the following definitions apply:

- **Subject Site** – The extent of direct impacts and any additional areas that could potentially be affected by the Project either directly or indirectly. This includes the area of proposed disturbance in 'Boggabri Extension', remaining areas of proposed disturbance within 'Boggabri Existing', the proposed site infrastructure and rail loop, haulage corridor;
- **Project Boundary** – The subject site and adjoining areas within the locality that could potentially be indirectly affected by the Project. The Project Boundary was the focus of the ecological assessment and is shown on **Figure 22**;
- **Study Area** – The study area included the Project Boundary plus additional area of the Leard State Forest that formed part of the Koala habitat surveys; and
- **Locality** – The area within 10 km of the Project Boundary.

Survey Methods

The flora field surveys were conducted over all four seasons and included the following:

- Stratification of vegetation communities based on the modification of previously mapped vegetation, consideration of other relevant environmental layers (i.e. topography and geology, etc) and findings of the aerial-photograph analysis.

  The initial stratification and vegetation community boundaries were subsequently ground truthed using a Global Positioning System (GPS);
- Condition of vegetation communities using four criteria:
  - Good = Vegetation that still retains the species complement and structural characteristics of the pre-European equivalent;
  - Moderate = Vegetation that generally still retains its structural integrity, but has been disturbed and has lost some components of its original species complement;
  - Poor = Vegetation that has lost most of its species and is significantly modified structurally; and
  - Very Poor = Similar to 'poor 'condition vegetation; however the canopy cover has undergone significant further reductions.
- Site specific floristic sampling using 400 m^2 (20 m X 20 m) quadrats (over 130 quadrats sampled);

- Random meander surveys in accordance with the technique described by Cropper (1993), to ground truth vegetation communities and specifically target habitats for Threatened and regionally significant flora species; and
- A combination of parallel transects and random meanders were conducted for the Threatened cryptic orchid *Diuris tricolor* during its known flowering period (September 2009) in areas of potential habitat.

The additionally required fauna survey work was conducted over two years, cumulating in over 4,102 trap nights and over 473 person hours of fauna surveys.

The survey effort was conducted over 20 fauna survey sites in four broad fauna habitat types. These surveys included the following:

- Microchiropteran bat surveys including anabat echolocation recordings and harp trapping;
- Reptile and amphibian surveys including funnel and pitfall trapping and active searches (diurnal and nocturnal);
- Bird surveys (diurnal and nocturnal);
- Small mammals (spotlighting, Elliott and cage trapping for arboreal species);
- Fauna habitat assessment;
- Systematic hollow-bearing tree assessment;
- Systematic koala habitat assessment utilising a grid-based sampling protocol in accordance with the koala habitat utilisation pilot study (Biolink Ecological Consultants, 2009). Regular grid-based sampling was undertaken using the Spot Assessment Technique (SAT) methodology at each sampling point. There were 94 survey sites sampled within the Project Boundary with an additional 52 survey sites located within the Leard State Forest outside the Project Boundary, with over 2,800 trees assessed; and
- Aquatic macroinvertebrate and fish surveys.

Terrestrial Flora and Fauna Descriptions

Vegetation Communities

The majority of the Project Boundary is dominated by remnant vegetation communities of the Leard State Forest with high natural species diversity and relatively few exotic species. However, these vegetation communities have often been structurally simplified, reflecting a history of disturbances consistent with commercial timber harvesting and regular thinnings.

The areas of the Project Boundary outside of Leard State Forest are characterised by highly disturbed communities affected by intensive agricultural land uses.

Four broad vegetation groups have been identified within the Project Boundary:

- Grassy Woodlands on Fertile Soils Communities;
- Shrubby Woodland / Open Forest on Skeletal Soils;
- Riverine Woodlands; and
- Grasslands.

These broad vegetation types have been subsequently split into a total of fifteen distinct vegetation communities. The status and location of these vegetation communities are listed in **Table 27** and shown in **Figure 22**.

Species of Plants

A total of 427 plant species were recorded within the Project Boundary of which 365 species (86%) were native. The most diverse family recorded was the *Poaceae* (grasses), with 81 species, followed by the *Asteraceae* and *Fabaceae*, with 51 and 44 species respectively. These include two Threatened flora species.

A list of the Threatened flora species that have been recorded or have the potential to occur within the Project Boundary are listed in **Table 28**. Known occurrences of these species within the Project Boundary and surrounding lands is shown on **Figure 23**.

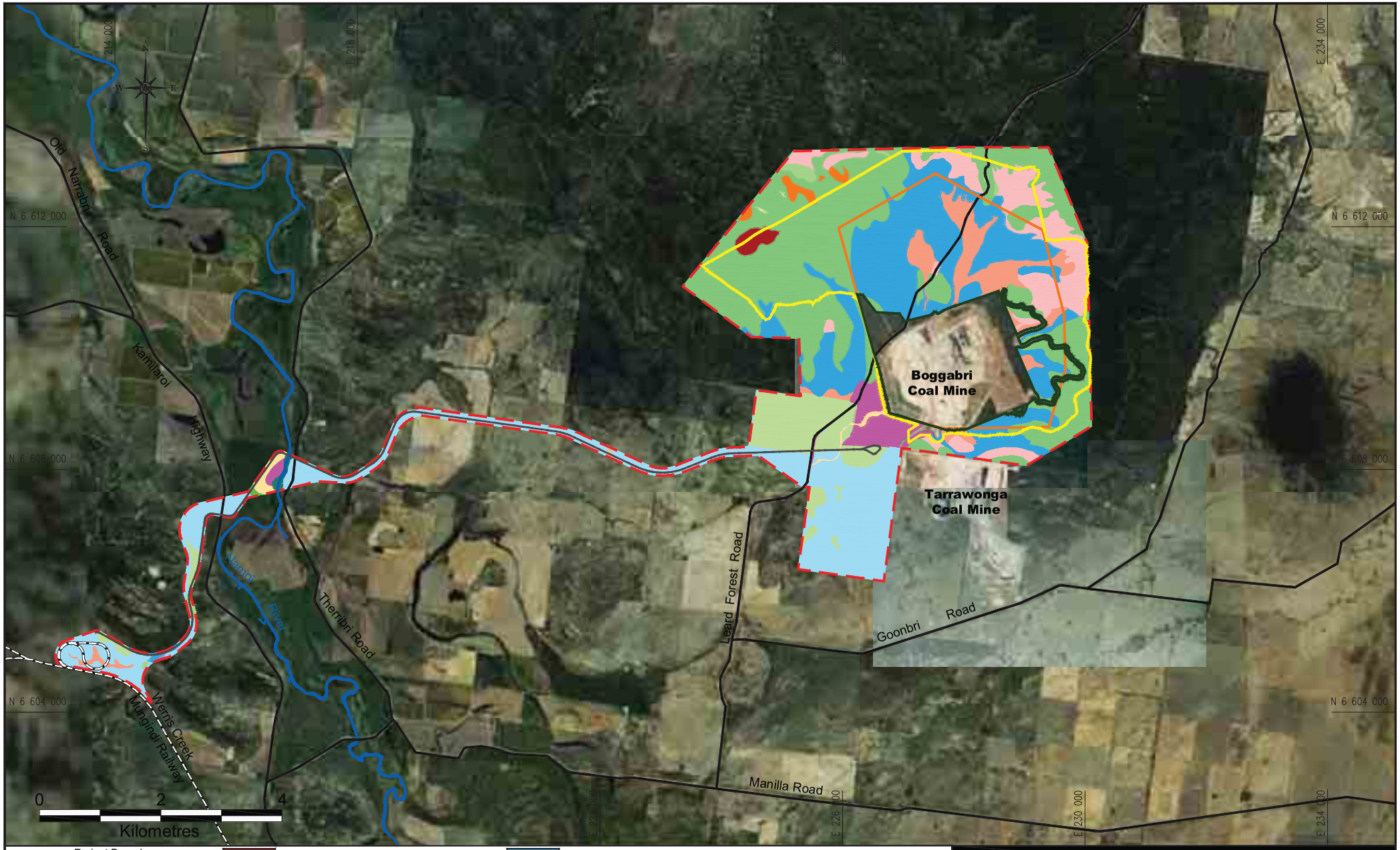
Table 27
Vegetation Communities within the Project Boundary

Vegetation Community	TSC Act	EPBC Act
Grassy Woodlands on Fertile Soils		
Yellow Box - Blakely's Red Gum grassy woodland	EEC[1]	CEEC[2]
White Box - White Cypress Pine grassy woodland	EEC[1]	CEEC[2]
White Box - Narrow-leaved Ironbark - White Cypress Pine grassy open forest	EEC[1]	CEEC[2]
Pilliga Box - Poplar Box - White Cypress Pine grassy open woodland	n/a	n/a
Weeping Myall open woodland	EEC[1]	EEC[2]
Shrubby Woodland / Open Forest on Skeletal Soils		
White Box - Narrow-leaved Ironbark - White Cypress Pine shrubby open forest	n/a	n/a
White Cypress Pine - Narrow-leaved Ironbark shrub / grass open forest	n/a	n/a
Silver-leaved Ironbark healthy woodland	n/a	n/a
Narrow-leaved Ironbark - Pine - Brown Bloodwood shrub / grass open forest	n/a	n/a
Dwyer's Red Gum woodland	n/a	n/a
Native Olive dry gully forest	n/a	n/a
Riverine Woodlands		
River Red Gum riverine woodlands and forests	n/a	n/a
White Box - Melaleuca riverine forest	n/a	n/a
Grasslands		
Derived Native grassland	n/a	n/a
Plains grassland	EEC[1]	CEEC[2]
Exotic grassland	n/a	n/a

[1] EEC = Endangered Ecological Community listed under TSC Act
[2] EEC = Endangered Ecological Community, CEEC = Critically Endangered Community under EPBC Act
n/a = Not Listed

Table 28
Threatened Flora Species Recorded or May Occur within the Project Boundary

Threatened Flora Species	TSC Act status	EPBC Act status	Recorded within the Project Boundary
Digitaria porrecta (Finger Panic Grass)	Endangered	Endangered	No
Diuris tricolor (Pine Donkey Orchid)	Vulnerable	Vulnerable	No
Pomaderris queenslandica (Scant Pomaderris)	Endangered	Not Listed	Yes
Pultenaea setulosa (Bush Pea)	Not Listed	Vulnerable	Yes



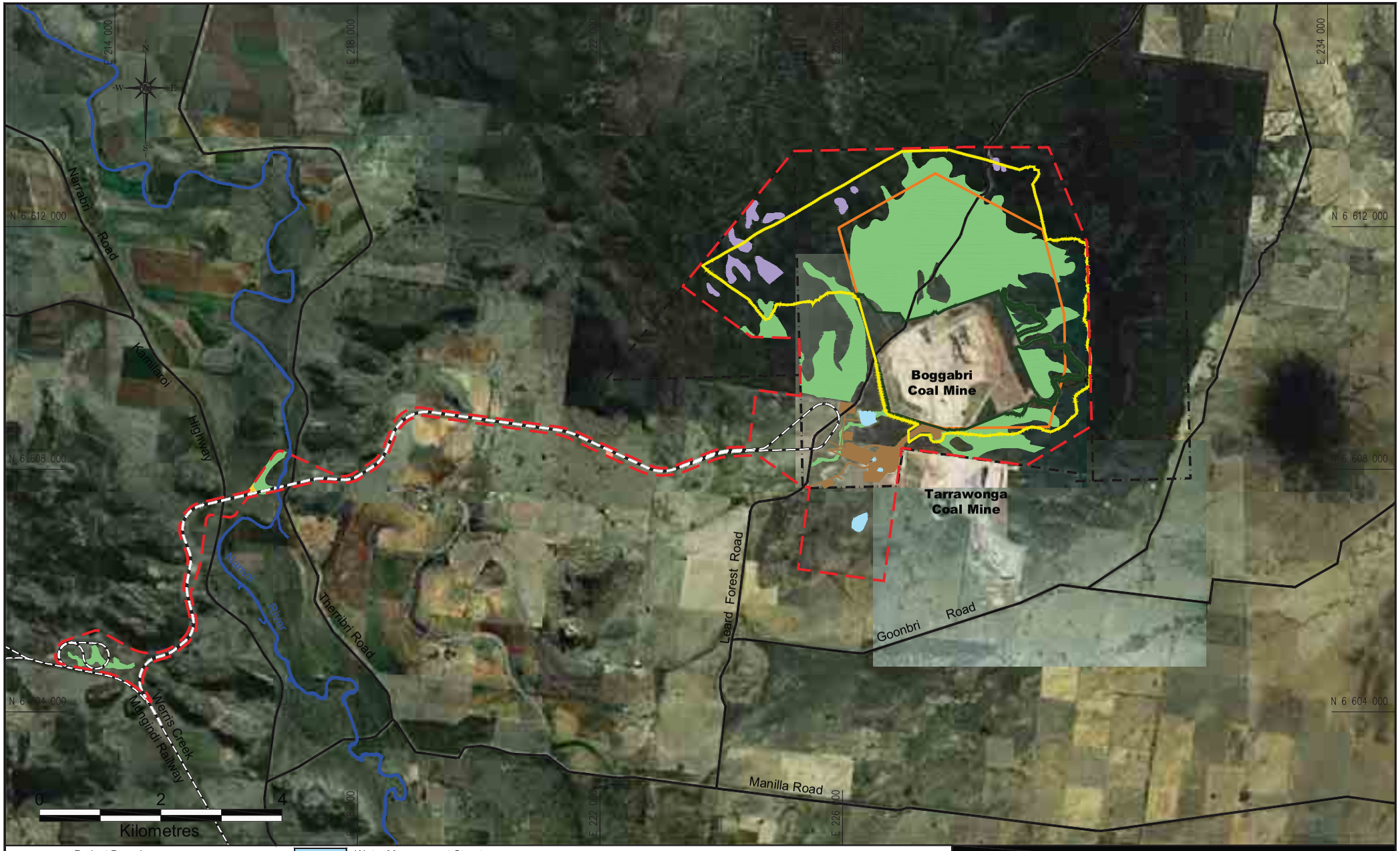
- Project Boundary
- Mine Disturbance to Nov 2011
- Existing Rail
- Roads
- River
- EIS Limit of Surface Mine
- Private Haul Road
- Mine Disturbance Boundary
- Exotic Grassland
- Derived native Grassland
- Dwyer's Red Gum Woodland
- Narrow-leaved Ironbark - Brown Bloodwood - White Cypress Pine Shrubby Open Forest
- Narrow-leaved Ironbark - White Cypress Pine Shrubby Open Forest
- Native Olive Dry Gully Forest
- Piliga Box - Poplar Box - White Cypress Pine Grassy Open Woodland
- Red River Gum Riparian Woodlands & Forest
- Weeping Myall Grassy Open Woodland
- Plains Grassland
- White Box - Narrow-leaved Ironbark - White Cypress Pine Grassy Open Forest
- White Box - Narrow-leaved Ironbark - White Cypress Pine Shrubby Open Forest
- White Box - White Cypress Pine Grassy Woodland
- White Box - Blakely's Red Gum - Melaleuca Riparian Forest
- Yellow Box - Blakely's Red Gum Grassy Woodland
- Silver-leaved Ironbark Heathy Woodland

Source: Parsons Brinkerhoff (2009), Google Maps (2009), Boggabri Coal (2009/2010)

BOGGABRI COAL MINE

Vegetation Communities

Cad File: 05407F.dwg	Date: 13.05.2010	Drawn: CP	Figure 22


E 214 000
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Narrabri Road
Kamilaroi Highway
Namoi River
Therribri Road
Leard Forest Road
Goonbri Road
Manilla Road
Werris Creek Mungindi Railway
Boggabri Coal Mine
Tarrawonga Coal Mine
0
2
4
Kilometres
Project Boundary
Boggabri Mining Tenements
Mine Disturbance to Nov 2011
Railway
Roads
River
Project Disturbance Limit
EIS Limit of Surface Mine
Proposed Infrastructure
Water Management Structures
White Box Woodland (CEEC)
Weeping Myall Woodlands (EEC)
Natural Grasslands (CEEC)
Pultenea Setulosa
Hansen Bailey
BOGGABRI COAL MINE
Threatened Ecological Comminities
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Date: 27.09.2010
Drawn: JD
Figure
23

Fauna

One hundred and ninety four species of animal were recorded within the Project Boundary during field surveys, including six amphibians, 129 birds, 31 mammals and 28 reptile species.

Of the species recorded 21 are listed as Threatened under the TSC Act and four are also listed as Threatened under the EPBC Act with a further two listed as Migratory species under the EPBC Act. In addition, a further three preliminary listed species on the TSC Act were recorded in the Project Boundary.

A list of the Threatened fauna species recorded during the surveys and identified as having potential habitat within the Project Boundary are included in **Table 29**.

The recorded locations of these Threatened fauna species within the Project Boundary are shown in **Figure 24** and **Figure 25**.

Birds were the most diverse group of animals in the Project Boundary with the majority of species being open country generalists and species common to Grassy Woodlands, Shrubby Woodlands / Open Forest or Riverine Woodland environments. Species included the Dusky Woodswallow, White-throated Treecreeper, and Fuscous Honeyeater.

The Eastern Grey Kangaroo, House Mouse and microchiropteran bats were the most abundant and widespread mammals with observations in all fauna habitats across the Project Boundary.

Arboreal mammals were scarce during field surveys with the Brushtail Possum being recorded twice in Elliott traps and once by observation.

One Sugar Glider was recorded as responding to call playback, whilst another individual was trapped and relocated from an area in close proximity to existing mining operations.

The results of the Koala survey confirmed very low habitat use (scats present in 5/166 survey sites sampled). Koala activity within these sites was typically low, ranging from < 5 to 20%, with a mean activity score (active sites only) of 11%.

Koala scats were observed under four species of *Eucalyptus: E. crebra*, *E. albens*, *E. pilligaensis* and *E. blakelyi*. One Koala was observed during the systematic searches for this species.

A second Koala was recorded opportunistically during the course of other survey efforts during March / April 2009. No records of Koala habitat use occurred within the remaining areas of the Leard State Forest outside the Project Boundary.

The low numbers of Koalas recorded during the survey indicates that the Leard State Forest is not dominated by habitat preferred by the Koala. Habitat generally preferred by the Koala is located on the lower valley areas.

Introduced mammals recorded were Rabbits, Brown Hare, House Mouse, Black Rat, Fox and Pig. These were recorded across the Project Boundary and further evidence of their presence outside of the Project Boundary, but primarily in Grassland and Grassy Woodland on fertile soil environments.

Amphibians recorded during field surveys in the Project Boundary include Broad-palmed Frog, Long-thumbed Frog, Spotted Grass Frog, Desert Tree Frog and Peron's Tree Frog from the Riverine Woodland. The Green Tree Frog was recorded opportunistically in Grassland and Grassy Woodland.

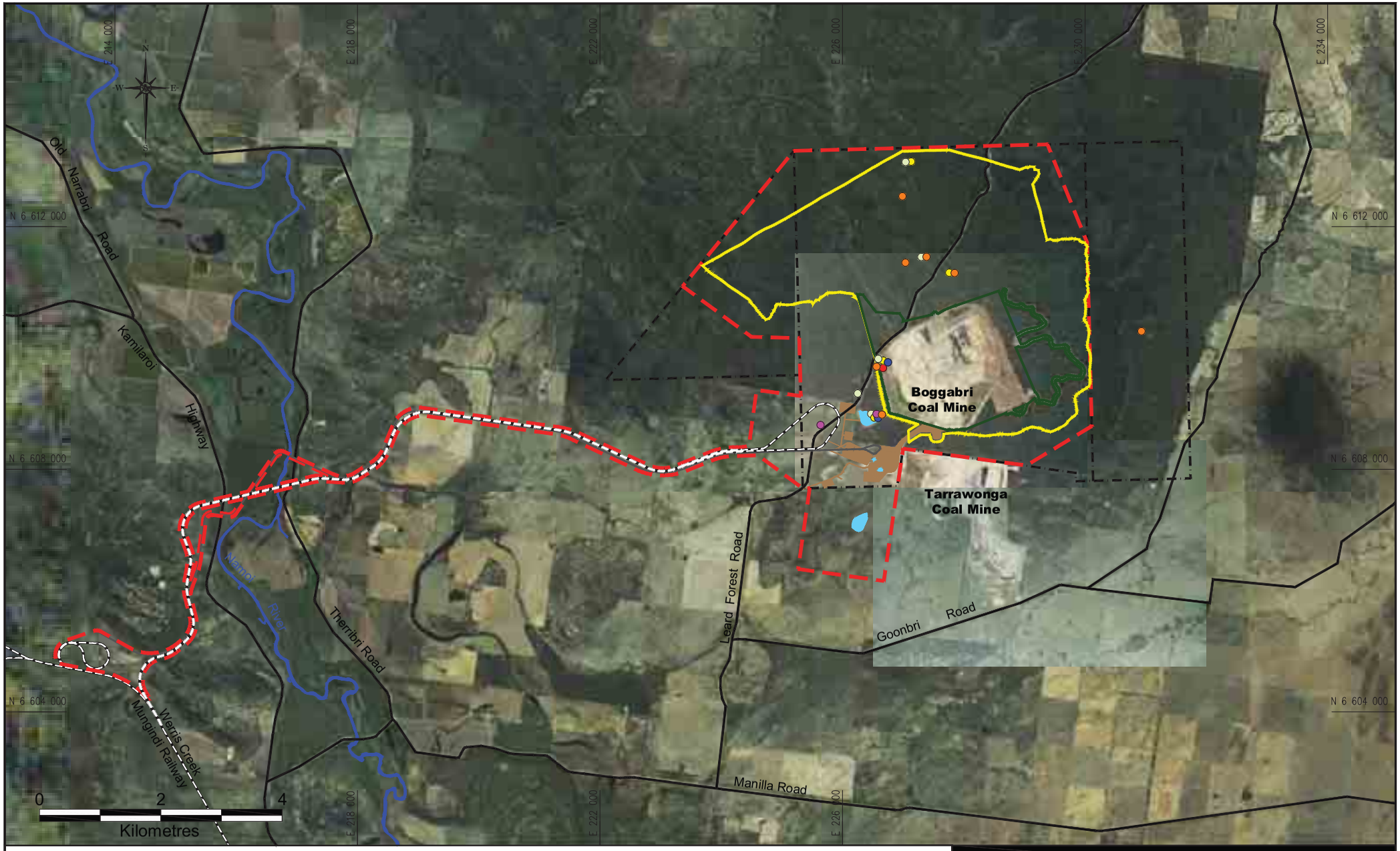
Common reptiles include Burton's Legless Lizard which was recorded under timber piles in Shrubby Woodland / Open Forest on Skeletal Soils, while the Thick-tailed Gecko was recorded in Grassy Woodland on Fertile Soils.

Tree Skinks were the most abundant reptile recorded in the Project Boundary, with records from all fauna habitat types.

A Tiger Snake was recorded in the Riverine Woodland habitat, with Red-bellied Black Snakes also commonly observed within this habitat type within the Project Boundary.

Table 29
Threatened Fauna Species Recorded or May Occur within the Project Boundary

Species Name	TSC Act	EPBC Act	Recorded within the Project Boundary
Sloane's Froglet	Vulnerable	Not listed	No – potential to occur as suitable habitat is present
Brown Treecreeper	Vulnerable	Not Listed	Yes
Hooded Robin	Vulnerable	Not Listed	Yes
Black-chinned Honeyeater	Vulnerable	Not Listed	Yes
Painted Honeyeater	Vulnerable	Not Listed	Yes
Pied Honeyeater	Vulnerable	Not Listed	Yes
Grey-crowned Babbler	Vulnerable	Not Listed	Yes
Speckled Warbler	Vulnerable	Not Listed	Yes
Diamond Firetail	Vulnerable	Not Listed	Yes
Varied Sittella	Vulnerable	Not Listed	Yes
White-browed Woodswallow	Vulnerable	Not Listed	Yes
Spotted Harrier	Vulnerable	Not Listed	Yes
Little Lorikeet	Vulnerable	Not Listed	Yes
Little Eagle	Vulnerable	Not Listed	Yes
Swift Parrot	Endangered	Endangered	No – potential to occur as suitable habitat is present
Square-tailed Kite	Vulnerable	Not Listed	No – potential to occur as suitable habitat is present
Turquoise Parrot	Vulnerable	Not Listed	Yes
Barking Owl	Vulnerable	Not Listed	Yes
Masked Owl	Vulnerable	Not Listed	Yes
Superb Parrot	Vulnerable	Vulnerable	No
Regent Honeyeater	Endangered	Endangered / Migatory	No – potential to occur as suitable habitat is present
Black-necked Stork	Vulnerable	Not Listed	Yes
Eastern False Pipistrelle	Vulnerable	Not Listed	Yes
Greater Long-eared Bat	Vulnerable	Vulnerable	Yes
Yellow-bellied Sheath-tail Bat	Vulnerable	Not Listed	Yes
Eastern Cave Bat	Vulnerable	Not Listed	Yes
Eastern Bent-wing Bat	Vulnerable	Not Listed	Yes
Large-eared Pied Bat	Vulnerable	Vulnerable	No – potential to occur as suitable habitat is present
Little Pied Bat	Vulnerable	Not Listed	Yes
Spotted-tailed Quoll	Vulnerable	Endangered	No – potential to occur as suitable habitat is present
Squirrel Glider	Vulnerable	Not Listed	No – potential to occur as suitable habitat is present
Koala	Vulnerable	Not Listed	Yes
Border Thick-tailed Gecko	Vulnerable	Vulnerable	No – potential to occur as suitable habitat is present



- Project Boundary
- Boggabri Mining Tenements
- Project Disturbance Boundary
- Mine Disturbance to 2011
- Railway
- Private Haul Road
- Roads
- River
- Proposed Infrastructure Area
- Water Management Infrastructure
- Black-chinned Honeyeater
- Brown Treecreeper
- Diamond Firetail
- Grey-Crowned Babbler
- Speckled Warbler
- Turquoise Parrot

Source: Google Maps (2009), Indemitsu (2009)

BOGGABRI COAL MINE

Threatened Birds

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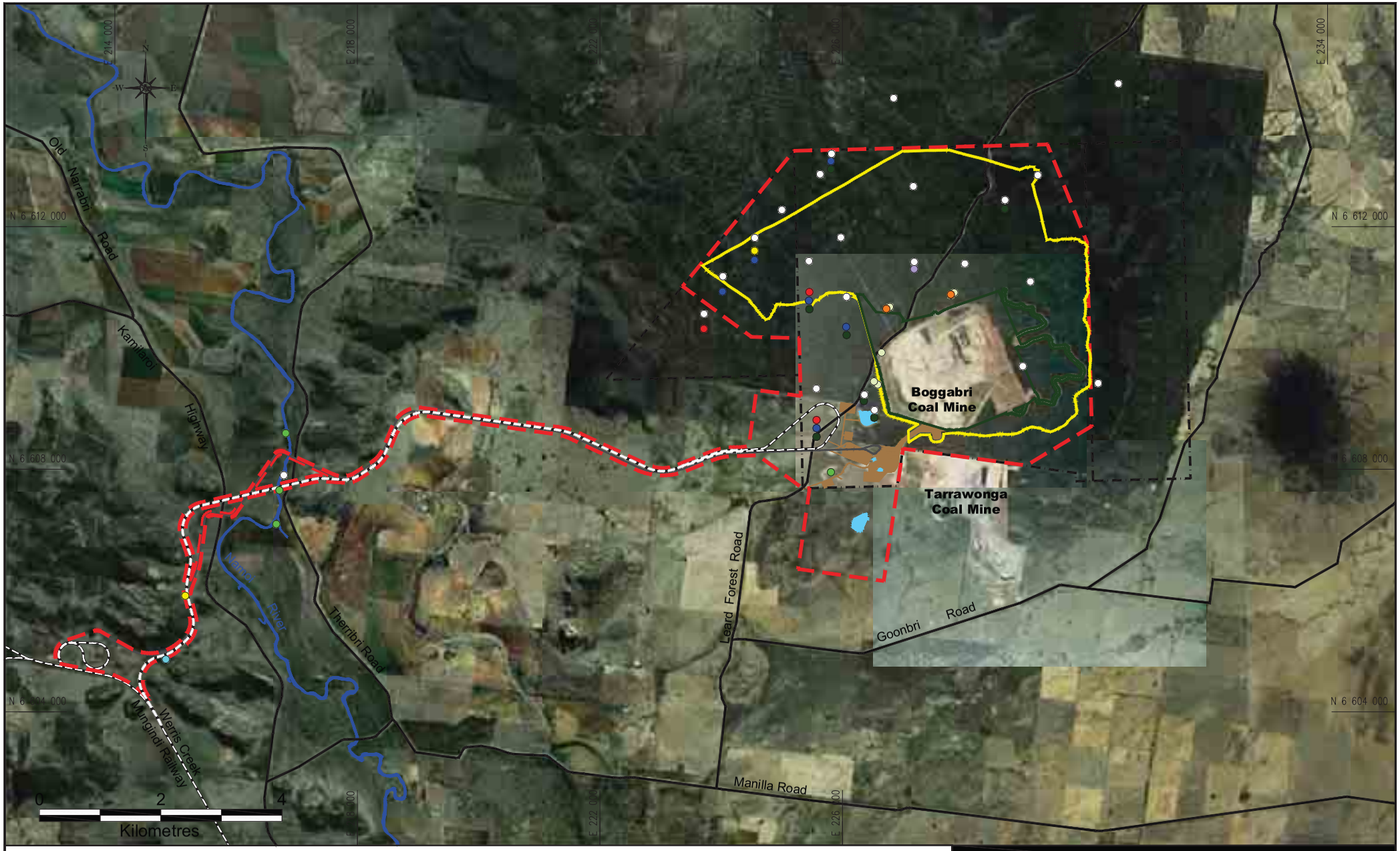

BOGGABRI COAL MINE

Threatened Mammals

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Aquatic Fauna and Macroinvertebrates

Field surveys were completed in August 2009 to quantify the physico-chemical water quality, assemblages of macroinvertebrates and fish at a number of spatial scales.

The key aquatic habitats within the Project Boundary were associated with the Namoi River and its floodplain and as such surveys focused on the location of the proposed crossing over the Namoi River and at one location upstream and one location downstream of the proposed works, two randomly nested sites were sampled (**Figure 25**).

At the time of the surveys all of the minor ephemeral streams within the proposed open cut disturbance area were dry with the only permanent water associated with artificial drainage contours and dams.

An additional location was also sampled within the only significant permanent aquatic habitat adjoining the proposed open cut disturbance area. This was a small farm dam immediately downstream of the proposed open cut disturbance (**Figure 25**).

A total of 26 individual fish (represented by three species) and 304 individual crustaceans (represented by two species) were collected from the sites using an Electrofisher and dip nets (**Table 30**).

The fish species were Mosquito Fish (*Gambusia* – 21 individuals), Australian Smelt (*Retropinna semoni* - three individuals) and Carp Gudgeon (*Hypseleotris sp*. - two individuals). The crustaceans were freshwater shrimps (*Paratya australiensis* – 284 individuals) and prawns (family *Palaemonidae* - 20 individuals).

A total of 923 individuals from 22 macroinvertebrate taxon (not including the *dipteran pupae*) were collected from the sites sampled.

The most abundant macroinvertebrate taxon was the *Corixidae* (388 individuals) followed by the *Atyidae* (141 individuals), *Dytiscidae* (116 individuals) and the *Hydrophilidae* (98 individuals).

The introduced fish, *Gambusia holbrooki*, was recorded (total of 21 individuals) at Location 1 (seven individuals), Location 2 (11 individuals) and Location 3 (three individuals) on the Namoi River (NR). No individuals of *Gambusia* were collected in the dam.

The total abundance of macroinvertebrates and the number of taxa were compared among locations (random factor) and among sites (nested factor) using analysis of variance.

There were no significant differences detected in the total abundance (number of individuals) and total richness (number of taxa) of aquatic macroinvertebrates at any scale.

The *Stream Invertebrate Grade Number Average Level* (SIGNAL) values calculated that all sites were severely polluted (

Figure *26*). The relative large number of pollution tolerant macroinvertebrate taxa suggested that the water quality was generally quite poor (Chessman, 2003).

8.4.2 Impact Assessment

The most significant impact of the Project will be loss of native vegetation and associated habitats on a local scale. The Project will result in the loss of nearly 1,384 ha of native vegetation, much of which is listed as Threatened under the Commonwealth (EPBC Act) or State (TSC Act) legislation (**Table 31**). This includes the proposed clearance of the following Threatened ecological communities:

- Approximately 623.6 ha of Box-Gum Woodlands;
- Approximately 0.3 ha Weeping Myall Woodlands;
- Approximately 0.4 ha of Natural Grasslands On Basalt And Fine-Textured Alluvial Plains Of Northern NSW and Southern Qld; and
- Approximately 1.2 ha of Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Darling River as listed under the FM Act.

Table 30
Fish and Crustaceans Recorded Using the Electrofisher in the Namoi River

Location	Scientific Name	NR1 Upstream		NR2 Crossing		NR3 Downstream	
Site		1	2	1	2	1	2
Common Name							
Australian Smelt	*Retropinna semoni*	0	1	0	0	1	1
Mosquito Fish	*Gambusia holbrooki*	3	4	9	2	0	3
Carp Gudgeon	*Hypseleotris sp.*	2	0	0	0	0	0
Freshwater Shrimp	*Paratya australiensis*	46	53	58	61	64	32
Freshwater Prawn	*Palaemonidae spp.*	3	0	16	1	0	0

Figure 26
Average Macroinvertebrate SIGNAL Values for Each Site and Location

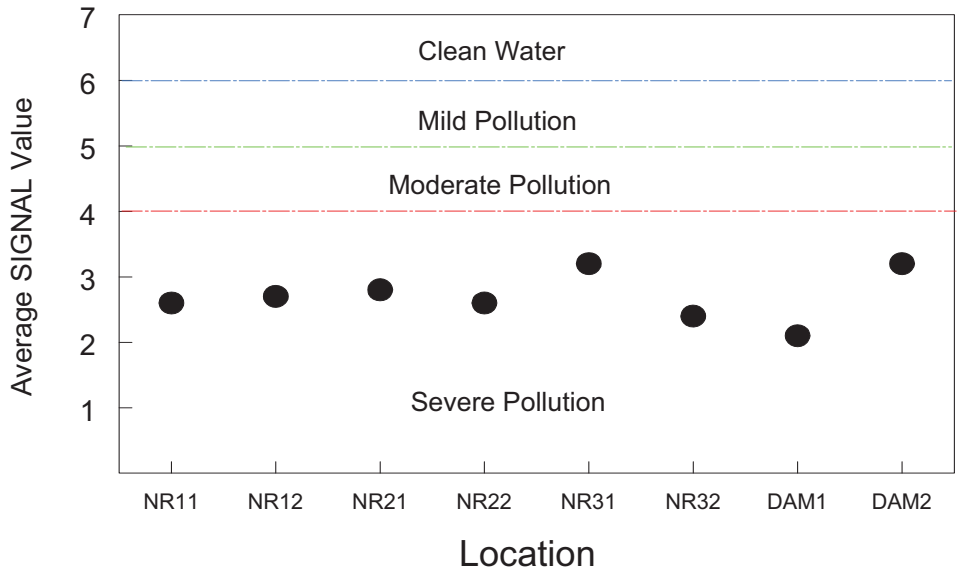

Table 31
Potential Loss of Vegetation and Habitat within the Project Boundary

Vegetation Communities	Project Boundary				Extent within Leard State Forest (ha)[5]
	Area Occupied within Project Boundary (ha)	Project Disturbance (ha)	Boggabri Existing (ha)	Boggabri Extension (ha)	
Grassy Woodlands on Fertile Soils Communities					
Yellow Box - Blakely's Red Gum grassy woodland*	17.5	2.0	1.5	0.5	268.0
White Box – White Cypress Pine grassy woodland *	216.2	147.2	135.0	12.2	1,262.0
White Box – Narrow-leaved Ironbark - White Cypress Pine grassy open forest*	651.4	474.4	405.1	69.3	1,684.0
Pilliga Box - Poplar Box- White Cypress Pine grassy open woodland	86.4	10.3	1.5	8.8	293.0
Weeping Myall grassy open woodland*	1.5	0.3	0.3	0.0	n/a
Shrubby Woodland / Open Forest on Skeletal Soils					
White Box – Narrow-leaved Ironbark - White Cypress Pine shrubby open forest	263.9	175.1	51.1	124	n/a
Narrow-leaved Ironbark - White Cypress Pine shrubby open forest	955.3	528.8	110.1	418.7	4,515.0
Silver-leaved Ironbark shrubby woodland	21.1	3.7	2.1	1.6	114.0
Narrow-leaved Ironbark - Brown Bloodwood - White Cypress Pine shrubby open forest	20.8	14.8	0.0	14.8	n/a
Dwyer's Red Gum woodland	21.7	0.3	0.0	0.3	n/a
Native Olive dry gully forest	0.8	0.0	0.0	0.0	n/a
Riverine Woodlands					
River Red Gum riparian woodlands and aquatic ecological community	9.0	0.6	0.6	0.0	n/a
White Box- Blakely's Red Gum - Melaleuca riparian forest	0.8	0.6	0.6	0.0	n/a
Derived native grassland	178.4	26.1	26.1	0.0	n/a
Grasslands					
Plains grassland*	1.0	0.4	0.4	0.0	n/a
Exotic grassland	315.4	40.6	40.6	0.0	n/a
Total	**2,761.2**	**1,425.2**	**775.0**	**650.2**	**8,136.0**

Vegetation Communities	Project Boundary				Extent within Leard State Forest (ha)[5]
	Area Occupied within Project Boundary (ha)	Project Disturbance (ha)	Boggabri Existing (ha)	Boggabri Extension (ha)	
Threatened Ecological Communities					
CEEC[1]	885.1	623.6	541.6	82	3,214
CEEC[2]	1.0	0.4	0.4	0.0	n/a
EEC[3]	1.7	0.3	0.3	0.0	n/a
EEC[4]	9.0	0.6	0.6	0.0	n/a
Total	**896.8**	**624.9**	**542.9**	**82**	**3,214**
Fauna Habitats for Threatened Species (Excluding exotic grassland)					
Grassy Woodland on fertile soils	973.0	634.2	543.4	90.8	3,237.0
Shrubby Woodlands / Open Forest on skeletal soils	1,283.6	722.7	163.3	559.4	4,629.0
Riverine Woodland	9.8	1.2	1.2	0.0	268.0
Grassland	179.4	26.5	26.5	0.0	0.0
Total	**2,445.8**	**1,384.6**	**734.4**	**650.2**	**8,136**

*Notes: * forms part of an Endangered Ecological Community.*

1 – Critically Endangered Ecological Community, White Box -Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland.

2 – Critically Endangered Ecological Community, Natural Grasslands on Basalt and Fine-Textured Alluvial Plains of Northern New South Wales (NSW) and Southern Queensland.

3 – Endangered Ecological Community, Weeping Myall Woodlands.

4 – Endangered Ecological Community, Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Darling River FM Act.

5 – Based on (James B. Croft and Associates 1983).

Impacts to Threatened Flora

In the absence of any mitigation measures the removal of approximately 1,384.6 ha of native vegetation is likely to exacerbate the key threatening processes of native vegetation removal and tree hollow loss.

The clearance of native vegetation required for the proposed mining operations will remove potential habitat for a range of Threatened flora species in the local area.

Habitat and individual specimens of *Pultenaea setulosa* will also be removed as part of the Project however, extensive areas of known and potential habitat as well as a significant proportion of the population will be retained within the Project Boundary and a viable population is anticipated to exist in the long term.

Potential habitat for *Pomaderris queenslandica* will be removed as part of the Project, however no occupied habitat will be affected.

Extensive areas of occupied habitat in the form of shrubby woodlands / open forest will be retained as part of the Project. Therefore it is unlikely to have a significant impact upon this Threatened species.

In the absence of a suitable Offsets Package the Project will have a significant impact on the White Box, Yellow Box, Blakely's Red Gum Woodland community as listed under the TSC Act and the equivalent community listed as critically endangered under the EPBC Act.

Three vegetation communities identified as potentially groundwater dependant will not be significantly impacted as the Project will not intercept groundwater from perched water tables within the Project Boundary.

Impacts to Threatened Fauna

The Project will be a barrier to fauna species and further fragment treed habitats in the region. However remnant vegetation will remain to the north, east and west of the Project Boundary in the Leard State Forest maintaining a fragmented wildlife corridor.

The Project will require the removal of hollow-bearing trees which provide roosting habitat for Threatened microchiropteran bats, arboreal mammals and birds.

The majority of land along the proposed rail spur alignment has been significantly disturbed by previous land uses such as agriculture. However, some minor additional fragmentation and isolation of remnant vegetation will result from the clearing of remnant vegetation for the rail spur.

The fragmentation may effectively isolate remaining vegetation on either side of the rail spur and haul road. This would particularly be the case for small and sedentary fauna, such as ground-dwelling mammals, reptiles and amphibians.

It is not considered to be significant as the remnant vegetation has been significantly disturbed by previous land uses and therefore impact is considered to be minor.

Further, more mobile species, such as birds and bats, may not be as affected by the barrier. The bridge for the rail crossing over the Namoi floodplain will be elevated over the entire floodplain including the Namoi River.

Therefore the rail crossing on the Namoi floodplain will not create a barrier effect for fauna, such as ground-dwelling mammals found along the river.

The Project will have a significant impact on Threatened woodland birds (including potentially the Regent Honeyeater) and hollow-dependent microchiropteran bats within the locality.

It is likely that the removal of a section of the Leard State Forest will result in the reduction of local population sizes for these species until successfully rehabilitated.

Large areas of contiguous known habitat for these species will be retained within the remaining areas of Leard State Forest and Leard State Conservation Area.

The clearing of a further section of the Leard State Forest will remove foraging and roosting habitat for a number of other Threatened fauna species that have been recorded or are predicted to occur within the Project Boundary.

With appropriate mitigation measures, the Project is not likely to have a significant impact on other Threatened biodiversity. It is unlikely that non Threatened biodiversity would be placed at risk of local extinction.

Table 32 summarises the CEECs, EECs, and the endangered and vulnerable flora and fauna that will be impacted by the Project and notes whether such impact is likely to be significant or not.

Table 32
Summary of Significance Assessments Completed

Threatened Biodiversity	Recorded in Project Boundary	TSC Act[1]	FM Act[2]	EPBC Act[3]	Likely Significant Impact
Threatened Ecological Communities					
Box-Gum Woodland	Yes	E		CE	Yes
Weeping Myall Woodland	Yes	E		E*	No
Plains Grassland	Yes	E		CE	No
Lowland Catchment of the Darling River	Yes		E		No
Threatened Plants					
Digitaria porrecta	No	E		E	No
Diuris tricolor	No			V	No
Pomaderris queenslandica	Yes	E			No
Pultenaea setulosa	Yes			V	No
Threatened Animals					
Sloane's Froglet	No	V			No
Threatened woodland birds assessed as a group (Brown Treecreeper, Hooded Robin, Black-chinned Honeyeater, Painted Honeyeater, Pied Honeyeater, Grey-crowned Babbler, Speckled Warbler, Diamond Firetail and Varied Sittella†)	Yes	V			Yes
White-browed Woodswallow	Yes	V†			No
Spotted Harrier	Yes	V†			No
Little Lorikeet	Yes	V			No
Little Eagle	Yes	V†			No
Swift Parrot	No	E		E	No
Square-tailed Kite	No	V			No
Turquoise Parrot	Yes	V			No
Barking Owl	Yes	V			No
Masked Owl	Yes	V			No
Superb Parrot	No	V		V	No
Regent Honeyeater	No	E		EM	Yes
Black-necked Stork	Yes	V			No
Threatened hollow-dependent microchiropteran bats assessed as a group (Eastern False Pipistrelle, Greater Long-eared Bat and Yellow-bellied Sheath-tail Bat)	Yes	V		V[4]	Yes
Threatened cave-dependent microchiropteran bats assessed as a group (Eastern Cave Bat, Eastern Bent-wing Bat, Large-eared Pied Bat and Little Pied Bat	Yes*			V[4]	No
Spotted-tailed Quoll	No	V		E	No
Squirrel Glider	No	V			No
Koala	Yes	V			No
Border Thick-tailed Gecko	No	V		V	No

*Notes: 1 – TSC Act, V = Vulnerable, E = Endangered. 2 – FM Act, E = Endangered. 3 – EPBC Act, CE = Critically Endangered, V = Vulnerable, E = Endangered, M = Migratory. 4 – Greater Long-eared Bat and Large-eared Pied Bat only. † Preliminary listing. *Large-eared Pied Bat probable record on ecolocation*

8.4.3 Mitigation and Management

Management measures proposed for the Project have followed the DECCWs policy for assessing the ecological impacts of proposed developments, with the aim to avoid, mitigate or offset all identified impacts, as follows:

- *Avoid*: to the extent possible, developments should be designed to avoid or minimise ecological impacts;
- *Mitigate*: where certain impacts are unavoidable through design changes, mitigation measures should be introduced to ameliorate the ecological impacts of the proposed development; and
- *Compensate*: the residual impacts of the Project should be compensated for in some way.

Each of these principles have been applied to the Project and addressed where reasonable and feasible, as discussed below.

Avoid

As discussed in **Section 4**, the mine plan for the Project has been specifically designed as far as possible to reduce environmental impacts, including specific impacts on Threatened flora and fauna species.

In particular, a proposed drainage structure around Merriown Mountain was removed from the mine plan and the upgrading of existing facilities within the current mine footprint was adopted to minimise disturbance of remnant vegetation.

A proposed tailings dam was also removed from the mine plan to minimise further disturbance. All other proposed Mine Extension Areas were reviewed to determine if any modifications could be facilitated to preserve ecological function and balance economic considerations.

It was found that the required coal bearing mining area could not be modified further to reduce the ecological impacts of the Project, whilst maintaining its economic feasibility and resulting in a sustainable final landform.

However, very substantive mitigation and compensation measures are proposed to offset the impacts of the Project on flora and fauna as described below. Significant modification to the current Mine Operations Plan and design of the Project has led to improved Biodiversity outcomes (refer **Table 33**).

Mitigate

Boggabri Coal currently has a range of management strategies in place to limit its impacts on biodiversity as part of the operating Boggabri Coal Mine. These management strategies will be revised and updated as required to mitigate any potential further impacts from the Project.

Table 33
Modification Avoiding Impacts

Modification	Area (ha) Avoided	Habitat Type
Removal of the western drainage structure around Merriown Mountain from the remnant Box-Gum Woodland within Leard State Forest	6	CEEC, Box-Gum Woodland
Relocation of proposed mine site infrastructure to existing areas of disturbance	25	Derived grassland and Grassy Woodlands
Utilisation of existing haulage route for the majority of the proposed rail corridor and elevation of the railway line over the Namoi River floodplain	24	Derived grassland, Riverine Woodland and Grassy Woodlands
Limiting the mining area to the northern portion of A 355	265	CEEC, Box-Gum Woodland, Derived grassland and Grassy Woodlands
Avoid using any area in A 399 as an of pit dump area	890	CEEC, Box-Gum Woodland, Riverine Woodlands and Shrubby Woodlands / Open Forest on skeletal soils