

## Section 4

# Assessment and Management of Key Environmental Issues

### PREAMBLE

*This section describes the specific environmental features of the Project Site and its surrounds that would or may be affected during the life of the Avoca Tank Project. The proposed design and/or operational management and mitigation measures are presented, followed by an assessment of the predicted level of impact the proposed activities may have after implementation of these measures. Where appropriate, proposed monitoring programs are also described.*

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## 4.1 BACKGROUND ENVIRONMENTAL SETTING

### 4.1.1 Introduction

The descriptions of various environmental aspects of the Proposal throughout this section are reliant upon a range of background information common to many of the key environmental issues. In this subsection, background information is provided on the topography, meteorological data, land ownership and residences and land uses surrounding the Project Site.

### 4.1.2 Topography and Drainage

#### 4.1.2.1 Regional Topography and Drainage

The Project Site is located within the Macquarie - Bogan Catchment, an area of approximately 92 000km, and is situated on a flat to gently sloping landform (**Figure 4.1**). The Bogan River rises approximately 19km northwest of Parkes before flowing in a north-northwesterly direction through Nyngan, approximately 55km to the southeast of the Project Site, and flows in a northerly direction, 25km to the west of the Project Site. The Bogan River merges with the Darling River, approximately 150km north of the Project Site.

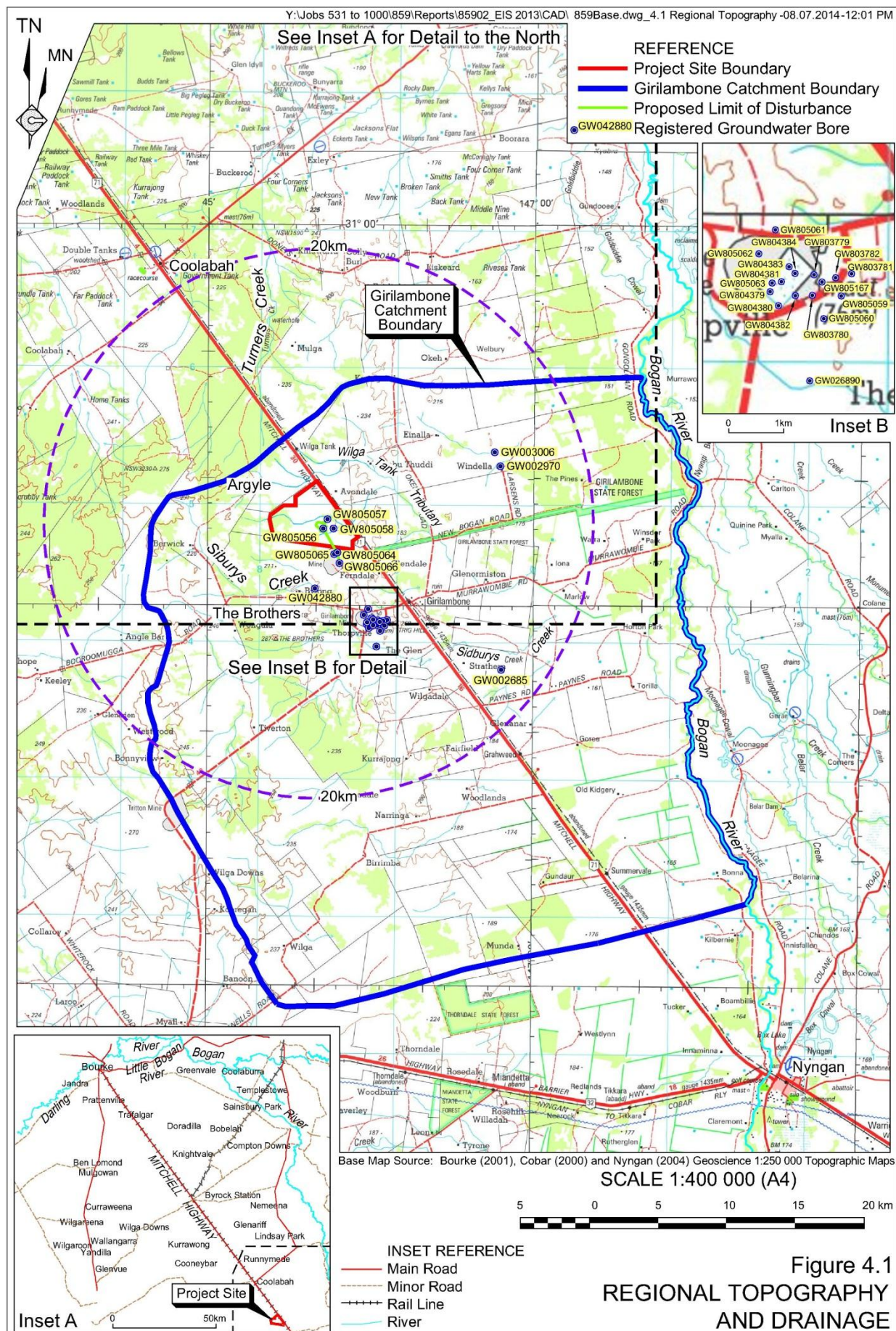
There are several major weirs on the Bogan River, including the Muddal Weir, located west of Peak Hill; the Nyngan Weir, located on the northern outskirts of Nyngan, and Gongolgon Weir located approximately 100km north of the Project Site where the mean daily flow exceeds 700ML.

Topography surrounding the Project Site is gently east sloping, with maximum elevations to the west and south of the Project Site from 250m AHD near the 'Argyle' residence and 287m AHD at 'The Brothers' respectively (**Figure 4.1**). To the north and east of the Project Site, elevations generally range between 200m AHD and 175m AHD and drain towards an unnamed tributary (referred to here as the Wilga Tank Tributary) and Siburys Creek, located approximately 1km north and 3km to the south of the Project Site respectively. All drainage lines are ephemeral and typically indistinct.

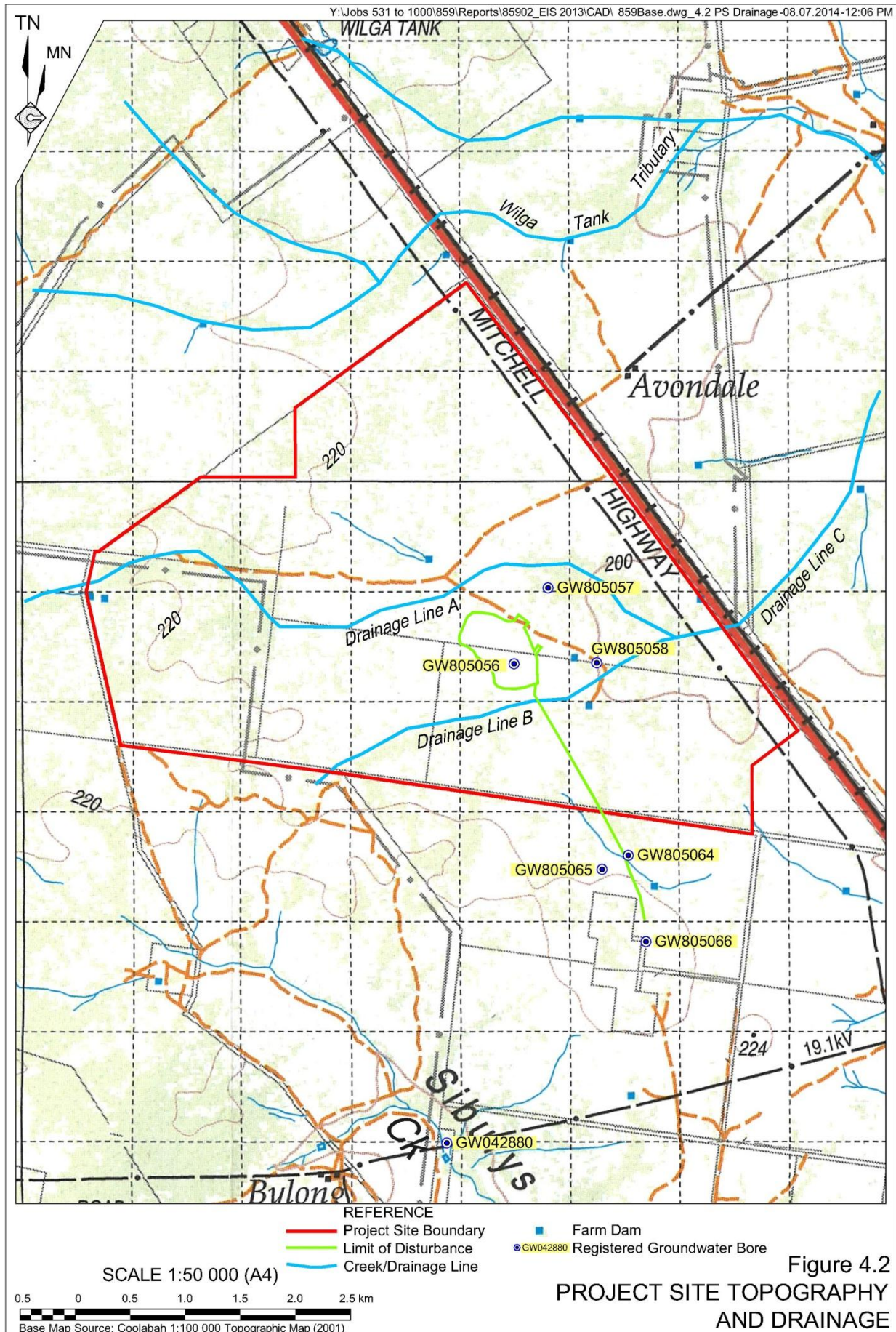
In the vicinity of the Project Site, a catchment divide immediately to the northwest of the Project Site separates the north-flowing Turners Creek from the east flowing Wilga Tank Tributary and Siburys Creek. For the purposes of this document, the east-flowing catchment including the Wilga Tank Tributary and Siburys Creek is referred to as the "Girilambone Catchment".

#### 4.1.2.2 Local and Project Site Topography and Drainage

The Project Site is situated on generally flat to gently east sloping land with a maximum elevation of approximately 220m AHD on the western boundary of the Project Site to a minimum elevation of approximately 195m AHD on the Project Site's eastern boundary (**Figure 4.2**). Average gradients within the Project Site are less than 1%.







Drainage throughout the Project Site generally flows in an easterly direction. Surface water flows into two, ephemeral, indistinct and poorly defined and unnamed drainage lines, referred to for the purposes of this document as 'Drainage Line A' and 'Drainage Line B' (**Figure 4.2**). Drainage Lines A and B are first order streams prior to merging into a second order stream in the eastern section of the Project Site, approximately 0.5km from the Project Site's eastern boundary. The merged drainage line (referred to as Drainage Line C) flows to the northwest before merging with the Wilga Tank Tributary, approximately 5km east of the Project Site.

### 4.1.3 Geology

#### 4.1.3.1 Regional Geology

The Project Site is located within the Girilambone Zone of the Lachlan Fold Belt. The Girilambone Zone includes widespread Girilambone Group metasediments and volumetrically minor mafic sequences (**Figure 4.3**). The Girilambone Group has recently been subdivided by the NSW Geological Survey into three north-south trending belts. The Western and Eastern zones are of similar Early Ordovician age while the faulted central portion has fossil ages of Middle to Late Ordovician. Metamorphic grades are generally greenschist facies with biotite facies recorded locally.

The Narrama Formation, a sub-unit of the Girilambone Group in the vicinity of the Tritton Copper Mine, consists of turbiditic psammites, psammopelites, pelites and quartzite with less abundant chert and mass flow breccias. Interspersed within the metasediment package are basaltic volcanics and intrusive dolerites, pyroxenites and gabbros as well as minor fault emplaced serpentinites. The volcanics occur as interbedded intermittent units that pinch and swell along strike. Many of the intrusives can also be found to be interbedded sill like with the stratigraphy. However, there are number of intrusives that appear to be vertically attenuated and cross cut stratigraphy. Minor granodioritic intrusives and dykes cut the older metasediment stratigraphy as do younger mafic dykes. Regionally, the stratigraphy is complicated by multiple deformations.

Much of the Girilambone Group is either covered by a thin veneer of alluvial sediments or is weakly dissected with sparse bedrock exposure. Where outcrop does occur, it is low lying and usually strongly weathered.

#### 4.1.3.2 Local Geology

Mineralisation within the Project Site is hosted by the Early Ordovician Girilambone Group at the contact between an upper sequence of interlayered metasediments and a lower sequence of mafic volcanics and intrusives with minor associated metasediment enclaves. The sediments are predominantly pelites, psammopelites and greywackes, with a significant silica-magnetite-carbonate-chlorite-sulphide exhalative unit occurring above the mineralisation. This unit is referred to as the Quartz Magnetite Hematite horizon and is equivalent to a similar unit identified in the vicinity of the Tritton Copper Mine. A greywacke (immature sandstone) dominant package of sediments is a useful local marker above the mineralised contact and Quartz Magnetite Hematite altered sequence.



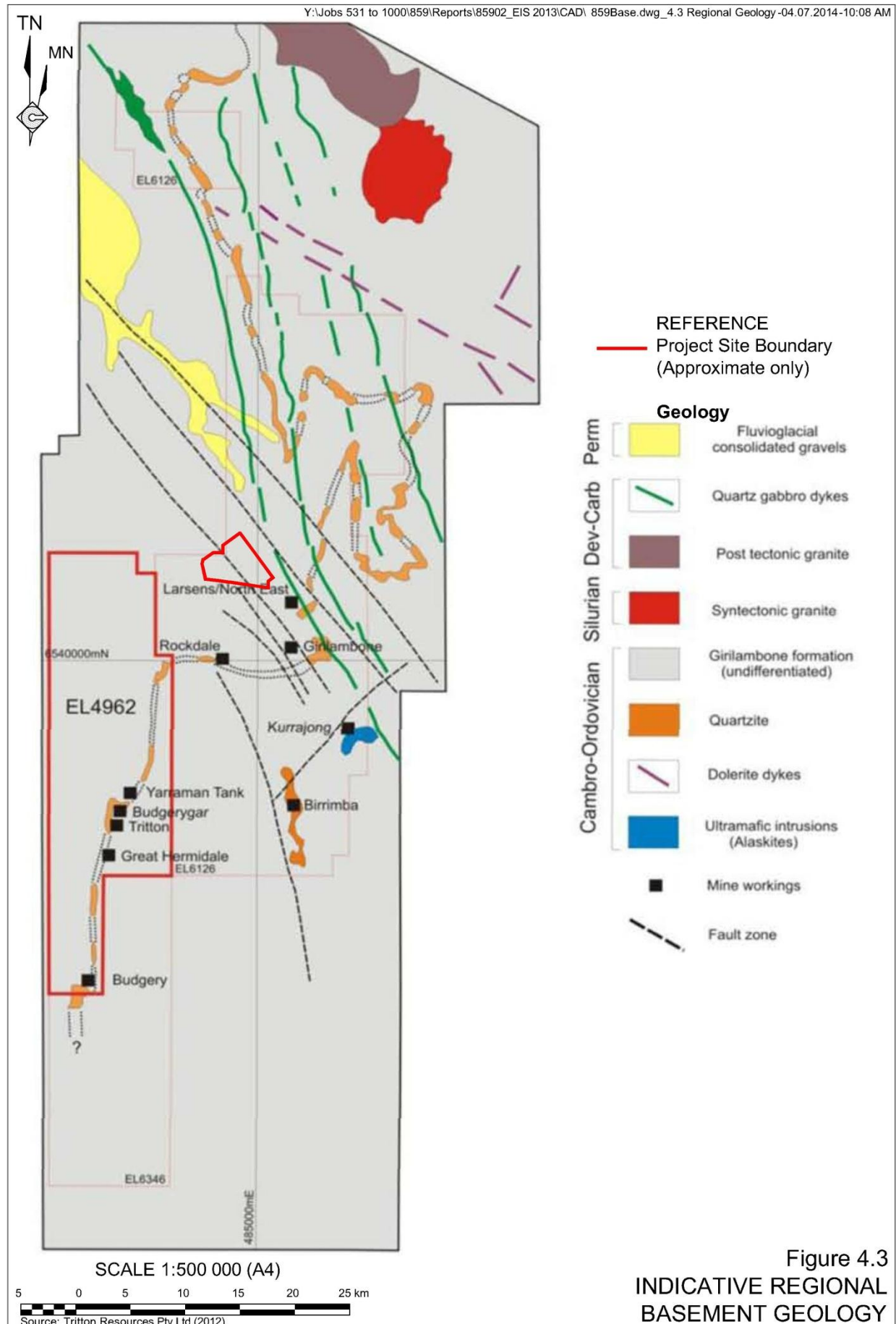


Figure 4.3  
 INDICATIVE REGIONAL  
 BASEMENT GEOLOGY

The Quartz Magnetite Hematite equivalent horizon is located 20m to 40m above the three mineralised lenses within the Project Site and consists of a 1m to 3m thick, strong to locally intense manganese, barium and strontium rich horizon which appears to thicken toward the north. This suggests proximity to a penecontemporaneous structure and/or vent source for the exhalative fluids coincident with the northern edge of the mineralisation. Immediately below the silica-carbonate-(magnetite-chlorite-hematite) horizon is a more sparsely (locally moderate) developed banded silica-magnetite-sulphide-chlorite altered zone.

The mafic volcanics, predominantly doleritic intrusives and basaltic volcanics, are footwall to the mineralised system. The mafics are quite variable and chemistry suggest subtle chemical differences to the various bodies and some show narrow brecciated hydrothermal fluid path zones. Metasediment enclaves are observed throughout and weak mineralisation is often observed along the sediment/volcanic contacts which also often show local evidence of thermal contact alteration.

#### 4.1.3.3 Mineralisation

Mineralisation at the Tritton group of mines is both structurally and lithologically controlled and would appear to be an analogue of the Besshi style of deposits in Japan. The polymetallic sulphides at Tritton, Budgery, Budgerigar, North East, Larsens and Murrawombie occur as moderate to large tabular sheets in association with strong silicification as well as footwall magnesian chlorite alteration and sulphide banding and stockworking.

The sulphide (dominantly pyrite with lesser chalcopyrite, sphalerite minor tennantite, arsenopyrite and galena and traces of gold) bodies were deposited synchronous with the host Ordovician sediments and minor basaltic sequences, as evidenced from sulphide breccia clasts and basaltic and mafic clasts within sedimentary breccias as well as petrographic descriptions which identify interlamination of fine grained sediments and fine grained sulphide. A laminar silica-hematite-magnetite pyrite unit often occurs at the top of the Tritton deposit indicative of an exhalite and minor quartz chlorite magnetite veining occurs within the main zone as well as within the foot wall as seen at Budgery and Tritton Deeps. Significant structural overprinting within dilation zones and structural traps (fold hinges) has upgraded zones within the sheets to form high grade pods of dominantly chalcopyrite and at the Tritton Copper Mine, minor bornite and tennantite mineralization.

Within the Project Site, the mineralisation is different in that it is strike limited due to geological conditions at the time of deposition (possible small graben structure or palaeo low bounded by mafic sequences), has multiple lenses and is of higher grade in copper, silver, zinc and gold to that of the remainder of the Girilambone Group of deposits.

Within the Project Site, mineralisation is dominated by massive pyrite-chalcopyrite-sphalerite, with minor but locally important magnetite-chalcopyrite and lesser banded pyrite-chalcopyrite and rare banded pyrite (containing high gold and silver). Three stacked lenses have been defined for the main portion of the resources with two additional lenses defined within the footwall sequence.

It is postulated that the higher grades within the Project Site are due to higher fluid temperatures and proximity to a vent source than elsewhere within surrounding mineralised zones. The alteration assemblages associated with the mineralisation also appear to be temperature elevated species including garnet-actinolite-biotite-magnetite-(chlorite).



Two additional mineralised systems occur deeper within the footwall mafic sequence and trend east-west or perpendicular to the main Avoca Tank mineralised lenses. The deeper of these appears to intersect the lower most mineralised horizon and is tentatively interpreted as a feeder zone which wanes in grade away from the main lenses. The mineralisation style is consistent with contorted banded pyrite-chalcopyrite-magnetite-chlorite with trace to locally weak sphalerite and galena.

#### **4.1.4 Climate**

##### **4.1.4.1 Introduction**

Climatic conditions have the potential to influence a range of Proposal-related impacts at surrounding residences and on the local environment. The climate in the vicinity of the Project Site may be classified under the Köppen climate classification as a “warm semi-arid climate”, i.e. hot, dry summers and relatively cool dry winters, with the rainfall pattern having a summer maximum.

This subsection provides a brief overview of the climatic conditions surrounding the Project Site, focusing particularly on those aspects of the climate that are likely to influence the potential Proposal-related environmental impacts.

##### **4.1.4.2 Data Sources**

Meteorological data from the following Bureau of Meteorology (BOM) stations is presented in **Table 4.1**. Long term climate data was sourced from the following locations as they provided the largest and most complete datasets within the local area.

- Nyngan Airport Automated Weather Station (Station Number 51039), located approximately 45km southeast of the Project Site (temperature, humidity and wind).
- Girilambone (Wongala) Station (Station Number 151158), located approximately 13km to the southwest of the Project Site (rainfall).

Evaporation data was sourced from the Bureau of Meteorology’s Average Pan Evaporation Map.

##### **4.1.4.3 Temperature and Humidity**

**Table 4.1** indicates that January is the hottest month, with a mean maximum temperature of 39.2°C and a mean minimum temperature of 28.6°C. July is the coldest month with a mean maximum temperature of 19.3°C and a mean minimum temperature of 13.4°C. Late autumn, winter and early spring (April to September) is typically the most humid time of the year.

**Table 4.1**  
**Monthly Meteorological Data**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
<b>Temperature (°C) <sup>1</sup> (1920 to 2013)</b>													
Mean Maximum	39.2	38.0	34.7	30.5	24.1	20.2	19.3	23.6	26.4	30.3	35.2	37.0	29.88
Mean Minimum	28.6	29.3	26.2	21.7	16.7	13.3	13.4	14.7	18.7	22.1	25.8	28.8	21.61
<b>Relative Humidity (%) <sup>1</sup> (9am – 1910 / 3pm – 1915 to 2010)</b>													
9:00am	48	53	56	61	72	80	79	70	59	51	47	46	60
3:00pm	31	36	37	40	49	55	52	44	38	34	30	29	39
<b>Rainfall (mm) <sup>2</sup> (1991 to 2013)</b>													
Mean rainfall	51.5	55.5	34.7	24.0	38.1	29.4	26.6	23.0	31.8	32.8	41.8	54.7	443.9
Highest daily rainfall	131.6	123.8	62.6	52.8	68.6	39.0	30.8	58.0	46.8	58.4	66.2	83.3	
<b>Evaporation (mm) <sup>3</sup> (1975 – 2005)</b>													
Average evaporation	300	250	200	125	80	50	60	80	125	175	300	300	2045
Source:													
<sup>1</sup> – Bureau of Meteorology – Nyngan Airport Station (Station Number 051039).													
<sup>2</sup> – Bureau of Meteorology – Girilambone (Wongala) Station (Station Number: 151158).													
<sup>3</sup> – Bureau of Meteorology – Average Pan Evaporation Maps ( <a href="http://www.bom.gov.au/jsp/ncc/climate_averages/evaporation/index.jsp">http://www.bom.gov.au/jsp/ncc/climate_averages/evaporation/index.jsp</a> ).													

#### 4.1.4.4 Rainfall and Evaporation

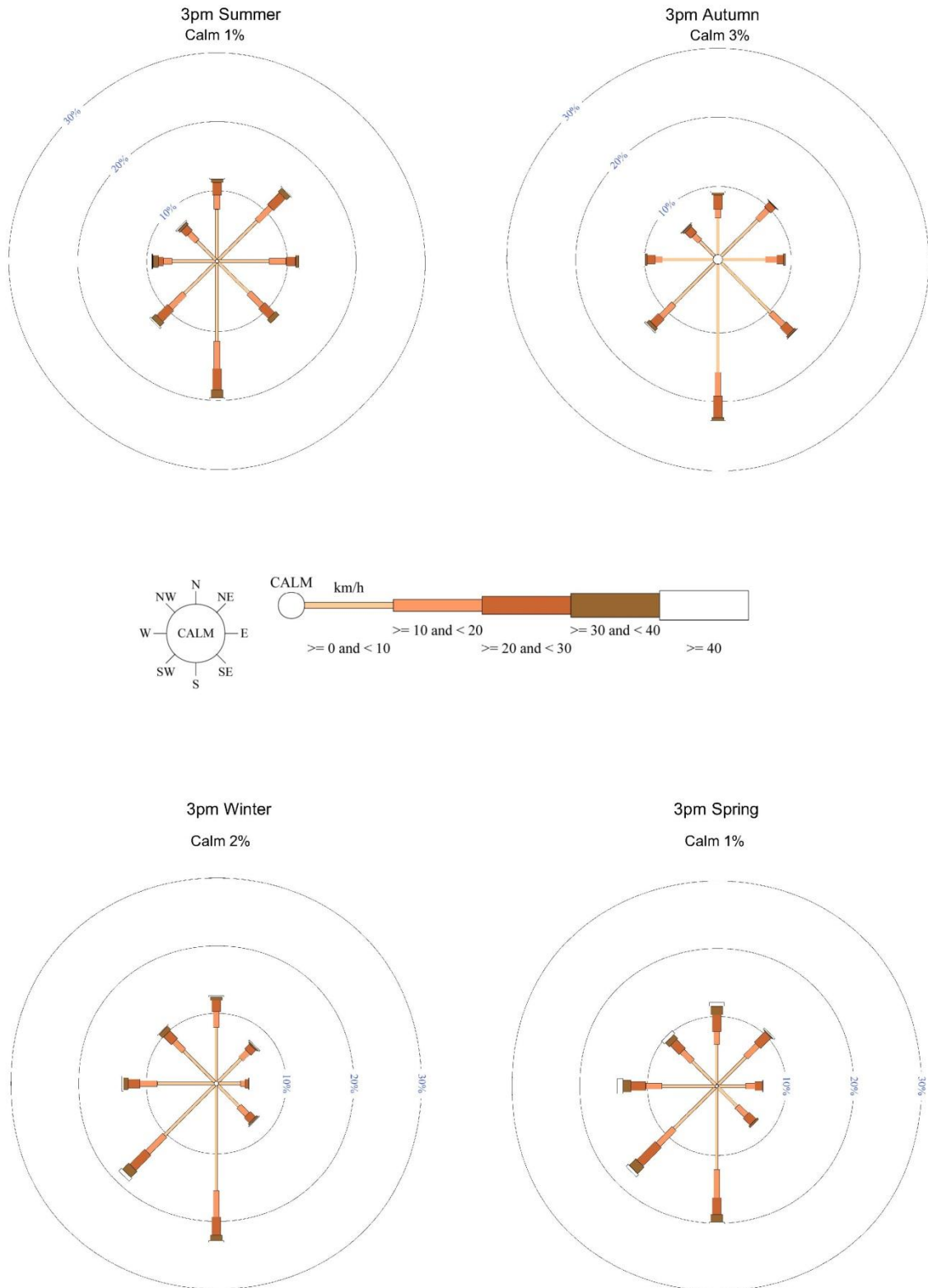
Monthly average rainfall varies between 23.0mm and 55.5mm, with more rainfall in summer than winter. Rainfall variability is greatest in the warmer months of December to February. In general, monthly rainfall can be highly variable, with all months recording no rainfall in some years. Similarly, maximum daily rainfall can more than double average monthly rainfall, particularly in late summer and autumn, indicating that intense storms can occur.

Mean monthly evaporation varies throughout the year, from approximately 300mm in November, December and January to approximately 50mm in June. Mean monthly evaporation exceeds rainfall in all months and annual evaporation exceeds annual rainfall by a factor of four, indicating that the area is typically in water deficit.

#### 4.1.4.5 Wind Conditions

Wind roses, indicating wind speed and direction, have been sourced from the BOM-operated Nyngan Airport Automated Weather Station (Station Number 051039) and are displayed on (**Figure 4.4**). That data indicates that during the spring and summer, prevailing winds are from the northeast or south. During the autumn and winter, prevailing winds are from the south and west. Prevailing winds in the vicinity of the Project Site typically do not blow from the Project Site towards the Girilambone village.

Y:\Jobs 531 to 1000\859\Reports\85902\_EIS 2013\CAD\ 859Base.dwg\_4.4 Wind Roses-04.02.2014-10:05 AM



**Figure 4.4**  
**SEASONAL WIND ROSES**  
**- NYNGAN AIRPORT**

Source: Bureau of Meteorology (2012) - Nyngan Automatic Weather Station (#051039)



## 4.1.5 Land Ownership, Residences and Land Use

### 4.1.5.1 Land Ownership and Residences

**Figure 4.5** presents land ownership in the vicinity of the Project Site. This data was sourced from an extensive search of the register of land titles administered by the Office of Land and Property Information.

Land within the Project Site is owned by Mr Peter Johnston. The Applicant has consulted with Mr Johnston who is aware of the Proposal and the proposed activities. Mr Johnston has provided landowner consent for the application for development consent.

The southern section of the Site Access Road is located on land owned by the Applicant.

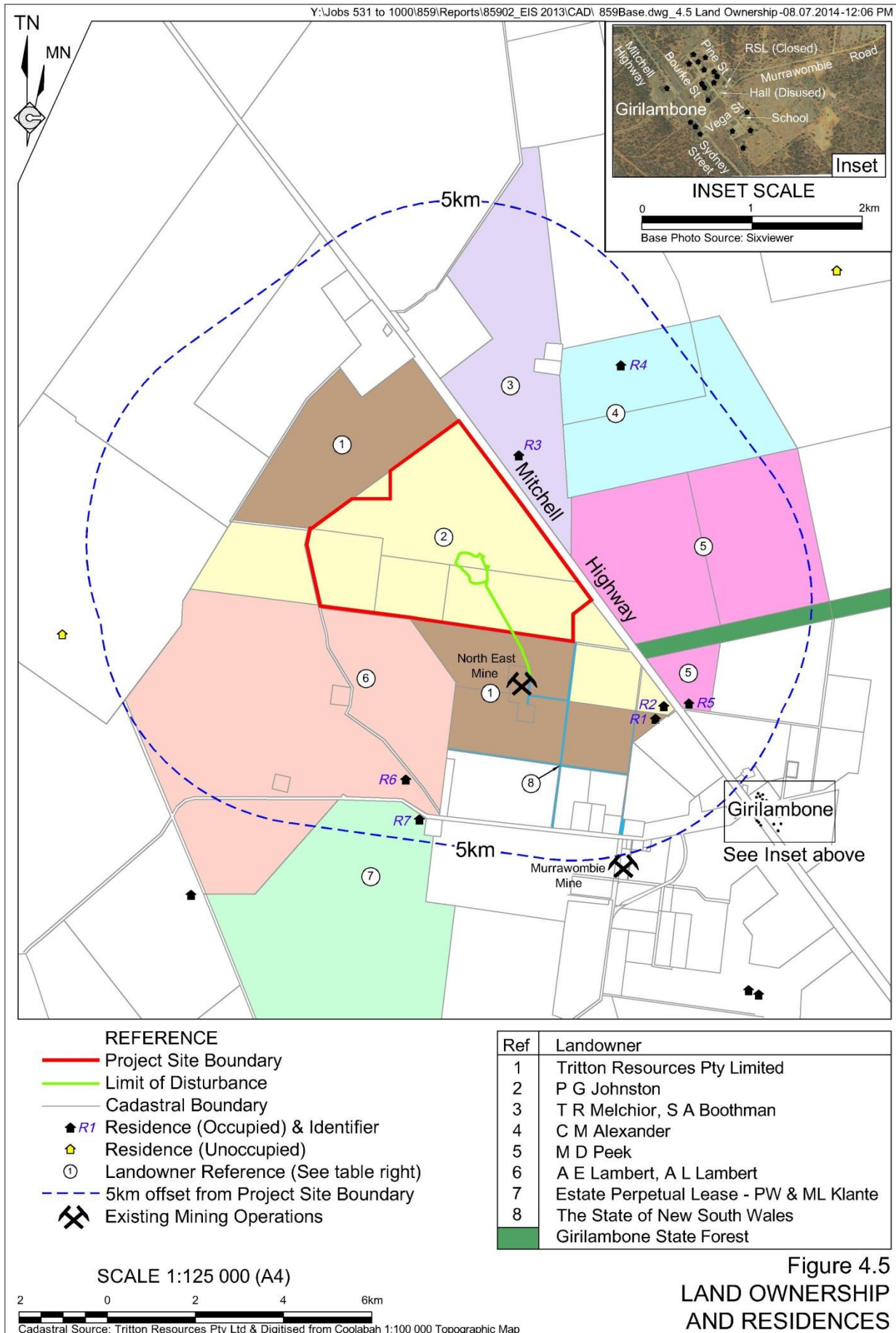
The closet residence to the proposed activities is Residence 3, located approximately 2.5km to the northeast of the hardstand area.

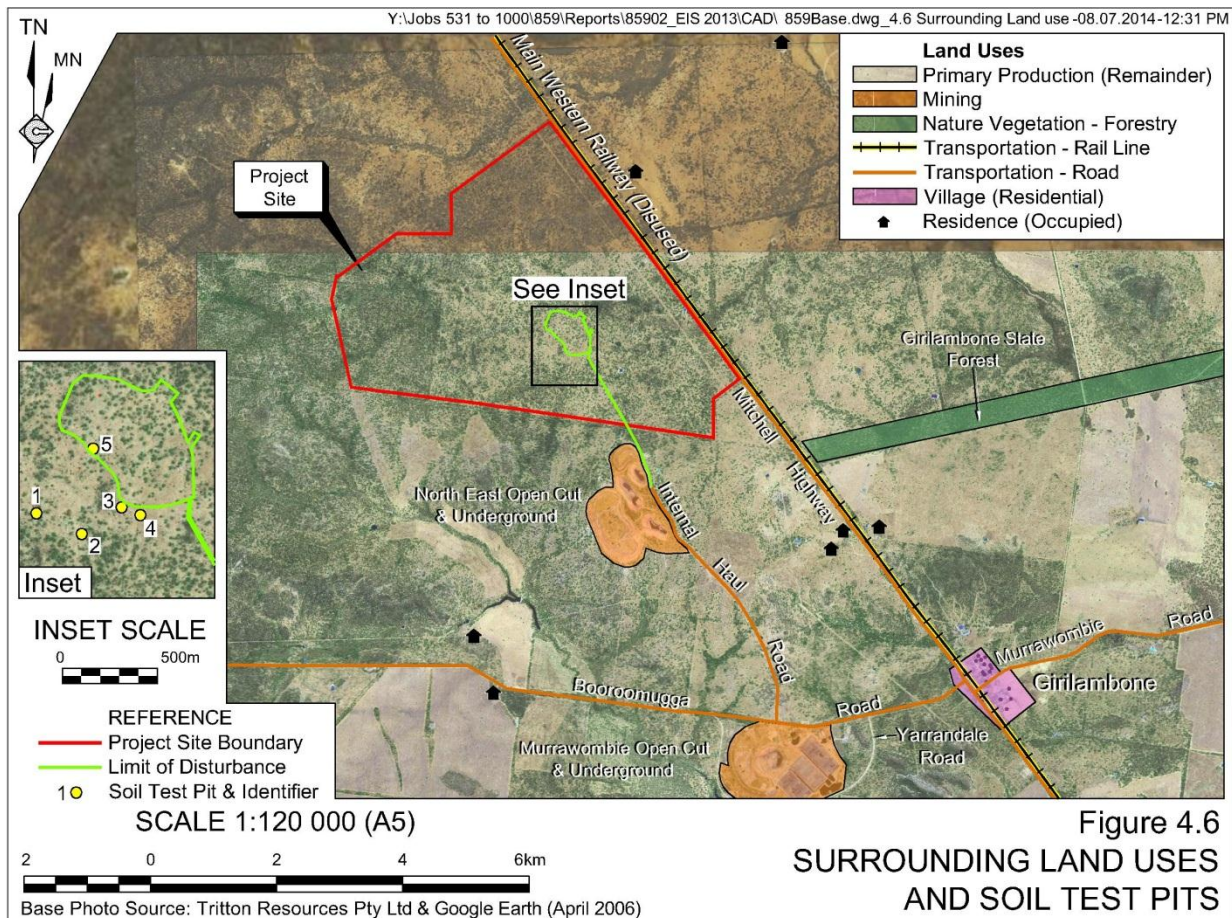
### 4.1.5.2 Land Use

**Figure 4.6** displays the range of land uses within and surrounding the Project Site. In summary, land uses are as follows.

- Mining - areas to the south and southeast of the Project Site include the Applicant's North East and Murrawombie Mines.
- Agriculture – land within and surrounding the Project Site has been or is currently being used for agricultural purposes, principally, intermittent sheep and cattle grazing. A range of agricultural properties include residences (**Figure 4.5**). To the Applicant's knowledge, no agricultural activities have been undertaken within the Project Site since approximately 2004.
- Nature conservation – substantial areas of native vegetation exist in the vicinity of the Project Site.
- Native vegetation forestry – The Girilambone State Forest occupies an area to the east of the Project Site.
- Transportation – a range of State and local roads exist in the vicinity of the Project Site, including Mitchell and Barrier Highways and Booramugga and Yarrandale Roads. The disused Main Western Railway is located to the east of the Mitchell Highway.
- Village residential – the village of Girilambone is located approximately 5km to the southeast of the Project Site.

The Applicant contends that the Proposal is consistent with the identified land uses and that the Project Site is suitable for the Proposal.





## 4.2 ABORIGINAL HERITAGE

The Aboriginal heritage assessment of the Proposal was undertaken by OnSite Cultural Heritage Management (OnSite CHM). The assessment draws together studies undertaken by OnSite CHM and the results of previous Aboriginal heritage surveys undertaken across the Project Site. The full assessment is presented in **Appendix 5** and is referenced throughout this section as OnSite CHM (2014a), with a summary of the assessment presented in the following subsections.

### 4.2.1 Introduction

Based on the risk analysis undertaken for the Proposal (**Section 5.2** and **Table 5.3**), the potential impacts relating to heritage factors and their risk rankings after the adoption of standard mitigation measures are as follows.

- Unauthorised destruction of known sites (moderate risk).
- Unauthorised destruction of unknown sites within approval areas (moderate risk).



In addition, the DGRs identify “*Heritage*” as a key issue for assessment in the *Environmental Impact Statement*. The principal assessment matters from DP&E relating to heritage matters include:

“an Aboriginal cultural heritage assessment (addressing both cultural and archaeological significance) which must demonstrate effective consultation with Aboriginal communities in determining and assessing impacts, and developing and selecting mitigation options and measures.”

Additional matters for consideration in preparing the *Environmental Impact Statement* were also provided in the correspondence attached to the DGRs from OEH. The additional matters identified are generally consistent with the DGRs.

Furthermore, the Aboriginal heritage assessment for the Proposal was undertaken in accordance with the following guidelines.

- *Aboriginal Cultural Heritage Consultation Requirements for Proponents* (DECCW, 2010a).
- *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (DECCW, 2010b).
- *Code of Practice for Archaeological Investigation in NSW* (DECCW, 2010c).
- *Guide to Investigation, Assessing and Reporting on Aboriginal Cultural Heritage in NSW* (OEH, 2011).

This subsection provides a summary of the Aboriginal consultation and subsequent field investigations undertaken over five days in April 2012 (referred to as the “Stage 1” investigations) and 3 days in October/November 2012 (referred to as “Stage 2” investigations).

The Stage 1 and Stage 2 investigations were undertaken as part of documentation supporting an application to conduct a proposed exploration drilling program. That application was subsequently approved by Division of Resources and Energy under Part 5 of the EP&A Act. The intention of the Stage 1 and Stage 2 investigations was to utilise information from those studies to support the current application for development consent. As a result, the Stage 1 and Stage 2 documentation has been amended and updated to include an Aboriginal Heritage Impact Assessment based upon the Proposal, as outlined in Section 2 of this document.

This subsection also describes the regional archaeological context; the results of previous surveys throughout the area surrounding the Project Site; a predictive model for Aboriginal heritage locations and the results of the 2012 surveys. Also presented are assessments of significance and the proposed management of the artefacts found through the investigation.

## **4.2.2 Ethnohistory**

The Aboriginal inhabitants within the region surrounding the Project Site are the Ngiyampaa Wangaaypuwan (Wongaibon) people who generally resided in country roughly bounded in the north by the Darling-Barwon and Bogan Rivers, and in the south by the Lachlan River (Beckett et al, 2003). Ngiyampaa people also defined their identity by the type of country they occupied i.e. stone country.

Following European colonisation of the surrounding areas from 1835 onwards, conflicts arose between local indigenous people and white settlers regarding land use. Further inflaming the situation, Aboriginal resistance to pastoralism west of the Great Dividing Range was met with a proclamation of martial law, resulting in Aboriginal people being removed from the land with those remaining in the area generally destined to work on European pastoral farms as stockmen. By the 1930s, in most parts of NSW, nearly all of the Aboriginal population were either fringe dwellers or ‘clients’ of the Aborigines Protection Board.

### 4.2.3 Previous Surveys

#### 4.2.3.1 Introduction

The results of previous surveys have been assembled from a search of the Aboriginal Heritage Information Management System (AHIMS) database and summarised in the following subsections. Also included are the summarised results of the previous surveys conducted within the Project Site.

#### 4.2.3.2 Archaeological Record

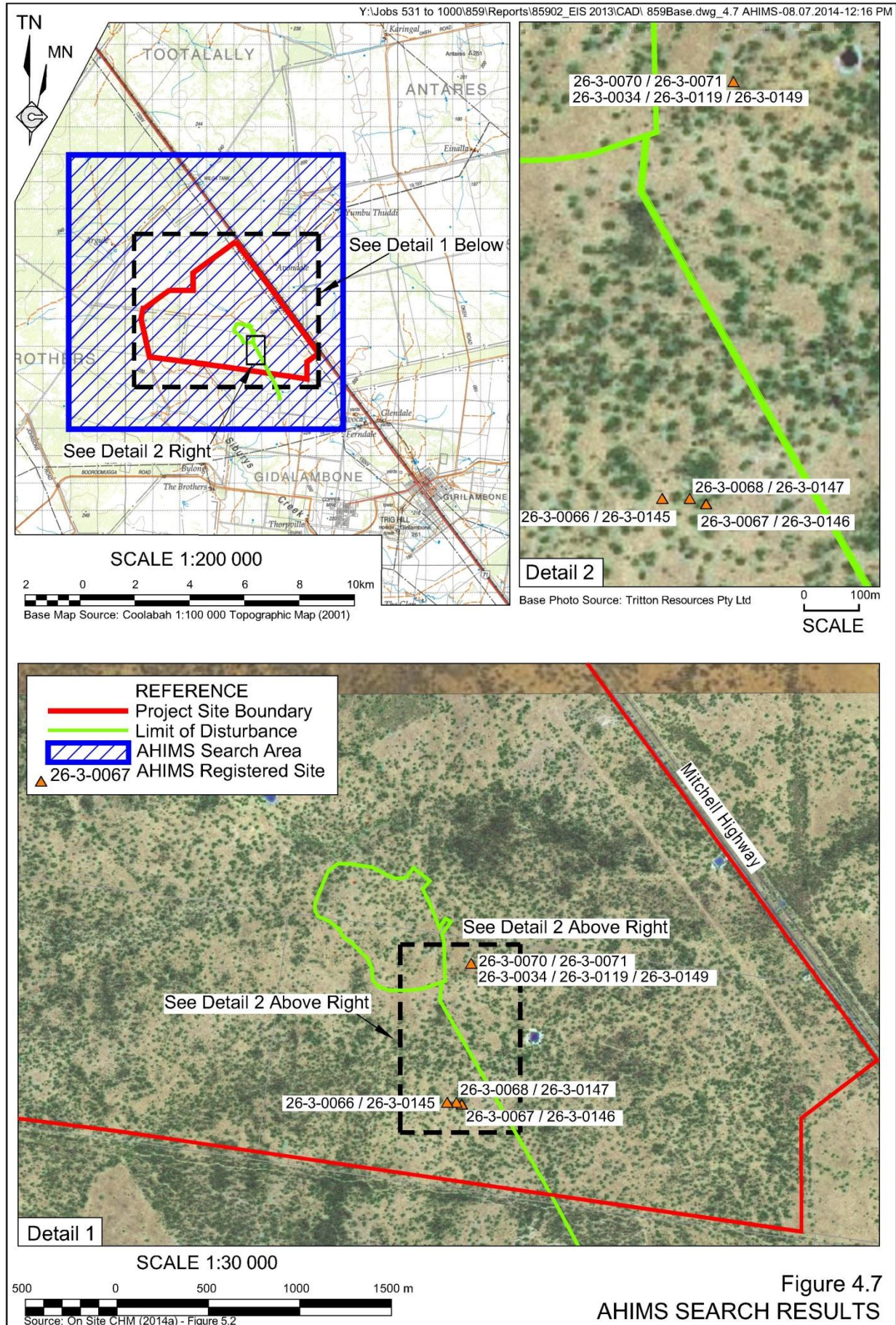
The search of the AHIMS database within an area 10km x 10km (100km<sup>2</sup>) centred on the Project Site was undertaken by OnSite CHM. The search identified 57 recorded sites. **Figure 4.7** displays the location of the AHIMS search area in the regional context and presents the location of those recorded sites within a 2km radius of the proposed area of disturbance. A full copy of the AHIMS site recording forms is presented in Appendix 4 of OnSite CHM (2014a).

Of the 57 identified AHIMS sites, 11 occur within or immediately surrounding the Project Site. A review of the AHIMS site cards revealed however duplicate recordings of these sites and their features. An examination of the site cards showed that the 11 AHIMS recorded sites are actually only five unique sites. As such, **Table 4.2** lists the 11 duplicated and 5 actual AHIMS sites, with these displayed on **Figure 4.7**.

**Table 4.2**  
**AHIMS Sites Recorded within the Project Site**

AHIMS Ref. or ID	Site Name	Site Features
26-3-0066 / 26-3-0145	GM-HS/27_(Hearth)	Earth Mound, hearth
26-3-0067 / 26-3-146	GM-HS-29_(Hearth)	Earth Mound, hearth
26-3-0068 / 26-3-0147	GM-OS/HS-1_(Hearth)	Earth Mound, hearth
26-3-0070 / 26-3-0071	GC-OS/HS-2_(Hearth)	Earth Mound, hearth , artefact
26-3-0034 / 26-3-0119 / 26-3-0149	GC-OS-1	Open Artefact scatter, hearth

Source: Modified after – OnSite CHM (2014a) - Table 5.4.





#### 4.2.3.3 Previous Project Site Surveys

Three separate investigations have been previously undertaken within the Project Site, with Anne Nicholson of National Heritage Studies having undertaken investigations in 1989 and 1990 for an *Environmental Impact Statement* and mining infrastructure purposes respectively and Central West Archaeological and Heritage Services undertaking investigations in 1995 in preparation for mineral exploration operations.

Each of the previous surveys concluded that the Project Site was probably not occupied by Aboriginal people for long periods of time, but was likely to have been visited and used opportunistically.

#### 4.2.4 Predictive Model

OnSite CHM developed a predictive model to establish the likely distribution of archaeological material against which the effectiveness and subsequent analysis of the survey results could be tested, compared and reasoned. The predictive model considered the existing archaeological record, resource availability, general knowledge of the habitation and land use patterns of the Aboriginal people of the region and factors affecting identification.

The predictive model identified that a general lack of reliable potable water sources is directly proportionate to the type and number of artefacts potentially occurring within the Project Site, with a review of the AHIMS sites determining that scarred trees are likely to be the most common site type, followed by hearths and open scatters. The scarcity of stone outcrops and the previous agriculture land uses practices, limit the likelihood of grinding stones or stone artefacts to occur within the Project Site.

On the basis of these predictions, the archaeological potential and sensitivity of the Project Site is considered to be low.

#### 4.2.5 Consultation

##### 4.2.5.1 Prior to Survey

In accordance with *Aboriginal Cultural Heritage Consultation Requirements for Proponents* (DECCW 2010a), requests were sent to a range of organisations during both Stage 1 and Stage 2 consultation, requesting any Aboriginal persons having a cultural knowledge of the Project Site to register their interest in determining the significance of the Proposal and Aboriginal values located therein.

Further to the above, an advertisement was posted in the *Nyngan Observer* on 4 April 2012 as part of Stage 1 consultation, and again on 10 October 2012 as part of Stage 2 consultation, requesting respondents register their interest in the Proposal. As a result of the consultation program, the following organisations were identified as Registered Aboriginal Parties (RAPs) for the Proposal.

- Bogan Aboriginal Corporation.
- Nyngan Local Aboriginal Land Council (Nyngan LALC).

- Native Title Services for Ngemba/Ngiyampaa Claimants (referred as “Ngemba/Ngiyampaa Native Title claim group”).
- Marra Wallan Pty Ltd.

A complete record of all correspondence is located within Appendices 1, 2 and 7 of OnSite CHM (2014a).

#### **4.2.5.2 During the Survey**

The following RAP representatives participated in the entire Stage 2 investigations with OnSite CHM and the Applicant in April 2012, and were present during the recording of all Aboriginal heritage sites.

- Ms Sheila Couley (Nyngan LALC).
- Mrs Lesley Ryan (Bogan Aboriginal Corporation).

The following RAP representatives participated in the entire Stage 1 investigations with OnSite CHM and the Applicant in October / November 2012, and were present during the recording of all Aboriginal heritage sites.

- Ms Sheila Couley (Nyngan LALC).
- Mrs Lesley Ryan (Bogan Aboriginal Corporation).

Mr Neville Merritt, of the Ngemba/Ngiyampaa Native Title claim group, also participated in the Stage 2 fieldwork and survey investigations on 1 and 2 November 2012. Mr Merritt who was also shown the Stage 1 investigation area site Avoca Tank 1, 2 and 4.

#### **4.2.5.3 Following the Survey**

A draft of the Stage 1 assessment report was sent to the RAPs on 26 July 2012, requesting their review and comments on the report within 28 days in accordance with DECCW (2010a), with no feedback provided by any RAPs.

A draft of The Stage 2 Assessment Report, incorporating the results of the Stage 1 assessment, was sent to the RAPs on 21 February 2013. The RAPs were provided 28 days to review the report and provide comment with the closing date being 22 March 2013.

All of the RAPs supplied comment on the draft Stage 2 Assessment Report, with Nyngan LALC and Bogan Aboriginal Corporation endorsing the assessment and resulting recommendations.

Native Title Services Corporation (NTS Corp), on behalf of the Ngemba/Ngiyampaa Native Title claim group, also provided comment on the assessment, noting clarification or opposition to issues such as survey descriptions, management (fencing) requirements and monitoring. As a result of this, OnSite CHM responded to NTS Corp, clarifying the survey description and management issues to the satisfaction of NTS Corp. However, NTS Corp remained adamant that further surveys were required following the final proposed location of all Proposal-related infrastructure, something which OnSite CHM disagreed with, outlining that due to the low

density of Aboriginal occupation evidence, further surveys were not required. Further information in relation to the post survey correspondence between OnSite CHM and MTS Group is provided in Appendix 7 of OnSite CHM (2014a).

A copy of all post survey correspondence with the RAPs is provided in Appendix 7 of OnSite CHM (2014a).

#### 4.2.5.4 Adequacy of Consultation

The Applicant contends that the consultation undertaken as part of the Stage 1 and Stage 2 assessments meets the requirements of DECCW (2010a) because the impact to known Aboriginal sites would be as per the impacts assumed in those assessments, namely, all sites would be avoided.

It is anticipated that each of the RAPs will be provided an opportunity to review and make comment on this report during the exhibition stage of the application. Should any comments and/or suggestions be received from the RAPs following the exhibition, a detailed response would be provided at the Response to Submissions stage.

#### 4.2.6 Survey Methodology

Throughout the Stage 1 and Stage 2 surveys undertaken in April and October / November 2012, the same survey methodology was applied, for consistency and comparability of results. Each survey consisted of a series of pedestrian transects in a north south direction, spaced approximately 200m apart depending on vegetation and proximity to water features (**Figure 4.8**). Surveyors paid close attention to trees of a suitable age to have cultural scars and areas that could potentially contain items such as hearths. Survey participants were spaced approximately 20m abreast within each transect, combining to allow an approximately survey reach of 100m per transect, ultimately providing good survey coverage. It was calculated that 41% of the total land within the Project Site was covered.

OnSite CHM (2014a) state that it was determined that the surveys undertaken satisfied the survey effectiveness requirements as prescribed in *National Parks and Wildlife Amendment (Archaeological Investigations) Regulation 2010*.

#### 4.2.7 Survey Results

The combined Stage 1 and Stage 2 surveys resulted in a total of five Aboriginal sites being identified within the Project Site. These were given the designations of Avoca Tank 1 to Avoca Tank 5. **Table 4.3** presents a description of each of the identified sites while **Figure 4.8** presents the location of each. It should be noted that two historic heritage (non-Aboriginal) sites were also located during the field surveys and were given the designations of Avoca Tank 6 and Avoca Tank 7. These are discussed in detail in Section 4.7.



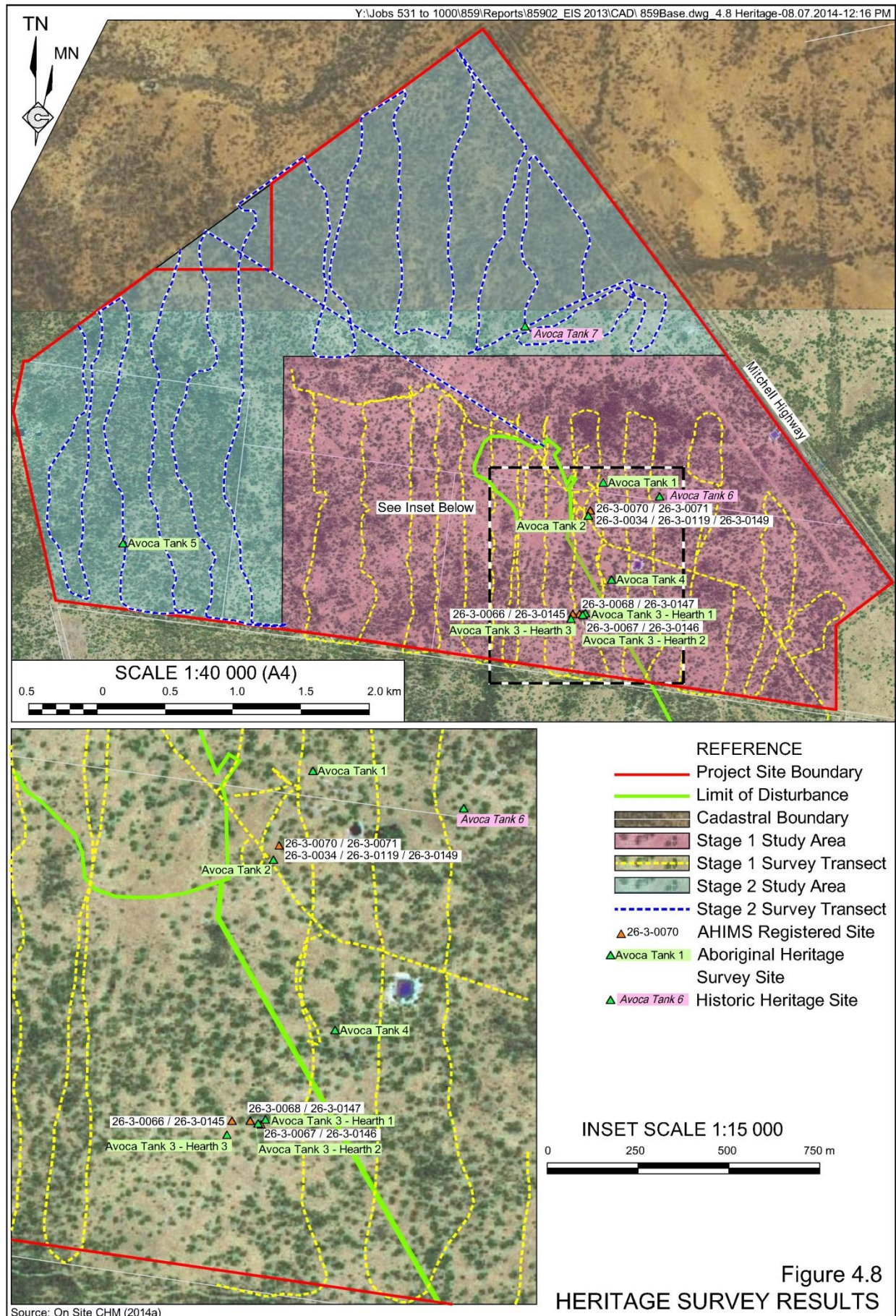


Figure 4.8  
 HERITAGE SURVEY RESULTS

**Table 4.3**  
**Identified Aboriginal Heritage Items within the Project Site**

Reference ID	Site Type	Site Context / Comments	Corresponding AHIMS Site ID
<b>Stage 1 Survey Results</b>			
Avoca Tank 1	Stone artefact scatter.	11 artefacts scatter located on an open gently undulating grassy plain with tall open eucalypt woodland 50m away from a dam. The geological type of artefacts indicates they were not manufactured locally.	26-3-0034 / 26-3-0119/ 26-3-0149 26-3-0070 / 26-3-0071
Avoca Tank 2	Isolated stone artefact.	Single silcrete artefact located on large open grassy plain with open woodland.	-
Avoca Tank 3	Hearths (x3).	3 separate hearths located within 80m of each other on large open grassy plain.  Hearth 1 – consists of 4 sediment nodules over 3m x 3m area.  Hearth 2 – consists of numerous small nodules with minor charcoal content over 1m x 1m area.  Hearth 3 – consists of numerous small nodules over 2m x 2m area.	26-3-0067 / 26-3-0146 26-3-0068 / 26-3-0147 26-3-0066 / 26-3-0145
Avoca Tank 4	Historic Scar Tree and Aboriginal Stockman's camp.	Situated in a low point within a grassy plain with two small waterholes nearby (1 natural, 1 likely man-made).  Scar on tree next to likely man-made waterhole extends 2.1m and around 80% of the tree. Displays markings similar to that of a steel axe.  Contains European material including a jar base and flattened tin.  Aboriginal community members suggest the evidence presents an Aboriginal stockman's camp associated with historical activities.	-
<b>Stage 2 Survey Results</b>			
Avoca Tank 5	Isolated stone artefacts (x2).	2 isolated quartz flakes in sparse grasses and mixed woodland.	Not Applicable
Source: OnSite CHM (2014a) – Section 7.			

Following a review of the type and location of the sites identified by OnSite CHM (2014a), it was recognised that several sites listed under the AHIMS register displayed similar site descriptions within similar areas to sites Avoca Tank 1 and Avoca Tank 3. The review identified that a number of the 11 previously recorded AHIMS sites were duplicate AHIMS site recordings based upon differing datum's originally used to record the sites (AGD 66, WGS 84 and GDA 94), with the review ultimately determining that the 11 AHIMS sites recordings actually represented two Aboriginal Heritage sites only namely, Avoca Tank 1 and Avoca Tank 3 (**Table 4.3**).

Avoca Tank 2, Avoca Tank 4 and Avoca Tank 5 are newly identified sites and have not previously been listed on the AHIMS register.

It should be noted that the hearth previously recorded at Site GC-OS/HS-2\_(Hearth) (AHIMS site 26-3-0070 / 26-3-0071) was unable to be relocated during the field surveys and is likely to have been eroded away. OnSite CHM (2014a) state that no further action is warranted regarding this site.

#### **4.2.8 Potential Impacts on Aboriginal Heritage Sites**

It is proposed that all identified heritage sites would be avoided throughout the construction and operational phases of the Proposal, with the proposed mitigation measures identified in Section 4.2.9, ensuring all sites are adequately protected.

#### **4.2.9 Mitigation Measures**

The Applicant would minimise the potential for harm to occur to the identified sites by avoiding all sites. To limit the potential for unintended disturbance, the Applicant would implement the following avoidance measures.

- Ensure each identified site is permanently fenced and signposted as a ‘no go’ area in accordance with the Applicant’s policy *Community and Heritage Policy and Straits Procedures – Heritage Management Planning (Australia)*.
- Inclusion of bush fire fuel load management within the Proposal’s *Environmental Management Strategy* for the Avoca Tank 4 fenced area to reduce the potential for bush fires to affect the scarred tree.
- Provide for a buffer of 50m between the identified sites and proposed mine infrastructure, ensuring that all mine site personnel are aware of the location of each site and show the location of the sites on accessible plans.
- Ensure that work crews in the vicinity of the identified sites are informed by way of an induction as to the location of each site and its legislative protection under the *National Parks Wildlife Act 1974*. All work crews would be informed that the fenced area remains a “no-go” area for the duration of the works.

#### **4.2.10 Assessment of Impacts**

##### **4.2.10.1 Assessment of Significance**

##### **Cultural Significance**

The Aboriginal or cultural significance of Aboriginal relics and sites can only be assessed by the Aboriginal community, and in particular, the Elders. Throughout the consultation, field work and report review by the RAPs, it was generally agreed that the Project Site contained a low level of Aboriginal significance.



### Research and Educational Potential

Archaeological research and educational potential refers to the degree to which a site can contribute data to answer specific research questions and be utilised for education purposes. It was determined that all of the sites had a low to moderate research potential due to the size, type and number of artefacts identified, as well as the impacts of previous land use practices, resulting in the degradation of potential for these sites to provide in situ research potential.

### Aesthetic Value

Although the environmental context of each site could be considered to have aesthetic values, those values are no greater than the surrounding areas without Aboriginal objects. Therefore, with the exception of the scar tree and environmental context of Avoca Tank 4 none of the recorded sites display any particularly prominent aesthetic values.

### Uniqueness and/or Rarity

Uniqueness and/or rarity refer to the frequency of a particular site type, or an activity at a site and the similarities between site types in the Project Site and the wider regional context. Excluding Avoca Tank 4, the remaining sites were identified as having a low to moderate level of archaeological research potential due to the common nature of the identified sites within the local context.

The assessment of impacts of Avoca Tank 4 is discussed in detail in Section 4.7.7

### Assessment of Site Impacts

The conclusions from the comprehensive background and field investigations of the identified Aboriginal heritage items is that the Proposal would not impact directly on any of the identified sites recorded within the Project Site.

#### 4.2.11 Conclusion

Based upon the avoidance of all identified sites occurring within the Project Site and the implementation of the outlined mitigation measures, it has been determined that there would be a negligible impact upon the local or regional Aboriginal heritage as a result of the Proposal.

## 4.3 ECOLOGY

*The ecology assessment for the Proposal was undertaken by EnviroKey Pty Ltd. The full assessment is presented as **Appendix 6** and is referred to hereafter as EnviroKey (2014). This subsection presents an overview of that assessment and should be read in conjunction with the full assessment.*



#### 4.3.1 Introduction

Based on the risk analysis undertaken for the Proposal (**Section 5.2** and **Table 5.3**), the potential impacts relating to ecology factors and their risk rankings after the adoption of standard mitigation measures are as follows.

- Loss of terrestrial ecology habitat, local vegetation and biodiversity (low risk).
- Injuries to native wildlife and fauna during clearing / earthworks (pre-strip) (low risk).
- Adverse impacts on groundwater dependent ecosystems (low risk).
- Indirect impacts to fauna communities due to light / noise / blasting etc. (low risk).

In addition, the DGRs identify “**Biodiversity**” as a key issue for assessment in the *Environmental Impact Statement*. The principal assessment matters from DP&E relating to biodiversity matters include the following.

- “Accurate predictions of any vegetation clearing on site or for any road upgrades.
- A detailed assessment of the potential impacts of the development on any threatened species or populations or their habitats, endangered ecological communities and groundwater dependent ecosystems.
- A detailed description of the measures to maintain or improve the consideration of a Biodiversity Offset Strategy.”

Additional matters for consideration in preparing the *Environmental Impact Statement* were also provided in the correspondence attached to the DGRs from OEH. The additional matters identified are generally consistent with the DGRs.

Furthermore, the Ecology assessment for the Proposal was undertaken in accordance with the following guidelines.

- *Threatened Biodiversity Survey and Assessment Guidelines for Development and Activities – Working Draft* (DECC, 2004)
- *The Threatened Species Assessment Guideline – The Assessment of Significance* (DECC, 2007).

This subsection provides information on the predicted and observed regional and local flora, fauna and vegetation communities, including threatened flora and fauna species within the Project Site. This subsection concludes with an assessment of the anticipated significance of Proposal-related impacts.

### 4.3.2 Regional and Local Setting

#### 4.3.2.1 Regional Setting

The Project Site is situated within the area managed by the NSW Central West Catchment Management Authority (CW-CMA) which comprises the Castlereagh, Bogan and Macquarie River valleys. Six separate bioregions exist within the CW-CMA area with the Project Site occurring within Cobar Peneplain Bioregion and the Canbelego Downs subregion.

It is noted that an appropriate 400m length of the Site Access Road between the southern boundary of the Project Site and the disturbed area adjacent to the North East Waste Rock Emplacement was not surveyed. However, given the uniform nature of vegetation and habitat within the surveyed area, the Applicant contends that this does not adversely impact on the assessment undertaken.

The Cobar Peneplain Bioregion has experienced significant vegetation losses since European Settlement, with 33% of the woody native vegetation cleared. The Bioregion does however, support dense shrubby woodlands with the widespread vegetation communities consisting of Poplar Box (*Eucalyptus populnea*), White Cypress Pine (*Callitrus glaucophylla*) and Gum Coolabah (*Eucalyptus intertexta*) communities, as well as extensive mulga areas where skeletal soils are present. Mallee woodland communities also form part of the regional vegetation and are considered to be of high conservation significance within the Bioregion. More than 90% of the original extent of mallee communities within the Cobar Peneplain Bioregion have been cleared or significantly altered.

The Bioregion's diverse landscape and vegetation also supports a wide variety of fauna species with 36 vulnerable and 7 endangered fauna species occurring in the Cobar Peneplain Bioregion, with an additional 64 birds, 12 mammals, 23 reptiles and 8 frogs considered as being of conservation concern.

#### 4.3.2.2 Local Setting

With the exception of the Bogan River, located approximately 25km to the east of the Project Site, all water courses are ephemeral and are likely to flow only after substantial rain. Notwithstanding this, these water courses are likely to provide locally important habitat for a variety of species. Five dams exist within the Project Site and are located in local depressions. These dams are generally dependant on rainfall and are regularly dry.

The native vegetation of the surrounding area is dominated by Poplar Box Woodland, with varying intergrades of Gum Coolabah, Cypress Pine and occasional Mulga. The status of vegetation surrounding the Project Site is considered similar to the current status of regional vegetation in that varying degrees of clearing for broad-scale agricultural activities such as cropping and grazing has previously occurred. The local vegetation has also endured modification through feral animals such as goats, rabbits and pigs.

### 4.3.3 Background Research

#### 4.3.3.1 Previous Ecological Studies

Whilst no previous ecological studies have been undertaken within the Project Site, EnviroKey have previously undertaken ecological studies on similar land associated with the Girilambone Copper Mine operations, principally:

- an assessment for the North East Mine entitled '*Flora and Fauna Impact Assessment: Proposed ROM Pad Extension, TRL North East Site (ML 1383) Girilambone, NSW*' (EnviroKey, 2011a);
- a draft flora and fauna study of the Murrawombie and North East Mine entitled '*Flora and Fauna Study: Murrawombie and North East Mine, Girilambone, N.S.W (ML1280, ML1383 & MPL295)*' (EnviroKey, 2011b); and
- a final flora and fauna study of the Murrawombie and North East Mine entitled '*Flora and Fauna Study: Murrawombie and North East Mine, Girilambone, N.S.W (ML1280, ML1383 & MPL295)*' (EnviroKey, 2011c).

#### 4.3.3.2 Database Searches

EnviroKey (2014) undertook a search on 3 February 2014 within a 50km radius of the Project Site for threatened flora and fauna species listed under the schedules of the *Threatened Species Conservation Act 1995* (TSC Act), within the Canbelego Downs subregion, on the Office of Environment and Heritage's (OEH) 'Threatened Species online database' and the OEH 'BioNET' database. EnviroKey also undertook a search on the Commonwealth Department of the Environment Protected Matters Database on 6 February 2014, using a 50km radius surrounding the Project Site for species or communities listed within the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

**Table 4.4** presents the results of the various 50km radius database searches, identifying 22 species of birds, 4 species of mammals/marsupials, 4 species of bats and 4 flora species listed within the schedules of TSC Act. The results also identified 3 endangered ecological communities, 5 flora species and 16 fauna species (9 of which are also migratory species) listed within the schedules of the EPBC Act.

A search of the Noxious Weeds List from the NSW Department of Primary Industries (DPI) website in February 2014 for the Bogan LGA area revealed 88 noxious weeds with the potential to occur within the Project Site.

#### 4.3.3.3 Predicted Species, Communities and Populations

Based on an analysis of habitat within the Project Site and online database searches (see **Table 4.4**), as well as, the results of EnviroKey (2011a and 2011b), the threatened species listed in **Table 4.5** have the potential to occur within the Project Site, with each species listed in **Table 4.5** subjected to a Significance Assessment (provided in full in Section 10 of EnviroKey (2014). It should be noted that no endangered ecological communities were identified as having the potential to be impacted as a result of the Proposal.

**Table 4.4**  
**Listed Species with Potential to Occur**

TSC Act Fauna Species	
Birds	
Barking Owl	Red-tailed Black Cockatoo
Blue-billed Duck	Spotted Harrier
Brolga	Superb Parrot
Brown Treecreeper	Turquoise Parrot
Diamond Firetail	Varied Sittella
Glossy Black Cockatoo	White-fronted Chat
Grey Falcon	<b>Bats</b>
Grey-crowned Babbler (eastern subspecies)	Greater Long-eared Bat
Hooded Robin	Little Pied Bat
Little Eagle	Yellow-bellied Sheath-tail bat
Magpie Goose	<i>Nyctophylus (?corbeni)</i>
Pink Cockatoo	<b>Mammals / Marsupials</b>
Malleefowl	Kultarr
Masked Owl	Stripe-faced Dunnart
Painted Honeyeater	White-footed Tree-rat
Pied Honeyeater	Yellow-footed Antechinus
TSC Act Flora Species	
Coolabah Bertya ( <i>Bertya oppositifolia</i> )	Cobar Greenhood Orchid ( <i>Pterostylis cobarensis</i> )
Pine Donkey Orchid ( <i>Diuris tricolor</i> )	Illawarra Ziera ( <i>Ziera granulate</i> )
EPBC Act Fauna Species	
Australian Painted Snipe <sup>1</sup>	Latham's Snipe <sup>1</sup>
Cattle Egret <sup>1</sup>	Malleefowl <sup>1</sup>
Fork-tailed Swift <sup>1</sup>	Painted Snipe <sup>1</sup>
Great Egret <sup>1</sup>	Rainbow Bee-eater <sup>1</sup>
Superb Parrot	White-bellied Sea-Eagle <sup>1</sup>
White-throated Needletail <sup>1</sup>	Silver Perch <sup>1</sup>
Brush-tailed Rock Wallaby	Spotted-tail Quoll
South-eastern Long-eared Bat	Murray Cod
EPBC Act Flora Species	
A speargrass ( <i>Austrostipa metatoris</i> )	Coolabah Bertya ( <i>Bertya oppositifolia</i> )
Cobar Greenhood Orchid ( <i>Pterostylis cobarensis</i> )	Pine Donkey Orchid ( <i>Diuris tricolor</i> )
Slender Darling-pea ( <i>Swainsona murrayana</i> )	
EPBC Act Threatened Ecological Communities	
Myall Woodland in the Darling Riverine Plains; Brigalow Belt South; Cobar Penplain; Murray-Darling Depression; Riverina and NSW South Western Slopes bioregions	Woodland in the Riverina; NSW South Western Slopes; Cobar Penplain; Nandewar and Brigalow Belt South Bioregions
Artesian Springs Ecological Community	
<sup>1</sup> Indicates Migratory species	
Source: EnviroKey (2014) – Map 2 and 3 and modified from Table 9.	



**Table 4.5**  
**Threatened Species with Potential to Occur within the Project Site**

Species	TSC Act	EPBC Act	Species	TSC Act	EPBC Act
Australian Bustard <sup>#</sup>	X		Pied Honeyeater	X	
Diamond Firetail	X		Pink Cockatoo <sup>#</sup>	X	
Grey-crowned Babbler	X		Spotted Harrier	X	
Grey Falcon	X		Superb Parrot*	X	X
Hooded Robin	X		Turquoise Parrot	X	
Little Eagle	X		Varied Sittella	X	
Mallefowl*	X	X	Kultarr	X	
Masked Owl	X		South-eastern Long-eared Bat <sup>**</sup>		X
Painted Honeyeater	X		Little Pied Bat	X	
Inland Forest Bat <sup>#</sup>	X		Yellow-bellied Sheath-tail Bat	X	
Cobar Greenhood Orchid	X	X			
* Indicates that the species is also listed as Vulnerable under the EPBC Act.					
<sup>#</sup> Indicates that whilst the species was not identified in <b>Table 4.4</b> , EnviroKey's experience within the region has determined that the species may potentially occur within the Project Site.					
Source: EnviroKey (2014) – Modified from Table 9.					

#### **4.3.4 Field Survey Methodology**

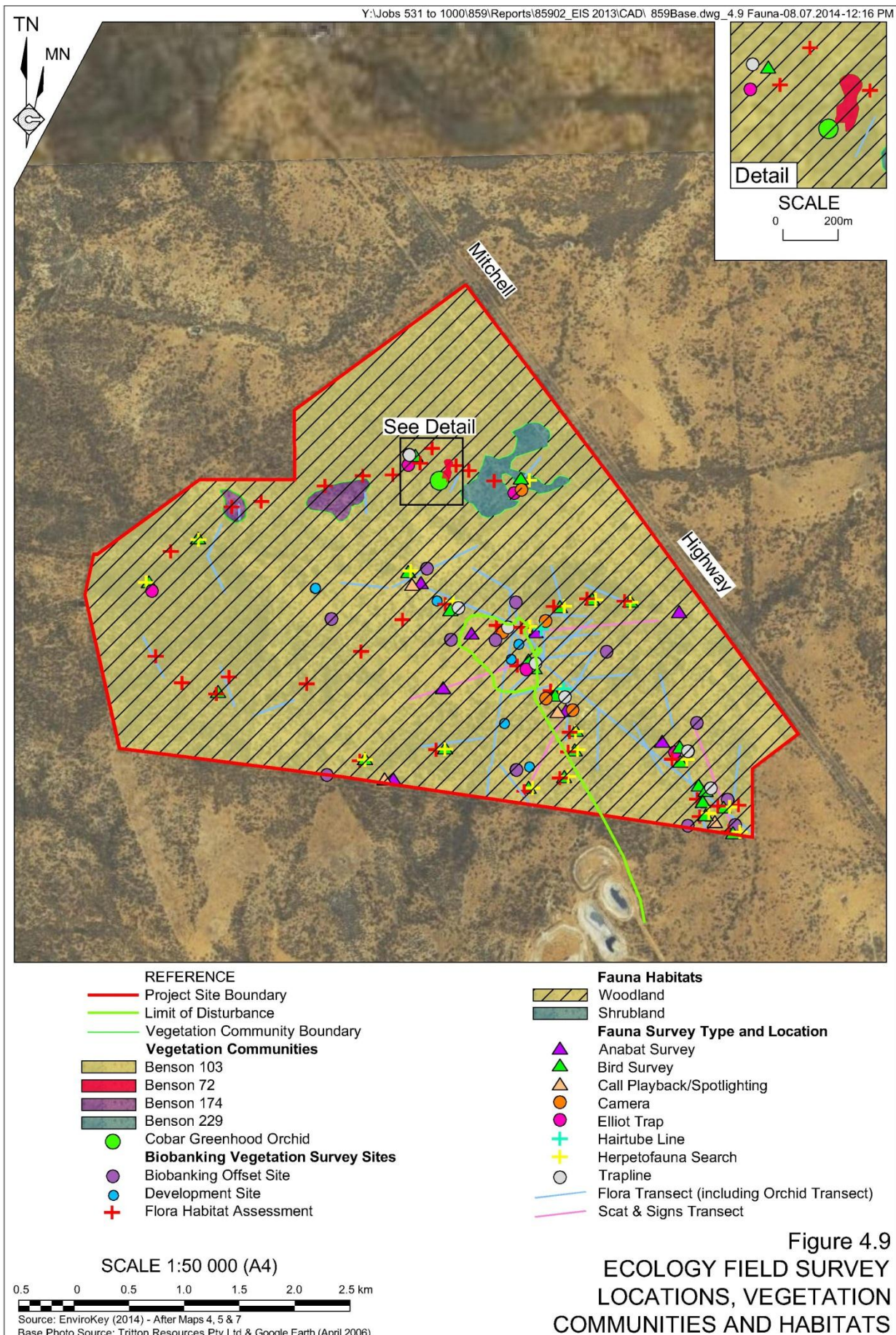
##### **4.3.4.1 Introduction**

Field surveys were completed by EnviroKey between 13 and 20 March 2012 and between 3 and 7 October 2012. This subsection provides an overview of the flora and fauna survey methodologies employed by EnviroKey (2014).

##### **4.3.4.2 Flora Survey Methodology**

Flora field surveys were carried out in conjunction with the fauna field surveys (see Section 4.3.4.3) and totalled 13 days.

The March 2012 survey consisted of desk-top air photo interpretation and on-ground validation of communities to ensure consistency with those detailed in recent classifications, with the November 2012 survey targeting threatened flora species predicted to occur within the Project Site, as well as surveying the remaining areas not previously completed within the first survey. Field surveys were conducted according to the Random Meander Method (transects) described by Cropper (1993). Transects were approximately 500m in length and were traversed abreast by two observers at 500m distance, before returning parallel to the original transect, effectively equating to 2km per transect. The distance covered by the 33 transects equates to 66km of field searches, representing all vegetation communities and habitat types within the Project Site (**Figure 4.9**).



Field data collected was consistent with the methodology outlined within the Biobanking Assessment Methodology and Credit Calculator Operation Manual (DECC 2008) with **Figure 4.9** displaying the flora habitat survey locations.

Classification of the observed vegetation communities and species mix within those communities was referenced using *Plants of Western NSW* (Cunningham *et al.* 2011) and the online version of the *Flora of NSW* (PlantNET 2012). Nomenclature has been aligned to that used by Benson (2006 and 2008) and Benson *et al.* (2006) for vegetation communities and the *Plants of Western NSW* and the online version of the *Flora of NSW* for individual species.

#### 4.3.4.3 Fauna Survey Methodology

Fauna field surveys undertaken at the locations displayed on **Figure 4.9**. A number of standard techniques were employed during the fauna surveys. These are described in detail in EnviroKey (2014) and are summarised briefly in **Table 4.6**.

### 4.3.5 Project Site Flora and Fauna

#### 4.3.5.1 Introduction

EnviroKey (2014) presents a detailed list of all species, vegetation communities and habitats recorded within the Project Site. This subsection presents an overview of that information.

#### 4.3.5.2 Vegetation Communities Identified

EnviroKey (2014), in accordance with the *BioMetric* classification system and consistent with Benson (2006), identified four main vegetation communities within the Project Site. Each of these communities is described as follows and displayed on **Figure 4.9**.

- Benson 103 – Poplar Box – Gum-barked Coolibah – White Cypress Pine shrubby woodland mainly in the Cobar Peneplain Bioregion. Some variation in vegetation composition is evident and is associated with subtle differences in topography. However, this community generally aligned to Benson 103 more than any other vegetation community or sub-community. This vegetation community dominates the Ecology Survey Area with approximately 97% total coverage.
- Benson 72 – White Cypress Pine – Poplar Box woodland on footslopes and peneplains mainly in the Cobar Peneplain Bioregion. This vegetation community occurs in one small cluster within Benson 103.
- Benson 174 – Mallee – Smooth-barked Coolibah woodland on red earth flats of the eastern Cobar Peneplain Bioregion. This vegetation community occurs in two separate clusters within Benson 103.
- Benson 229 – Derived mixed shrubland on loamy-clay soils in the Cobar Peneplain Bioregion. This vegetation community occurs in one large patch within the Project Site.

**Table 4.6**  
**Fauna Survey Methods**

<b>Survey Type</b>	<b>Total Survey Effort</b>
Diurnal Birds	44 locations for 20 minutes each. <b>Total survey effort:</b> 880 minutes.
Trap Lines	Survey 1: Six locations over 216 trap nights/288 trap days. Survey 2: Five locations over 80 trap nights/100 trap days. <b>Total survey effort:</b> 296 trap nights/388 trap days.
Echolocation Call Recording	Survey 1: Eight locations over four nights. Five locations were surveyed for one hour on one night. Two sites were surveyed for one hour on four nights. Mobile monitoring between two sites over four nights. <b>Total</b> 13 recording hours plus mobile monitoring. Survey 1: Three sites for one hour each. <b>Total</b> 3 hours. <b>Total survey effort:</b> 16 recording hours.
Hair Tubes	<b>Survey 1:</b> Two sites (25 tubes each site) over 7 consecutive nights. <b>Total survey effort:</b> 350 trap nights.
Elliot trapping	Survey 1: Three sites (25 traps each site) over a total of 450 trap nights. Survey 2: Four sites (25 traps each) over a total of 400 trap nights. <b>Total survey effort:</b> 850 trap nights.
Motion Activated Infrared Cameras	Survey 1: Five sites over 7 nights/9 days resulting in 35 camera nights/45 camera days. Survey 2: Four sites over 4 nights/5days resulting in 16 camera nights/20camera days. <b>Total survey effort:</b> 51 camera nights/65 camera days.
Call Playback	Survey 1: Five sites in total. Three sites were surveyed each night for 4 nights (12 surveys). Two sites on one occasion (2 surveys). Each survey was completed in 1hr. Total survey effort was 14 hours over four nights. Survey 2: Three sites for one hour on each occasion. Total effort 3 person hours over three nights. <b>Total survey effort:</b> 17 hours.
Spotlighting	Survey 1: Five sites in total. Three sites were surveyed each night for 4 nights (12 surveys). Two sites on one occasion (2 surveys). Each survey was completed in 1person hour. Total survey effort was 14 person hours over four nights. Survey 2: Three sites in total for a total of 1 person hour at each site. Total of 3 person hours over three nights. <b>Total survey effort:</b> 17 person hours.
Herpetofauna Search	29 sites in total for 30 minutes each. <b>Total survey effort:</b> 870 person minutes.
Track and Scat Search	Transect searches. <b>Total survey effort:</b> approximately 70kms in total.
Habitat Assessment	41 sites using a 50m x 20m quadrat.

Source: EnviroKey (2014) – Table 3.



EnviroKey (2014) stated that, based upon soil erosion, soil scalds, evidence of ringbarked / cut Poplar Box trees, patches of dense White Cypress Pine regrowth, as well as the presence of derived grassland associated with more recent clearing, the Project Site has been historically heavily grazed. Despite this, the vegetation within the Project Site is considered to be in moderate to good condition in accordance with DECC (2008).

#### 4.3.5.3 Flora Species Identified

EnviroKey (2014) identified a total of 127 flora species within the Project Site, comprising 114 native species and 13 exotic species. A full list of identified flora species is provided in EnviroKey (2014) – Appendix 3.

One population of the Cobar Greenhood Orchid (*Pterostylis cobarensis*), listed as vulnerable under both the TSC Act and EPBC Act, was recorded within the Benson 72 vegetation community, with its location displayed on **Figure 4.9**.

A total of 13 introduced weed species were identified within the Project Site with one noxious weed occurring (as listed under the NSW DPI Noxious Weeds list for the Bogan LGA) identified, namely Bathurst Burr (*Xanthium spinosum*).

#### 4.3.5.4 Fauna Species Identified

##### Overview

A total of 114 fauna species (106 native and 8 introduced) were recorded by EnviroKey (2014) comprising:

- 25 reptile species (none threatened);
- 9 frog species (none threatened);
- 17 mammal species (including 8 species of microchiropteran bat, 3 being threatened and 1 being a species of concern in western NSW); and
- 63 bird species signalling moderate to high bird diversity with the Project Site, including:
  - 6 vulnerable TSC Act - only threatened species;
  - 1 EPBC Act - only migratory species; and
  - 2 species listed as vulnerable under both the TSC Act and EPBC Act.

An earlier survey conducted on land adjoining the Project Site in October 2011 (EnviroKey, 2011b) recorded a total of 99 fauna species. The combined 2011 and 2012 surveys identified:

- 25 reptile species;
- 10 frog species;
- 22 mammal species (including 9 species of microchiropteran bat); and
- 87 bird species.

A consolidated list of identified fauna species is provided in EnviroKey (2014) – Appendix 4.

The location and summary of all fauna species listed under the TSC Act or EPBC Act recorded within the Project Site by EnviroKey during the 2012 field surveys are displayed on **Figure 4.10** and listed in **Table 4.7**.

NSW or nationally listed critical habitats and/or critically endangered populations were not recorded within the Project Site.

**Table 4.7**  
**Recorded Threatened Fauna Species**

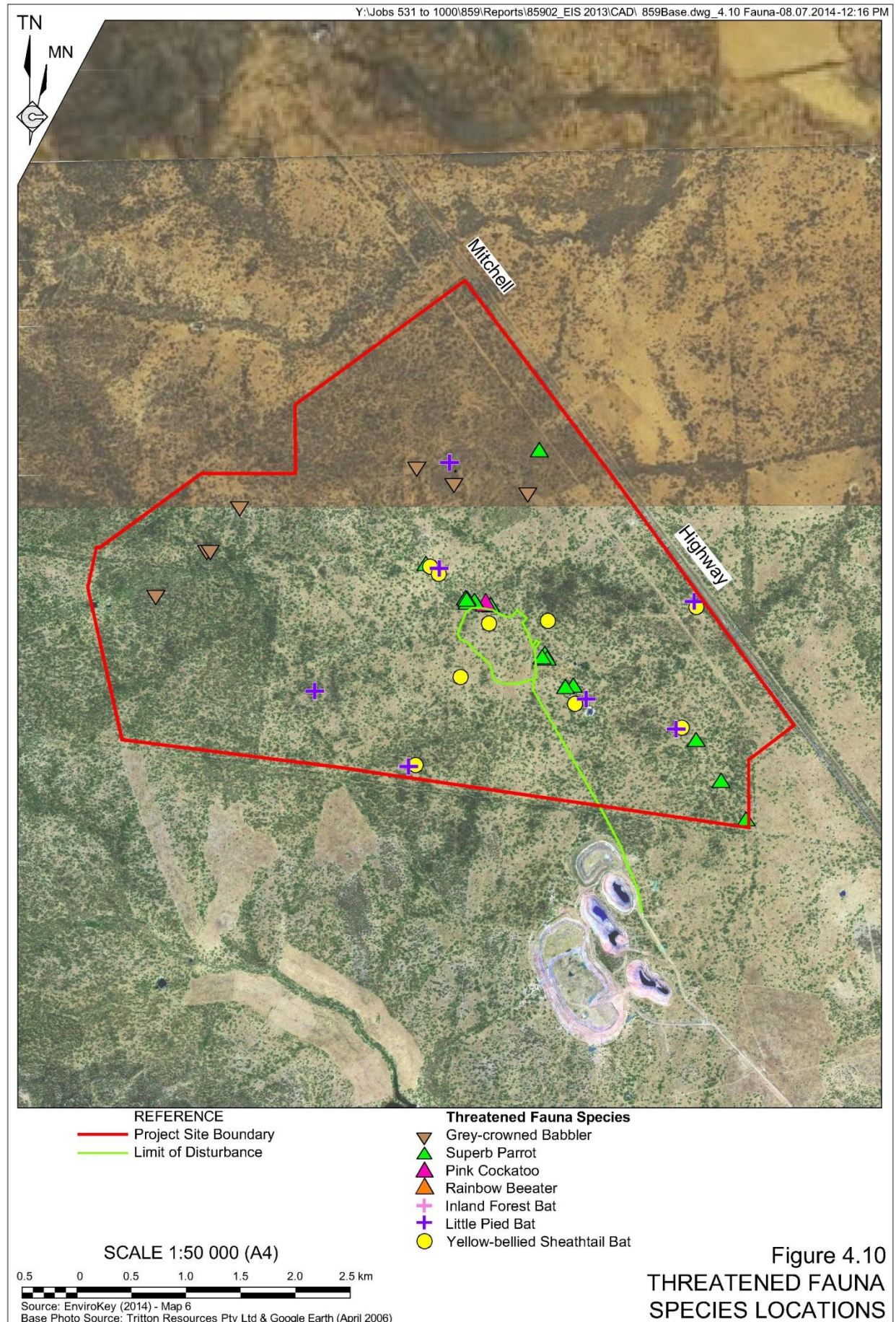
Scientific Name	Common Name	Status
<i>Cacatua leadbeateri</i>	Pink Cockatoo	Vulnerable (TSC Act)
<i>Pomatostomus temporalis temporalis</i>	Grey-crowned Babbler	Vulnerable (TSC Act)
<i>Polytelis swainsonii</i>	Superb Parrot	Vulnerable (TSC Act) Vulnerable (EPBC Act)
<i>Vespadelus balstoni</i>	Inland Forest Bat	Vulnerable (TSC Act)
<i>Chalinolobus picatus</i>	Little Pied Bat	Vulnerable (TSC Act)
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail Bat	Vulnerable (TSC Act)
<i>Nyctophilus corbeni</i> *	South Eastern Long-eared Bat	Vulnerable (TSC Act) Vulnerable (EPBC Act)
<i>Merops ornatus</i>	Rainbow Bee-eater	Migratory (EPBC Act)
* Indicates identification under the precautionary principle.		
Source: EnviroKey (2014) – Appendix 2.		

## Avifauna

Of the total 63 bird species identified by EnviroKey (2014), three threatened species (listed in **Table 4.7**), were identified as being vulnerable under the TSC Act and/or the EPBC Act, as well as one species listed as a migratory species (Rainbow Bee-eater (*Merops ornatus*)). The assemblage of birds is considered typical of semi-arid woodlands in western NSW but was noted that bird diversity was considerably lower than that recorded during the EnviroKey (2011b) study on adjoining land, largely as a result of the notable absence of many waterbirds due to the drier than average conditions prior to the 2012 survey.

## Mammals (Excluding Microchiropteran Bats)

Eight of the total 13 species of mammals (excluding microchiropteran bats) were identified as introduced species. The Yellow-footed Antechinus (identified in EnviroKey 2011c), despite not being listed as a threatened species under the TSC Act, is regarded as a species of conservation concern in western NSW with the overall past disturbance practices and feral introduced species, providing an explanation as to the notable absence of many mammal species.





### Microchiropteran Bats

Eight species of microchiropteran bat were recorded using Anabat recordings, three of which (Little Pied Bat (*Chalinolobus picatus*), Inland Forest Bat (*Vespadelus balstoni*) and Yellow-bellied Sheath-tail (*Saccolaimus flaviventris*)) are listed under the TSC Act. A fourth threatened species, South-eastern Long-eared Bat (*Nyctophilus corbeni*) (formerly *N. timoriensis*), was also potentially identified within the Project Site, as recordings could not be distinguished from the wider genus. This species was subsequently defined as occurring under the precautionary principle. One additional species of microchiropteran bat (Chocolate Wattled Bat (*Chalinolobus morio*)) was recorded on the adjoining land in 2011 but was not identified as occurring during the 2012 field surveys.

### Reptiles

Reptile species richness is considered high with 25 species recorded by EnviroKey (2014) within the Project Site. However, no threatened reptile species were recorded and none are known or expected to occur in the local setting due to the absence of suitable habitat (i.e. spinifex grasslands).

### Frogs

Frog diversity is considered highly diverse with nine species detected during the EnviroKey (2014) field surveys. Many species were recorded within the vicinity of existing farm dams, however, numerous tadpoles and metamorphs were observed in and around small ephemeral pools.

No threatened frog species were recorded as occurring within the Project Site.

#### 4.3.5.5 Habitats Recorded

EnviroKey (2014) identified two fauna habitats within the Project Site, namely 'Woodland' and 'Shrubland', accounting for 98.4% and 1.6% of the Project Site respectively (see **Figure 4.9**). Habitat conditions are considered moderate to good across the landscape, as reflected by the diversity of microhabitats and the condition of native vegetation (where previous land clearing practices have been a considerable influence).

### 4.3.6 Potential Direct and Indirect Biodiversity Impacts

#### 4.3.6.1 Introduction

The following potential direct impacts could occur as the result of the Proposal.

- Clearing of and loss of native vegetation including threatened flora habitat.
- Loss of fauna habitats (hollow-bearing trees).
- Injury and mortality of protected and threatened fauna.
- Loss of connectivity through fragmentation and the degradation of wildlife and habitat corridors.
- Exacerbate key threatening processes.



The following potential indirect impacts could occur as the result of the Proposal.

- Invasion and spread of weeds and pest fauna species.
- Edge effects from noise, vibration and light.
- Introduction or increased exposure to key threatening processes that may affect terrestrial and aquatic species, populations, ecological communities and their habitat (including threatened biota).
- Regional cumulative impacts affecting the long-term viability and survival of common and threatened species, populations and ecological communities and their habitats.

Each of these direct or indirect impacts are discussed in detail in the following subsections.

#### **4.3.6.2 Direct Biodiversity Impacts**

##### **Clearing of Native Vegetation and Loss of Threatened Species Habitat and Communities**

Clearing of native vegetation is a key threatening process listed under the TSC Act and the EPBC Act. The Proposal would result in the clearing of approximately 34ha, equating to approximately 2% of the Project Site.

Only the ‘Benson 103 – Poplar Box – Gum-barked Coolibah – White Cypress Pine shrubby woodland mainly in the Cobar Penneplain Bioregion vegetation community’ would be impacted.

All identified threatened fauna species are highly mobile species (with the exception of Grey-crowned Babbler) that forage over large areas and are unlikely to be confined to the boundaries of the Project Site. It was noted that although the Grey-crowned Babbler was identified as occurring within the Project Site (**Figure 4.10**), the location of the proposed disturbance footprint would be well clear of any of the occupied home ranges of the Grey-crowned Babbler that occur within the northwest and western sections of the Project Site.

Of the 34ha proposed for clearing, no threatened ecological communities as listed by the TSC Act or EPBC Act would be impacted as none occur within the Project Site.

The loss of fauna habitats, in particular hollow-bearing trees, has the potential to occur as the results of the Proposal. However, due to the previous land uses and associated land clearing for agricultural purposes, hollow-bearing trees are generally restricted to ‘stags’ given that the majority of canopy trees have either been removed completely or ring-barked.

Based upon EnviroKey’s previous surveys at surrounding locations, a conservative assumption of 1.13 hollow-bearing trees per hectare with 2.14 hollows per hollow-bearing tree has been adopted. With a disturbance of 34ha, approximately 41 hollow-bearing trees containing approximately 73 hollows may occur within the Proposed Disturbance Footprint. When put into context and based upon the stated calculations, the Project Site may contain up to 4 461 hollows, with the Proposal accounting for the removal of approximately 2% of hollows potentially present within the Project Site.

### Injury and Mortality

Injury and mortality of fauna has the potential to occur, primarily related to the interactions of mine vehicles during clearing and transport operations.

### Habitat Connectivity and Fragmentation

It is highly unlikely that the Proposal would impact habitat connectivity and fragmentation due to the small size of the proposed disturbance footprint and the similar habitats that exist within and surrounding the Project Site.

### Exacerbate Key Threatening Processes

Key threatening processes are listed under the TSC Act and EPBC Act that have the potential to either:

- adversely affect threatened species, populations or ecological communities; or
- cause common species, populations or ecological communities to become threatened.

The listed key threatening processes identified and summarised in **Table 4.8** have been identified as being relevant to the Proposal.

**Table 4.8**  
**Key Threatening Processes**

Key Threatening Process	Listed Act	Type of Threat	Potential Impacts
Clearing of native vegetation	TSC Act EPBC Act	Habitat loss/change	The proposal would result in the clearing of approximately 34ha of native vegetation.
Infection of native plants by <i>Phytophthora cinnamoni</i>	TSC Act EPBC Act	Pathogen	Infected root material can be dispersed by earth moving equipment and other vehicles.
Loss of hollow-bearing trees	TSC Act EPBC Act	Habitat loss	It is likely that up to 38 hollow-bearing trees will be removed.
Source: Modified from EnviroKey (2014) - Table 8.			

#### 4.3.6.3 Potential Indirect Impacts on Flora and Fauna

##### Noxious Weeds and Feral Fauna Species

The potential exists for the dispersal and propagation of the 13 identified weed species (including one noxious weed species – see Section 4.3.5.3) to occur on land surrounding the Project Site that are relatively weed-free or consist of native vegetation as the result of Proposal soil and vehicle-related interactions.

The Proposal may also provide for feral fauna species to extend their reach into the natural environment as the constructed roads and cleared areas have been noted as providing a means for feral animals to travel further into native vegetated areas.

### **Noise, Vibration and Light**

The potential for noise, vibration and light to affect existing fauna exists, however given that the larger, open cut mining operations occurring nearby have had no notable effect on threatened species (EnviroKey; 2010, 2011a; 2011b; 2011c) it is anticipated that these issues would not impact upon existing fauna species or communities. Furthermore, it was also identified in EnviroKey (2012) that lighting associated with similar mining operations provided opportunities for foraging for microchiropteran bats as the lights attract moths and other flying insects.

### **Cumulative Impacts**

There is a potential cumulative impact on biodiversity given the proximity of the existing Girilambone Copper Mine. However, it is recognised that both operations have relatively small footprints in the regional landscape and EnviroKey (2014) determined that it is unlikely that the Proposal would contribute to a cumulative impact to the local biodiversity at any scale.

## **4.3.7 Management and Mitigation Measures**

### **4.3.7.1 Introduction**

The Applicant has designed the Proposal to minimise impacts on threatened species by firstly avoiding and then mitigating potential biodiversity impacts. The following subsections present the design features, operational controls and management measures proposed to avoid and mitigate impacts on local biodiversity.

It should be noted that a Biodiversity Offset Strategy is not required for the Proposal because the general principles of ‘avoid and minimise’ have been adopted. This is evidenced by the following.

- Minimisation of the area of disturbance.
- Avoidance of areas of key habitat for the Cobar Greenhead Orchid.
- Implementation of a range of management plans (see Section 4.3.7.3).
- Retention of those sections of the Project Site that would not be disturbed by the Proposal (approximately 1 812ha) for the existing land use, namely intermittent agriculture.

### **4.3.7.2 Avoidance of Impacts**

The layout of the surface infrastructure has been designed with the intent to minimise disturbance and concentrate activities in areas previously disturbed by agricultural activities, minimise the clearing of remnant native vegetation and utilise existing access tracks where possible to ensure that no ‘significant effect’ would occur upon any threatened or migratory biota or their habitats.

#### 4.3.7.3 Mitigation of Impacts

The Applicant would implement the following to mitigate disturbance of natural vegetation and threatened species habitat.

- Draft and implement the following plans to manage potential biodiversity impacts.
  - *Pest Animal Management Plan.*
  - *Weed Management Plan.*
  - *Fauna Management Plan.*
  - *Threatened Species Monitoring Plan.*
- Clearly mark-out the proposed disturbance footprint boundaries and identify vegetation to be cleared.
- Implement a hollow-bearing tree pre-clearance survey where a qualified professional inspects all hollows and immediate surrounds for any species prior to clearing activities. If any fauna is identified, these would be relocated to areas outside of the proposed disturbance footprint prior to clearing.
- Ensure machinery required for the Proposal remains existing on vehicular access tracks or within the proposed disturbance footprint, where practicable. Where this is not possible, machinery would be manoeuvred to avoid sapling or remaining canopy trees wherever possible.
- Place felled canopy trees in adjacent vegetation areas outside of the proposed disturbance footprint to improve existing habitats.
- Eradicate any identified noxious weed and other weed material encountered, ensuring that the weed is destroyed and/or removed using appropriate methods to ensure weeds do not spread into the remainder of the Project Site.
- Install sediment and erosion control structures where appropriate.
- Stabilise exposed soils to prevent potential erosion.

#### 4.3.8 Assessment of Impacts

##### 4.3.8.1 Introduction

This subsection presents an assessment of the anticipated Proposal-related impacts on listed flora and fauna species and communities within the Project Site. The residual impacts are presented assuming the adoption of the various measures outlined in Section 4.3.7.

#### 4.3.8.2 Vegetation Communities

Of the four identified vegetation communities, 34ha out of the total 1 836ha of the ‘Benson 103 – Poplar Box – Gum-barked Coolibah – White Cypress Pine shrubby woodland mainly in the Cobar Peneplain Bioregion vegetation community’ within the Project Site would be impacted upon by the Proposal. This equates to less than 2% of the Benson 103 vegetation community within the Project Site. EnviroKey (2014) concluded that the Proposal would not have a significant impact upon this vegetation community.

#### 4.3.8.3 TSC Act Impact Assessment

Significance Assessments were undertaken by EnviroKey (2014) for the 22 fauna species identified in **Table 4.5** and listed under the TSC Act that were either known to, or have the potential to occur within the Project Site, concluding that, following the implementation of the measures outlined in Section 4.3.7, the Proposal is unlikely to have a significant effect on all identified threatened species.

#### 4.3.8.4 EPBC Act Assessment

Significance assessments were undertaken by EnviroKey (2014) for the three threatened species identified in **Table 4.5** as listed under the EPBC Act that were either known to, or have the potential to occur within the Project Site, concluding that, following the implementation of the measures outlined in Section 4.3.7, the Proposal is ‘*unlikely*’ to have a ‘*significant effect*’ on the three threatened species.

Furthermore, although one migratory species that was recorded during the field survey (Rainbow Bee-eater), with a further four species identified as potentially occurring within the Project Site, the overall Project Site was considered to not comprise habitat to support these species. As such, the impacts from the Proposal are ‘*unlikely*’ to impact the identified migratory species.

#### 4.3.8.5 Matters of National Environmental Significance

No additional matters of National Environmental Significance were identified as being related to the Proposal.

#### 4.3.9 Conclusion

EnviroKey (2014) has undertaken an assessment of significance of impact in accordance with *Draft Guidelines for Threatened Species Assessment* (DECCW and DPI July 2005) and the 7-part test of Section 5A of the EP&A Act. It is concluded from the assessment of significance of impact and the proposed management measures that the Proposal is unlikely to have a significant impact upon the identified species.



## 4.4 GROUNDWATER

*The Groundwater Impact Assessment for the Proposal was undertaken by Environmental Strategies (ES). The full assessment is presented as **Appendix 7** and is referred to hereafter as ES (2014). This subsection presents an overview of that assessment and should be read in conjunction with the full assessment.*

### 4.4.1 Introduction

Based on the risk analysis undertaken for the Proposal (Section 5.2 and **Table 5.3**), the potential impacts relating to groundwater and their risk rankings after the adoption of standard mitigation measures are as follows.

- Reduction in groundwater discharge to surrounding creeks/rivers, adverse impacts on groundwater dependent ecosystems or surrounding groundwater users (low risk).
- Reduction in groundwater discharge to surrounding creeks/rivers, adverse impacts on groundwater dependent ecosystems or surrounding groundwater users (low risk).
- Discharge of poor quality groundwater to surrounding aquifers (low risk).

In addition, the DGRs identify “**Water Resources**”, including groundwater, as a key issue, which includes groundwater, for assessment in the *Environmental Impact Statement*. The principal assessment matters from DP&E relating to noise matters includes the:

- identification of any licensing requirements or other approvals under the *Water Act 1912* and/or *Water Management Act 2000*;
- an assessment of potential impacts on the quality and quantity of existing surface and groundwater resources;
- description of the measures proposed to ensure the development can operate in accordance with the requirements of any relevant Water Sharing Plan or water source embargo;
- an annual site water balance for representative years of the proposed life of the Proposal; and
- a detailed description of the proposed water management system (including sewage), water monitoring program and other measures to mitigate surface and groundwater impacts.

Additional matters for consideration in preparing the *Environmental Impact Statement* were also provided in the correspondence attached to the DGRs from NOW, EPA and DRE. The additional matters identified are generally consistent with the DGRs, with the addition of the following.

- The impact of groundwater, including impact on groundwater dependant ecosystems and other water users (EPA).

- Groundwater impacts associated with mining operations ... and long term recovery patterns of groundwater and any bearing these may have on subsequent land uses in rehabilitation and mine closure phases (DRE).

Furthermore, the groundwater assessment for the Proposal was undertaken in accordance with the following guidelines.

- *Guidelines for Fresh and Marine Water Quality and Guidelines for Water Quality Monitoring and Reporting* (ANZECC & ARMCANZ, 2000).
- *Using the ANZECC Guideline and Water Quality Objectives in NSW* (DEC, 2000).
- *Aquifer Interference Policy* (DPI, 2012).

#### **4.4.2 Hydrogeological Setting**

##### **4.4.2.1 Regional Hydrogeology**

The Project Site is within the NSW Murray-Darling Basin (MDB) fractured rock groundwater source, in particular the Lachlan Fold Belt MDB groundwater source. This consists of a fractured rock aquifer with a low to moderate level of connection between surface water and groundwater.

Regional groundwater displays typically low yields and high salinity, with electrical conductivity (EC) levels generally between 20 000 and 25 000 $\mu$ S/cm (Green *et al*, 2011).

##### **4.4.2.2 Local Hydrogeology**

Groundwater within the immediate vicinity of Project Site is situated within rocks of the Girilambone Group with typically low primary permeability. Secondary permeability is controlled by fractures, faults and foliation within the strata. From observations at the nearby Girilambone Copper Mine and Tritton Copper Mine, secondary permeability is likely to be controlled by the dominant north-northeast trending foliation and faults, as well as bedding, which dip to the east-southeast.

Recharge of the regional groundwater system is thought to be primarily via rainfall infiltration; however, a component may come from infiltration through the base of drainage lines and rivers during periods of flow (Green *et al*, 2011).

As the result of a groundwater assessment of the Girilambone Copper Mine operations undertaken by OTEK Australia Pty Ltd (OTEK) in 2012 (OTEK, 2012), it was determined the standing water levels range between 8m to 127m below surface in bores located closest to the Project Site. It was also determined that from the bore construction notes, water bearing zones ranged from 41m to 59m below surface level and displayed a fracture permeability zone thickness of 6m. Surrounding groundwater users are described in further detail in Section 4.4.2.4.

#### 4.4.2.3 Project Site Hydrogeology

Three groundwater monitoring bores exist within the Project Site (**Figure 4.2.** and **Table 4.9**).

**Table 4.9**  
**Groundwater Monitoring Bores**

Local Bore ID	Works Request No.	Licence Number	Standing Water Level (SWL) below ground level (m)	Water Bearing Zone (m)	Total Depth (m)
AT001	GW805056	80BL620335	39.97	29-65	66.00
AT002	GW805057	80BL620336	35.95	47-53	54.00
AT003	GW805058	80BL620335	31.04	41-47	48.00

Source: ES (2014) - Table 5.1.

#### 4.4.2.4 Surrounding Groundwater Users

A review of the NSW Natural Resource Atlas identified 22 registered groundwater bores within a 20km radius of the Project Site (**Figure 4.1**). **Table 4.10** provides the standing water level, water bearing zone and total depth of each identified bore.

The nearest groundwater water supply bore (GW026890) that is registered for stock purposes is located approximately 8.5km southeast of the Project Site. Based on the drilling logs, this bore is screened within an unconsolidated formation and not within the fractured rock formation which the Proposal would intercept. The nearest water supply bore (GW002970), which is registered for stock purposes and within fractured rock aquifer is located approximately 15km to the east of the Project Site.

#### 4.4.2.5 Groundwater Quality

Groundwater quality from the monitoring bores within the Project Site, collected monthly between November 2012 and March 2013, is summarised in **Table 4.11**.

These results are consistent with the Girilambone Copper Mine's groundwater monitoring results for March 2013, which may be summarised as follows.

- Salinity (measured as TDS) – approximately 13 000 mg/L.
- Electrical Conductivity – approximately 21 000µS/cm.

#### 4.4.2.6 Groundwater Dependent Ecosystems

ES (2014) undertook a search of the Groundwater Dependent Ecosystems Atlas (Australian Government, Bureau of Meteorology, <http://www.bom.gov.au/jsp/weave/gde.html>), confirming that no groundwater dependant ecosystems exist within 150km of the Project Site. As a result, groundwater dependant ecosystems are not discussed any further in this document.

**Table 4.10**  
**Surrounding Groundwater Bores**

<b>Works Request No.</b>	<b>Licence Number</b>	<b>Depth to Water – Standing Water Level (SWL) (m)</b>	<b>Water Bearing Zone (m)</b>	<b>Total Depth (m)</b>
GW805065	80BL620254	82.00	80 – 86	87.00
GW805066	80BL620254	127.00	125 – 131	132.00
GW042880	80BL106391	18.00	22 – 62	62.00
GW805061	80BL620307	24.00	30-36	37.00
GW805062	80BL620254	127.00	125 – 131	132.00
GW805064	80BL620254	64.10	75-81	82.00
GW803782	80BL245097	8.00	28-29	40.00
GW804384	80BL245970	N.R	31-39	43.00
GW803779	80BL245099	11.00	26-28	40.00
GW805063	80BL620255	26.77	125-131	132.00
GW804381	80BL245970	N.R	34-47	52.00
GW804379	80BL245970	N.R	47-52	61.00
GW804382	80BL245970	N.R	34-47	52.00
GW803780	80BL245100	10.60	31-32	40.00
GW803781	80BL245098	39.00	39-40	40.00
GW805059	80BL620337	11.78	15-21	22.00
GW804383	80BL245970	N.R	25-33	40.00
GW804380	80BL245970	N.R	55-57	61.00
GW805167	80WA716017	7.94	N.R	17.56
GW026890	80WA709380	N.R	22.30-22.90 & 26.10-27.50	27.40
GW805060	80BL620338	9.32	12-18	19.00
GW003006	N.R	N.R	N.R	86.00
GW002970	N.R	N.R	21.30	61.30
GW002685	N.R	N.R	26.2 – 32.0	86.90
GW805056*	80BL620335	39.97	29-65	66.00
GW805057*	80BL620336	35.95	47-53	54.00
GW805058*	80BL620335	31.04	41-47	48.00

Note 1: N.R indicates no result.

Note 2: \* Indicates Project Site bores.

Source: ES(2014) – Table 5-1 & Table 5.2.

**Table 4.11**  
**Project Site Groundwater Quality**

<b>Works Request No.</b>	<b>Bore ID</b>	<b>Average pH</b>	<b>Average EC (µS/cm)</b>	<b>Total Dissolved Solids (TDS) (mg/L)</b>
GW805056	AT001	7.7	20 560	12 920
GW805057	AT002	7.6	23 660	14 680
GW805058	AT003	7.8	21 480	13 340

Source: ES (2014) - Table 6.1.



#### 4.4.3 Groundwater Use and Supply

Groundwater within the adjacent and surrounding areas is typically used for monitoring or stock purposes. Due to the low yields and high salinity values, the groundwater is of marginal use for stock watering, based upon the ANZECC & ARMCANZ (2000) guidelines that state water with TDS levels over 10 000mg/L is generally unsuitable for stock use.

#### 4.4.4 Assessment Methodology

##### 4.4.4.1 Introduction

ES (2014) undertook an assessment of groundwater-related impacts associated with the Proposal using two alternative methodologies as follows.

- A qualitative assessment based on a review of groundwater inflows to the Applicant's other mining operations at the Girilambone and Tritton Copper Mines.
- A quantitative assessment based on the following.
  - Theis Equation – 1935.
  - Cooper-Jacob Equation – 1946.
  - Thiem Equation – 1906.

This subsection provides a description of the conceptual model that was developed by ES (2014) to describe the hydrogeological setting of the proposed mine, as well as an overview of each of the above assessment methodologies.

##### 4.4.4.2 Conceptual Model

As noted in Section 4.4.2.1, the proposed mine is located within the Lachlan Fold Belt MDB groundwater source. The aquifer that would be intersected by the proposed mine may be described as follows.

- Fractured rock aquifer with limited primary permeability and porosity. Groundwater is typically hosted in localised fractures, potentially with limited interconnectivity.
- ES (2014) note that monitoring bores within the Project Site have been installed to approximately 66m below surface. As the proposed mine would extend to approximately 500m below surface, ES (2014) have conservatively assumed that the observed fracture density in the monitoring bores extends to the base of the mine. In reality, fracture density and permeability is likely to decrease with depth. ES (2014) have assumed cumulative water bearing fracture zone thickness of 1m every 100m vertically, totalling a saturated thickness of 5m.

- Limited interconnection between surface water and groundwater. As a result, rainfall and evaporation have not been considered.
- Limited groundwater would be removed with the ore and waste rock. As a result, the modelling has assumed the all groundwater inflows would report to the mine sump and would be required to be pumped from the mine.

#### 4.4.4.3 Qualitative Assessment

ES (2014) note that each of the Applicant's mining operations are in similar hydrogeological settings, namely fractured rock aquifers with variable levels of interconnectivity between fractures. As a result, measured groundwater inflows to the existing mines are likely to be a reasonable approximation for the likely inflows that would be expected at the proposed mine. The Applicant has measured the volume of water pumped into and out of the Tritton Copper Mine since May 2010, with the difference between these volumes presumed to be attributable to groundwater inflow to the mine. During the period May 2010 to May 2014, the average annual groundwater inflow was 111ML per year, with monthly inflows varying between nil and 16ML. This variation is likely to be a reflection of the fact that groundwater in flows are likely to be greatest when a fracture zone is first intersected, with flow rates decreasing once the fracture zone has been dewatered.

Flow rates have been estimated for each of the Girilambone Copper Mine operations. **Table 4.12** presents the Applicant's estimated annual groundwater inflow for each of the existing mining operations.

**Table 4.12**  
**Estimated Groundwater Inflow**

Mining Operation	Measured Annual Inflow	
Larsons Open Cut/Underground	17ML	104ML
North East Open Cut	87ML	
Hartmans Open Cut	-	
Murrawombie Open Cut	130ML	
Tritton Underground Mine	111ML	
Source: ES (2014) – After Table 13.		

#### 4.4.4.4 Quantitative Assessment

##### Limitations Associated with Quantitative Assessments

The quantitative assessment undertaken by ES (2014) relies on the equations identified in Section 4.4.4.1. These equations attempt to approximate the real-world hydrogeological setting of the proposed mine and then impose a simulated “well” on that aquifer to estimate likely groundwater impacts. As a result, a number of assumptions and approximations are required. **Table 4.13** summarises the key assumptions and approximations that relate to the Proposal and the assessment undertaken by ES (2014) and provides commentary in relation to how each may vary from the actual hydrogeological setting. It is noted that these assumption tend to overstate the extent and connectivity of the aquifer and, as a result, the quantitative assessments are likely to be moderately to highly conservative.

**Table 4.13**  
**Groundwater Assumptions and Approximations**

Parameter	Assumption/Approximation	Comment
Saturated aquifer thickness	1m/100 vertical metres for a total of 5m over proposed 500m vertical extent of workings.	
Aquifer extent	Infinite	Limited connectivity between fractures likely to limit aquifer extent.
Aquifer parameters	Homogenous	Fracture density would vary within the aquifer.
	Isotropic	Fractures likely to have a preferred orientation, therefore aquifer would be anisotropic.
	Uniform thickness	Aquifer thickness is likely to vary.
Existing piezometric surface	Horizontal	The piezometric surface is likely to broadly reflect the existing surface topography.
Rate of dewatering	Constant	Dewatering rate is likely to vary as new water-filled fractures are intersected and then become dewatered (see Section 4.4.4.5).
Source: ES (2014) – After Section 14.3.2.		

**Table 4.14** presents the assumed rate of underground development based on the mine schedule prepared by the Applicant at the time the groundwater assessment was undertaken. The Applicant subsequently revised the mining schedule, reducing the life of the mining operations from 63 months or 5.25 years to 48 months or 4 years. The Applicant contends that this would not significantly impact on the groundwater assessment as the mine plan, including depth of extraction, would not change.

**Table 4.14**  
**Modelled Rate of Underground Development**

Month <sup>1</sup>	Depth of Underground Development (m below surface)
6	100
15	200
27	300
42	400
63	500
Note 1: Following commencement of decline development.	
Source: ES (2014) – After Table 11.1.	

### Aquifer Parameters

**Table 4.15** presents the aquifer parameters used by ES (2014) during the quantitative groundwater assessment.

**Table 4.15**  
**Aquifer Parameters**

Parameter	Value 1 <sup>1</sup>	Value 2 <sup>1</sup>
Hydraulic Conductivity (m/day)	0.483	0.781
Specific Storage	4.563x10 <sup>-6</sup>	1.565x10 <sup>-6</sup>
Transmissivity (m <sup>2</sup> /day)	2.415	3.905
Storativity	2.2815x10 <sup>-5</sup>	7.825x10 <sup>-6</sup>
Note 1: Based on pump test results at the Girilambone Copper Mine for close (Value 1) and distant (Value 2) monitoring bores.		
Source: ES (2014) – After Tables 13.1 and 13.2.		

### Theis Equation

The Theis Equation is as follows. This equation was used to estimate the volume of groundwater that would flow into the proposed mine and the extent of the cone of drawdown.

$$s = \frac{Q}{4\pi T} W(u)$$

$$u = \frac{r^2 S}{4Tt}$$

Where:

$Q = m^3/\text{day}$

$s = \text{drawdown (m)}$

$T = \text{transmissivity (m}^2/\text{day)}$

$W = \text{Theis well function}$

$r = \text{radius (m)}$

$S = \text{storativity (dimensionless)}$

$t = \text{time (days)}$

### Cooper-Jacob Equation

The Cooper-Jacob Equation is based on the Theis Equation and is as follows. This equation was also used to estimate the volume of groundwater that would flow into the proposed mine and the extent of the cone of drawdown.

$$s = \frac{2.3Q}{4\pi T} \log \frac{2.25Tt}{r^2 S}$$

Where:

$Q = m^3/\text{day}$

$s = \text{drawdown (m)}$

$T = \text{transmissivity (m}^2/\text{day)}$

$r = \text{radius (m)}$

$S = \text{storativity (dimensionless)}$

$t = \text{time (days)}$

### Thiem Equation

The Thiem Equation is as follows. This equation was used to estimate the extent of the cone of groundwater drawdown based on the volumes of groundwater that would flow into the proposed mine determined by the Theis and Cooper-Jacob Equations.

$$Q = \frac{2\pi T(s_1 - s_2)}{2.3 \log(r_2/r_1)}$$

Where:

$Q = m^3/\text{day}$

$s = \text{drawdown (m)}$

$T = \text{transmissivity (m}^2/\text{day)}$

$r = \text{radius (m)}$

$S = \text{storativity (dimensionless)}$

$t = \text{time (days)}$

#### 4.4.5 Management and Mitigation Measures

The Applicant would implement the following to mitigate the potential for adverse groundwater-related impacts.

- Prepare and implement a *Water Management Plan* prior to the commencement of site establishment and construction operations. The plan would describe management of the following.
  - Sediment and erosion control.
  - Hydrocarbons and chemicals.
  - Water balance, including separation of clean, dirty and mine water and monitoring of water flows within the Project Site.
  - Surface water and groundwater monitoring.
- Store all hydrocarbon and chemical products within a bunded area complying with the relevant Australian Standard.
- Refuel all equipment within designated, sealed areas of the Project Site, where practicable.
- Undertake all maintenance works involving hydrocarbons, where practicable, within designated areas of the Project Site such as the workshop.
- Direct all water from wash-down areas and workshops to oil/water separators and containment systems.
- Ensure all hydrocarbon and chemical storage tanks are either self-bunded or bunded with an impermeable surface and a capacity to contain a minimum 110% of the largest storage tank capacity.



- Ensure that volumes of water pumped into and out of the proposed mine are monitored and recorded to enable net groundwater inflows to be determined.
- Ensure that standing water levels in surrounding monitoring bores and groundwater inflow rates to the proposed mine are monitored monthly and should the actual groundwater inflows or reduction in standing water levels be greater than that assessed, ensure that the advice of a suitable qualified hydrogeologist is sought.

#### 4.4.6 Assessment of Impacts

##### 4.4.6.1 Groundwater Inflows

**Table 4.16** presents the groundwater inflow results derived from the qualitative and quantitative groundwater assessments using the methodologies identified in Section 4.4.4.

**Table 4.16**  
**Qualitative and Quantitative Groundwater Inflow Results**

Month	Qualitative Assessment	Quantitative Assessment							
		Theis Equation				Cooper-Jacob Equation			
		Scenario 1		Scenario 2		Scenario 1		Scenario 2	
	ML/y	ML/d	ML/y	ML/d	ML/y	ML/d	ML/y	ML/d	ML/y
6	104 to 130	0.18	66	0.26	95	0.18	66	0.26	95
15		0.43	157	0.61	223	0.43	157	0.61	223
27		0.65	237	0.94	343	0.65	237	0.94	343
42		0.87	318	1.26	460	0.87	318	1.26	460
63		1.07	392	1.55	567	1.07	392	1.55	567
Source: ES (2014) – After Tables 14.4 and 14.6 and Section 14.2.									

In summary, the quantitative analysis suggests that groundwater inflows would gradually increase from between 0.18ML/d and 0.26ML/d to between 1.07ML/d and 1.55ML/d. This equates to a maximum annual groundwater inflow of between 392ML/y and 566ML/y. However, ES (2014) note that for the reasons identified in Section 4.4.4.4, the quantitative assessment is likely to significantly overestimate the actual groundwater inflows to the proposed mine. As a result, ES (2014) propose that the measured inflows from the Applicant's existing mining operations should be used as a likely approximation of actual inflows to the proposed mine, namely, that the likely maximum inflow to the proposed mine are likely to be 111ML/y.

##### 4.4.6.2 Groundwater Drawdown

**Table 4.17** presents the extent of groundwater drawdown at the end of the proposed life of the mine. These results are derived from the quantitative groundwater assessments using the methodologies identified in Section 4.4.4. For the purposes of this summary, the limit of groundwater drawdown is the distance from the centre of the proposed mine to the point where the modelled drawdown is less than 1m.

**Table 4.17**  
**Quantitative Groundwater Drawdown Results**

Scenario	Groundwater Inflow		Modelled Drawdown (km)		
			Theis Equation	Cooper-Jacob Equation	Thiem equation
Scenario 1	ML/d	ML/y	35.0 to 44.5	20.4 to 21.1	21.1
Scenario 2	1.07	392	67.6 to 94.5	42.9 to 45.8	45.7
	1.55	567			
Source: ES (2014) – After Tables 13-5, 13-7 and 13-8.					

In summary, the predicted drawdown is expected to be between 20.4km and 44.5km from the centre of the proposed mine for Scenario 1 and between 42.9km and 4.5km for Scenario 2. The (ES(2014), however, note that this is likely to be a very significant overestimate of the actual extent of groundwater drawdown because it is highly unlikely that there would be fracture connectivity over the sort of distances identified by the modelling. Rather, it is likely that fracture connectivity and therefore the extent of drawdown would be limited to a much smaller distance. Furthermore, the Applicant's existing operations do not show the degree of drawdown suggested by the quantitative modelling. As a result, ES (2014) suggest that the maximum groundwater drawdown would be approximately 20.4km.

#### **4.4.6.3 Groundwater Quality**

ES (2014) and the Applicant note the following in relation to existing groundwater quality and matters with the potential to adversely impact on groundwater quality.

- Groundwater within and surrounding the Project Site is of poor quality, with limited beneficial uses.
- Hydrocarbons and other chemicals would be stored and used in accordance with the commitments in Section 4.4.5 and relevant industry and other standards.
- The contaminated water circuit would be managed as described in Section 2.6.
- During mining operations dewatering of the proposed mine would ensure that the groundwater gradient would be towards the mine.

In light of the above, ES (2014) and the Applicant contend that the Proposal would not adversely impact on groundwater quality during or following the life of the Proposal.

#### **4.4.6.4 Groundwater Users**

ES (2014) note that there are limited groundwater users in the vicinity of the Project Site (see Section 4.4.2.4) and that the groundwater has limited beneficial uses. As a result, the Proposal is unlikely to adversely impact on groundwater users surrounding the Project Site.

#### 4.4.6.5 Groundwater Dependent Ecosystems

ES (2014) note that the closest high priority groundwater dependent ecosystem or groundwater outflow zone is more than 150km from the Project Site. As a result, the Proposal is unlikely to adversely impact on any groundwater dependent ecosystems.

#### 4.4.7 Licensing Requirements

ES (2014) recommend the Applicant obtain an aquifer interference approval under the *Water Management Act 2000* to permit construction of the proposed mine and extraction of up to 111ML per year. The Applicant notes that it holds a range of licences and approvals permitting extraction of groundwater from its current operations. A proportion of the allocations associated with those licences and approvals may be reallocated to the Proposal. Alternatively, the Applicant would ensure that an adequate allocation would be purchased prior to intersection of groundwater within the proposed decline

#### 4.4.8 Groundwater Monitoring

The Applicant would continue monitoring the existing monitoring bores monthly, with the results reported in the *Annual Environmental Management Reports* for the Proposal.

### 4.5 NOISE

*The Noise Impact Assessment for the Proposal was undertaken by EMGA Mitchell McLennan (EMM). The full assessment is presented as **Appendix 8** and is referred to hereafter as EMM (2014). This subsection presents an overview of that assessment and should be read in conjunction with the full assessment.*

#### 4.5.1 Introduction

Based on the risk analysis undertaken for the Proposal (Section 5.2 and **Table 5.3**), the potential impacts relating to noise factors and their risk rankings after the adoption of standard mitigation measures are as follows.

- Amenity impacts on residential and other sensitive residences (including infrasound) (low risk).
- Health impacts on residential and other sensitive residences (including infrasound) (low risk).
- Amenity impacts on residential and other sensitive residences (low risk).

In addition, the DGRs identify “*Noise*” as a key issue for assessment in the *Environmental Impact Statement*. The principal assessment matters from DP&E relating to noise matters includes the:

“assessment of the potential impacts of the proposal during the establishment, operation and decommissioning of the proposal, particularly any potential noise and vibration impacts on nearby private receptors due to construction, operation and road haulage”

Additional matters for consideration in preparing the *Environmental Impact Statement* were also provided in the correspondence attached to the DGRs from EPA. The additional matters identified are generally consistent with the DGRs.

The DGRs require that the noise assessment refer to the following guideline documents.

- The *NSW Industrial Noise Policy* (EPA, 2000).
- The *NSW Road Noise Policy* (EPA, 2011).
- The *Interim Construction Noise Guideline* (DECC, 2009).

## 4.5.2 Existing Noise Climate

### 4.5.2.1 Introduction

The existing meteorological and acoustic environment surrounding the Project Site has been reviewed in order to determine the atmospheric conditions under which noise modelling is required, as well as to establish noise criteria at representative receivers surrounding the Project Site and adjacent to the transport routes. The following subsections provide a summary of the existing noise sources and meteorological and acoustic conditions.

### 4.5.2.2 Existing Noise Sources and Identified Residences

The Project Site is situated in a rural area and is sparsely populated. As such, the existing acoustic environment of the Project Site is characterised by rural noise sources such as agricultural machinery, stock, birds, traffic on local roads, particularly the Mitchell Highway, wind generated noises.

**Figure 4.5** identifies the privately-owned residences surrounding the Project Site that may potentially be impacted by Proposal-related noise. It should be noted that due to the distance between the Project Site and the village of Girilambone, it is anticipated that noise impacts at Residences R1, R2 and R5 would be greater than impacts within the village and as such, residences within the village have not been assessed.

**Table 4.18** presents the co-ordinates of relevant residences and distance to the closest disturbance within the Project Site from these residences.

**Table 4.18**  
**Identified Noise Residences**

<b>Residence</b>	<b>Easting</b>	<b>Northing</b>	<b>Distance to closest Disturbance (km)</b>
R1	488604	6545101	5.0
R2	488804	6545250	5.0
R3	485502	6550984	2.4
R4	487827	6553240	5.3
R6	489237	6545308	5.5
R7	482857	6543708	5.6
Source: EMM (2014) - Table 2.1.			

#### **4.5.2.3 Meteorological Conditions**

Due to the lack of available local meteorological information, a following range of worst-case meteorological parameters were assumed, consistent with those prescribed within the guideline documents identified within parenthesis below.

- Wind – Worst-case wind conditions were adopted for each residence at 3m/s wind speed from the direction of the noise source (*NSW Industrial Noise Policy*)
- Temperature Inversions – The *NSW Industrial Noise Policy* requires that for areas classed as arid/semi-arid (i.e. areas with <500mm average rainfall), that a ‘G’ Class Stability should be used.
- Drainage Flow Winds – Considered applicable for Residences R1 to R5 but not for R6 and R7 due to intervening topography.

#### **4.5.2.4 Background Noise Levels**

In the absence of background noise data and the generally rural nature of the Project Site, the default background noise level as identified within the *NSW Industrial Noise Policy* of 30dB(A) was adopted for all residences surrounding the Project Site for all noise assessment periods.

### **4.5.3 Environmental Noise Criteria**

#### **4.5.3.1 Introduction**

The following subsections summarise the noise criteria that were used to assess the potential noise vibration impacts of the Proposal on the surrounding environment.



#### 4.5.3.2 Operational Noise Criteria

The Industrial Noise Policy specifies two noise criteria:

- an *intrusiveness criterion* which limits  $L_{Aeq}$  noise levels from the industrial source to a value of ‘background plus 5dB(A); and
- an *amenity criterion* which aims to protect against excessive noise levels where an area is becoming increasingly developed.

**Table 4.19** applies the intrusiveness and amenity noise criteria to the Proposal, with the Project Specific Noise Level also included as this would be formed and implemented as the result of the lowest noise level from the intrusive or amenity criteria.

**Table 4.19**  
**Industrial Noise Policy Criteria**

Intrusive Criteria			
Residence	Time Period	Rating Background Level (RBL), dB(A)	Criteria dB(A)( $L_{Aeq(15min)}$ )
All Residences	Day	30	35
	Evening	30	35
	Night	30	35
Amenity Criteria			
Residence	Time Period	Recommended Noise Level dB(A) Acceptable	Recommended Noise Level dB(A) Maximum
All Residences	Day	50	$55L_{Aeq(15min)}$
	Evening	45	$50L_{Aeq(15min)}$
	Night	40	$45L_{Aeq(15min)}$
Project Specific Noise Level			
Residence	Time Period	Recommended Noise Level dB(A) Acceptable	Criteria dB(A)( $L_{Aeq(15min)}$ )
All Residences	Day	30	35
	Evening	30	35
	Night	30	35

Source: EMM (2014) - Tables 3.1 to 3.4.

#### 4.5.3.3 Sleep Disturbance Criteria

The EPA recommends an  $L_{A(1-minute)}$  sleep disturbance criterion at the facade of a residence should be the Rating Background Level plus 15dB(A) during the night-time period (10:00pm to 7:00am). Therefore, based upon the Rating Background Level of 30dB(A), EMM (2014) has adopted a sleep disturbance criterion of 45dB(A)  $L_{max}$  for all residences.

#### 4.5.3.4 Road Traffic Noise Criteria

The road traffic and noise assessment was conducted in accordance with the *NSW Road Noise Policy* with the Mitchell and Barrier Highway's being defined as "freeway/arterial/sub-arterial" with Booramugga and Yarrandale Roads being defined as a "local road" type. **Table 4.20** presents the relevant road noise criteria for each identified road type.

**Table 4.20**  
**Road Traffic Noise Assessment Criteria for Residential Land Uses**

Type of Development	Noise Level Criterion	
	Day	Night
Arterial or sub-arterial roads	$L_{Aeq,15hr}$ 60dB(A)	$L_{Aeq,9hr}$ 55dB(A)
Local Roads	$L_{Aeq,1hr}$ 55dB(A)	$L_{Aeq,1hr}$ 50dB(A)
Source: Modified after EMM (2014) - Table 3.6.		

#### 4.5.4 Assessment Methodology

##### 4.5.4.1 Site Establishment and Noise and Operational Noise

Assessment of site establishment/construction and operational noise was conducted using *Brüel and Kjær Predictor Version 8.14* noise prediction software that calculates total noise levels at residences from the concurrent operation of multiple noise sources. Noise modelling was based on three-dimensional digitised ground contours of the surrounding land and over the two operational scenarios, namely a site establishment and construction phase and an operational phase, for the Proposal. The model for each scenario was developed by placing the various noise sources (of known sound power levels) in typical/worst case locations as shown diagrammatically on **Figure 4.11**. It should be noted that the ventilation fan was identified as potentially being a 'low frequency' noise component and a 5dB penalty was applied in accordance with the requirements outlined within the *NSW Industrial Noise Policy*.

**Table 4.21** provides the identified noise sources used in the modelling, as well as providing the associated sound power levels for each piece of equipment.

##### 4.5.4.2 Traffic-related Noise

The traffic noise assessment was undertaken by adopting the closest identified residence on the identified road and assessing the Proposal-related noise impacts at that residence, noting that if the results complied with the relevant criteria, the remaining residences along the transport route would also comply during both the site establishment/construction and operational phases. The assessment was undertaken using the Calculation of Road Traffic Noise (UK Department of Transport) method and was based upon a maximum of 80 road train (heavy vehicle) movements and 60 employee (light vehicle) movements per day on any road. Section 5.5 of EMM (2014) provides detailed information regarding road traffic scenarios.

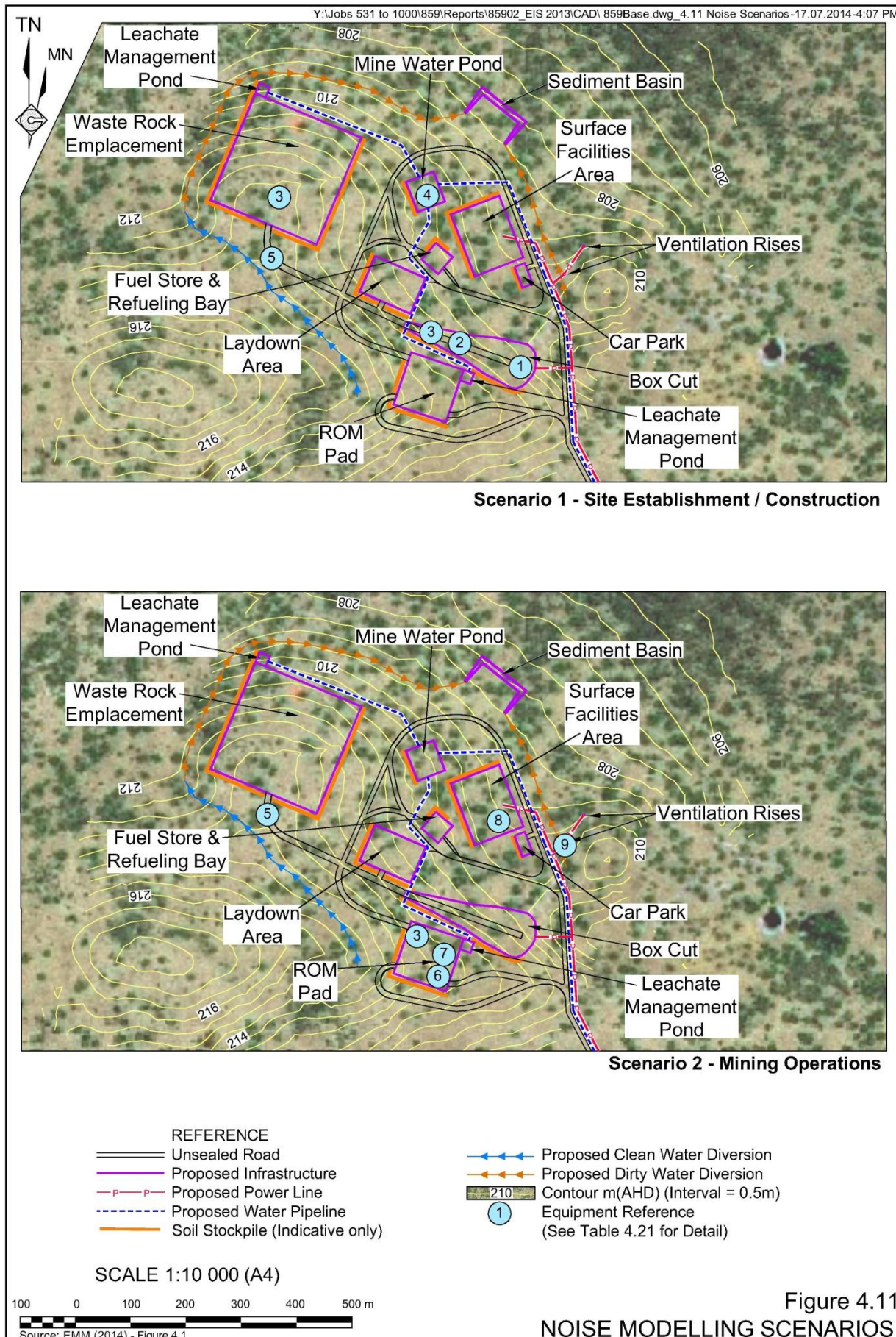


Figure 4.11  
NOISE MODELLING SCENARIOS

**Table 4.21**  
**Equipment for Noise Modelling**

Equipment Description	Noise Modelling Reference	Units		L <sub>w</sub> , L <sub>eq(15-min)</sub> , dB(A)
		Site Establishment/ Construction	Mining Operations	
Blast drill rig	1	1	0	115
Excavator	2	1	0	107
Haul truck - 50 t	3	2	1	111
Bulldozer	4	1	0	111
Grader - Cat 14H	5	1	1	104
Road train	6	0	1	102
Front-end loader (FEL) - Cat 998	7	0	1	108
Generator - 800KVa	8	0	1	113
Ventilation fan - 500 kW/1.5 kPa	9	0	1	104
Note 1: See Figure 4.11 for equipment locations.				
Note 2: Table 2.3 notes that two haul trucks would be utilised during mining operations. However, only one would typically operate on the surface at any one time.				
Source: Modified from EMM (2014) – Tables 4.1 and 4.2.				

The closest distance of a residence being to the centre line of a road utilised for the Proposal is as follows.

- Booramugga and Yarrandale Roads (Operational Phase) – 700m.
- Mitchell Highway (Girilambone Village) (Operational Phase) – 15m.
- Mitchell Highway (Site Establishment and Operational Phase) – 15m.
- Barrier Highway (Site Establishment and Operational Phase) – 15m.

Existing road traffic noise data for Booramugga and Yarrandale Roads were obtained from the "Road Train Noise Assessment" prepared by Bridges Acoustics in October 2013 (Bridges, 2013) for Tritton's Girilambone Mine. The road traffic noise assessment also took into account the proposed modification to Girilambone Copper Mine transport operations (increase from 3.3 movements per hour to 14 movements per hour currently before Bogan Shire Council. As such, two Girilambone Copper Mine cumulative transport scenarios were undertaken to calculate noise generated from future truck movements as follows.

1. The existing road traffic noise level (including Girilambone Copper Mine's current transport operations) combined with road traffic noise level associated with the Proposal.
2. Potential future ambient road traffic noise level (assuming a modification of the approval for Girilambone Copper Mine's current transport operations) combined with road traffic noise level associated with the Proposal.

#### 4.5.5 Management and Mitigation Measures

The Applicant would implement the following noise management and mitigation measures throughout the life of the Proposal.

- Strictly comply with the proposed hours of operation identified in **Table 2.11**.
- Regularly service all on-site equipment to ensure sound power levels of each item remains at or below the default/or factory-set values.
- Install frequency modulated reversing alarms to all mobile equipment.
- Ensure that all truck drivers would be required to comply with the Applicant's Drivers Code of Conduct outlining procedures for reducing noise impacts during transportation within the Project Site and off site.
- Maintain an open dialogue with the surrounding community and neighbours to ensure any concerns over noise or vibration are addressed.

#### 4.5.6 Assessment of Impacts

##### 4.5.6.1 Site Establishment and Construction Noise

The predicted noise levels assessed within the site establishment and construction phase under worst-case meteorological scenario conditions identified that all residences would comply with the relevant criteria.

##### 4.5.6.2 Operational Noise

The predicted noise levels assessed with the operational phase under worst-case meteorological scenario conditions identified that all residences would comply with the Project Specific Noise Level operational noise criteria of 35dB(A). Furthermore, EMM (2014) determined that cumulative noise emissions associated with the Proposal and the Girilambone Copper Mine would be insignificant.

##### 4.5.6.3 Sleep Disturbance

Maximum noise levels at all residences were modelled under the same worst-case meteorological conditions as for the operational scenario, identifying that  $L_{max}$  noise levels associated with road train loading operations satisfied the sleep disturbance criteria at all residences.

##### 4.5.6.4 Road Traffic Noise

The predicted noise levels, under both cumulative transport scenarios between the Proposal and the Girilambone Copper Mine identified that the predicted road traffic noise levels satisfy the *NSW Road Noise Policy* criteria at all residences on Booramugga and Yarrandale Roads and along the Mitchell and Barrier Highways.



## 4.6 BLASTING AND VIBRATION

*The Blasting and Vibration Assessment was included as part of the Noise Impact Assessment for the Proposal and was undertaken by EMGA Mitchell McLennan (EMM). The full assessment is presented as **Appendix 8** and is referred to hereafter as EMM (2014). This subsection presents an overview of that assessment and should be read in conjunction with the full assessment.*

### 4.6.1 Introduction

Based on the risk analysis undertaken for the Proposal (Section 5.2 and **Table 5.3**), the potential impacts relating to noise factors and their risk rankings after the adoption of standard mitigation measures are as follows.

- Amenity impacts on residential and other sensitive residences (low risk).
- Flyrock ejected outside blast envelope resulting in damage to nearby residences / surrounding property / infrastructure / stock (low risk).
- Flyrock ejected outside blast envelope resulting in injury or death (low risk).
- Flyrock and airblast impacting upon airborne aircraft and aerial operations (low risk).

Whilst blasting is not specifically outlined within the DGRs as requiring particular assessment, it was identified within the risk assessment that blasting poses a low risk and as such, blasting studies were undertaken as a component of the noise and vibration assessment and have been addressed separately within this section of the *Environmental Impact Statement*.

### 4.6.2 Blasting Criteria

The EPA adopts blasting assessment criteria based on the human comfort criteria identified in the document *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration – September 1990* published by the Australian and New Zealand Environment and Conservation Council (ANZECC, 1990). These criteria have been adopted for blasting for the Proposal and are as follows.

- The recommended maximum overpressure level for blasting is 115dB(L).
- The level of 115dB(L) may be exceeded for up to 5% of the total number of blasts over a 12-month period, but should not exceed 120dB(L) at any time.
- The recommended maximum vibration velocity for blasting is 5mm/s Peak Particle Velocity (PPV).
- The PPV level of 5mm/s may be exceeded for up to 5% of the total number of blasts over a 12-month period, but should not exceed 10mm/s at any time.

### 4.6.3 Assessment Methodology

As specific details relating to the Maximum Instantaneous Charge that would be required to construct the box cut and portal to access the underground mining operations were not available at the time of completion of EMM (2014), the blasting assessment assumed a very conservative Maximum Instantaneous Charge of 1000kg. The closest residence (Residence R3 at 2 400m away from the proposed box cut and portal location) was used during the assessment, with more distant residences likely to receive lower vibration and air blast impacts than those modelled. It is recognised that the actual Maximum Instantaneous Charge would be significantly less than the modelled Maximum Instantaneous Charge of 1000kg. However, if compliance is met at 1000kg, it is assumed any blasts less than 1000kg would be well below all blasting criteria.

Blast overpressure and vibration results were calculated using the method given in the Australian Standard *AS2187-2: Explosives – Storage and use Part 2: Use of explosives*, (2006) and ICI Explosives Blasting Guide, as applicable to blasting in hard rock.

### 4.6.4 Assessment of Impacts

The blast overpressure and vibration calculations identified that the use of a Maximum Instantaneous Charge of 1 000kg or less would result in compliance with the ANZECC blasting criteria at the nearest Residence R3 as displayed in **Table 4.22**.

**Table 4.22**  
**Blast Calculations at 1 000kg Maximum Instantaneous Charge**

Distance to Residence R3 (m)	Maximum Instantaneous Charge (kg)	Derived overpressure (dB(L)peak)	Derived vibration PPV (mm/s)
2 400	1 000	107	5
<b>Criteria</b>		<b>115</b>	<b>5</b>
Source: Modified from EMM (2014) - Table 5.4			

It has also been assessed that due to the distance between privately-owned residences and the proposed box-cut, no issue would occur with regards to flyrock or blast fumes. Should blast fumes be visible at surrounding residences, the Applicant would undertake a review of the blast in question and discuss with the blasting contractor to identify the issue and ensure that it is not repeated should further blasts be required.

### 4.6.5 Monitoring

The Applicant would ensure that initial blasts are monitored to determine compliance with the criteria identified in Section 4.6.2 at distances less than 2.4km from the box cut. Once compliance has been demonstrated, monitoring would be discontinued.

## 4.7 HISTORIC HERITAGE

*The historic heritage assessment of the Proposal was undertaken by OnSite Cultural Heritage Management Pty Ltd (OnSite CHM). The full assessment is presented in **Appendix 9** and is referenced throughout this section as OnSite CHM (2014b), with a summary of the assessment presented in the following subsections.*

### 4.7.1 Introduction

Based on the risk analysis undertaken for the Proposal (Section 5.2 and **Table 5.3**), the potential impacts relating to historic heritage and their risk rankings after the adoption of standard mitigation measures are as follows.

- Impact to known European heritage sites within the Project Site (low risk).

In addition, the DGRs identify “**Historic Heritage**” as a key issue for assessment in the *Environmental Impact Statement*. The principal assessment matter from DP&E relating to historic heritage matters include a historic heritage assessment which must include a statement of heritage impact for any state significant or locally significant historic heritage items.

### 4.7.2 Historical Record

The area surrounding the Project Site was first explored in 1828 by Charles Sturt who named the Bogan River, with Major Mitchell further exploring and surveying the area in 1835. The municipality of Bogan was proclaimed on 17 February 1891, with Nyngan having a population of 1 355 in that year. The wider Bogan Shire was incorporated in 1906.

The earliest retrievable records indicate that land within the southern section of the Project Site was owned by Mr Kenneth MacKinnon in 1910, with a total of 4 087 acres. The land was utilised not only for grazing but also for mining or at least mineral prospecting (OnSite CHM, 2014b).

Land within the northern section of the Project Site comprised part of a wider 1 575 acres that in 1910 was under the control of Mr Henry Thorpe, with the land also used for both grazing and mining purposes.

Throughout the 20th Century until present, the area surrounding the Project Site was utilised intermittently for agricultural purposes, with the continuation of localised mining operations associated with historic copper deposits and from the 1980s onwards, commencement of modern mining operations.

### 4.7.3 Background Research

A search of the following historic-heritage databases was undertaken on 26 May 2014.

- The Commonwealth Department of Environment website for items on the Australian Heritage Database including the National Heritage List, Commonwealth Heritage List and Register of the National Estate.

- Office of Environment and Heritage Database – for items listed under the:
  - State Heritage Register as administered by the Heritage Council of NSW and under the statutory protection of the *NSW Heritage Act 1977*; and
  - State Heritage Inventory – this includes items listed by local government and State agencies.
- *Bogan Shire Local Environmental Plan 2011*.

The results of the database searches identified that no of Federal, State or locally identified historic heritage places or items are registered within the Project Site.

#### 4.7.4 Survey Methodology

Further to the background database searches, a field survey was conducted by OnSite CHM in association with the Aboriginal heritage surveys. The methodology for both surveys is fully described previously in Section 4.2.6.

#### 4.7.5 Survey Results

OnSite CHM (2014b) identified three historic heritage sites, namely Avoca Tank 4, Avoca Tank 6 and Avoca Tank 7 (**Figure 4.8**). Details of each site are included in **Table 4.23** and locations shown on **Figure 4.8**.

**Table 4.23**  
**Historic Heritage Sites**

Site Name	Site Features	Easting	Northing
Avoca Tank 4	Historic Scar Tree and Aboriginal Stockman's camp	55 485027	6547775
Avoca Tank 6	Historic glass fragment	55 485381	6548386
Avoca Tank 7	Historic glass bottle (1939)	55 484392	6549640
Source: OnSite CHM (2014b) – Table 5.1.			

Avoca Tank 4 was also recorded as a site of the same name as part of the Aboriginal heritage assessment. Avoca Tank 4 comprises the following historical heritage components:

- A likely man-made or modified natural waterhole.
- An earthenware ceramic jar and flattened tin can.
- Three blackened rocks, likely used as part of a campfire.
- An iron strip wedge, which may have been for bark extraction or for locking of cart wheels in place.
- A scar tree with sharp, straight and even edged axe marks, indicating the use of a steel axe.

The Aboriginal community members participating in the survey were of the opinion that the Avoca Tank 4 site represented the remains of an Aboriginal stockmen's camp. During the early years of European settlement and pastoral activity, Aboriginal people remaining in the area were widely employed as stockmen which included practices of clearing lands and ring barking trees.

Both Avoca Tank 6 and Avoca Tank 7 represent isolated finds likely reflecting a low level of pastoral activity.

#### **4.7.6 Mitigation Measures**

The Applicant would implement the management and mitigation measures identified in Section 4.2.9, as well as the following additional measures.

- Ensure Avoca Tank 4 is fenced with a suitable buffer for the life of the Proposal.
- Ensure that mine site personnel are aware of the location of Avoca Tank 4 and provide the location of the site on mine plans.
- Ensure all work crews would be informed that the fenced area are "no-go" areas for the duration of the works.
- Ensure that mine site personnel do not disturb historic artefacts at Avoca Tank 6 and Avoca Tank 7.
- Ensure that mine site personnel report any additional historic finds they may find and not remove or disturb historic artefacts.

Avoca Tank 6 and Avoca Tank 7 are of considerable distance from the Proposed Limit of Disturbance and would not be impacted by the Proposal.

#### **4.7.7 Assessment of Impacts**

Avoca Tank 4 is deemed to have a moderate to high level of cultural significance (Aboriginal and archaeological significance). The scar tree has rarity value due to their steady state of decline within the natural environment and vulnerability to destructive natural and biological elements. Whilst the explanation for the site as an Aboriginal stockman's camp remains anecdotal, it is a plausible explanation for the presence of the different features and as such, is relatively rare in the immediate area. Avoca Tank 4 is therefore considered significant at the local level with both Avoca Tank 6 and 7 assessed to be of low significance.

Based upon the avoidance of all historic heritage sites, including the implementation of the outlined mitigation measures for Avoca Tank 4, it has been determined that there would be a negligible impact upon the local or regional historic heritage as a result of the Proposal.



## 4.8 AIR QUALITY

*The air quality assessment for the Proposal was prepared by RW Corkery & Co Pty Limited based on experience with similar mining projects in western NSW.*

### 4.8.1 Introduction

Based on the risk analysis undertaken for the Proposal (Section 5.2 and **Table 5.3**), the potential impacts relating to air quality factors and their risk rankings after the adoption of standard mitigation measures are as follows.

- Amenity impacts on residents and other sensitive residences (low risk).
- Health and / or amenity impacts on residential and other sensitive residences (low risk).
- Increased dust load on crops on surrounding agricultural land (low risk).

In addition, the DGRs identify “**Air Quality**” as a key issue for assessment in the *Environmental Impact Statement* with the principal assessment matter from DP&E being that

“The EIS must describe what measures would be implemented to avoid, minimise, mitigate, offset, manage and/or monitor the potential impacts on Air Quality, particularly any potential dust impacts on nearby private receptors from construction, operation and road haulage.”

Additional matters for consideration in preparing the *Environmental Impact Statement* were also provided in the correspondence attached to the DGRs from EPA. The additional matters identified are generally consistent with the DGRs.

The DGRs require that the air quality assessment refer to the following guideline document.

- *Approved Methods for Sampling and Analysis of Air Pollutants* (DEC, 2007)

The following subsections consider the existing environment, the sources of dust emissions, proposed management measures and impact assessment. In light of the rural and isolated location of the Project Site, and the fact that the only seven residences are located within 5km of the Project Site, it is not considered necessary to undertake air quality modelling to complete an assessment of the likely impact of the Proposal. Rather a qualitative air quality assessment, focussing on the potential impacts of principal pollutants, has been prepared.

It is noted that emissions to the air associated with construction and operation of the water pipeline and power transmission line would be limited and short-term in nature. As a result, air quality emissions associated are not included in this assessment.

In addition, it is also noted that the proposed activities and their associated greenhouse gas emissions would be limited in nature and would largely replace activities that are currently being undertaken at the Applicant’s Girilambone Copper Mine. In light of this, assessment of greenhouse gas emissions has not been undertaken

## **4.8.2 Existing Environment**

### **4.8.2.1 Introduction**

Air quality surrounding the Project Site is typical of an outback/rural environment where influences are determined principally by the season, the extent and nature of surrounding agricultural activities and mining activities undertaken at the adjacent Girilambone Copper Mine.

### **4.8.2.2 Existing Sources of Air Pollutants**

The closest operations with the potential to generate particulate emissions are associated with the Girilambone Copper Mine, located immediately south of the Project Site. The Girilambone Copper Mine (see Section 1.4.3.2) currently extracts material from a combination of open cuts and underground operations. Waste rock is currently placed in-pit or underground and ore material is either placed on the Murrawombie Heap Leach pads or transported to the Tritton Copper Mine for processing.

As a result, potential sources of particulate emissions from the Girilambone Copper Mine include:

- dust emissions associated with the unloading and loading of waste rock and ore material;
- wind-generated dust from exposed areas (i.e. open cuts , waste rock emplacements and haul roads); and
- dust entrainment due to vehicle movements on internal roads; and

Furthermore, the local area is subject to agricultural activities which may also result in particulate emissions associated with:

- the movement of farm vehicles or livestock over unsealed access roads, farm tracks and areas devoid of vegetation;
- cropping activities, particularly ploughing, sowing and harvesting;
- the movement of vehicles on the unsealed local road network; and
- wind-blown dust from cleared or heavily grazed areas.

#### 4.8.2.3 Background Deposited Dust Levels

The Applicant collects deposited dust data from a range of locations within the Project Site and in the vicinity of the Tritton and Girilambone Copper Mines and Hermidale. The locations of the monitoring points are presented on **Figure 4.12** and an overview of the results of the monitoring program from December 2011 to August 2013 is presented in **Table 4.24**. The results may be summarised as follows.

- Average deposited dust results at locations that are remote from the Applicant's existing mining operations vary between  $0.4\text{g/m}^2/\text{month}$  and  $2.7\text{g/m}^2/\text{month}$ . This is in line with background deposited dust results within rural communities throughout western NSW.
- Average deposited dust levels in close proximity to the Applicant's Girilambone and Tritton Copper Mines vary between  $0.5\text{g/m}^2/\text{month}$  and  $5.9\text{g/m}^2/\text{month}$ , with two locations recording average deposited dust levels of  $8.1\text{g/m}^2/\text{month}$  (Site TD23) and  $25.9\text{g/m}^2/\text{month}$  (TD3B). These monitoring locations are in close proximity to the Tritton Copper Mine's Waste Rock Emplacement and the elevated deposited dust values are likely to be related to waste rock placement and wind generated dust from the exposed surface of the emplacement.

#### 4.8.3 Potential Sources of Dust Emissions

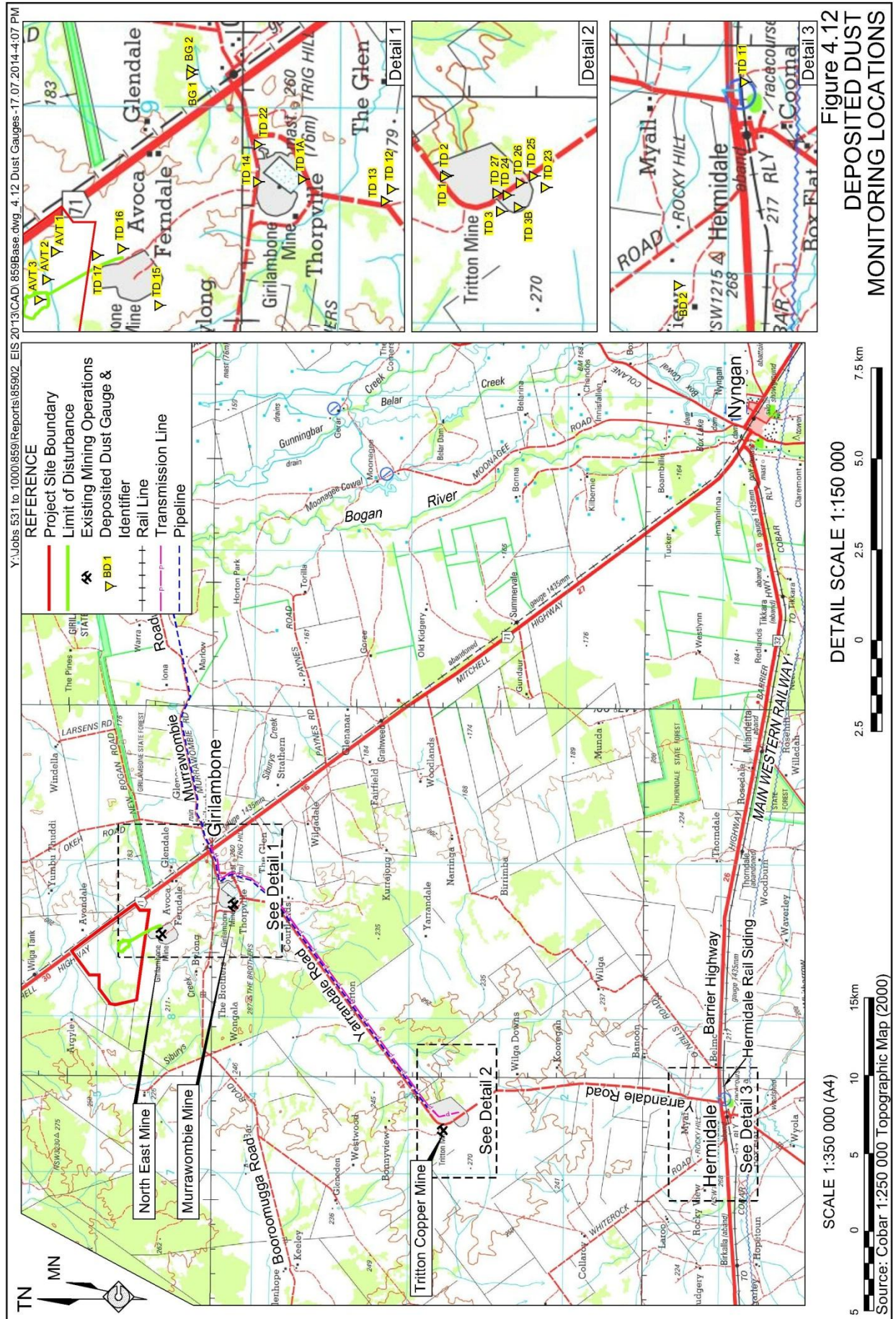
Potential sources of dust emissions associated with the Proposal include the following.

- Construction of the various surface infrastructure components.
- Surface-based materials handling activities across the Project Site including front-end loader operation in the vicinity of the ROM Pad.
- Haulage of material from the Box Cut to the ROM Pad or waste rock emplacement and the movements of vehicles on the unsealed site access road.
- Placement of material onto the ROM Pad and waste rock emplacement.
- Wind erosion associated with exposed surfaces throughout the Project Site.
- Maintenance of unsealed roads.

Stockpiles associated with the stripping of topsoil would be stabilised shortly after construction and would therefore not be a significant contributing source to air quality emissions.

#### 4.8.4 Air Quality Guidelines

In NSW, accepted practice is that dust-related nuisance can be expected to impact on residential areas when annual average dust deposition levels exceed  $4\text{g/m}^2/\text{month}$  or the existing dust deposition levels as a result of a Proposal would increase by more than  $2\text{g/m}^2/\text{month}$ .



**Table 4.24**  
**Deposited Dust Monitoring Results – 2012 and 2013**

Location		Insoluble Solids (g/m <sup>2</sup> /month)			
Site	Identifier	No. Samples	Average	Min	Max
<b>Background Monitoring Results</b>					
Avoca Tank	AVT1	12	0.8	0.1	1.6
Avoca Tank	AVT2	12	0.9	0.2	2.4
Avoca Tank	AVT3	12	0.4	0.1	0.6
Budgery	TD8A	20	1.8	0.4	5.1
Yarrandale Rd	TD12	19	2.0	0.1	11.3
Yarrandale Rd	TD13	20	0.9	0.1	2
Girilambone	BG1	19	0.7	0.1	1.5
Girilambone	BG2	18	2.7	0.2	15.5
<b>Girilambone Copper Mine</b>					
Murrawombie	TD1A	20	3.3	0.5	13.6
Murrawombie	TD14	20	2.5	0.7	6.5
North East	TD15	17	0.5	0.1	1.2
North East	TD16	20	0.7	0.2	1.5
North East	TD17	20	0.6	0.1	1.6
Murrawombie	TD22	19	0.6	0.2	1.2
<b>Tritton Copper Mine</b>					
Yarrandale Rd	TD1	20	1.1	0.2	4
Yarrandale Rd	TD2	20	1.3	0.2	3.8
Tritton	TD3	19	2.3	0.4	10.6
Tritton	TD3B	19	25.9	1.1	85
Tritton	TD23	18	8.1	1.1	50.3
Tritton	TD24	20	4.7	0.8	27.9
Tritton	TD25	20	5.4	0.4	21.5
Tritton	TD26	20	5.9	1.6	21.3
Tritton	TD27	20	2.1	0.1	10.4
Source: Tritton Resources Pty Ltd.					

#### 4.8.5 Management and Mitigation Measures

The Applicant would implement the following management and mitigation measures throughout the life of the Proposal.

- Limit, where practicable, excavation of material during periods of high winds.
- Limit disturbance to the minimum area necessary for mining and associated activities.
- Operate the largest practical truck size to reduce the number of movements necessary to transport the ore and waste rock.



- Adhere to all vehicle speed limits.
- Profile all surfaces to reduce velocity of overland winds.
- Apply vegetative cover to non-operational exposed surfaces such as water management structures and soil stockpiles as soon as practical after disturbance.
- Maintain ore handling areas / stockpiles in a moist condition by using water carts to water down areas likely to generate wind-blown and traffic-generated dust.
- Apply water to all roads and trafficked areas using water trucks to minimise the generation of dust.
- Water stockpiles to maintain moisture content and minimise the generation of dust.
- Minimise drop heights when loading ore material for transportation to the Tritton Copper Mine.
- Clearly define all haul roads edges with marker posts or equivalent to control their locations, especially when crossing large areas of non-descript disturbance.
- Close, rip and revegetate all obsolete roads.
- Reshape, topsoil and rehabilitate all completed areas as soon as practicable after the completion of mining operations.

#### **4.8.6 Assessment of Impacts**

Based on the proposed best practice management measures and operational controls, the distance to surrounding residences, the results of the Applicant's existing dust monitoring program and the experience of R.W. Corkery & Co. Pty Limited, the Proposal would be highly unlikely to result in dust levels that would exceed the air quality guidelines at residences surrounding the Project Site.

#### **4.8.7 Air Quality Monitoring**

Monitoring of deposited dust levels would continue to be undertaken at locations AVT1, AVT2 and AVT3 throughout the life of the Proposal. All deposited dust monitoring results would be reported within *Annual Environmental Management Reports* that would be prepared as a condition of the Mining Lease.

### **4.9 SURFACE WATER**

*The surface water assessment of the Proposal was undertaken by RW Corkery & Co Pty Limited based on experience with similar mining projects in western NSW*

#### 4.9.1 Introduction

Based on the risk analysis undertaken for the Proposal (Section 5.2 and **Table 5.3**), the potential impacts relating to surface water factors and their risk rankings after the adoption of standard mitigation measures are as follows.

- Discharge of sediment-laden water impacting upon riverine ecology and downstream users (low risk).
- Pollution of surface water and shallow groundwater (low risk).
- Impact on surface or groundwater biota within surface water and shallow groundwater environments (low risk).
- Diversion and retention banks erosion / instability leading to increased sediment loads (low risk).

In addition, the DGRs identify “**Water Resources**” as a key issue for assessment in the *Environmental Impact Statement*. The principal assessment matter from DP&E relating to surface water includes:

- “identification of any licensing requirements or other approvals under the Water Act 1912 and/or Water Management Act 2000;
- an assessment of potential impacts on the quality and quantity of existing surface ... water resources;
- a description of the measures proposed to ensure the development can operate in accordance with the requirements of any relevant Water Sharing Plan or water source embargo;
- an annual site water balance for representative years of the proposed life of the project; and
- a detailed description of the proposed water management system (including sewage), water monitoring program and other measures to mitigate surface and groundwater impacts.”

Additional matters for consideration in preparing the *Environmental Impact Statement* were also provided in the correspondence attached to the DGRs from NSW Office of Water and EPA. The additional matters identified are generally consistent with the DGRs.

Furthermore, the DGRs require that the surface water assessment refer to the *Soils and Construction: Managing Urban Stormwater* (Landcom, 2004) guidelines in addition to the water quality guidelines outlined in Section 4.4.

#### 4.9.2 Existing Environment

##### 4.9.2.1 Drainage

Regional, local and Project Site drainage is described in Section 4.1.2. In summary, the Project Site is located within the Macquarie - Bogan Catchment, with the Bogan River located approximately 25km to the east of the Project Site (**Figure 4.1**). Within the Project Site, two ephemeral, poorly defined, unnamed drainage lines, referred to as Drainage Line A and

Drainage Line B have been identified (**Figure 4.2**). Drainage Line A and B are first order streams prior to merging into a second order stream, approximately 0.5km from the Project Site's eastern boundary. The merged drainage line flows to the northwest before merging with the Wilga Tank Tributary.

#### 4.9.2.2 Surface Water Quality

Surface water within the Project Site is typically only present immediately following substantial rainfall. Surface water flow is anticipated to be primarily sheet flow and is likely to have elevated suspended sediment concentrations.

#### 4.9.2.3 Surface Water Users

The Applicant obtains makeup water from the Bogan River in the vicinity of its confluence with Gunningbar Creek (**Figure 4.1**). That water obtained under the following Water Access Licences issued under the *Water Management Act 2000*.

- WAL009374 – 705ML/year – high security.
- WAL009375 – 210ML/year – general security.
- WAL009940 – 16ML/year – supplementary water.

That water is pumped initially to storage facilities at the Girilambone Copper Mine via a pipeline within or parallel to the Murrawombie Road. From the Girilambone Copper Mine it is pumped to the Tritton Copper Mine and North East Open Cut. The village of Girilambone and residents along the route of the pipeline also access water via the pipeline.

In addition, other water users surrounding the Project Site capture water via overland flows and store it in on-farm storages. That water is used, when available, for watering stock.

### 4.9.3 Management and Mitigation Measures

Section 2.6 presents the surface water management and mitigation measures that would be implemented throughout the life of the Proposal.

### 4.9.4 Assessment of Impacts

The Applicant contends that the Proposal would have a negligible impact on the surface water environment within and surrounding the Project Site for the following reasons. Section references in parenthesis identify relevant sectors of this document where each of the following is discussed in more detail.

- Prepare and implement a *Water Management Plan* prior to the commencement of site establishment and construction operations. The plan would describe management of the following.
  - Sediment and erosion control.

- Hydrocarbons and chemicals.
- Water balance, including separation of clean, dirty and mine water and monitoring of water flows within the Project Site.
- Surface water and groundwater monitoring.
- Ensure that clean water is diverted away from areas of proposed disturbance and permitted to flow to natural drainage.
- Ensure that dirty water is retained until the suspended sediment concentration is less than 50mg/L prior to discharge. Alternatively use that water for mining related purposes. .
- Ensure that contaminated water, including saline groundwater, is retained and is not be permitted to flow to natural drainage.
- Manage the flow of make up water to ensure that discharge of water from the Mine Water Pond does not occur.
- Treat waste water would be using a suitable waste water treatment or pump out septic system.

#### 4.9.5 Monitoring

The Applicant would ensure that the concentration of dirty water within the sediment basin is less than 50mg/L prior to discharge to natural drainage lines.

### 4.10 TRAFFIC AND TRANSPORTATION

*The traffic and transportation assessment of the Proposal was undertaken by RW Corkery & Co Pty Limited based upon similar mining projects and associated traffic and transportation assessments.*

#### 4.10.1 Introduction

Based on the risk analysis undertaken for the Proposal (Section 5.2 and **Table 5.3**), the potential traffic and transportation-related impacts and their risk rankings after the adoption of standard mitigation measures are as follows.

- Increased traffic levels due to movement of workforce and contractors resulting in:
  - increased traffic congestion (low risk);
  - elevated risk of accident/incident on local roads (low risk); and/or
  - road pavement deterioration (low risk).

- Increased heavy vehicle movements for product transportation resulting in:
  - increased traffic congestion (low risk);
  - elevated risk of accident/incident on local roads (high risk); and/or
  - road pavement deterioration (moderate risk).

In addition, the DGRs identify “**Traffic and Transport**” as a key issue for assessment in the *Environmental Impact Statement* with the assessment matters from DP&E including:

- “An assessment of potential traffic impacts on the capacity, efficiency and safety of the road network, in particular the assessment must include a Road Safety Audit to review the condition of the proposed routes and identify and safety issues which may be exacerbated by the development.
- A description of the measures that would be implemented to maintain and/or improve the capacity, efficient and safety of the road network in the surrounding area of the life of the Project.”

Additional matters for consideration in preparing the *Environmental Impact Statement* were also provided in the correspondence attached to the DGRs from Roads and Maritime Services (RMS) and Bogan Shire Council. The additional matters identified are generally consistent with the DGRs.

#### **4.10.2 Existing Road Traffic Environment**

Section 2.7.2 provides a description of the road network surrounding the Project Site. In summary, ore material and would be transported from the Project Site to the Tritton Copper Mine via the following route (**Figure 4.12**). This route would also be used by light and heavy vehicle traffic travelling between the Tritton Copper Mine and the Project Site.

- The proposed Site Access Road.
- The existing private haul road between the North East and Murrawombie operations.
- Booramugga and Yarrandale Roads.

Booramugga and Yarrandale Roads are both local public roads, with the vast majority of traffic on these roads related to the Applicant’s operations. The roads are in good condition and are administered by Bogan Shire Council.

Traffic travelling between Nyngan and the Project Site would do so via the Mitchell Highway and Booramugga Road (**Figure 4.12**).

The Applicant has been advised that traffic count data on Booramugga and Yarrandale Roads is not available. However, the Applicant undertook a road traffic noise assessment to support an application to permit 24-hour transportation of ore material between the Girilambone and Tritton Copper Mines via Yarrandale Road (Bridges, 2013). That noise assessment included a count of road train traffic during ore transportation operations between 7.43am and 3.30pm on 15 October 2013. During that 7 hour, 48 minute period, 26 road train passbys were recorded. Conservatively assuming that this rate of transportation is sustained for a full 24 hour period, the existing road train transport is approximately 80 movements per day.

As noted in Section 1.4.3, approval exists for transportation of up to 1Mtpa from the combined Girilambone Copper Mine operations to the Tritton Copper Mine. At an indicative capacity of 52t per two trailer road train and transportation operations on approximately 270 days per year, the approved daily heavy vehicle movements is approximately 140 per day (70 loads).

In addition, to ore transportation operations, the Applicant estimates that there are an average of approximately four non-ore related heavy vehicle and 12 light vehicle movements per day between the Girilambone and Tritton Copper Mines. The Applicant also estimates that traffic levels associated with local residents and non-mining activities is limited and is conservatively estimated at between 20 and 40 movements per day.

Finally, the Applicant anticipates that the Proposal would replace traffic that would otherwise travel between the Girilambone and Tritton Copper Mines. As a result, **Table 4.25** presents the anticipated traffic levels on Booramugga and Yarrandale Roads associated with all of the Applicant's operations, both approved and proposed.

**Table 4.25**  
**Anticipated Maximum Daily Traffic Movements<sup>1</sup>**

Route	Applicant-related Movements			Non-Applicant Related Movements
	Light Vehicles	Heavy Vehicles	Long and Oversize Vehicles	
Proposal Construction				
Project Site – Tritton Copper Mine	12	2	nil	20 to 40
Project Site – Nyngan	24	4	nil	
Proposal Operation				
Project Site – Tritton Copper Mine	6	2	50 <sup>2</sup>	20 to 40
Project Site – Nyngan	12	2	nil	
Note 1: Two vehicle movements = one return trip.				
Note 2: Based on the maximum production rate of 316 000tpa, transportation operations on 270 days per year and 52t per load.				
Source: Tritton Resources Pty Ltd.				

As a result, existing and proposed traffic levels on Booramugga and Yarrandale Road is expected to be between 78 and 98 movements per day. This is significantly below the 500 movements per day recognised as a level appropriate to local rural roads.

In light of this the Applicant has not undertaken a Road Safety Analysis or formal intersection or road performance analysis.



#### 4.10.3 Management and Mitigation Measures

The Proponent would implement the following management and mitigation measures throughout the life of the Proposal.

- Water or treat internal roads with chemical suppressants, where appropriate, to minimise dust generation.
- Restrict vehicle speed on the Site Access Road to 80km/hr or such lower speeds as may be appropriate.
- Ensure that all vehicles transporting ore are not loaded beyond their legal capacity.
- Ensure that the trays of all heavy vehicles transporting ore are covered prior to leaving the ROM Pad.
- Prepare, implement and enforce a Driver's Code of Conduct for all heavy vehicle drivers accessing the Project Site regularly.
- Investigate any complaints in relation to transportation operations promptly.

#### 4.10.4 Assessment of Impacts

In light of the above, the Applicant contends that the Proposal would not adversely impact on the public road network surrounding the Project Site.

### 4.11 VISUAL AMENITY

*The visual amenity assessment of the Proposal was undertaken by RW Corkery & Co Pty Limited based upon similar mining projects in Western NSW.*

#### 4.11.1 Introduction

Based on the risk analysis undertaken for the Proposal (Section 5.2 and **Table 5.3**), the potential visibility-related impacts and their risk rankings after the adoption of standard mitigation measures are as follows.

- Amenity impact through change in content and composition of views from residences and public vantage points (low risk).
- Visual intrusion or reduction in scenic quality at residential and other sensitive receptors (moderate risk).
- Local amenity impact of visibility of industrial traffic on residential and other sensitive receptors (low risk).

In addition, the DGRs identify “*Visual Amenity*” as a key issue for assessment in the *Environmental Impact Statement* with the principal assessment matter from DP&E being that:

“The EIS must describe what measures would be implemented to avoid, minimise, mitigate, offset, manage and/or monitor the potential impacts on visual amenity.”

Additional matters for consideration in preparing the *Environmental Impact Statement* were also provided in the correspondence attached to the DGRs from Bogan Shire Council. The additional matters identified are generally consistent with the DGRs.

It is noted at the outset that the value placed upon visual amenity and the impacts upon surrounding visual amenity varies from person to person and from location to location. As a result, a visual amenity assessment is, by its nature, highly subjective. As a result, emphasis has been placed on providing a description of the existing visual amenity surrounding the Project Site and the measures that would be undertaken by the Applicant to minimise potential visual amenity-related impacts on surrounding residents and publically accessible vantage points.

#### 4.11.2 Existing Visual Amenity

The existing visual amenity surrounding the Project Site is typical of rural areas in western NSW, with the outlook from most rural residences and other vantage points predominantly that of scrubby woodland vegetation within land cleared and developed for agriculture.

To the south of the Project Site, views of the Applicant’s mining operations at the Tritton and Girilambone Copper Mines are available from Booramugga and Yarrandale Roads.

The Project Site is effectively screened in all directions by natural woodland vegetation. The closest residence (Residence R3) and publically accessible vantage point (on the Mitchell Highway on the eastern boundary of the Project Site), are approximately 2.4km and 1.5km respectively from the closest area of proposed disturbance.

The Project Site is located in a landscape with very few artificial light sources. These include:

- the Applicant’s operations at the Girilambone Copper Mine;
- vehicles, including the Applicant’s vehicles moving on local roads; and
- lights from rural residences and agricultural operations.

#### 4.11.3 Management and Mitigation Measures

The Applicant would implement the following management and mitigation measures throughout the life of the Proposal. It is noted that many of these controls serve a dual function in the management of other environmental parameters, such as air quality management and rehabilitation.

- Design surface infrastructure to ensure that the height of any stockpiles (ROM Pad and waste rock emplacement) or buildings (workshop, office and crib room) are constructed to the lowest manageable height to reduce the potential for components to be visible on the horizon from surrounding locations.

- Construct built structures from dull coloured, non-reflective materials.
- Undertake active dust suppression to reduce the potential for the creation of a ‘dust cloud’ over the Project Site.
- Include appropriate waste management to ensure that wind-blown rubbish does not spread from the Project Site.
- Orientate night lighting towards the active areas of operation and towards the ground, minimising the light spill from the Project Site.
- Ensure that lighting not required is turned off.
- Decommission and remove surface infrastructure following the completion of extraction operations, ultimately returning the Project Site to a post-mining comparable landform through rehabilitation and revegetation activities.

#### **4.11.4 Assessment of Impacts**

Based on the relative isolation of the Project Site (both from surrounding residential locations and public vantage points such as roads), and the proposed visual amenity related controls, it is assessed that the proposed activities would not impact significantly on local visual amenity.

The proposed final landform would also provide for a landscape amenable for future agricultural uses and should therefore eventually blend with the surrounding undisturbed lands.

### **4.12 BUSH FIRE MANAGEMENT**

*The bush fire management assessment of the Proposal was undertaken by RW Corkery & Co Pty Limited and draws information from EnviroKey (2014).*

#### **4.12.1 Introduction**

Based on the risk analysis undertaken for the Proposal (Section 5.2 and **Table 5.3**), the potential impacts relating to bush fire and their risk rankings after the adoption of standard mitigation measures are as follows.

- Fire initiated off site threatening Site operations, impacting on-site stock and infrastructure (moderate risk).
- Fire initiated on site threatening Site operations or spreading off site and impacting on stock and infrastructure (moderate risk).

In addition, Bogan Shire Council identified that the *Environmental Impact Statement* should “Detail management activities to reduce the potential for bushfires and emergency procedures in the event of a bushfire.”

This subsection identifies the dominant vegetation type within the Project Site and surrounding landholdings in order to determine the potential bush fire hazard associated with the Proposal.

In identifying the bush fire hazard, the document *Planning for Bushfire Protection* produced by the NSW Rural Fire Service in consultation with the then Planning NSW (now Department of Planning and Environment) in 2006 (RFS, 2006), forms the basis of the identification of bush fire hazard.

## **4.12.2 Existing Bush Fire Hazard Environment**

### **4.12.2.1 Vegetation**

As identified in Section 4.3.5.2, the vegetation within and surrounding the Project Site is dominated by Poplar Box Woodland with varying intergrades of Gum Coolabah, Cypress Pine and occasional Mulga, generally defined by EnviroKey (2013) as ‘Poplar Box – Gum-barked Coolabah – White Cypress Pine shrubby woodland mainly in the Cobar Peneplain Bioregion (Benson 103)’.

RFS (2006) classifies vegetation into 12 ‘formations’, based upon designations defined within Keith (2004), and a variety of ‘sub-formations’ to provide an indication of flammability and therefore bush fire hazard. The vegetation within the Project Site has been classified as Formation 11 – Semi-arid woodlands (Low Woodlands) – Shrubby sub-formation’, which has been paraphrased from RFS (2006) as woodland with widely spaced tree canopies <15m high and an understorey of drought resistant shrubs and variable grass cover. This sub-formation is prevalent in the western plains region with rainfall between 250mm/year to 500mm/year. A maximum fuel load of 8t/ha is assigned to this vegetation type.

The vegetation of the landholdings surrounding the Project Site is dominated by the same vegetation community as found on the Project Site.

### **4.12.2.2 Slope Classification**

The Project Site typically displays very low slopes (<5 °).

### **4.12.2.3 Distance to Activities**

In calculating the distance from the vegetation to the activities, it has been assumed that during a bush fire event, people would withdraw from vegetated areas to either open areas (i.e. the hardstand, waste rock emplacement or ROM Pad) or the relative safety of the buildings.

Buildings are generally located within the centre of the area of disturbance (or surrounded by hardstand areas that would act as a fire break) with an average setback distance at least 30m to vegetated areas.

#### 4.12.2.4 Hazard Assessment

The bush fire hazard assessment takes into account not only the vegetation and associated bush fire hazard within the Project Site, but the vegetation immediately surrounding the Project Site, the local area generally and the Fire Danger Index (FDI), determined by location and included within RFS (2006). **Table 4.26** presents the parameters for the assessment, which were then compared to RFS (2006) to determine bush fire hazard (referred to as bush fire attack category in RFS (2006)).

**Table 4.26**  
**Bush fire Hazard Assessment**

Assessment	Vegetation Classification	Slope	Distance to Vegetation	FDI	Category of Bush fire Attack
Formation 11	Semi-arid woodlands (Low Woodlands) – Shrubby sub formation	<5°	>15m	80	Level 1 (Moderate)
Source: Based RFS (2001) – Appendix 3.3.					

A moderate category of bush fire attack describes a site or asset where specific construction requirements for buildings are required (outlined in Section 4.12.3)

The result of the bush fire hazard assessment generally reflects the land within the Project Site and surrounds being defined as ‘Category 1 bush fire prone land’, as identified in the Bogan LEP.

#### 4.12.3 Management and Mitigation Measures

The Applicant would implement the following management and mitigation measures throughout the life of the Proposal to manage risks associated with bush fire that may impact on the Project Site.

- Ensure that personnel are evacuated from the underground mine in the event of a bush fire encroaching upon or starting within the Project Site.
- Consider evacuation of all non-essential personnel from the Project Site if required.
- Liaise with Rural Fire Service or other emergency service personnel, in the event of a bush fire and provide all assistance required, including equipment and personnel, and follow all instructions in relation to fire management.

In addition, the following management and mitigation measures would be implemented throughout the life of the Proposal to prevent a bush fire starting as a result of Proposal-related activities.

- Undertake refuelling within the designated refuelling bay or within cleared areas, with all vehicles turned off during refuelling.
- Enforce a no smoking policy in designated areas of the Project Site.
- Maintain fire extinguishers within site vehicles and refuelling areas.

- Ensure housekeeping activities are maintained to limit potential fuel loads within the active sections of the Project Site.
- Ensure a water cart with fire fighting capabilities would be available to assist in extinguishing any fire ignited.
- Ensure a cleared area of at least 15m is maintained around all buildings and other infrastructure within the Project Site.

#### 4.12.4 Assessment of Impact

In light of the relatively low bush fire risk within the Project Site and proposed management and mitigation measures, the Applicant contends that the Proposal would not result in a significant adverse bush fire-related risk.

### 4.13 SOIL AND LAND CAPABILITY

*The soil and land capability assessment of the Proposal was undertaken by RW Corkery & Co Pty Limited. The assessment draws on the results of a program of soil test pitting and analysis undertaken by Mr Greg Stephenson of Tritton Resources Pty Ltd.*

#### 4.13.1 Introduction

Based on the risk analysis undertaken for the Proposal (Section 5.2 and **Table 5.3**), the potential impacts relating to soil and land capability factors and their risk rankings after the adoption of standard mitigation measures are as follows.

- Inadequate soil available for rehabilitation purposes leading to less successful rehabilitation and increased rehabilitation costs and maintenance (low risk).
- Degradation of soil in stockpiles leading to less successful rehabilitation and increased rehabilitation costs and maintenance to the Mine Area (moderate risk).
- Erosion of soil stockpiles leading to increased sediment loads in creeks (low risk).

In addition, the DGRs identify “**Land Resources** – including ... soils and land capability” as a key issue for assessment in the *Environmental Impact Statement*.

Additional matters for consideration in preparing the *Environmental Impact Statement* were also provided in the correspondence attached to the DGRs from the EPA and DRE. The additional matters identified are generally consistent with the Director-General’s Requirements, with the addition of matters related to soil contamination and acid sulphate soils from the EPA.



#### 4.13.2 Existing Environment

##### 4.13.2.1 Regional Soil Landscapes

The soil resources of the Project Site is typical of that of the more elevated sections of the Boorindal Plains sub-region of the Cobar Peneplain, with red earths and red texture contrast soils with stony lag gravels on slopes.

The soils of the Girilambone – Hermidale area have been described by Walker (1991) as varying in depth and characteristics with their position in the landscape. Walker (1991) identifies two soil landscape units in the vicinity of the Project Site, as follows.

- Cobar Land System – comprising soils that are shallow gravely loamy soils, grading to deeper acid and neutral red earths with hardpans down slope and in drainage lines.
- Mineshaft Land System – comprising soils that are shallow stony, sandy and loamy soils and which deepen slightly along drainage lines.

Straits Resources (2009) identifies that the soils surrounding the Murrawombie Open Cut comprise sands and red brown sandy gravels and colluvial soil with a large number of quartzitic and schistose outcrops with skeletal soils. Silt clays and sandy loams predominate on the hill flanks and plains. Soils surrounding the North East Open Cut are described as red earths with very little topsoil present. Gully erosion is evident surrounding the North East Open Cut.

##### 4.13.2.2 Project Site Soils

A program of test pitting within the Project Site was undertaken by Mr Greg Stephenson of Tritton Resources Pty Ltd. That program comprised the following.

- Hand excavation of five soils pits to a depth of approximately 50cm. The location of each of the test pits is shown on **Figure 4.6**.
- Visual logging of each of the test pits.
- Collection of representative samples for analysis by the Soil Conservation Service.

**Table 4.27** presents a brief description the soil profiles within each test pit. In summary, the soils of the Project Site may be described as red earths with variable gravel and increasing clay with depth.

**Table 4.27**  
**Soil Test Pit Results**

	Description
Soil Profile 1	Red coloured, sandy loam with abundant gravel from the surface to 35cm. Below this, the soil becomes more clay rich, with less gravel. Roots of trees/shrubs were observed to a depth 32cm.
Soil Profile 2	Red coloured, sandy loam with abundant gravel from the surface to 39cm. Below this, the soil becomes more clay rich, with occasional gravel. Roots of trees/shrubs were observed to a depth 27cm.
Soil Profile 3	Red coloured, sandy loam with abundant limited gravel to a depth of 25cm. Below this, gravel is abundant to a depth of 34cm where the soil becomes more clay rich, with rare gravel. Roots of trees/shrubs were observed to a depth 25cm.
Soil Profile 4	Red coloured loam with rare gravel, except at the surface where gravel is common. Below a depth of 25cm, the soil becomes more clay rich. No roots were observed.
Soil Profile 5	Red coloured loam with abundant gravel from the surface to 23cm. Below this, the soil becomes more clay rich, with abundant gravel. Roots of trees/shrubs were observed to a depth 40cm.
Source: Tritton Resources Pty Ltd.	

**Table 4.28** presents the results of the soil analyses undertaken by the Soil Conservation Service. The results may be summarised as follows.

- Electrical conductivity/salinity – Electrical conductivity of soils within the Project Site is typically less than 40µs/cm, with Soil Profile 2 returning salinities of 50µs/cm and 70µs/cm, indicating that the Project Site soils are typically non-saline.
- pH – Optimal pH for plant growth is between 6.0 and 6.5. Near surface soils within the Project Site typically returned pH values between 6.3 and 7.2, with soils in Soil Profile 1 returning results less than 6.0. Subsoils tended to be slightly more alkaline than their associated topsoils. This indicates that soil pH within the Project Site is highly variable.
- Emerson aggregate test – Near surface soils within the Project Site are typically classified as Class 3(2) or Class 3(3). By contrast, deeper soils are typically classified as Class 2(2) or 3(3). As a result, the near surface soils may be classified as unlikely to be sodic or having a slight to moderate dispersibility. By contrast, the deeper soils may be classified as being likely to be sodic or having a high to moderate dispersibility.

#### **4.13.3 Project Site Land Capability**

Soils within the Project Site are identified as Class 6 land, or land with very severe limitations in accordance with OEH (2012). This corresponds with the current land use for the Project Site, which includes infrequent grazing agriculture.

**Table 4.28**  
**Soil Analysis Results**

Horizon	Depth (cm)	EC (µS/cm)	pH	CEC	Exchangeable Cations (me/100g)					P (mg/kg)	EAT	Texture
					Na <sup>+</sup>	K <sup>+</sup>	Ca <sup>2+</sup>	Mg <sup>2+</sup>	Al <sup>3+</sup>			
Soil Profile 1												
A1	8	10	5.4	6.2	0.3	0.7	2.2	1.4	0.5	4	3(2)	Fine sandy loam
A2	27	<10	5.8	6.2	0.4	0.5	2.2	1.8	0.4	2	3(2)	Fine sandy clay loam
B	>35	10	6.4	9.8	0.8	0.6	3.9	4.1	<0.3	1	2(2)	Clay loam
Soil Profile 2												
A	39	50	7.0	8.3	0.4	0.4	5.0	2.5	0.4	2	3(2)	Sandy clay loam
B	>39	70	7.4	11.9	0.5	0.5	6.8	3.9	0.4	1	3(3)	Clay loam
Soil Profile 3												
A1	25	10	6.3	7.5	0.3	0.7	4.0	1.8	0.4	2	3(2)	Fine sandy loam
A2	9	10	7.2	9.3	0.4	0.5	5.3	2.4	<0.3	1	2(1)	Fine sandy clay loam
B	>34	20	7.6	12.4	0.7	0.5	5.7	4.3	<0.3	<1	2(2)	Clay loam
Soil Profile 4												
A	25	10	6.7	13.2	0.4	0.8	6.8	3.5	<0.3	1	3(3)	Loam
B	>25	30	7.6	20.3	1.0	0.7	12.2	7.4	-	<1	2(1)	Clay loam
Soil Profile 5												
A	23	20	6.6	9.3	0.2	1.0	4.7	2.0	<0.3	3	3(2)	Loam
B	>23	40	7.1	10.0	0.5	0.7	4.4	2.2	<0.3	2	2(2)	Clay loam
Note 1: EC = Electrical conductivity; CEC = Cation Exchange Capability; EAT = Emerson Aggregate Test.												
Note 2: EAT Classes.												
<ul style="list-style-type: none"><li>Class 2(2) Highly likely to be sodic.</li><li>Class 2(1), 3(4), and 3(3) May be sodic.</li><li>Class 3(2) Unlikely to be sodic.</li></ul>												

#### 4.13.4 Management and Mitigation Measures

The Applicant would implement the following management and mitigation measures throughout the life of the Proposal.

- Minimise handling of all soils, so that they retain their structural integrity, by:
  - locating soil stockpiles adjacent to or as close as possible to disturbance areas;
  - stripping soil using a bulldozer or scrapper and directly placing that material into stockpiles; and
  - clearly marking areas for stripping and stockpiling.
- Strip topsoil from all areas of disturbance to a depth of approximately 20cm and store in stockpiles no more than 2m high.

- Strip subsoil within the footprint of the Box cut, Mine Water Pond, ROM Pad and waste rock emplacement to a depth of 50cm below the base of the topsoil and store in stockpiles no more than 3m high. Subsoil would not be removed from other areas of disturbance because those areas would not be subject to further excavation or compaction of the subsoil.
- Spread 100mm topsoil on the subsoil stockpile to facilitate revegetation.
- Refrain from stripping or placing soils during wet conditions.
- Ensure that the formed soil stockpile surfaces have a surface that is as ‘rough’ as possible, in a micro-scale, to assist in surface water runoff control and seed retention and germination.
- Spread seed of a suitable non-persistent cover crop on all soil stockpiles.
- Ensure that soil stockpiles are constructed with side slopes of 1:3 (V:H) or less and that the surface of all stockpiles achieves an effective 70% cover within 10 days of formation. This may be achieved through the use of mulches, spray on polymer-based products or hessian that would allow a vegetative cover to become established.
- Fence and signpost all soil stockpiles and limit operation of machinery on the stockpiles to minimise compaction and further degradation of soil structure.
- Construct clean water diversions/dirty water retention banks to direct overland surface water flow away from the soil stockpiles and retain sediment laden water.
- Maintain an inventory of all soil stripped, stockpiled and used during rehabilitation within the Project Site and elsewhere at the Applicant’s operations.

#### 4.13.5 Assessment of Impacts

Adherence to the recommended soil stripping, handling, stockpiling procedures and other management practices together with appropriate rehabilitation practices would result in a generally minimal impact to soils and land capability within the Project Site. Land capability of the final landform, with the exception of the Box cut, the Mine Water Pond, and the sediment basin would be the same as the existing land capability, namely Class 6 land. The Box cut would remain as a void and the Mine Water Pond and sediment basin would remain as water storages for the final land use.

## 4.14 AGRICULTURAL RESOURCE ASSESSMENT

*The agricultural resource assessment of the Proposal was undertaken by RW Corkery & Co Pty Limited with the assistance of the Applicant.*

### 4.14.1 Introduction

Based on the risk analysis undertaken for the Proposal (Section 5.2 and **Table 5.3**), the potential impacts relating to agricultural resource factors and their risk rankings after the adoption of standard mitigation measures are as follows.

- Inability of local business to compete with mining wages leading to reduced staff availability for local agricultural businesses (low impact).
- Mining operations leading to negative impacts on agriculture within the LGA (positive impact).

In addition, the DGRs identify “***agricultural impacts***” as a key issue for assessment in the *Environmental Impact Statement*. In its correspondence attached with the DGRs the Department of Primary Industries referred to agricultural resources as a matter to be addressed in the *Environmental Impact Statement* suggesting that an assessment consistent with that identified in the DGRs would be sufficient.

The development of mineral resources needs to be balanced with the continued use and preservation of productive agricultural resources. The term ‘agricultural resources’ is used here to describe the land upon which agriculture is dependant, the water that is used to sustain it and the industry and secondary businesses that develop to directly supply and support agriculture. As the Proposal is classified as ‘Regional Development’ the following assessment of the potential impact of the Proposal to agricultural resources has been based upon the DPI factsheet *Agricultural Issues for Extractive Industry Development*.

A range of matters identified in that fact sheet are addressed in previous subsections. These include:

- the location and description of the proposed development, including areas of temporary and permanent disturbance and hours of operation (Section 2); and
- an assessment of dust (Section 4.8), noise (Section 4.5), blasting (Section 4.6), visual amenity (Section 4.11), waste (Section 2.9), ecology (Section 4.3), bush fire hazards (Section 4.12) and emergency response measures such as spill kits (Section 2.8).

In addition, general information in relation to management of and impacts upon groundwater, surface water, transport and rehabilitation is provided in Sections 4.4, 4.9, 4.10 and 2.13 respectively.

The following subsections include assessments of potential agricultural-specific impacts in the vicinity of the Project Site.

#### 4.14.2 Existing Agricultural Environment

##### 4.14.2.1 Agricultural Resources and Enterprises

##### Regional Agricultural Resources and Enterprises

A community profile from the 2011 ABS Census (see Section 4.15.3) indicates that for those people working in the Bogan LGA, agriculture is the largest employer (34.9% of the working population) followed by mining (14.9% of the working population). Of those working in the agriculture industry 79% recorded their occupation as either owner or manager, indicating that most agricultural operations are single person operations.

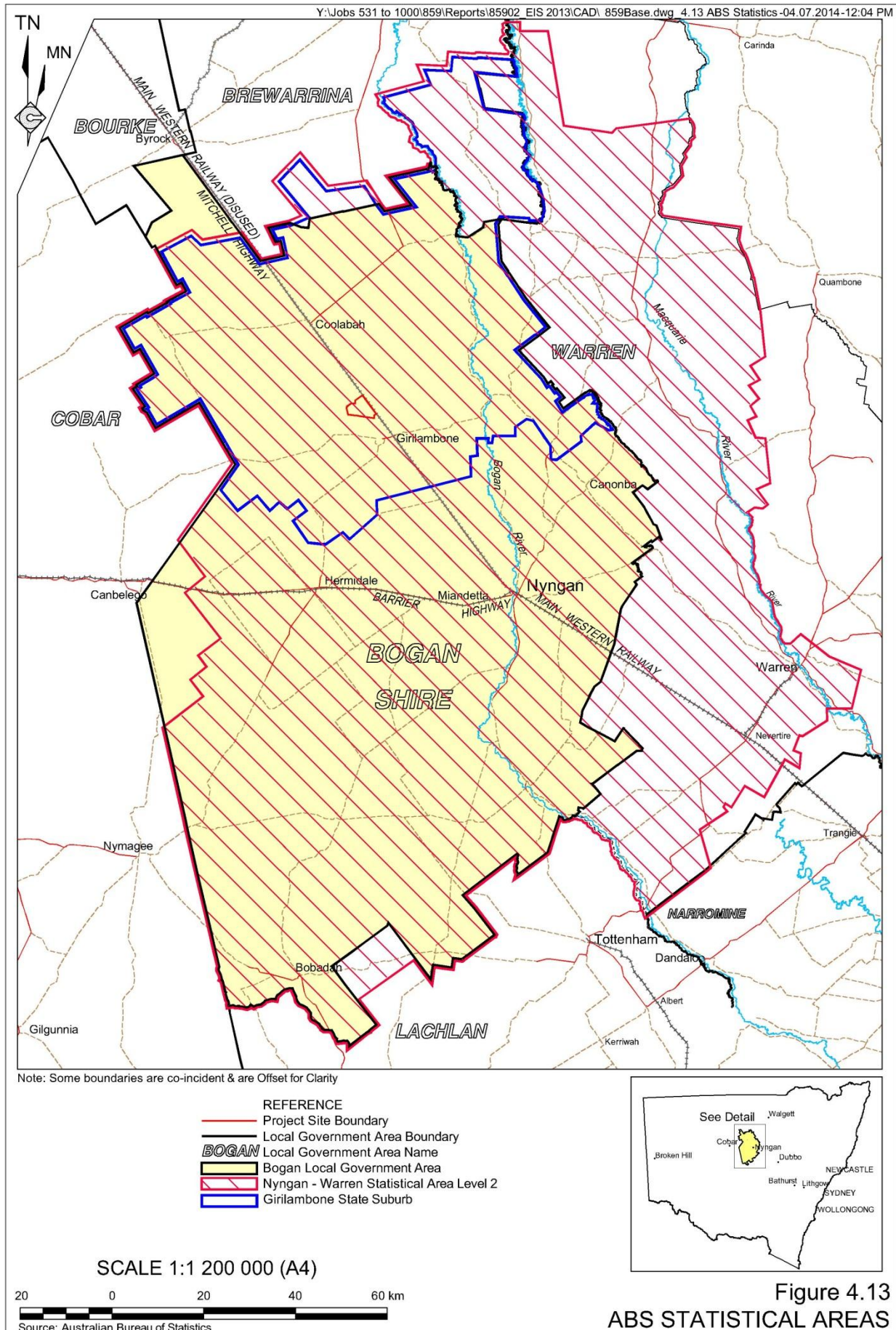
Australian Bureau of Statistics (ABS) information relating to land used for agriculture and gross production values is not available at a Local Government Area level. However, the data is available for “Nyngan-Warren Statistical Area (SA) 2” (**Figure 4.13**). **Table 4.29** presents an overview of land used for agriculture and gross production values for the Nyngan-Warren SA2 for the 12 months to June 2011. These figures are compared to the same statistics for NSW as a whole.

The area of holdings within the Nyngan-Warren SA2 is 2.77% of the total area of holdings within NSW. However, the SLA2 includes 4.07% of NSW broad-acre cropping area, with cropping within the SA2 contributing \$169 million to the NSW economy during 2010/2011 financial year. Other significant agricultural commodities were livestock for slaughter (\$37 million) and wool (\$26 million).

**Table 4.29**  
**Regional Agricultural Production – Nyngan-Warren 2010-11**

Component	Nyngan-Warren SA2		NSW
	Value	% of NSW	
Cropping (ha)			
Area of Holding	1 614 343	2.77%	58 326 346
Broadacre crops – cereal	222 137	4.07%	5 452 675
Vegetables for human consumption	Nil	0.00%	15 909
Fruit and nuts – Orchard trees and nut trees	34	0.07%	47 483
Fruit and nuts – Other fruit	2	0.01%	48 324
Broadacre crops – non-cereal	62 677	3.26%	1 923 621
Livestock/Grazing (number of head)			
Dairy cattle	14	0.01%	325 821
Meat cattle	74 307	0.40%	5 383 931
Sheep	715 773	0.89%	26 824 697
Pigs	73	0.01%	486 178
Gross Value of Agricultural Production (\$ million)			
Agricultural production – Total gross	232	1.98%	11 714
Crops	169	2.39%	7 079
Livestock slaughtered and other disposals	37	1.20%	3 084
Wool	26	3.05%	853
Source: ABS Catalogues 7121.0 and 7503.0 2012.			





In addition to primary production the agriculture industry in the Nyngan-Warren SA2 includes a variety of support services that include but are not limited to the following.

- Wholesale and retail supply stores.
- Stock and station agents such as Elders and Landmark.
- Farm maintenance businesses such as fence and yard building contractors, tradesmen, mechanical repairs and veterinary businesses.
- Abattoir services such as KJ Halal Meat.
- Various business advice agencies, such a legal or accounting firms.

There is no cattle saleyard in the Bogan LGA, with stock typically sold through the saleyard in Dubbo, one of the busiest saleyards in NSW. In addition the presence of offices for the Livestock Health and Pest Authority and Rural Financial Counselling Service in Nyngan indicate the historic and significant role that agriculture has played in the Bogan LGA.

### **Local Agricultural Resources and Enterprises**

Cleared land within and surrounding the Project Site has been or is currently being used for agricultural purposes, principally, sheep and cattle grazing. However, to the Applicant's knowledge, no agricultural activities have been undertaken within the Project Site since at least 2004.

The land capability assessment for the Project Site (Section 4.13.3) identified the land as Class 6 land, or land with very severe limitations. This has limited the potential for agricultural use of the Project Site to the infrequent grazing.

#### **4.14.2.2 Water Resources**

As indicated in Section 4.1.2, all drainage lines within and surrounding the Project Site, with the exception of the Bogan River located approximately 25km to the east of the Project Site, are ephemeral and only flow following substantial rainfall. As a result, surface water resources are limited to farm dams which are likely to dry up frequently during extended periods without rain.

In addition, as indicated in Section 4.4.2.5 groundwater water in the vicinity of the Project Site is highly saline and are generally of limited use for agriculture. The closest bore licenced for groundwater production in the vicinity of the Project Site is located approximated 8.5km to the southeast of the Project Site.

As a result, water resources in the vicinity of the Project Site are limited in availability and quality and severely limit agricultural activities.

#### **4.14.2.3 Road Transport Infrastructure**

Agricultural enterprises in the vicinity of the Project Site are generally well serviced by State roads as described in Section 4.10.2. In summary, the Mitchell Highway provides access to markets to the south and east of the Project Site, including the Dubbo Sale Yards, while the Barrier Highway provides access to the west.

Local sealed and unsealed road provide access from the State road network to individual properties

#### **4.14.2.4 Management and Mitigation Measures**

The Applicant would ensure that the following management and mitigation measures would be implemented throughout the life of the Proposal.

- Ensure that appropriate weed and pest management programs are implemented in consultation with surrounding landholders and the Bogan Shire Council weeds officer.
- Ensure that appropriate bush fire management measures as identified in Section 4.12 are implemented to prevent initiation of a fire within the Project Site or management of any fire that may impact on the Project Site.

#### **4.14.3 Impact Assessment**

Taking into account the limited agricultural activities within and surrounding the Project Site and the fact that the Proposal would result in limited disturbance, either directly or indirectly, the proposed activities are likely to have no or negligible adverse impacts on Agricultural activities in the vicinity of the Project Site. Indeed as noted in Section 4.15, the Applicant's ongoing operations provide opportunity for off-farm income for local residents, supporting those agricultural enterprises that would otherwise be non-viable.

### **4.15 SOCIO-ECONOMIC**

*The socio-economic assessment for the Proposal was undertaken by R.W. Corkery & Co. Pty Limited in consultation with the Applicant.*

#### **4.15.1 Introduction**

Based on the risk analysis undertaken for the Proposal (Section 5.2 and **Table 5.3**), the potential impacts relating to socio-economic factors and their risk rankings after the adoption of standard mitigation measures are as follows.

- Inability of local business to compete with mining wages leading to reduced staff availability for local agricultural businesses (low risk).

- Perception of negative health impacts on the community at surrounding residences (low risk).
- Increased pressure on local infrastructure (low risk)

In addition, the DGRs identify “**Socio-economic**” as a key issue for assessment in the *Environmental Impact Statement*.

#### 4.15.2 Policy Context

##### 4.15.2.1 Introduction

The following strategies and plans have been identified as applying to the region in which the Project Site is located and, as such, the objectives and aims of each has been summarised in the following subsections.

- *Orana Regional Action Plan (2012).*
- *Bogan Shire Community Strategic Plan – 2026 (2013).*
- *Bogan Shire Delivery Program 2013 – 2017 (2013).*

##### 4.15.2.2 Orana Regional Action Plan

The *Orana Regional Action Plan* (Orana RAP) was compiled as part of the overarching planning document *NSW 2021 – A Plan to Make NSW Number One* (NSW 2021) prepared by the Department of Premier and Cabinet. The Principal objective of NSW 2021 is to ‘rebuild the economy, return quality services, renovate infrastructure and protect our local environment and community’. To achieve that, the Orana RAP identifies, amongst other things, the following actions.

- Stimulate mineral and petroleum investment (Priority 1).
- Leverage opportunity for Orana from the growth within the mining sector (Priority 1).
- Build a strong and skilled local workforce (Priority 1).
- Develop the NSW Freight and Port Strategy (Priority 4).
- Provide funding to local councils to improve local infrastructure (Priority 4).

##### 4.15.2.3 Bogan Shire Community Strategic Plan – 2026

The *Bogan Shire Community Strategic Plan – 2026* was compiled by Council and adopted in March 2013 to ‘identify the community’s main priorities and aspirations for the future and to plan strategies for achieving these goals’. These goals include the following.

- Goal 1 – Build the community by creating a connected and cohesive community with opportunities for all residents, workers and visitors.

- Goal 2 – Connect the community through a transport network which enables efficient movements of people and freight.
- Goal 3 – Manage the environment to support the current and long-term liveability of the Shire.
- Goal 4 – Enhance the health and safety of the community through provision of effective essential services and ensuring equitable access.
- Goal 5 – Develop the economy by stimulating and maintaining economic growth to build a strong economic and support the development of local businesses.
- Goal 6 – Maintain a responsible local government which is open and transparent in delivering responsive services to the community.

A range of strategies exist within the above listed goals that relate to the Proposal. In particular, strategies within Goal 5 (Economy) with the most applicable, socio-economic-related strategies outlined below.

- Strategy 5.1.1 – Work in conjunction with the mines to obtain mutual benefit from an abundance of natural mining resources which provide our shire with opportunities for local economic growth and employment.
- Strategy 5.1.5 – Support and strengthen local businesses networks to encourage the sharing of information and resources to build the capacity of local business and industry.
- Strategy 5.1.4 – Investigate opportunities to support the township of Nyngan and the villages of Girilambone, Coolabah and Hermidale.

#### **4.15.2.4 Bogan Shire Delivery Program (2013 – 2017)**

The Bogan Shire Delivery Program was developed and implemented by Council in June 2013 to translate the strategies within the *Bogan Shire Community Strategic Plan* into actions during the 2013 – 2017 period (Council office terms).

Strategies 5.1.1, 5.1.2 and 5.1.3 are identified in the Delivery Program to occur as ‘ongoing’ throughout the 2013 – 2017 period with either the General Manager or the Manager of Development and Environmental Services being the Council contact leader.

### **4.15.3 Community Profile**

#### **4.15.3.1 Surrounding Communities**

The Project Site is located within the Central West of NSW approximately:

- 7km northwest of the village of Girilambone;
- 40km north-northeast of the village of Hermidale; and
- 55km northwest of the township of Nyngan.

The Project Site is located within the Bogan Local Government Area (LGA), fully encompassed by the Orana Region of NSW.

Communities surrounding the Project Site include the following.

- Immediate neighbours and local residents surrounding the Project Site, particularly to the east of the Project Site in the township of Girilambone (see Section 4.1.5).
- Residents of the surrounding rural properties and village of Hermidale.
- Residents of the town of Nyngan and other areas within the Bogan LGA

Each of these communities would be impacted to a greater or lesser degree depending on their proximity to the Project Site and the size, resilience and cohesiveness of the relevant community and its economy. For the purpose of this assessment, particular focus is placed on those communities most likely to be impacted by the Proposal, including residents of Girilambone and Hermidale, as well as the regional town of Nyngan, and the Bogan LGA.

The village of Girilambone was established in 1884 to service the construction of the Main Western Railway that connects the rural townships of Nyngan and Bourke. The village has steadily declined since the late 1800's to a population today of less than 200. The village hosts a service station, public school and a general store.

The village of Hermidale, located on the Barrier Highway, was established in 1892. Hermidale hosts a single service station, hotel and a general store/post office. Hermidale also hosts a rail siding and loading facility that is used by the Applicant to load the concentrate from the Tritton and Girilambone Copper Mines.

Nyngan is a regional township of approximately 2 000 people located approximately 660km northwest of Sydney in the geographical centre of New South Wales. The township was originally settled in 1835 by an exploration party but the local village of Canonba, located 28km north of Nyngan, was the region's main village up until 1880. It was at this time that the Dubbo-Bourke branch of the Main Western Railway was built through Nyngan and that resulted in the township growing around the railway. Nyngan has continued to serve as an important regional centre but has declined in population over the 20<sup>th</sup> and 21<sup>st</sup> centuries due to outward migration.

The Bogan LGA is located within the Orana Region of New South Wales and is surrounded by the Warren LGA to the east, Lachlan LGA to the south, Cobar LGA to the west and the Bourke and Brewarrina LGA's to the north. Nyngan is the largest populated town within the Bogan LGA, with the population of the LGA recorded in 2011 as 2 900. The LGA is generally supported by agricultural production, grazing of sheep and cattle and cropping, primarily wheat, as well as mining activities.



#### 4.15.3.2 Community Statistics

The following demographic data was sourced primarily from the Australian Bureau of Statistics (ABS) 2011 census data, with limited supporting data from the 2006 census (where available). All data has been gathered from the community profile tables and quick data sets from the ABS website (<http://www.abs.gov.au/>). Information is provided for the “Girilambone State Suburb” (Girilambone SS) and the Bogan LGA (**Figure 4.13**) as well as utilising NSW data for comparison purposes.

#### Population and Age Characteristics

**Table 4.30** presents the population data from both the 2006 and 2011 census, excluding the Girilambone SS as statistics from 2006 was not available. In summary, the population of Girilambone SS and Bogan LGA in 2011 were 220 and 2900 respectively. Population growth within the Bogan LGA between 2006 and 2011 was significantly lower than the NSW average, with only a 0.6% population gain, including a population decline of 1.2% of males, compared with 5.3% gain for NSW as a whole

**Table 4.30**  
**2006 and 2011 Census Population Statistics**

	Girilambone SS		Bogan LGA			NSW		
	2006	2011	2006	2011	%	2006	2011	%
<b>Total</b>	NA	220	2 882	2 900	0.6	6 549 177	6 917 658	5.3
<b>Males</b>	NA	106	1 496	1 478	-1.2	3 228 451	3 408 878	5.3
<b>Females</b>	NA	114	1 386	1 422	2.5	3 320 726	3 508 780	5.4
Note: NA = not available.								
Source: ABS 2011 and 2006 Census.								

**Table 4.31** presents the 2011 Census population data broken down by age. In summary, the Girilambone SS age statistics are generally comparable to the Bogan LGA statistics across the majority of age brackets. In comparison to the whole of NSW, the Bogan LGA had a higher proportion of people aged between 5 and 14 and 65 and 74 years and a lower proportion of people between 25 and 34 years old. This potentially reflects limited economic and employment opportunities for those in the early stages of their working life.

#### Employment

**Table 4.32** presents employment statistics from the 2011 Census. These indicate that more persons are involved in full-time employment in the Girilambone SS and Bogan LGA when compared to NSW total labour force as a whole. The total labour force participation rates indicate that more persons within the Girilambone SS (69.2%) hold full-time and part-time employment in comparison to the Bogan LGA and NSW with participation rates of 59.6% and 59.7% respectively.

**Table 4.31**  
**2011 Census Age Statistics**

	Girilambone SS		Bogan LGA		NSW	
	No.	%	No.	%	No.	%
Children						
0-4	16	7.2	229	7.8	458 735	6.6
5-14	34	15.4	452	15.5	873 776	12.6
Studying or Working						
15-19	7	3.1	169	5.8	443 416	6.4
20-24	12	5.4	159	5.4	449 687	6.5
25-34	28	12.7	283	9.7	941 496	13.6
35-44	38	17.2	414	14.2	971 629	14.1
45-54	35	15.9	374	12.8	950 451	13.7
Approaching Retirement or Retired						
55-64	28	12.7	298	10.2	810 290	11.7
65-74	14	6.3	318	10.9	541 687	7.8
75-84	6	2.6	154	5.3	336 756	4.9
85+	3	1.3	49	1.6	139 735	2.0
Total	220		2 900		6 917 658	
Source: ABS 2011 Census.						

**Table 4.32**  
**2011 Census Employment Statistics**

	Girilambone SS	Bogan LGA	NSW
	2011	2011	2011
<b>Employed</b>			
Full-time <sup>1</sup>	76 (72.5%)	860 (68.9%)	2 007 925 (63.1%)
Part-time	16 (15.2%)	294 (23.5%)	939 464 (29.9%)
Employed, away from work	7 (6.6%)	55 (4.4%)	120 121 (3.8%)
Employed, hours not stated	6 (5.7%)	38 (3.0%)	70 821 (2.2%)
<b>Total</b>	<b>105</b>	<b>1 247</b>	<b>3 138 331</b>
<b>Unemployed, Looking for</b>			
Full-time work	0 (0%)	47 (2.1%)	116 697 (1.7%)
Part-time work	12 (7.1%)	29 (1.3%)	79 829 (1.2%)
<b>Total</b>	<b>12</b>	<b>76</b>	<b>196 526</b>
<b>Labour Force Participation</b>			
Total labour force	117	1 323	3 334 857
Not in labour force	49	722	1 933 275
Labour force status not stated	3	172	317 017
<b>Total Persons</b>	<b>169</b>	<b>2 217</b>	<b>5 585 149</b>
<b>Labour force participation</b>	<b>69.2%</b>	<b>59.6%</b>	<b>59.7%</b>
Source: ABS 2011 Census.			

## Industry of Employment

**Table 4.33** presents employment by industry statistics from the 2011 Census. The most significant industry of employment in the Girilambone and Bogan LGA is agriculture, forestry and fishing, with 60% and 34.9% respectively, compared to the State average of 2.2%. Importantly, mining comprised 14.9% of employment within the Bogan LGA, with the majority of this attributable to the existing Tritton and Girilambone Copper Mines owned and operated by the Applicant.

**Table 4.33**  
**2011 Census Industry of Employment Statistics**

	Girilambone SS		Bogan LGA		NSW	
	2011	% of Labour Force	2011	% of Labour Force	2011	% of Labour Force
Agriculture, forestry & fishing	33	60.0%	245	34.9%	69 576	2.2%
Mining	0	0.0%	105	14.9%	31 186	1.0%
Manufacturing	0	0.0%	24	3.4%	264 865	8.4%
Electricity, gas, water & waste services	0	0.0%	15	2.1%	34 203	1.1%
Construction	3	5.5%	49	7.0%	230 057	7.3%
Wholesale trade	6	10.9%	10	1.4%	138 890	4.4%
Retail trade	0	0.0%	45	6.4%	324 727	10.4%
Accommodation & food services	0	0.0%	14	2.0%	210 380	6.7%
Transport, postal & warehousing	4	7.3%	43	6.1%	155 027	4.9%
Information media & telecommunications	0	0.0%	0	0%	72 488	2.3%
Financial & insurance services	0	0.0%	0	0%	158 422	5.1%
Rental, hiring & real estate services	4	7.3%	4	0.6%	51 554	1.6%
Professional, scientific & technical services	0	0.0%	10	1.4%	247 295	7.9%
Administrative & support services	0	0.0%	7	1.0%	102 354	3.3%
Public administration & safety	0	0.0%	49	7.0%	192 634	6.1%
Education & training	0	0.0%	20	2.8%	248 951	7.9%
Health care & social assistance	0	0.0%	16	2.3%	364 321	11.6%
Arts & recreation services	0	0.0%	8	1.1%	46 330	1.5%
Other services	5	9.1%	17	2.4%	117 615	3.8%
Inadequately described/Not stated	0	0.0%	22	3.1%	77 455	2.5%
<b>Total</b>	<b>55</b>		<b>703</b>		<b>3 138 330</b>	

Source: ABS 2011 Census.

## Income

**Table 4.34** presents income statistics from the 2011 Census. The data indicates that the median individual income and median household income in Girilambone SS is less than for the Bogan LGA and which is in turn less than for NSW as a whole.

**Table 4.34**  
**2011 Census Income Statistics**

	<b>Girilambone SS</b>	<b>Bogan LGA</b>	<b>NSW</b>
Median individual income (\$/weekly)	\$422	\$478	\$561
Median family income (\$/weekly)	\$1 300	\$1 182	\$1 477
Median household income (\$/weekly)	\$866	\$902	\$1 237
Source: ABS 2011 Census.			

### Housing Cost

**Table 4.35** presents housing cost statistics from the 2011 Census. The data indicates that the Girilambone SS median housing loan monthly repayment was 10% and 51% lower than Bogan LGA and NSW respectively, with median weekly rents displaying similar trends with Girilambone SS approximately 32% and 68% lower than Bogan LGA and NSW respectively.

**Table 4.35**  
**2011 Census Cost of Housing and Household Size Statistics**

	<b>Girilambone SS</b>	<b>Bogan LGA</b>	<b>NSW</b>
Median housing loan repayment (\$/monthly)	\$975	\$1 083	\$1 993
Median rent (\$/weekly)	\$95	\$140	\$300
Average number of persons per bedroom	1.2	1.1	1.1
Average household size	2.5	2.5	2.6
Source: ABS 2011 Census			

### Education

**Table 4.36** presents post-school education statistics from the 2011 Census. The data indicates that fewer people hold bachelor degrees, graduate diplomas and postgraduate degrees (university level education) in the Girilambone SS and Bogan LGA than for NSW as a whole. By contrast, people with certificate levels and advanced diplomas (TAFE level education) were more common in the Girilambone SS and Bogan LGA when compared to NSW. This may reflect the general lack of accessible universities for residents of in the Bogan LGA and limited professional opportunities for those with such qualification. By contrast, the higher proportion of TAFE-based qualification identifies that the Nyngan-based TAFE is critical infrastructure for the local population.

#### 4.15.3.3 Community Facilities and Social Infrastructure

While Census data provides a range of information in relation to population statistics, a range of other factors are indicative of the level of social cohesiveness and resilience of communities. This subsection provides an overview of the facilities and social infrastructure that exist within the communities surrounding the Project Site.

**Table 4.36**  
**2011 Census Post School Level of Education**

	<b>Girilambone SS</b>	<b>Bogan Shire LGA</b>	<b>NSW</b>
Postgraduate Degree Level	0 (0%)	15 (1.5%)	238 851 (7.5%)
Graduate Diploma and Graduate Certificate Level	0 (0%)	14 (1.4%)	82 617 (2.6%)
Bachelor Degree Level	9 (15%)	146 (15%)	787 336 (24.6%)
Advanced Diploma and Diploma Level	12 (20%)	95 (9.8%)	462 059 (14.4%)
Certificate Level	29 (48.3%)	387 (39.9%)	986 704 (30.9%)
Level of education inadequately described	0	16 (1.7%)	100 290 (3.1%)
Level of education not stated	10 (16.7%)	298 (30.7%)	539 067 (16.9%)
<b>Total</b>	<b>60</b>	<b>971</b>	<b>3 196 924</b>
Source: ABS 2011 Census			

## **Education**

### **Early Childhood**

A range of childcare services and support groups for younger children exist within the Bogan LGA and include, but are not limited to the following:

- A preschool centre in Nyngan offering a variety of early childhood services, including daycare and pre-schooling, catering for children between the ages of 3 and 5.
- The Bogan Bush Mobile is a mobile playgroup that caters to children up to 6 years throughout the Bogan LGA, travelling to villages including Girilambone and Hermidale on a fortnightly basis.

### **Schools**

**Table 4.37** presents the number of public primary and secondary schools within the Bogan LGA, along with enrolment numbers.

Consultation with Regional Asset Planners for the Department of Education and Training for Western NSW identified that the Department takes a “whole of region” approach to managing capacity, with demountable classrooms available to all public schools where demand requires additional classroom space.

**Table 4.37**  
**Schools within the Bogan LGA**

School	Years Available	Enrolment numbers (Pupils)*
Nyngan High School	Years 7 – 12	180
Nyngan Public School	Kindergarten – Year 6	142
Marra Creek Public School	Kindergarten – Year 6	10
St Joseph's (private)	Kindergarten – Year 6	148
Hermidale Public School	Kindergarten – Year 6	14
Girilambone Public School	Kindergarten – Year 6	16
Pre-school	3 – 5 years old	Unknown
Pre-school (mobile)	0 – 6 years old	Unknown
* 2012 information.		
Source: Department of Education and Training.		

### Higher Education

Nyngan College, a TAFE Western branch of TAFE NSW, is the only tertiary or adult education facility within the Bogan LGA and focuses on programs for the local community in agricultural, business and computing. Courses at Nyngan College include the following.

- Aboriginal programs.
- Agriculture, Horticulture and Animal Care.
- Arts, media and entertainment.
- Building, construction and architecture.
- Business, finance and property services.
- Environment and Conservation.
- Hairdressing and Beauty.
- Health and community services.
- Vocational Access.
- Information and communications technology.
- Language.
- Manufacturing and Engineering.
- Mining.
- Sport and recreation.
- Textiles, clothing, footwear and furnishings.
- Tourism, Travel and Hospitality.
- Transport: Automotive.

### Health

A local public hospital, namely the Nyngan Multi-Purpose Service, caters for accidents and emergency services, admissions, aged care and outpatient services. The service also contains an ambulance service for transportation to surrounding hospitals for additional treatment, such as childbirth, mental health conditions and surgery.

Two general practice surgeries also exist in Nyngan, along with a dental surgery and pharmacy.



### **Recreational and Cultural Facilities**

There is a large variety of recreational and cultural facilities available in the Bogan LGA, with most centred on the town of Nyngan. Cultural and tourism facilities include:

- the Nyngan Museum, Mid State Shearing Shed, Nyngan Agricultural Show grounds and annual show;
- Cobb and Co. Heritage Trail Tour and historical buildings throughout the township;
- Macquarie Marshes; and
- Bogan River (for water sports, fishing and other water activities).

Sporting and recreational infrastructure in Nyngan include:

- various sporting fields that accommodate a variety of sporting clubs (rugby league, soccer, netball, cricket and Little Athletics);
- a golf club;
- a lawn bowling club;
- a jockey club;
- a pony club;
- a tennis club;
- a boxing club;
- water ski club; and
- the Nyngan and District War memorial Swimming Pool and associated swimming club.

Recreational facilities in Hermidale include sports and gun clubs.

### **Other Community Facilities and Groups**

A number of community facilities and social organisations exist in Nyngan, including:

- the Bogan Shire Library;
- craft groups;
- water sports clubs;
- scouts and girl guides clubs;
- a Men's Shed;
- Nyngan Garden Club;
- the Country Women's Association (CWA);
- Lions Club International; and
- Rotary International.

CWA branch and a community library are both available in the village of Hermidale.

#### 4.15.3.4 Economic Profile

Currently, Girilambone only has one operating business, being the ‘Hog and Billy Hotel’. This business provides meals and alcohol to residents and visitors to Girilambone. The village previously supported a general store, a Returned Serviceman’s League Club (RSL) and a bowling club.

The village of Hermidale has a local pub (‘Big Red Tavern’), the Hermidale Hotel and a local post office/general store. Fuel is also available for purchase from the Big Red Tavern for locals and travellers along the Barrier Highway.

The township of Nyngan, and by virtue the wider Bogan LGA, includes numerous industries and related businesses, including the following.

- Automotive Sales.
- Accountants.
- Gift Shops.
- Real Estates.
- Trades (Electricians, plumbers, engineers).
- Restaurants, Cafes and Take-aways.
- Hair and Beauty services.
- Rural supply services.
- Caravan Park.
- Bed and Breakfasts.
- Hardware.
- Clothing.
- News Agency and Post Office.
- Banking.
- Computing services.
- Fuel stores.
- Insurance services.
- Tourism services, including the Mid State Shearing Shed.
- Motels.
- Pubs.

#### 4.15.4 Social and Economic Contributions

##### 4.15.4.1 Introduction

The Applicant anticipates that the proposed Avoca Tank mining operations would replace existing mining operations at the Girilambone Copper Mine. As a result, the Proposal would effectively extend the Applicant’s current mining operations at or close to their present levels for the life of the Proposal.

This subsection provides an overview of the Applicant’s current social and economic contribution to the surrounding communities, including an overview of the employment contributions, direct and indirect economic contributions and financial and other contributions to community and other organisations within the Bogan LGA.

#### 4.15.4.2 Employment Contributions

The Applicant, as of 4 November 2013, had a combined workforce at the Tritton and Girilambone Copper Mines of 318 people. **Table 4.38** presents an overview of the residential locations for each those directly employed by the Applicant. In summary, more than half of the Applicant's employees live within the Bogan LGA, with a further 39% living in surrounding regions or elsewhere within NSW. It is noted that when compared with the 1 247 persons identified in the 2011 Census employment statistics as being employed within the Bogan LGA (**Table 4.38**), the Applicant's operations provides approximately 13% of all jobs in the Bogan LGA. In addition, the Applicant's operations are likely to contribute to a significant number of additional jobs through indirect employment through suppliers of goods and services directly to the Applicant or to its employees.

**Table 4.38**  
**Direct Employment Contributions – 2012/2013**

Location	Employment Numbers		Annual Employment Costs (\$M)
	Number of employees	% of total workforce	
Bogan LGA			
Girilambone	13	4%	1.1
Hermidale	5	2%	0.5
Nyngan	143	45%	14.1
Subtotal	161	51%	15.8
Elsewhere in NSW			
Orana Region	65	20%	7.0
Other Regions of NSW	59	19%	6.3
Subtotal	124	39%	13.3
Interstate			
Interstate	33	10%	4.5
TOTAL	318	100%	33.6
Source: Tritton Resources Pty Ltd.			

In addition, the Applicant provides a range of training opportunities for it's employees, including employment of approximately 10 apprentices and support for a range of other training opportunities.

#### 4.15.4.3 Direct Economic Contribution

**Table 4.38** presents an overview of the wages and salaries paid by the Applicant during the 2012/2013 financial year. It is noted that after tax wages and salaries are largely spent within the local community where the employee lives and works, generating further economic activity and employment through the provision of goods and services, effectively multiplying the impact of the contribution. In summary, the Applicant contributed, through wages and salaries. Approximately \$15.8M to the economy of the Bogan Local Government Area, with a further \$7.0M contributed to the wider Orana Region.

In addition, the Applicant's records indicated that a further \$630 000 was paid to a range of local contractors for labour hire-related services.

**Table 4.39** presents the amounts paid to suppliers of good and non-labour hire services during the 2012/2013 financial year. In summary, The Applicant contributed approximately \$10M to businesses within the Bogan Local Government Area during the 2012/2013 financial year, with a further \$20.1M and \$60.2M contributed to the Orana and wider NSW economies during that time.

Finally, during the 2012/2013 financial year, the Applicant contributed approximately \$15M to local, State and Commonwealth government through payment of various taxes, rates and royalties. In addition, additional government revenue was generated through payment of local rates and income tax by the Applicant's employees and those of its suppliers and payment of GST on goods and services purchased.

**Table 4.39**  
**Direct Supplier Contributions – 2012/2013**

Location	Annual Supplier Costs (\$M)
<b>Bogan LGA</b>	
Girilambone	1.0
Hermidale	3.4
Nyngan	6.6
<b>Subtotal</b>	<b>10.0</b>
<b>Elsewhere in NSW</b>	
Orana Region	20.1
Other Regions of NSW	60.2
<b>Subtotal</b>	<b>80.3</b>
<b>Interstate/International</b>	
Interstate	35.3
International	0.1
<b>TOTAL</b>	<b>35.4</b>
Source: Tritton Resources Pty Ltd.	

#### 4.15.5 Management and Mitigation Measures

In addition to the mitigation measures and management procedures relating to other environmental aspects identified in Section 4 previously, the Applicant would implement the following management and mitigation measures to ensure that benefits for the community surrounding the Project Site arising from the Proposal are maximised and adverse impacts are minimised.

- Continue to engage in regular dialogue with surrounding neighbours in relation to the Applicant's activities and maintain an "open door" policy for interested parties to discuss aspects of those activities that may be perceived as problematic.

- Support community organisations, groups and events, as appropriate, and review any request by a community organisation for support or assistance.
- Form and maintain a Community Consultative Committee (CCC) in accordance with the guidelines established in the document *Guidelines for Establishing and Operating Community Consultative Committees for Mining Projects - June 2007*.
- Regularly brief the CCC and wider community on the Applicant's activities and seek feedback in relation to any actual or perceived adverse impacts. Seek advice on how to provide assistance to resolve issues raised by any member of the community in an effective, fair and equitable manner.
- Maintain a community complaints telephone line and ensure that the existence of the number is advertised widely.
- Give preference when engaging new employees, where practicable, to candidates from the surrounding communities over candidates with equivalent experience and qualifications from elsewhere and ensure that the mining and other contractors do so as well.
- Encourage the involvement of the local Aboriginal community in the workforce.
- Encourage and support participation of locally-based employees and contractors in training or education programs to impart the appropriate skillsets and qualifications in them for continued development and economic growth within the surrounding communities following completion of the Proposal.
- Give preference, where practicable and cost-competitive, to suppliers of equipment, services or consumables located within the surrounding communities.
- Assist community members and others, as appropriate, to establish complementary businesses, where those businesses would provide a benefit to the community through increased economic development.
- Assist Bogan Shire Council to promote and encourage economic development that would continue beyond the life of the Proposal.
- Encourage and support, in consultation with the local community, the provision of services to the community. These may include health, education, transportation and other services.
- Ensure that the land capability of those sections of the final landform to be used for grazing is similar to the current land capability.

#### **4.15.6 Impact Assessment**

The Proposal would result in a range of socio-economic benefits to the community surrounding the Project Site. These benefits would include the following.

- Continued employment for approximately 318 persons, of which approximately 50% would continue to reside within the Bogan LGA.

- Continued contribution to the local, Regional, State and National economies, including contributions of approximately \$15.8M and \$10M annually within the Bogan LGA through wages and salaries and purchase of goods and services respectively, with additional indirect contributions.
- Continued support for local Community Organisations and Services.

Assessment of the potential socio-economic impacts demonstrates the beneficial impacts of the Proposal far outweigh any minor adverse impacts associated with the operations.