Section 5

Environmental Features, Safeguards and Impacts

PREAMBLE

This section describes the specific environmental features of the Quarry Site and its surrounds that would or may be affected by the Proposal. Information on existing conditions, proposed management and mitigation measures and potential impacts the Proposal may have following the implementation of these measures is presented for all relevant issues.

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5.1 Traffic and Transport

5.1.1 Introduction

The SEARs for the Proposal require an assessment of potential impacts associated with traffic and transportation including:

- accurate predictions of the road traffic generated by the construction and operation of the development, including a description of the types of vehicles likely to be used for transportation of quarry products;
- an assessment of potential traffic impacts on the capacity, condition, safety and efficiency of the local and State road networks, detailing the nature of the traffic generated, transport routes, traffic volumes and potential impacts on local and regional roads;
- a description of the measures that would be implemented to maintain and/or improve the capacity, efficiency and safety of the road network (particularly the proposed transport routes) over the life of the development;
- evidence of any consultation with relevant roads authorities, regarding the establishment of agreed contributions towards road upgrades or maintenance; and
- a description of access roads, specifically in relation to nearby Crown roads and fire trails.

In addition, assessment requirements relating to traffic were received from Council, RMS and NSW DPI - Agriculture. **Appendix 3** presents a summary of where all relevant assessment requirements have been addressed in the EIS.

The following subsections describe the setting of the Proposal and provide a summary of the Traffic Impact Assessment (TIA) prepared by The Transport Planning Partnership (TTPP, 2020) (**Appendix 4**), and describes the management and mitigation measures to be implemented by the Applicant.

5.1.2 Existing Road Transport Environment

5.1.2.1 Introduction

This subsection provides an overview of the existing road transport environment used by heavy and light vehicles travelling to and from the Quarry. An overview of the existing road conditions and traffic levels is provided as well as a summary of road safety on the surrounding road network.

5.1.2.2 Road Network and Intersections

The road network used by vehicles travelling to and from the Quarry is displayed in **Figure 5.1**. The existing and proposed routes use both State and local roads with the route varying depending on the direction of travel.

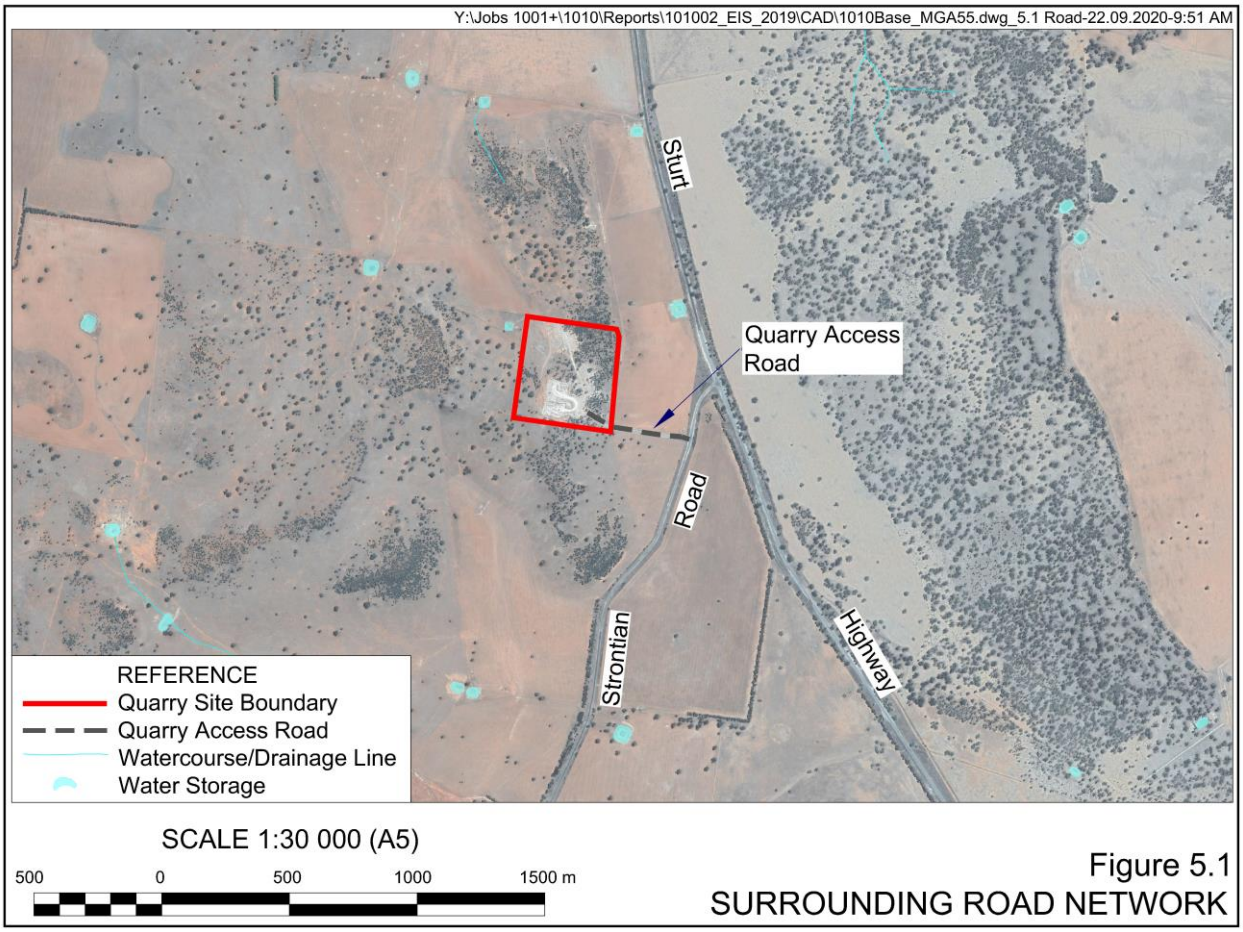


Figure 5.1
SURROUNDING ROAD NETWORK

Quarry Access Road

The Quarry Access Road is a private roadway which extends westwards from Strontian Road and is used by all vehicles accessing the Quarry Site. The Quarry Access Road is approximately 8m wide, with a sealed surface and gravel shoulders with access controlled by a gate. Sight distance for vehicles approaching the gate provides for adequate warning of vehicles approaching from the opposite direction. The Quarry Access Road has no sign posted speed limit and no centre or edge line marking.

Strontian Road

Strontian Road is a sealed two lane, two-way road with unsealed shoulders. It provides a north-south link between the Sturt Highway in the north and Boree Creek in the south. In the vicinity of the Quarry Site, Strontian Road is approximately 6m wide, with localised widening on both sides near the Quarry Access Road to facilitate the movement of trucks turning left from the Quarry into Strontian Road, and to allow southbound vehicles to pass around trucks which have slowed to turn right into the Quarry. It has gravel shoulders, and no centre or edge line marking beyond edge lines at the intersection with the Sturt Highway. Sight distances available at its intersection with the Quarry Access Road are satisfactory.

Sturt Highway

The Sturt Highway provides a major east-west link from Hume Highway at Tarcutta, via Wagga Wagga, Narrandera, Hay, Balranald, Gol Gol and Buronga to the Victorian border at Mildura, then continues west to Adelaide. In the vicinity of Strontian Road, the Sturt Highway has a single travel lane in each direction with sealed shoulders, a single broken centre line and unbroken edge lines and guideposts. It has a posted speed limit of 100 km/h.

The intersection of the Sturt Highway with Strontian Road is constructed with a widened sealed shoulder opposite Strontian Road, to allow southbound vehicles to pass around vehicles which have slowed to turn into Strontian Road. Widened shoulders are also provided to assist vehicles turning left into and out of Strontian Road. There is no "give way" signage or line marking at the intersection. There is an advance warning sign of the approaching intersection for drivers in Strontian Road, and a bidirectional hazard marker also alerts those drivers to the intersection. Sight distances available for drivers at the intersection are satisfactory.

5.1.2.3 Traffic Volumes

Daily Traffic Volumes

Traffic counts were commissioned by TTPP as part of the TIA to establish traffic volumes and vehicle types using the existing road network at the following locations.

- Quarry Access Road
- Strontian Road (between the Quarry Site and the Sturt Highway)
- Sturt Highway (south of Strontian Road)

Table 5.1 presents a summary of the daily traffic volumes at the surveyed locations.

Table 5.1
Surveyed Daily Traffic Volumes (vehicles per day)

	Quarry Access Road		Strontian Road		Sturt Highway	
	Light	**Heavy**	**Light**	**Heavy**	**Light**	**Heavy**
Monday	12	36	76	27	1 457	708
Tuesday	10	36	74	27	1 445	805
Wednesday	6	31	66	25	1 590	889
Thursday	16	39	88	23	1 633	835
Friday	12	43	84	9	1 842	772
Saturday	0	1	78	8	1 558	477
Sunday	0	2	46	5	1 356	444
Average Day	**8**	**27**	**73**	**18**	**1 554**	**704**
Average Weekday	**11**	**37**	**78**	**22**	**1 593**	**802**
Source: TTPP (2020) – Table 3.2						

The results in **Table 5.1** demonstrate that heavy vehicle volumes on the road network are noticeably lower on weekends than on weekdays. At the time of the traffic surveys, the Quarry generated an average of 37 heavy vehicle movements per weekday.

Peak Hour Traffic Volumes

TTPP (2020) identifies distinct peaks in two-way traffic on the Sturt Highway in the morning and evening, with slightly lower volumes carried through the middle of the day. Strontian Road and the Quarry Access Road have no distinct peaks in traffic. **Table 5.2** presents a summary of the surveyed peak hourly traffic volumes at the surveyed locations over the average weekday.

Table 5.2
Surveyed Weekday Peak Hour Traffic Volumes 2020 (vehicles per hour)

	AM Peak Hour			PM Peak Hour		
	Hour	Light	Heavy	Hour	Light	Heavy
Quarry Access Road	6:00am	0	5	12:00pm	1	8
Strontian Road	8:00am	9	3	5:00pm	7	2
Sturt Highway	8:00am	123	52	3:00pm	145	48
Source: TTPP (2020) – Modified after Table 3.3						

5.1.2.4 Level of Service

Level of Service (LOS) is defined as a qualitative measure describing the operational conditions within a traffic stream as perceived by drivers and/or passengers. A LOS definition generally describes these conditions in terms of factors such as speed and travel time, freedom to manoeuvre, traffic interruptions, comfort, convenience and safety. LOS A provides the best traffic conditions, with no restriction on desired travel speed or overtaking. LOS B to D describes progressively worse traffic conditions. LOS E occurs when traffic conditions are at or close to capacity, and there is virtually no freedom to select desired speeds or to manoeuvre in the traffic stream. In rural situations, LOS C is generally considered to be acceptable.

The Austroads (2020) *Guide to Traffic Management Part 3: Traffic Studies and Analysis* provides guidelines for the capacity and performance of two lane, two-way rural roads, which in turn, refers to the Highway Capacity Manual (HCM) (Transportation Research Board, 2016). The HCM identifies three classes of roads (Class I, Class II and Class III). LOS on Class I roads is defined in terms of Percent Time Spent Following (PTSF) and Average Travel Speed (ATS), with the worst of these adopted as the criteria. LOS on Class II roads is defined only in terms of PTSF. LOS on Class III roads is defined in terms of Percent of Free-Flow Speed (PFFS), which is the ratio of ATS to the free-flow speed.

The LOS criteria for two lane, two-way rural roads are shown in **Table 5.3**. The existing LOS for both Strontian Road (Class II) and the Sturt Highway (Class I) in the vicinity of the Quarry Site is considered to be good with both roads classified as LOS A.

Table 5.3
Level of Service Criteria for Two Lane, Two-way Rural Roads

	Class I		Class II	Class III
Level of Service	Average Speed (km/h)	PTSF (%)	PTSF (%)	PFFS (%)
A	> 90	≤ 35	< 40	> 91.7
B	> 80 – 90	> 35 – 50	> 40 – 55	> 83.3 – 91.7
C	> 70 – 80	> 50 – 65	> 55 – 70	> 75.0 – 83.3
D	> 60 – 70	> 65 – 80	> 70 – 85	> 66.7 – 75.0
E	≤ 60	> 80	> 85	≤ 66.7
Source: Austroads (2020) – Table 5.3				

5.1.2.5 Road Safety

Road crash information was obtained from Transport for New South Wales between the period 1 July 2015 to 30 June 2019 for the surrounding road network. Throughout the period investigated, a total of eight crashes were reported, all of which occurred on the Sturt Highway. Fatigue was nominated as a contributing factor in three of the crashes with speed contributing to at least one crash. Of the eleven vehicles involved in the crashes, two were heavy vehicles.

The road crash history does not highlight any clustering of crashes that might suggest an inherent concern with the design of the roads surrounding the Quarry Site.

5.1.3 Predicted Changes to Traffic Environment

5.1.3.1 Roads and Intersections

Quarry Entrance

The design of the proposed intersection of the Quarry Access Road and Strontian Road would take into consideration the Austroads *Guide to Road Design Part 4: Intersections and Crossings – General* rural property access treatments suitable for articulated vehicles, to enhance safety for turning vehicles and minimise interference to through traffic. The intersection design would provide basic left turn (BAL) and right turn (BAR) treatments and would allow for Quarry trucks to turn left from the Quarry Access Road into Strontian Road without crossing the centreline of Strontian Road.

Strontian Road

Upgrades to Strontian Road would be as described in Section 2.4.8. In summary, Strontian Road would be upgraded from approximately 50m south of the intersection of the Quarry Access Road and Strontian Road to the intersection of Strontian Road and the Sturt Highway to include 8.0m of bitumen (2 x 3.5m lanes and 2 x 0.5m sealed shoulders) in addition to a 1.0m gravel shoulder on each side of the road.

5.1.3.2 Traffic Volumes

Baseline Future Traffic Volumes

Changes to existing traffic conditions can be expected to occur which are not directly attributable to any specific development. For the purpose of the TIA, TTPP (2020) assumes an average growth rate of 2% per annum which would increase the background peak hourly and daily traffic volumes over time. A future horizon assuming ten years of growth has been adopted for the purposes of this assessment, with the resulting traffic volumes summarised in **Table 5.4**.

Proposal Contribution to Future Traffic Volumes

Section 2.7.3 presents the anticipated traffic volumes for the Proposal. The forecast future peak hourly and weekday traffic volumes, including Proposal-generated traffic, are summarised in **Table 5.5**. These forecasts assume that all Proposal-generated heavy vehicle traffic would travel northwards on Strontian Road and southwards on the Sturt Highway.

Table 5.4
Baseline Future Traffic Volumes

	AM Peak[1] (vehicles per hour)		PM Peak[1] (vehicles per hour)		Daily (vehicles per day)	
	Light	**Heavy**	**Light**	**Heavy**	**Light**	**Heavy**
Quarry Access Road	0	5	1	8	11	37
Strontian Road	11	4	9	2	95	27
Sturt Highway	150	63	177	59	1 942	978
Note 1: Time of peak hours at each location are presented in Table 5.2						
Source: TTPP (2020) – Modified after Table 3.5						

Table 5.5
Future Weekday Traffic Volumes with Proposal-generated Traffic

	AM Peak[1] (vehicles per hour)		PM Peak[1] (vehicles per hour)		Daily (vehicles per day)	
	Light	**Heavy**	**Light**	**Heavy**	**Light**	**Heavy**
2020 with Maximum Product Transportation						
Quarry Access Road	4	24	4	24	12	96
Strontian Road	13	27	11	26	90	118
Sturt Highway	125	76	147	72	1 599	898
2030 with Maximum Product Transportation						
Quarry Access Road	4	24	4	24	12	96
Strontian Road	15	28	13	26	107	123
Sturt Highway	152	87	179	83	1 948	1 074
Note 1: Time of peak hours at each location are presented in Table 5.2						
Source: TTPP (2020) – Modified after Table 4.4						

On those occasions when Proposal-generated heavy vehicle traffic travels northwards on the Sturt Highway, traffic volumes would be similar to those presented above. In the event that all Proposal-generated heavy vehicle traffic would travel south on Strontian Road, volumes would be similar to (but likely somewhat less than) volumes presented for Strontian Road north of the Quarry Access Road.

5.1.4 Management and Mitigation Measures

5.1.4.1 Design Features

Section 5.1.3.1 presents the design standards to be achieved for the proposed upgrades to Strontian Road and its intersection with the Quarry Access Road.

5.1.4.2 Operational Safeguards and Management Measures

In order to ensure that the traffic and transport impacts of the Proposal are minimised, the following management and mitigation measures would be implemented.

- The proposed upgrades to Strontian Road and its intersection with the Quarry Access Road would be completed during the early stages of development.

- All loads would be covered prior to leaving the Quarry Site to prevent loose materials falling onto the roadway or the creation of excessive dust.
- A Driver's Code of Conduct, identifying required driver behaviour and enforcement mechanisms for drivers of heavy vehicles, including subcontractors, regularly accessing the Quarry Site, would be developed and enforced to minimise risks to other road users and livestock.
- A comprehensive Environmental Management Plan for the ongoing management of relevant environmental issues at the Quarry would be developed which would comprise a separate section in relation to Traffic Management.

5.1.5 Assessment of Impacts

TTPP (2020) concludes that the transportation of up to 125 000tpa of Quarry products from the Strontian Quarry, involving a maximum of 12 laden truck movements per hour and 48 laden truck movements per day, would be accommodated on the surrounding road network with acceptable impacts on the capacity, efficiency and safety of the road network.

The LOS on Strontian Road and the Sturt Highway would remain good during the morning and evening peak hours with the combined effects of background traffic growth and additional Proposal-generated traffic with both routes predicted to maintain their LOS A classification. Drivers would experience only minor delays as a result of interaction with other traffic.

TTPP (2020) also confirms that adequate line of sight is available at all intersections and that the proposed upgrades to Strontian Road and its intersection with the Quarry Access Road would enhance the safety for turning vehicles and minimise the risk of interference to through traffic.

5.2 Air Quality

5.2.1 Introduction

The SEARs for the Proposal require the EIS to include an assessment of the likely air quality impacts including:

- an assessment of the likely air quality impacts of the development in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*. This assessment is to give particular attention to potential dust impacts on any nearby private receivers due to construction activities, the operation of the quarry and/or road haulage.

The assessment requirements identified by the Environment Protection Authority (EPA) were also considered during the preparation of the air quality assessment. A summary of the SEARs and requirements of the EPA are included in **Appendix 3** together with a record of where each requirement is addressed in the EIS.

An air quality impact assessment for the Proposal was undertaken by Northstar Air Quality Pty Ltd (Northstar). The resulting report is presented as **Appendix 5** and is hereafter referred to as Northstar (2020).

The following subsections provide a summary of Northstar (2020) describing the existing air quality environment, potential emission sources and the criteria adopted for the air quality impact assessment. This is followed by an overview of the proposed ongoing operational control measures that would be implemented by the Applicant. Finally, the assessment methodology and results are reviewed and the residual air quality impacts of the Proposal considered following the adoption of safeguards and management measures.

5.2.2 The Existing Environment

5.2.2.1 Sensitive Receivers

The air quality impact assessment (Northstar, 2020) considers potential impacts on air quality at ten privately-owned residential properties surrounding the Quarry Site. **Figure 4.4** presents details of the residences considered in the air quality impact assessment. It is noted that only privately-owned properties with residences were considered in this assessment.

5.2.2.2 Meteorological Environment

The weather experienced within a given area can govern the generation, dispersion and eventual fate of pollutants in the atmosphere. The site-specific meteorological parameters required for the air quality assessment (Northstar, 2020) were generated using observational data from the Narrandera Airport automatic weather station (AWS), and subsequent meteorological modelling using the TAPM and CALMET software. A full description of the modelling exercise, methods and input data used to establish site-specific meteorological conditions is presented in Appendix B of Northstar (2020).

A description of the wind data relied upon in this assessment is provided in Section 4.2.4.

5.2.2.3 Air Quality Environment

Regional Air Quality

The existing air quality experienced in the area surrounding the Quarry Site was determined by examining measurements obtained from the NSW DPIE Air Quality Monitoring Network (AQMN). As the Quarry Site is not located in close proximity to any air quality monitoring station (AQMS) within this network, Northstar (2020) determined that data from the Wagga Wagga North AQMS were the most appropriate to determine background regional pollutant concentrations. **Table 5.6** presents a summary of the background air quality used in the air quality impact assessment.

Table 5.6
Summary of Background Air Quality Used in the AQIA

Pollutant	Averaging Period	Value	Notes
PM_{10}	24-hour	Daily varying	The 24-hour maximum PM_{10} in 2014 at Wagga Wagga North was measured to be 88.2 µg/m^3
	Annual	20.7 µg/m^3	
$PM_{2.5}$	24-hour	Daily varying	The 24-hour maximum $PM_{2.5}$ in 2014 at Wagga Wagga North was measured to be 27.6 µg/m^3
	Annual	7.6 µg/m^3	
TSP	Annual	48.4 µg/m^3	Estimated on TSP:PM_{10} ratio of 2.3404:1
Dust Deposition	Monthly	2 g/m^{2}month^1	Difference in NSW EPA maximum allowable and incremental impact criterion
Source: Northstar (2020) – Modified after Table 7			

Cumulative Impacts

Northstar (2020) performed a desktop study to determine the potential for cumulative impacts from particulate generating operations conducted in proximity to the Quarry Site. It was determined that, as the area surrounding the Quarry Site is generally agricultural in nature with no significant sources of particulate matter, regional background air quality data would appropriately account for any potential cumulative impacts associated with surrounding land uses.

5.2.3 Criteria for Assessment

Table 5.7 presents the air quality criteria listed in the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (EPA, 2017a) which were adopted for the Proposal. It is noted that the criteria are based on reducing any potential impacts to human health and amenity.

Table 5.7
Air Quality Assessment Criteria

Pollutant	Averaging period	Criterion	Notes
PM_{10}	24 hours	50µg/m^3	Numerically equivalent to the AAQ NEPM[(b)] standards and goals.
	1 year	25µg/m^3	
$PM_{2.5}$	24 hours	25µg/m^3	
	1 year	8µg/m^3	
TSP	1 year	90µg/m^3	
Deposited Dust	1 year[(c)]	2g/m^2/month	Assessed as insoluble solids as defined by AS 3580.10.1
	1 year[(d)]	4g/m^2/month	
Notes: (a): micrograms per cubic metre (b): National Environment Protection (Ambient Air Quality) Measure (c): maximum increase in deposited dust level (d): maximum total deposited dust level			
Source: Northstar (2020) - Table 3			

In addition to the criteria outlined in **Table 5.7**, Northstar (2020) also considered the potential impacts of respirable crystalline silica (RCS). In the absence of NSW EPA criteria associated with RCS, the criterion adopted was sourced from the Victoria EPA which is an annual average of 3µg/m^3.

5.2.4 Potential Sources of Air Contaminants

The following potential sources of operational emissions were considered by Northstar (2020).

- Particulate emissions from overburden handling (including the construction of the perimeter safety bund).
- Particulate emissions from drilling and blasting.
- Loading of processing equipment with raw material.
- Processing of raw material.
- Management of product stockpiles.
- Loading of product trucks with product.
- Wheel-generated particulate emissions from the transport of product off site on unsealed and sealed surfaces.
- Emissions from vehicle and equipment exhaust.
- Wind erosion of disturbed areas.

It is noted that no assessment of potential impacts associated with construction activities (other than the construction of the perimeter safety bund) was undertaken as the operational scenarios chosen were considered to appropriately cover any emissions generated during these activities.

5.2.5 Assessment Methodology

Air dispersion modelling was used to simulate prevailing meteorological conditions, dust sources and intensity as well as mitigating factors such as the use of a water truck to dampen roads during dry conditions. Modelling was performed using the NSW EPA approved CALPUFF atmospheric dispersion model. The modelling was performed in CALPUFF 3-dimensional (3-D) mode.

An assessment of the impacts of activities at the Quarry Site was undertaken to characterise the likely day-to-day operation of the Proposal. This assessment relied upon average and likely maximum operational characteristics to assess the Proposal against longer term (annual average) and shorter term (24-hour) criteria for particulate matter. Two operational scenarios were selected for dispersion modelling (Stages 1 and 3 of extraction operations) as presented in **Figures 5.2** and **Figure 5.3**. It is noted that Stages 1 and 3 were selected as these stages were considered to be representative of the progressive development of the extraction area. The modelling scenarios provide an indication of the air quality impacts of the activities being performed as part of the Proposal. The regional background air quality was added to these impacts to represent the air quality which may be expected within the area surrounding the Quarry Site.

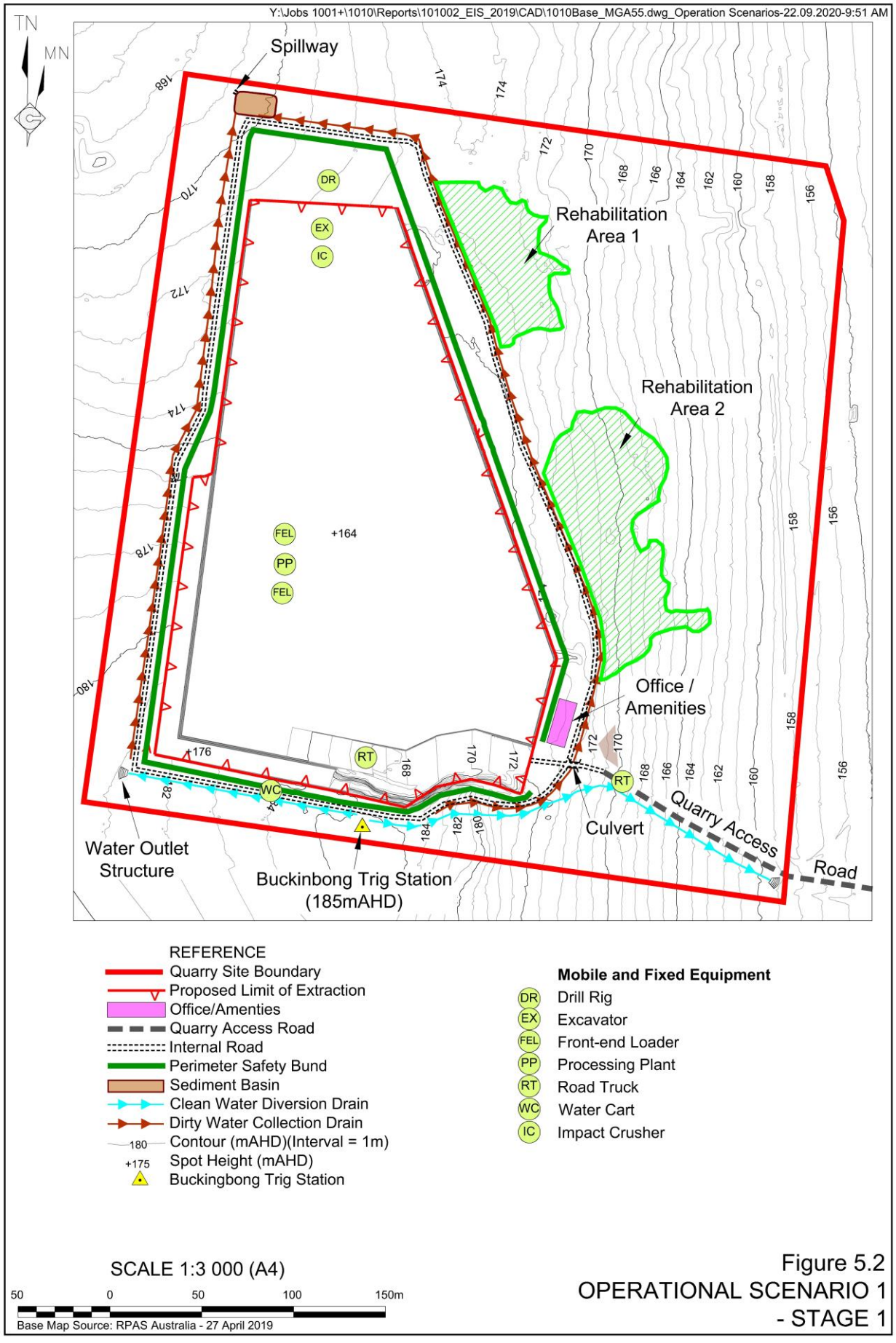


Figure 5.2
OPERATIONAL SCENARIO 1 - STAGE 1

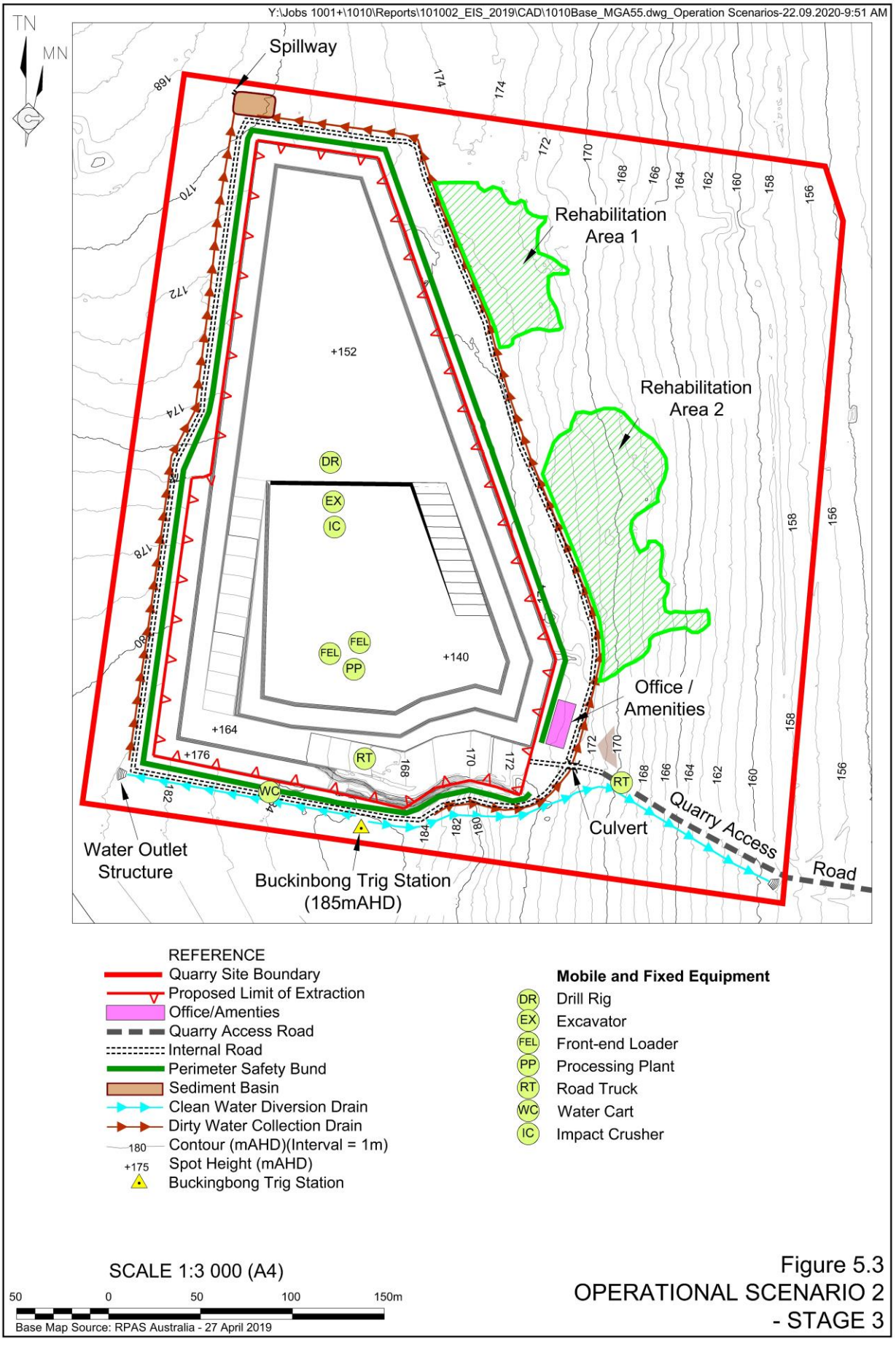


Figure 5.3
OPERATIONAL SCENARIO 2 - STAGE 3

As the background data for 24-hour $PM_{2.5}$ and PM_{10} used for the assessment includes periods when the standard assessment criteria is exceeded (i.e. the criteria is exceeded within any assumed background level, regardless of the operation of the Quarry), Northstar (2020) assessed 24-hour average $PM_{2.5}$ and PM_{10} using the Level 2 Contemporaneous Assessment Method provided in the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (EPA, 2017a). In this approach, the measured background levels for each day over a representative year are added to the corresponding predicted incremental dust levels from the Quarry to establish the number of additional days (if any) in a representative year when the criteria would be exceeded as a result of the proposed changes. Northstar (2020) performed the air quality impact assessment based on air quality and meteorological data from the year 2014 which was determined to be most representative for the area.

5.2.6 Management and Mitigation Measures

The Applicant would employ the following best practice mitigation measures to ensure that dust impacts are minimised.

- The dust collection system on the drill rig would be regularly serviced to ensure it remains effective.
- Misting water sprays would be used on the mobile processing plant.
- All unsealed internal roads would be surfaced with appropriate materials to limit dust lift-off, when necessary.
- Unsealed roads and unformed tracks and/or surfaces utilised by vehicles (e.g. tracks used by product transport trucks within the extraction area) would be watered, as required.
- Appropriate care would be taken to avoid spillage during loading.
- Load size would be limited, as appropriate, to ensure materials do not extend above truck sidewalls.
- Each truck cover would be fully extended on laden product transport trucks before each truck leaves the Quarry Site.
- All vehicles travelling on the Quarry Access Road would be limited to a speed no greater than 40km/h.
- All vehicles travelling on internal unsealed roads or unformed tracks within the Quarry Site would be limited to a speed no greater than 20km/h.
- The timing of blasts would be managed to ensure that meteorological conditions are appropriate.
- The Applicant's complaints management system would continue to be maintained to ensure that all complaints are dealt with through investigation and implementation of corrective treatments.

5.2.7 Assessment of Impacts

The following worst-case cumulative outcomes at the identified privately-owned residential properties have been predicted through the dispersion modelling undertaken by Northstar (2020).

- Cumulative annual average TSP concentration of 48.5µg/m^3 based on an incremental impact of <0.1µg/m^3 and assumed background of 48.4µg/m^3.
- Cumulative annual average PM_{10} concentration of 20.8µg/m^3 based on an incremental impact of <0.1µg/m^3 and assumed background of 20.7µg/m^3.
- Cumulative annual average $PM_{2.5}$ concentration of 7.7µg/m^3 based on an incremental impact of <0.1µg/m^3 and assumed background of 7.6µg/m^3.
- Cumulative monthly average deposited dust levels of 2.1g/m^2/month and incremental monthly deposited dust levels of <0.1 g/m^2/month based on an assumed background level of 2.0 g/m^2/month.

In all cases, the assessed outcomes are mostly driven by the assumed background levels which are a conservative estimate of likely conditions in the vicinity of the Quarry Site.

The air quality impact assessment also considered potential impacts associated with RCS. Based on the assumption that 100% of modelled annual average $PM_{2.5}$ impacts would be RCS, impacts were predicted to represent <3.5% of the relevant criterion.

The worst-case incremental outcome of modelled predictions for 24-hour PM_{10} and 24-hour $PM_{2.5}$ under the Proposal is for an incremental impact up to 1.0µg/m^3 for PM_{10} and 0.2µg/m^3 for $PM_{2.5}$. The Level 2 Contemporaneous Assessment of cumulative 24-hour PM_{10} and 24-hour $PM_{2.5}$ indicated that there would be no additional exceedances of the assessment criteria as a result of the Proposal.

A comprehensive list of assessment results at residences in the vicinity of the Quarry is presented in Section 6 of Northstar (2020).

5.2.8 Greenhouse Gas Assessment

A quantitative assessment of greenhouse gas (GHG) emissions generated by the Proposal was undertaken by Northstar (2020) with emissions compared to national and State totals. Emissions associated with the Proposal would represent approximately 0.0002 % of Australian and 0.0009 % of NSW emissions totals for the year 2018. Emissions are proposed to be reduced further through the implementation of a maintenance program for all plant and equipment.

5.2.9 Conclusion

The results of the air quality assessment undertaken by Northstar (2020) based on consideration of two operational scenarios (Stage 1 and Stage 3) have concluded that the Proposal is predicted to comply with all impact assessment criteria for annual average concentrations of TSP, $PM_{2.5}$, PM_{10} and deposited dust.

The assessment of 24-hour average $PM_{2.5}$ and 24-hour average PM_{10} applying a Level 2 Contemporaneous Assessment has indicated that there would be no additional exceedances of the assessment criteria as a result of the Proposal.

The GHG assessment concluded that average Scope 1 emissions from the Proposal would represent approximately 0.0002% of Australian and 0.0009% of NSW GHG emissions which represents a very minor proportion of global GHG emissions.

5.3 Noise and Vibration

5.3.1 Introduction

The SEARs require the EIS to include an assessment of the potential impacts of the Proposal on noise and blasting, including:

- construction and operational noise and off-site transport noise impacts of the development;
- reasonable and feasible mitigation measures to minimise noise emissions;
- monitoring and management measures;
- a description of the proposed blasting hours, frequency and methods; and
- an assessment of the likely blasting and vibration impacts of the development.

The assessment requirements provided by the EPA were also considered during the preparation of the noise and vibration assessment. A summary of the SEARs and requirements of the EPA are listed within **Appendix 3** together with a record of where each requirement is addressed in the EIS.

A noise and vibration impact assessment for the Proposal was undertaken by Muller Acoustic Consulting Pty Ltd (MAC). The resulting report is presented as **Appendix 6** and is hereafter referred to as MAC (2020). The following subsections provide a summary of the noise and vibration impact assessment and describe the operational safeguards and management measures to be implemented by the Applicant.

5.3.2 The Existing Environment

5.3.2.1 Sensitive Receivers

MAC (2020) considers potential impacts to the existing noise environment at ten privately-owned properties surrounding the Quarry Site. **Table 4.2** and **Figure 4.4** present details of the properties considered in the noise and vibration impact assessment.

5.3.2.2 Meteorological Environment

The atmospheric conditions most relevant to noise and vibration impact assessments are temperature inversions, and source to receiver winds. The *NSW Noise Policy for Industry* (EPA, 2017b) states that wind effects need to be assessed where source to receiver winds (at

10m height) of 3m/s or below occur for 30% or more of the time in any season in any assessment period. An analysis of wind conditions using the EPA's Noise Enhancement Wind Analysis (NEWA) program determined that prevailing winds were not applicable to the noise and vibration impact assessment.

The following points are the most significant with respect to noise propagation and were adopted as parameters for noise modelling.

- A value of 90% Relative Humidity (RH) was adopted for morning shoulder[1] (inversion) conditions and a value of 60% RH was adopted for daytime[2] (calm) conditions.
- Noise modelling for morning shoulder (inversion) conditions was carried out under F Class stability conditions (i.e. worst case) and assumed a temperature of 10°C and no wind. Noise modelling for daytime (calm) conditions was carried out under the prevailing condition of neutral atmospheric conditions and assumed a temperature of 20°C and no wind.

5.3.2.3 Existing Acoustic Environment

There is minimal existing industrial noise in the area surrounding the Quarry Site, apart from the existing quarry, and the areas potentially affected by noise emissions from the Proposal are best described acoustically as rural.

It is anticipated that the daytime background noise levels in the rural areas surrounding the Quarry Site (excluding existing quarrying activities) would be below 30 dB(A) and, in accordance with section A1.2 of the NPI, a default minimum daytime background noise level of 35 dB(A),L_{90} has been adopted as the basis for determining project-specific noise goals.

5.3.2.4 Existing Blasting Operations

Blasting operations at Strontian Quarry have been carried out since extraction operations commenced in 2012. Since this time, the Applicant has developed a blasting method suited to the conditions at the Quarry Site. The existing blast schedule includes blasting at approximately bimonthly intervals, however, these intervals can be more frequent during periods of high product demand.

5.3.3 Criteria for Assessment

5.3.3.1 Operational Noise Criteria

Construction Criteria

The Noise Management Level (NML) for construction activities for all residential receivers is 45dB $LAeq_{(15min)}$.

[1] The morning shoulder period is defined as the period from 6am to 7am Monday to Saturday.
[2] The daytime period is defined as the period from 7am to 6pm Monday to Saturday and 8am to 6pm on Sundays and public holidays.

Intrusiveness Criteria

The intrusiveness criteria limit Equivalent Continuous Noise Level (Leq) from the industrial source to a value of 'background plus 5dB' averaged over a 15 minute period. That is, the Rating Background Level (RBL) for the time period, plus 5 dB(A). The RBL (L_{A90}) is defined as the overall single figure background level representing each assessment period. The intrusiveness criteria for the Proposal are as follows.

- Morning Shoulder – 35 dB(A) $L_{eq(15\ min)}$
- Day – 40 dB(A) $L_{eq(15\ min)}$

Amenity Criteria

The amenity criteria aim to protect against excessive noise in situations where an area is becoming increasingly developed. The criteria are based on the nature of the receiver area and existing levels of industrial noise. The amenity criteria for the Proposal are as follows.

- Morning Shoulder – 43 dB(A) $L_{eq(15\ min)}$
- Day – 53 dB(A) $L_{eq(15\ min)}$

Project Noise Trigger Levels

The Project Noise Trigger Levels (PNTLs) are the lower of the intrusiveness or amenity criteria and are the project-specific criteria against which the Proposal is required to be assessed. The PNTLs adopted for the Proposal are, therefore, the intrusiveness criteria.

Maximum Noise Level Criteria

The maximum noise trigger levels apply to transient noise events that have the potential to cause sleep disturbance and would, therefore, apply to any operations undertaken prior to 7:00am between Monday to Saturday. The maximum noise level criteria for the Proposal are as follows.

- 40 dB(A) $L_{eq(15\ min)}$
- 52 dB LA_{max}

5.3.3.2 Road Traffic Noise Criteria

In accordance with the NSW *Road Noise Policy (*RNP), the noise and vibration impact assessment has adopted the "Freeway/arterial/sub-arterial road" category for the designated transport routes, consistent with their classification as "principal haulage routes". The criteria adopted for the Proposal are as follows.

- Day (7am to 10pm) – 60 dB(A) $LA_{eq(15\ hr)}$
- Night (10pm to 6pm) – 55 dB(A) $L_{eq(9\ hr)}$

5.3.3.3 Blasting Criteria

Overpressure and vibration levels from blasting are assessable against criteria proposed by the Australian and New Zealand Environment and Conservation Council (ANZECC) in their publication *"Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration – September 1990"*. These criteria are summarised as follows.

- The recommended maximum overpressure level for blasting is 115dB.
- The level of 115dB may be exceeded for up to 5% of the total number of blasts over a 12-month period, but should not exceed 120dB at any time.
- The recommended maximum vibration velocity for blasting is 5mm/s Peak Vector Sum (PVS).
- The PVS 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.
- Blasting should generally only be permitted during the hours of 9:00am to 5:00pm Monday to Saturday and should not take place on Sundays and Public Holidays.
- Blasting should generally take place no more than once per day, except in the event of a misfire.

5.3.4 Management and Mitigation Measures

5.3.4.1 Noise Design and Operational Safeguards

The Applicant is committed to minimising the noise generated by extraction, processing and transport activities through the implementation of the following operational noise controls and management measures.

- All hours of operation presented in Section 2.11 would be strictly adhered to.
- The maximum number of truck movements per day would be limited to 96 movements per day (48 laden trucks).
- All drivers would be required to sign a Driver's Code of Conduct requiring a high standard of driver performance, avoidance of using exhaust brakes in built-up areas and travel at the required speeds.
- The internal road network would be surfaced, as required, to limit body noise from empty trucks.
- All equipment on the Quarry Site would be regularly serviced to ensure sound power levels of each item remains at or below that nominated for noise modelling purposes.

5.3.4.2 Blast Design and Operational Safeguards

The following operational controls would be implemented to ensure that any potential impacts from blasting are limited and that blasting processes are undertaken efficiently and safely.

- Blasting would be restricted to between the hours of 10:00am to 3:00pm, Monday to Friday as specified in Section 2.11.
- Blasting would take place no more than once per day as specified in the ANZECC guidelines.
- Blast impacts would be monitored during each blast to ensure that blast characteristics do not result in overpressure or vibration levels that are not consistent with the existing blasting methods.
- A blast notification protocol would be implemented and planned blasting would be pre-emptively discussed with surrounding residents.

5.3.5 Assessment Methodology

5.3.5.1 Inputs and Assumptions

Operational Scenario

In order to assess the noise impacts for the operation of the Proposal, a single worst-case operational scenario was considered by MAC (2020). The scenario chosen is displayed in **Figure 5.2** and is representative of the worst-case operational activities during Stage 1 of operations. No further scenarios were considered by MAC (2020) due to the negligible impacts at surrounding residences.

Noise Sources

The sound power levels of the equipment used in the operational scenario are provided in **Table 5.8**.

Table 5.8
Noise Source Sound Power Levels

Noise Source / Item	Number	Sound Power Level dB(A) $L_{eq(15min)}$
Processing Plant	1	114
Impact Crusher	1	114
Drill Rig	1	114
Excavator	1	106
Front-end Loader	2	106
Bulldozer	1	110
Water Cart	1	101
Road Trucks	2	102
Loading Product into Road Truck	-	117
Source: MAC (2020) – Modified after Table 17		

Road Transport Conditions

The following inputs/assumptions were included in the assessment of road transport noise levels.

- The closest residences to the transportation routes are located 20m from the Sturt Highway (south), 75m from the Sturt Highway (north) and 40m from Strontian Road (south).
- At maximum production, up to 48 laden trucks per day and 12 laden trucks per hour could utilise a given transport route.
- Existing measured traffic volumes on Strontian Road comprised 91 vehicles per day. Existing measured traffic volumes on the Sturt Highway comprised 2 259 vehicles per day.

Blasting Parameters

Blasting within the Quarry would typically be required approximately three to four times per year, however, in the interest of practical limits for ongoing operations, blasting of no more than once per month is proposed. The indicative blast design adopted for the blasting assessment are presented in **Table 2.1** (50 000t blast).

5.3.5.2 Operational Noise Assessment

Predictive noise modelling was undertaken by MAC (2020) using DGMR (iNoise, Version 2020) software to quantify noise emissions from the operational activities identified in Section 5.3.5.1 and **Figure 5.2**. The model incorporated a three-dimensional terrain map, noise source data, ground type, attenuation from barriers and atmospheric information to predict noise levels at the nearest potentially impacted residences.

Construction activities associated with the relocation of the office and amenities, excavation and/or construction of erosion and sediment controls and roadworks associated with upgrades to Strontian Road and the intersection of the Quarry Access Road and Strontian Road would be undertaken during periods of reduced or no production. Preliminary modelling identified that construction activities would not contribute to noise levels above the noise goals. As such, MAC (2020) considers that no further assessment of construction activities is required.

5.3.5.3 Road Traffic Noise Assessment

MAC (2020) undertook an assessment of road traffic noise using the US Environmental Protection Agency's road traffic calculation method to predict the LA_{eq} noise levels from Proposal-related trucks travelling past existing residences located adjacent to the product transport routes. This method is an internationally accepted theoretical noise prediction model and is ideal for calculating road traffic noise where relatively small traffic flows are encountered.

5.3.5.4 Blasting Assessment

In order to predict blast overpressure and ground vibration levels, a series of standard equations were applied using the proposed blast parameters. The equations used are discussed in detail in Section 4.4 of MAC (2020).

5.3.6 Assessment of Impacts

5.3.6.1 Predicted Operational Noise Levels

The following worst-case noise levels have been predicted through the modelling undertaken by MAC (2020). All modelled results predict noise levels below the adopted criteria (see Section 5.3.3.1).

- Operational noise levels of <30 dB(A) $L_{eq(15min)}$ at all residences in both morning shoulder and day periods.
- Operational noise levels of <30 dB LA_{max} at all residences during morning shoulder periods.

Sections 5.1 and 5.2 of MAC (2020) present the predicted operational noise levels at each of the residential receptors considered in the noise and vibration impact assessment.

5.3.6.2 Predicted Road Traffic Noise Levels

Predicted traffic noise levels at the closest residential receptors adjacent to the product transport routes were calculated to determine the potential impacts of the Proposal. **Table 5.9** presents a summary of the predicted operational road traffic noise levels at the closest residences to the respective roads. In all cases, the predicted noise levels would be below the adopted criteria.

Table 5.9
Operational Road Traffic Noise Levels – Residential Receivers

Distance from Road	Assessment Criteria	Traffic Noise (dB $LA_{eq(period)}$)		Total Change (dB $LA_{eq(period)}$)
		Existing Traffic	Future Traffic	
Sturt Highway (Northbound)				
75m	Day 60 dB $LA_{eq(15hr)}$	42.1	42.2	0.1
	Night 55 dB $LA_{eq(9hr)}$	37.7	37.9	0.2
Sturt Highway (Southbound)				
20m	Day 60 dB $LA_{eq(15hr)}$	56.2	56.3	0.1
	Night 55 dB $LA_{eq(9hr)}$	52.1	52.2	0.1
Strontian Road				
40m	Day 60 dB $LA_{eq(15hr)}$	32.1	33.4	1.3
	Night 55 dB $LA_{eq(9hr)}$	23.6	27.7	4.1
Source: MAC (2020) – Table 22				

5.3.6.3 Predicted Blast Impacts

Table 5.10 presents the results for air blast overpressure and ground vibration levels for receivers surrounding the Quarry Site. It is predicted that blasts would satisfy all relevant ANZECC overpressure and vibration criteria.

Table 5.10
Predicted Blast Overpressure and Ground Vibration

Residence	Distance (m)	Overpressure (dBZ Peak)	Criterion (dBZ Peak)	Vibration (mm/s)	Criterion (mm/s)
R3	6 890	92.1	115	0.08	5
R6A	5 980	93.9		0.10	
R6B	6 590	92.7		0.08	
R7	7 280	91.5		0.07	
R8	6 780	92.4		0.08	
R9	3 950	99.2		0.19	
R10	4 050	98.8		0.18	
R14	4 030	98.9		0.19	
R15	4 810	96.7		0.14	
R17	5 010	96.1		0.13	
Note 1: See Figure 4.4 for residence locations					
Source: MAC (2020) – Modified after Table 23					

5.3.7 Monitoring

5.3.7.1 Noise Monitoring

Given the significant distance between surrounding residences and the Quarry Site, monitoring of noise is not proposed. However, should any substantiated complaint(s) relating to noise be received, the Applicant would commission an independent noise assessment to establish the actual levels and compliance with the criteria set out in Section 5.3.3.

5.3.7.2 Blast Monitoring

The drill and blast contractor would be required to monitor each blast in accordance with existing practices with monitoring typically undertaken near the entrance to the Quarry Site.

5.3.8 Conclusion

Based on the predictive assessments undertaken by MAC (2020), the continued operation of Strontian Quarry in the manner proposed is not expected to exceed the criteria adopted for the operational and road traffic noise assessments or the blasting assessment. The Proposal would therefore result in negligible impacts at residential properties surrounding the Quarry Site and minimal impacts at residences along the transport routes used by Quarry-related trucks.

5.4 Water Resources

5.4.1 Introduction

The SEARs require the EIS to include an assessment of the potential impacts of the Proposal on water, including:

- a detailed site water balance and an assessment of any volumetric water licensing requirements;

- identification of any licensing requirements or other approvals required under the *Water Act 1912* (Water Act) and/or *Water Management Act 2000* (WM Act);
- demonstration that water for the construction and operation of the development can be obtained from an appropriately authorised and reliable supply in accordance with the operating rules of any relevant Water Sharing Plan (WSP);
- 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 assessment of activities that could cause erosion or sedimentation issues, and the proposed measures to prevent or control these impacts;
- an assessment of any likely flooding impacts of the development;
- an assessment of potential impacts on the quality and quantity of existing surface and ground water resources; and
- a detailed description of the proposed water management system, water monitoring program and other measures to mitigate surface and groundwater impacts.

In addition, DPI-Agriculture, EPA and NRAR included water-related issues for assessment that included demonstration that the operation would have an adequate and secure water source and any licensing requirements be identified for the Proposal.

The following subsections provide an assessment of potential impacts to water resources as a result of the Proposal and describe the management and mitigation measures that would be implemented by the Applicant. As part of the assessment process, R.W. Corkery & Co. Pty Limited prepared a report quantifying the sediment basin storage requirements for the Proposal. The resulting report is presented as **Appendix 7** and is hereafter referred to as RWC (2020).

5.4.2 Groundwater

5.4.2.1 Existing Environment

Hydrogeological Setting

The Quarry Site is intersected by the boundary between the Lachlan Fold Belt Murray Darling Basin Groundwater Source and the Mid Murrumbidgee Zone 3 Groundwater Source which are managed under the *Water Sharing Plan for the NSW Murray – Darling Basin Fractured Rock Groundwater Sources 2011* and the *Water Sharing Plan for the Murrumbidgee River Unregulated and Alluvial Water Sources 2012*, respectively (**Figure 5.4**).

The Lachlan Fold Belt Murray Darling Basin Groundwater Source is an extensive groundwater system which extends from the Great Dividing Range to the western rangelands near Cobar. This water source provides both stock and domestic groundwater supplies with groundwater stored in fractures, joints, bedding plains, faults and cavities within the rock mass (DPE, 2019). The proposed extraction area is principally located within the area underlain by this groundwater source.

The Mid Murrumbidgee Zone 3 Groundwater Source comprises the principal alluvial aquifer between the Malebo Range and Narrandera. The thickness of the aquifer varies between approximately 65m to a maximum of 160m at Narrandera with the width of the system broadening from east to west from approximately 4km in the east to 24km at the central and western extents of the zone (NSW Department of Water and Energy, 2007).

Groundwater Levels

Groundwater has not been intersected during previous extraction and exploration drilling activities within the Quarry Site with drilling completed to a depth of between 24m to 27m adjacent to and beneath the floor of the existing extraction area i.e. to a minimum elevation of approximately 141m AHD. This observation is consistent with the known geology within the Quarry Site which comprises material with only moderate porosity (approximately 5%) (Geochempet Services, 2018) and minimal structural features (i.e. faults, fractures etc.).

Surrounding Groundwater Users

Registered groundwater bores within the vicinity of the Quarry Site are displayed on **Figure 5.4** indicating that the closest registered bore is approximately 1.8km from the Quarry Site boundary (GW404803 within Property Reference 12).

5.4.2.2 Management and Mitigation Measures

Due to the absence of groundwater during previous extraction and exploration drilling activities, specific management and mitigation measures in relation to groundwater are not considered to be required for the Proposal. However, the Applicant would continue to ensure that appropriate management and mitigation measures are implemented in relation to the handling and storage of hydrocarbons to manage the risk of groundwater contamination (see Section 5.9.3) and would visually monitor for any signs of groundwater inflow during extraction operations (see Section 5.4.2.4).

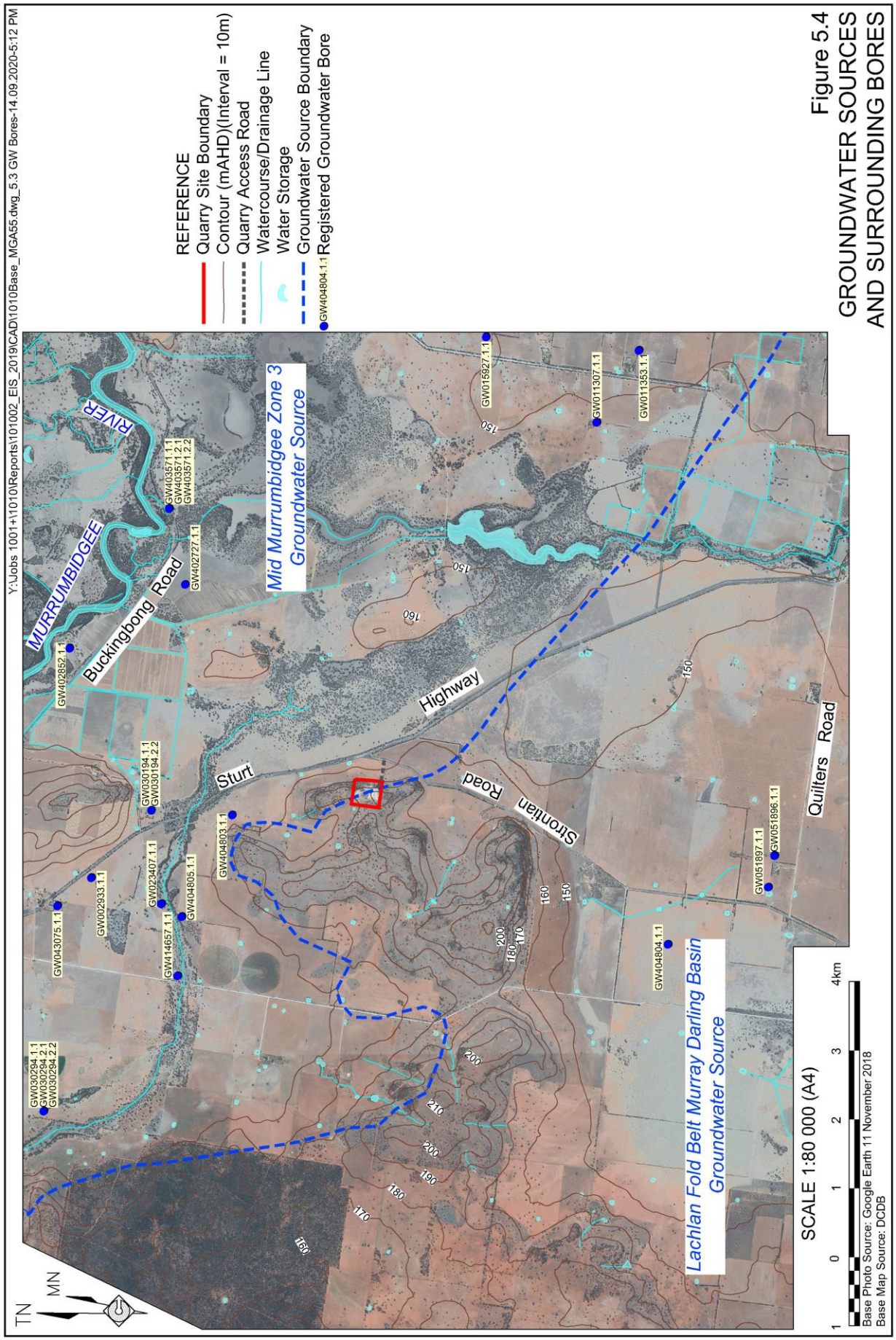
5.4.2.3 Assessment of Impacts

Due to the elevation of the Quarry Site and the proposed extraction depth of approximately 140m AHD, it is considered unlikely that groundwater would be intercepted through extraction activities. In addition, groundwater is not proposed to be used as a water source.

Registered groundwater bores within the vicinity of the Quarry Site are displayed on **Figure 5.4**, indicating that the closest registered bore is approximately 1.8km from the Quarry Site boundary (GW404803 within Property Reference 12). As a result, it is not considered that the Proposal would constrain groundwater used by surrounding residents/land users nor result in contamination of these groundwater resources.

5.4.2.4 Monitoring

Whilst it is anticipated that groundwater inflow to the extraction area would not occur, the Applicant proposes to visually monitor for groundwater inflows. Should it be established that sustained inflow is occurring, the Applicant would arrange for a water access licence to cover groundwater inflow.


Y:\Jobs 1001+\1010\Reports\101002_EIS_2019\CAD\1010Base_MGA55.dwg_5.3 GW Bores-14.09.2020-5:12 PM
REFERENCE
Quarry Site Boundary
Contour (mAHD)(Interval = 10m)
Quarry Access Road
Watercourse/Drainage Line
Water Storage
Groundwater Source Boundary
GW404804.1.1 Registered Groundwater Bore
Figure 5.4
GROUNDWATER SOURCES
AND SURROUNDING BORES
MURRUMBIDGEE RIVER
Buckingbong Road
Mid Murrumbidgee Zone 3
Groundwater Source
Sturt Highway
Strontian Road
Quilters Road
Lachlan Fold Belt Murray Darling Basin
Groundwater Source
GW403571.1.1
GW403571.2.2
GW402727.1.1
GW402852.1.1
GW030194.1.1
GW030194.2.2
GW004803.1.1
GW043075.1.1
GW002933.1.1
GW023407.1.1
GW414657.1.1
GW404805.1.1
GW030294.1.1
GW030294.2.1
GW030294.2.2
GW404804.1.1
GW051897.1.1
GW051896.1.1
GW011307.1.1
GW011353.1.1
GW015927.1.1
150
160
170
180
190
200
210
TN
MN
SCALE 1:80 000 (A4)
0 1 2 3 4km
Base Photo Source: Google Earth 11 November 2018
Base Map Source: DCDB

5.4.2.5 Conclusion

As it is anticipated that groundwater would not be intersected as part of the Proposal, and given the substantial distances between the Quarry Site and surrounding groundwater users, it is considered that the Proposal would have negligible impacts on groundwater and surrounding groundwater users.

5.4.3 Surface Water

5.4.3.1 Existing Environment

Regional Setting

The Quarry Site is located within the Murrumbidgee River Catchment with surface water resources managed under the *Water Sharing Plan for the Murrumbidgee Unregulated and Alluvial Water Sources 2012.*

Quarry Site Topography and Drainage

An overview of the regional and Quarry Site topography and drainage is presented in Section 4.1. It is noted that there are no mapped watercourses or drainage features located within the Quarry Site.

Flood Risk

The Quarry Site is located on a topographic high with a maximum elevation of 185m AHD and is not at risk of flooding. As such, flood risks are not considered further in this assessment.

5.4.3.2 Management and Mitigation Measures

5.4.3.2.1 Quarry Site Water Management

The proposed water management system for the Quarry has been developed in order to ensure that water is managed in a manner that maximises opportunities for reuse and recycling and minimises the possibility of uncontrolled discharge. The site water management system has been developed in a manner that enables the:

- efficient recovery and use of natural resources;
- effective management of available storage volumes that prevents uncontrolled discharge to receiving environments; and
- effective water quality management strategies that prevent discharge of sediment-laden water to receiving environments.

The site water management infrastructure required for the management of sediment-laden runoff generated on catchments disturbed by quarrying activities, is of a volume that meets the maximum harvestable right under the WM Act[3]. Subsequently, it is proposed that runoff

[3] The sediment basin would have a capacity of approximately 0.5ML The maximum harvestable right dam capacity for the Quarry Site is 0.825ML.

collected within the sediment basin would be used to contribute towards meeting the operation's water demand. No licences or approvals would be required for the Proposal under the WM Act or the Water Act.

5.4.3.2.2 Catchments and Surface Water Management Structures

Figures 5.5 and **5.6** display representative catchments within the Quarry Site during the development of the Quarry and the proposed water management structures that would be constructed and/or excavated to separate "clean" and "dirty" surface water runoff.

Extraction Area – Sediment-laden Runoff

Rainfall captured within the extraction area would remain in this location and ultimately infiltrate towards the regional groundwater table below the extraction floor. The extraction area catchment is expected to reach its maximum extent of 5.2ha at the end of Stage 1 of operations.

Operational Disturbance Area – Sediment-laden Runoff

A permanent sediment basin would be constructed to collect and manage sediment-laden runoff at the northwestern extent of the Quarry Site. The catchment area for this sediment basin would reach its maximum extent of approximately 5.5ha during the initial development of the Quarry following the removal of vegetation and topsoil from within the footprint of the proposed extraction area. The catchment area for the sediment basin would progressively decrease during the extension of the extraction area and would ultimately cover an area of approximately 1.5ha.

The calculation of sediment basin capacity requirements (RWC, 2020) applied estimates of rainfall and erosion data, the soil hydrologic group and the catchment area to determine the capacity of the sediment basin within the Quarry Site. The capacity comprised the minimum settlement and storage requirements for a 90th percentile 5-day rainfall event i.e. 25.4mm (the design rainfall event specified in Volume 2E of the Blue Book for standard receiving environments (Landcom, 2004)). The assumptions and final calculations used for the operational disturbance area catchment are included in **Appendix 7** and a summary of the results provided in **Table 5.11**.

Table 5.11
Settlement and Storage Volume Requirements

Dam	Water Settlement Zone (m^3)	Sediment Storage Zone (m^3)	Total (m^3)
Sediment Basin – Initial Development	231	264	495
Sediment Basin – Final Design	63	72	135
Source: RWC (2020) – see Appendix 7			

The sediment basin would be maintained such that it would continue to meet capacity requirements. This would involve excavation of sediment when this exceeds the sediment storage zone for the sediment basin and stabilisation of drainage and sediment basin walls. Excavated sediment would be stockpiled on the floor of the extraction area for incorporation in road base products or used in rehabilitation activities.

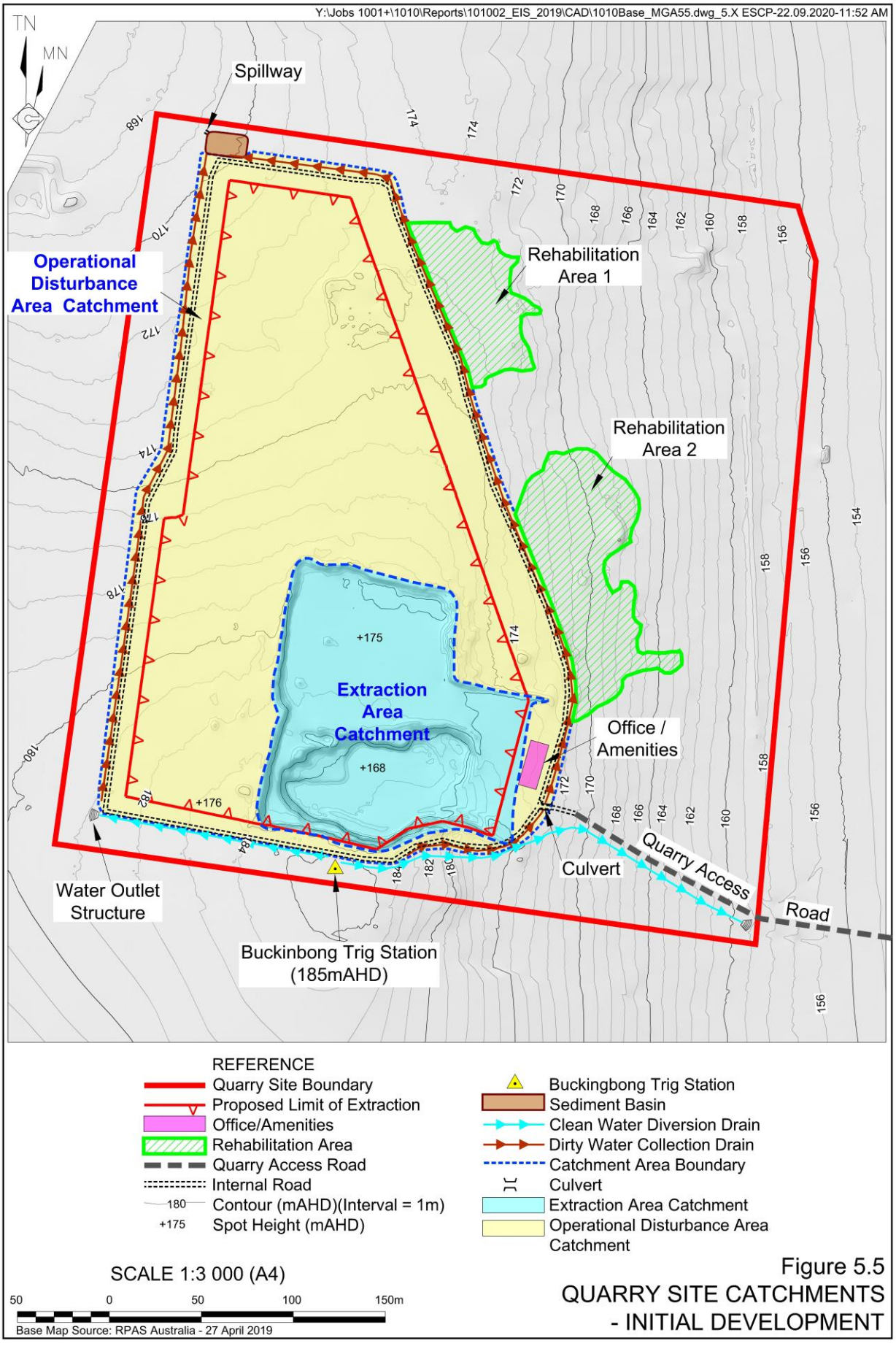


Figure 5.5
QUARRY SITE CATCHMENTS - INITIAL DEVELOPMENT

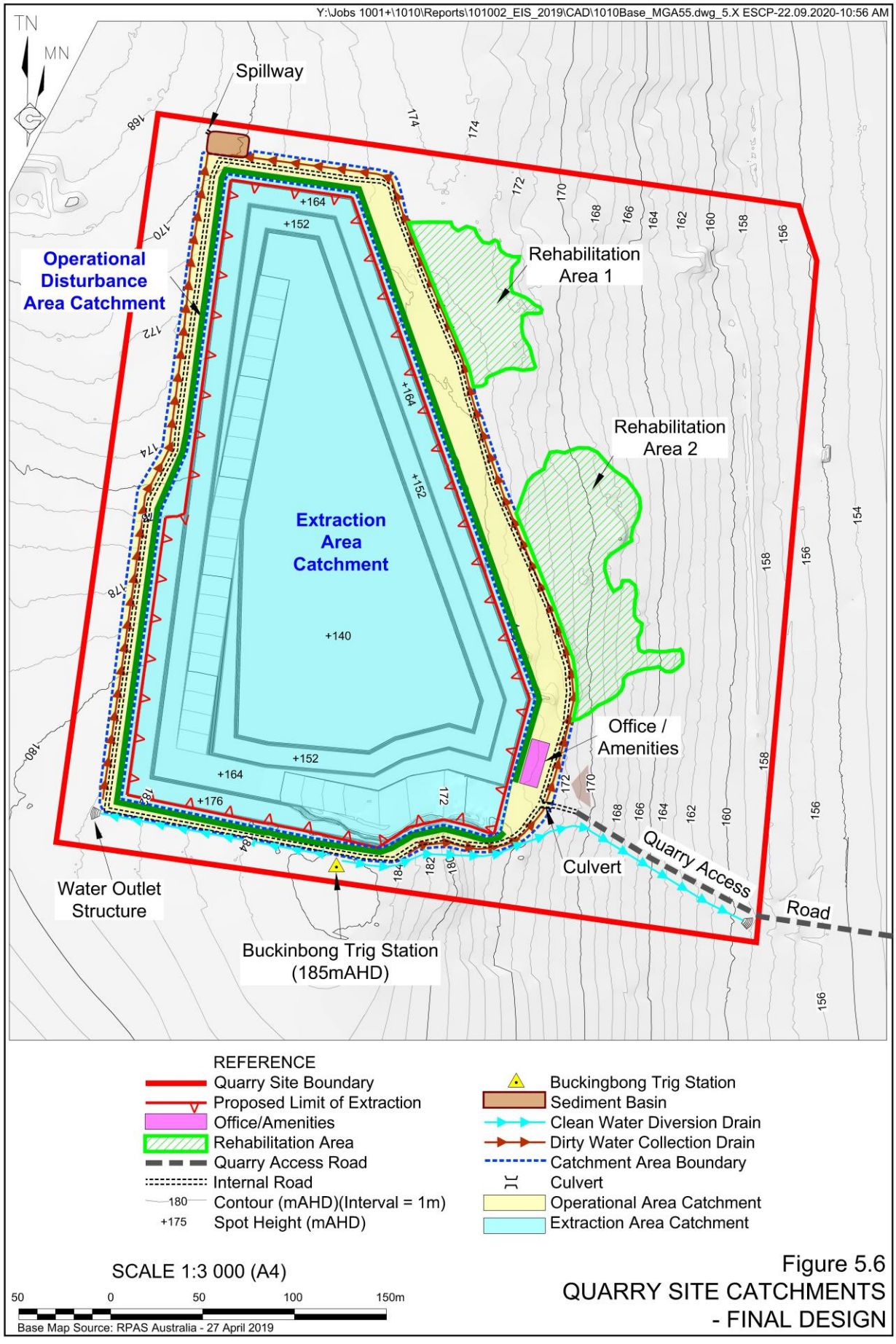


Figure 5.6
QUARRY SITE CATCHMENTS
- FINAL DESIGN

As discussed in Section 2.4.3, two dirty water collection drains would be constructed to convey sediment-laden runoff from the operational disturbance area to the sediment basin. These drains would be constructed around the perimeter of the operational area of disturbance to prevent sediment-laden runoff entering undisturbed areas. A culvert would be installed beneath the internal road providing access to the extraction area in order to convey sediment-laden runoff from the southeastern part of the operational disturbance area catchment.

Undisturbed Areas – Clean Runoff

As discussed in Section 2.4.3, a clean water diversion would be constructed to direct runoff from the undisturbed areas upslope of the extraction area, away from disturbed areas. The diversion drain would be situated to the south of the extraction area and would convey runoff downslope to the west and east.

5.4.3.3 Water Use

Water use within the Quarry Site to date has been limited to that required by a water truck for application on internal roads and other unsealed surfaces during extraction and processing campaigns as well as water sprays on the mobile processing plant. Water for this purpose has previously been sourced from a Council standpipe with a maximum of 30kL per day typically required during campaigns. The Applicant proposes that water for dust suppression would continue to be sourced from the Council standpipe, however, water would also be sourced from the settlement zone of the sediment basin in order to reduce reliance on mains water and ensure the capacity of the sediment basin is maintained.

It is estimated that water use for dust suppression would require no more than 36kL each operational day throughout the life of the Proposal. Assuming an average of 83 campaign days during maximum production years, water use requirements are not expected to exceed 3ML per year.

5.4.3.4 Assessment of Impacts

Assuming the adoption of the design controls detailed in Section 5.4.3.2, it is anticipated that there would be a low likelihood that sediment-laden water would be discharged to the surrounding environment. The proposed sediment dam would provide sufficient capacity to manage predicted runoff resulting from a 90th percentile 5-day rainfall event and storage volume to provide water for use by the water cart for dust suppression on unsealed areas of the Quarry Site, if required.

5.4.3.5 Monitoring

Due to the low risk of sediment-laden discharge to the surrounding environment, regular surface water monitoring is not proposed. However, the Applicant would undertake inspections of all structures to ensure stability and sediment storage capacity is maintained after any significant rainfall event. Where it is required, the Applicant would implement measures to remove any excess sediment and/or debris and repair the sediment basin and control structures.

5.4.3.6 Conclusion

It is considered that the Proposal would have negligible impacts on surface water given the proposed management and mitigation measures. Additionally, the operation has demonstrated an ability to access enough water supplies to provide for dust suppression activities throughout the life of the Proposal.

5.5 Biodiversity

5.5.1 Introduction

The SEARs for the Proposal identified biodiversity as a key issue requiring that the EIS include:

- accurate predictions of any vegetation clearing on site;
- a detailed assessment of the likely biodiversity impacts of the development, paying particular attention to threatened species, populations and ecological communities and groundwater dependent ecosystems, undertaken in accordance with Sections 7.2 and 7.7 of the *Biodiversity Conservation Act 2016* (BC Act); and
- a detailed description of the proposed measures to maintain or improve the biodiversity values of the site in the medium to long term, as relevant.

In addition, assessment requirements relating to biodiversity values were received from the then OEH and NSW DPI - Agriculture. **Appendix 3** presents a summary of where all relevant assessment requirements have been addressed in the EIS.

A Biodiversity Development Assessment Report (BDAR) for the Project has been prepared by OzArk Environmental and Heritage Management Pty Ltd which is referred to as OzArk (2021) and is presented as **Appendix 8.** The following subsections describe the setting of the Proposal and provide a summary of the BDAR and describes the management and mitigation measures to be implemented by the Applicant.

5.5.2 Assessment Methodology

5.5.2.1 Desktop Assessment

The following information sources were considered in preparation for field surveys of the Quarry Site. This information provided suitable background to inform the type and timing of surveys that would be required and to identify species likely to be present and potentially affected by the Proposal.

- BioNet Vegetation Classification
- BioNet Threatened Biodiversity Data Collection
- BioNet Atlas
- Register of Declared Areas of Outstanding Biodiversity Value
- NSW Government Web Map Service (WMS) layers for NSW Imagery

- State Vegetation Type Map: Riverina Region Version 1.2 – VIS_ID 4469
- NSW DPI threatened fish indicative distribution maps
- Biodiversity Values Map
- Mapping of vulnerable lands – steep and highly erodible
- Acid Sulphate Soils Risk mapping
- Directory of Important Wetlands Australia
- Important area mapping for Regent Honeyeater and draft important area mapping for Swift Parrot
- PlantNET
- EPBC Act Protected Matters Search Tool

5.5.2.2 Field Surveys

OzArk completed field surveys within the Quarry Site on 29 August, 19 September, 29 October and 31 October 2019 to validate predictions made based on the desktop assessment completed above and map potential habitats and identified species within the Quarry Site. The survey methods are described in full in Section 2.3 of OzArk (2021) and comprised:

- twelve survey plots consistent with the Biodiversity Assessment Methodology (BAM);
- general habitat searches to identify significant habitat features such as hollow-bearing trees;
- incidental threatened flora and fauna searches;
- threatened flora transects and habitat searches;
- search for scats / signs of habitat use;
- Koala Spot Assessment Technique (SAT) searches;
- Barking Owl (*Ninox connivens*) call playback and nocturnal spotlighting;
- diurnal bird surveys;
- 1 x song meter SM4 acoustic recorder (21 days); and
- 1 x song meter SM3 bat detector (13 nights).

5.5.3 Vegetation Communities and Threatened Species

Plant Community Types

Field surveys within the Quarry Site identified the following three Plant Community Types (PCTs).

- PCT 70 - White Cypress Pine woodland on sandy loams in central NSW wheatbelt.

- PCT 80 - Western Grey Box - White Cypress Pine tall woodland on loam soil on alluvial plains of NSW South Western Slopes Bioregion and Riverina Bioregion.
- PCT 185 - Dwyer's Red Gum - White Cypress Pine - Currawang shrubby woodland mainly in the NSW South Western Slopes Bioregion.

A total of 3.93ha of vegetation would be removed by the Proposal comprising approximately 2.64ha of vegetation in poor condition and 1.29ha in moderate condition. **Figure 5.7** and **Table 5.12** present the vegetation types that would be removed by the Proposal together with their respective areas.

Table 5.12
Vegetation Integrity Assessment

PCT	Condition	Area to be Cleared (ha)	Number BAM Plots Completed	Vegetation Integrity
70	Moderate	0.04	2	49.4
80	Moderate	0.27	4	63.7
80	Poor	2.64	2	9.5
185	Moderate	0.98	2	43.4
Source: OzArk (2021) – Modified after Table 7-1				

Threatened Ecological Communities

No threatened ecological communities (TEC) listed under the *Biodiversity Conservation Act 2016* (BC Act) or the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) were present within the Quarry Site.

Flora Species

A total of 52 flora species were observed within the Quarry Site. Of these, 46 species were native and six were exotic. A complete listing of flora species identified during field surveys is presented in Appendix C of OzArk (2021). Paterson's Curse (*Echium plantagineum*), a high threat weed, was identified within the Quarry Site.

Fauna

A total of 40 fauna species were identified within the Quarry Site. Of these, 37 were native and three were exotic. A complete listing of fauna species identified during field surveys is presented in Appendix C of OzArk (2021).

Threatened Species

For the purpose of credit calculations, threatened species are listed as either ecosystem credit species or species credit species, where:

- an ecosystem credit species is a species whose likelihood of occurrence can be predicted by vegetation surrogates and landscape features, or for which targeted survey has a low probability of detection.
- a species credit species is a species whose likelihood of occurrence cannot be predicted by vegetation surrogates and/or landscape features and can be reliably detected by survey.

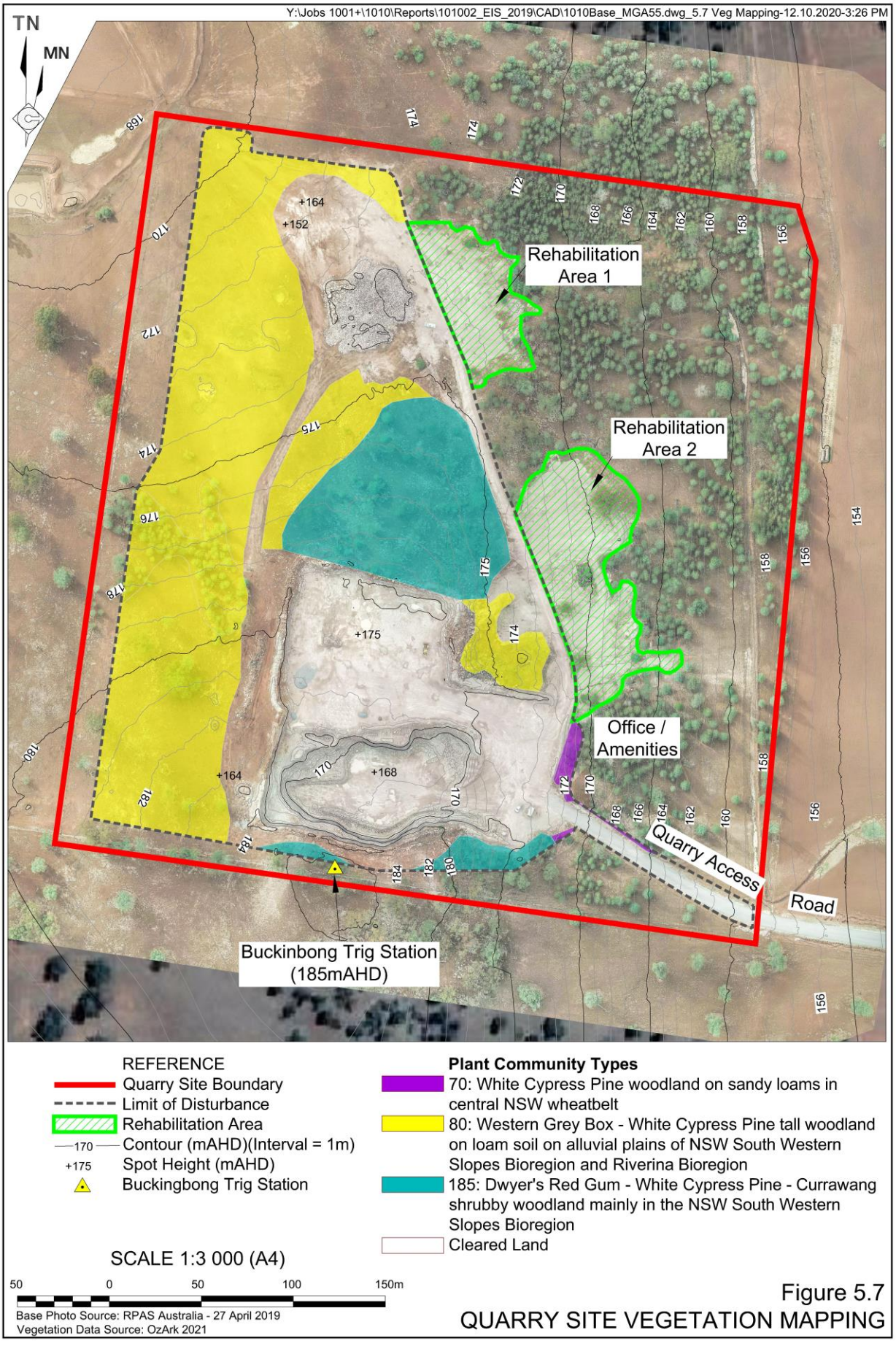


Figure 5.7
QUARRY SITE VEGETATION MAPPING

A total of 29 ecosystem credit species and seven species credits species were assumed to frequent the Quarry Site. Complete listings of ecosystem and species credit species are provided in Tables 5-1 and 5-2 of OzArk (2021).

5.5.4 Management and Mitigation Measures

The Applicant would implement the following management measures to avoid or mitigate the risk of adverse impacts on threatened species within the Quarry Site.

Vegetation Clearing

- Areas of proposed disturbance would be clearly marked prior to the commencement of clearing campaigns to minimise the potential for over clearing of vegetation.
- Vegetation would be removed in a manner that avoids damage to surrounding vegetation.
- The following procedures would be adopted to guide the clearing of all mature trees.
  - Where necessary, a qualified or suitably experienced spotter-catcher would be engaged to undertake an initial assessment of the area to be cleared for threatened species.
  - All trees would be checked for the presence of nesting or roosting fauna before felling or pushing.
  - Clearing activities would be ceased if threatened bat species are detected until after individuals have dispersed.
  - Felled mature trees would be relocated to the two rehabilitation areas to enhance habitat.
- Bush rock, tree trunks and major limbs would be used in rehabilitation of disturbed areas within the Quarry Site.
- All personnel and contractors would be inducted and made aware that unauthorised clearing of native vegetation may have legislative consequences.

Fauna Management

- Fauna that has become displaced from vegetation clearing would be allowed to relocate to remnant vegetation.
- Vehicular access would be limited to formed and marked roads and tracks with speed limits restricted to 40km/h on the Quarry Access Road and 20km/h on unsealed roads within the Quarry Site to limit the potential for vehicle trauma to wildlife.

Weed Management

- Machinery would be cleaned of soil and weeds before entry to the Quarry Site.
- Weed control programs would be undertaken periodically to manage invasive species.

Topsoil Management

- Stripped soil would be placed directly onto rehabilitation areas or stockpiled for use in progressive rehabilitation activities to maximise the opportunity for retention of the natural seed stock.

Rehabilitation

- Disturbed areas within the Quarry Site would be revegetated as described in Section 2.12.
- Species used during rehabilitation operations would be consistent with vegetation community types located within and surrounding the Quarry Site or other suitable pasture species, as appropriate.

Management measures that are described elsewhere in this EIS would also mitigate impacts to biodiversity values include the following.

- Erosion and sediment controls would be implemented to limit the potential for sediment-laden runoff to leave the Quarry Site.
- Waste would be managed to limit the presence of feral animals and rubbish inadvertently entering areas of remnant vegetation.
- Operational activities would be limited to between 6:00am to 6:00pm to minimise indirect impacts on threatened fauna.

5.5.5 Assessment of Impacts

5.5.5.1 Impacts to Native Vegetation

A total of 3.93ha of native vegetation would be removed under Proposal (see **Table 5.12**). The removal of native vegetation would be offset in accordance with the Biodiversity Offset Scheme under the BC Act (see Section 2.13). It is noted that the Quarry Site has been designed to avoid impacts to a hollow-bearing habitat tree which was identified to the south of the extraction area.

5.5.5.2 Indirect Impacts

The principal impacts of the Proposal would be contained within the Quarry Site. Disturbance from operational activities would occur (e.g. noise and dust), however, these impacts would be minimised by implementing the management and mitigation measures identified in Section 5.5.4.

5.5.5.3 Serious and Irreversible Impacts

OzArk (2021) identified that one of the species present (or assumed present) within the Quarry Site, the Oaklands Diuris (*Diuris* sp. (*Oaklands, D.L. Jones 5380*)), required assessment for potential serious and irreversible impacts (SAII). The Oaklands Diuris is associated with PCT 80 and 75. PCT 80 occurs within the Quarry Site in both a poor and moderate condition. Up to 2.91ha of available habitat for the species would be removed under the Proposal (approximately 0.19% of suitable habitat within the local area). However, there are no current records of the species within the local area and impacts to the species would be limited to the reduction of potential occupancy of the species through the reduction of suitable habitat.

5.5.5.4 Matters of National Environmental Significance

Under the environmental assessment provisions of the EPBC Act, Matters of National Environmental Significance (MNES) and impacts on Commonwealth land are required to be considered to assist in determining whether the proposal should be referred to the Commonwealth Department of Agriculture, Water and the Environment (DoAWE).

A total of four Critically Endangered and ten Endangered species and ten Vulnerable species were determined to have the potential to be impacted by the Proposal in addition to seven migratory species. OzArk (2021) determined that the Proposal would not have a significant impact on MNES or on the environment in general. A complete listing of species and habitats considered in relation to MNES is provided in Appendix F of OzArk (2021).

5.5.6 Conclusion

The Proposal would include the removal of approximately 3.93ha of native vegetation comprising 0.04ha of PCT 70 (moderate condition), 0.27ha of PCT 80 (moderate condition), 2.64ha of PCT 80 (poor condition) and 0.98ha of PCT 185 (moderate condition). This vegetation has the potential to provide habitat through foraging areas or breeding habitat. Residual impacts to native vegetation would be offset in accordance with the Biodiversity Offset Scheme (see Section 2.13).

It has been concluded that potential direct (residual) impacts would be suitably offset and potential indirect impacts would be managed through the implementation of measures to avoid or mitigate potential risks. There would be no significant impacts to SAII or MNES as a result of the Proposal.

5.6 Cultural Heritage

5.6.1 Introduction

The SEARs for the Proposal identified Aboriginal heritage as a key issue, requiring that the EIS include an assessment of:

- potential impacts on Aboriginal heritage (cultural and archaeological), including evidence of appropriate consultation with relevant Aboriginal communities / parties and documentation of the views of these stakeholders; and

- historic heritage in the vicinity of the development and an assessment of the likelihood and significance of impacts on heritage items, having regard to relevant policies and guidelines.

Additional Aboriginal and historic heritage-related requirements from government agencies for inclusion in the EIS were provided by the then Office of Environment and Heritage (OEH) (now Heritage NSW)[4]. **Appendix 3** presents an overview of the SEARs and government agency requirements, and where each has been addressed.

The following subsections describe the setting of the Proposal and provide a summary of the Aboriginal Archaeological Impact Assessment (AAIA) and Historic Heritage Impact Assessment (HHIA) prepared by OzArk Environment & Heritage (OzArk, 2020) (**Appendix 9**), and describes the management and mitigation safeguards to be implemented by the Applicant.

5.6.2 Aboriginal Cultural Heritage

5.6.2.1 Ethnohistory and Environmental Setting

The Quarry Site is located within the territory of the Wiradjuri people, with their territory encompassing an area of the Murray Darling Basin from the highlands or central tablelands in the east, the riverine plains in the west, and the transitional western slopes zone in-between. The Quarry Site is located within the riverine plains in the western area of the Wiradjuri tribal areas. Within the Wiradjuri region, the presence of Aboriginal people has been dated to approximately 40 000 years ago with a spread east into the mountains thought to have occurred between approximately 14 000 to 12 000 years ago (Hope, 1981 as cited in Haglund (1985)).

OzArk assessed the local environmental context of the Quarry Site and noted the following regarding potential Aboriginal occupation and use of the landscape and associated resources.

- Aboriginal occupation in the area surrounding the Quarry Site is likely to have occurred, although this would have varied depending on the availability of local resources. Mature, native tree species common to the area would have provided a resource for Aboriginal people in the past.
- The topography of the surrounding landforms in the area surrounding the Quarry Site would have allowed for ample elevation to support sporadic occupation, transitory movement and use as a vantage point across the landscape.
- The lack of a reliable water source in the area surrounding the Quarry Site indicates that no repeated, long-term occupation of the area would have occurred. Resources suitable to support a large population of people would have been more readily available closer to permanent water sources, such as the Murrumbidgee River.
- Past land uses including quarrying and agriculture are likely to have removed any potential evidence of Aboriginal cultural heritage.

[4] It is noted that the Aboriginal heritage compliance functions of the Biodiversity Conservation Division are now in Heritage NSW.

5.6.2.2 Aboriginal Community Involvement

A site officer from the Narrandera Local Aboriginal Land Council (LALC), Mr Derick Lyons, accompanied the archaeologist during the pedestrian survey. Appendix 1 of OzArk (2020) includes a log and copy of all correspondence with the Aboriginal Community.

5.6.2.3 Desktop Review and Predictive Model

A review of the Commonwealth Heritage List, National Heritage List, National Native Title Claims Search, State heritage listings and Narrandera Shire Council's Local Environmental Plan undertaken by OzArk indicated that no Aboriginal objects, sites or places were listed as occurring within the Quarry Site. A search of the Aboriginal Heritage Information Management System (AHIMS) indicated that 101 Aboriginal sites are located within 10km of the Quarry Site. These sites comprise a total of 76 artefact scatters or isolated finds and 16 modified trees with the other sites including conflict and/or massacres sites, burial sites, ceremonial and dreaming sites and a stone quarry. **Figure 5.8** displays the AHIMS-listed Aboriginal Heritage Sites in the area surrounding the Quarry Site.

The predictive model developed for the Quarry Site by OzArk indicated that the most frequently recorded site types for similar environments included isolated finds, scarred trees and stone procurement sites. OzArk determined that the presence of artefact scatters, conflict sites and burial sites would be unlikely.

5.6.3 Survey and Results

An archaeological survey of areas within the Quarry Site not subject to active extraction or operational disturbance, including all mature native trees with the potential to contain Aboriginal scarring, was undertaken on foot by OzArk.

Table 5.13 calculates the effective survey coverage within the Quarry Site including a breakdown of the ground surface visibility (GSV) and ground surface exposure (GSE) at any location within particular landform units.

Table 5.13
Effective Survey Coverage within the Quarry Site

Survey Unit	Landform	Survey Unit Area (m^2)	Visibility (%)	Exposure (%)	Effective Coverage Area (m^2)	Effective Coverage (%)
1	Elevated flats and upper slope	69 814	50	75	26 180	38
2	Slopes	40 873	40	50	8 175	20
Source: OzArk (2020) – Modified after Table 5-1						

The GSV within the elevated flats and upper slope landform was approximately 50% with a GSE of 75% resulting in an effective coverage of 38%. GSV was low–moderate across the sloping landforms, with short grasses, patches of scalding and gravel present on the ground surface. The effective coverage on sloping landforms was 20%.

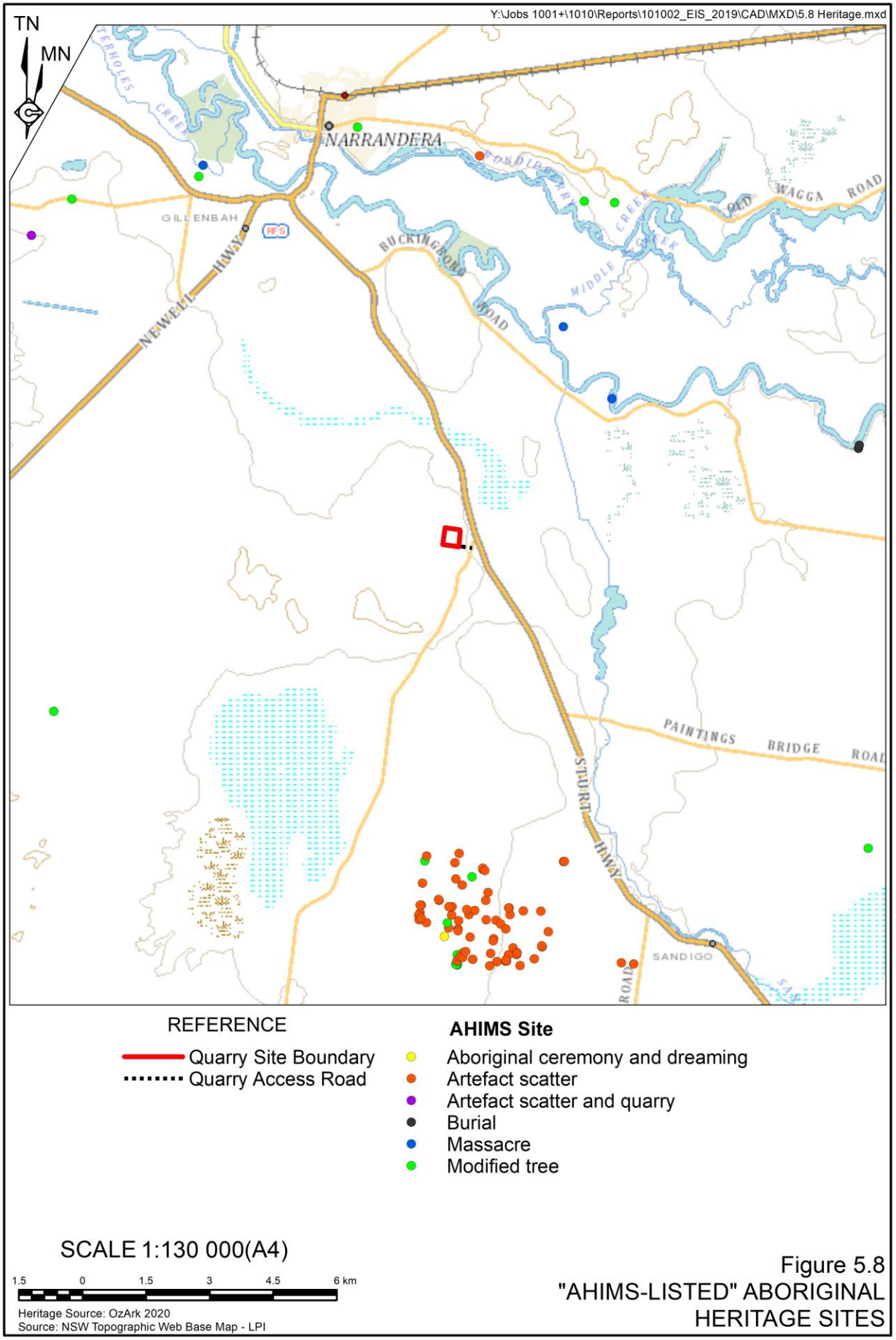


Figure 5.8
"AHIMS-LISTED" ABORIGINAL HERITAGE SITES

Despite the high survey efficacy, no Aboriginal sites or features were recorded during the survey. Two historical features were recorded during the survey, namely Strontian HS-01 and Strontian HS-02. Strontian HS-01 was identified as a survey blaze tree which is located next to a stand of regrowth cypress pine trees near the western boundary of the Quarry Site. Strontian HS-02 was identified as a stone cairn trigonometrical station used to mark the highest point of Buckingbong Hill at the southern extent of the Quarry Site. It is noted that neither Strontian HS-01 or Strontian HS-02 meet the criteria for local, state or national significance. **Figure 5.9** displays the location of the historical features recorded during the survey.

5.6.4 Management and Mitigation Measures

The Applicant would implement the following management and mitigation measures at the Quarry Site in order to avoid or mitigate the potential for impacts on historic heritage features and Aboriginal cultural heritage-related values.

- Quarry operations would be restricted to within the nominated area of disturbance to avoid potential impacts to identified historical features and any potential unidentified artefacts. The boundary of operational disturbance would be surveyed and clearly marked prior to any vegetation or earthworks.
- All Quarry staff and personnel involved in activities with the potential to result in disturbance would be made aware of the legislation protecting sites and places of heritage significance and the associated penalties for disturbance of these sites. Work crews would also undergo cultural heritage induction to ensure they recognise Aboriginal artefacts that may be found within the Quarry Site.
- The following would be implemented in the event that unexpected finds are discovered during works.
  - All work would cease in the immediate vicinity of the find.
  - A 10m buffer (50m buffer for human skeletal remains) would be taped off with high visibility tape or fencing noting that works would proceed outside of the buffer area.
  - Heritage NSW would be contacted immediately (and the NSW Police for human skeletal remains).

5.6.5 Assessment of Impacts

No Aboriginal sites were recorded during the assessment. As such, it has been assessed that there would be no adverse impacts on Aboriginal objects or cultural heritage values as a result of the Proposal. Given the management and mitigation measures identified in Section 5.6.4, it is further anticipated that Strontian HS-01 and Strontian HS-02 would not be impacted by the Proposal.

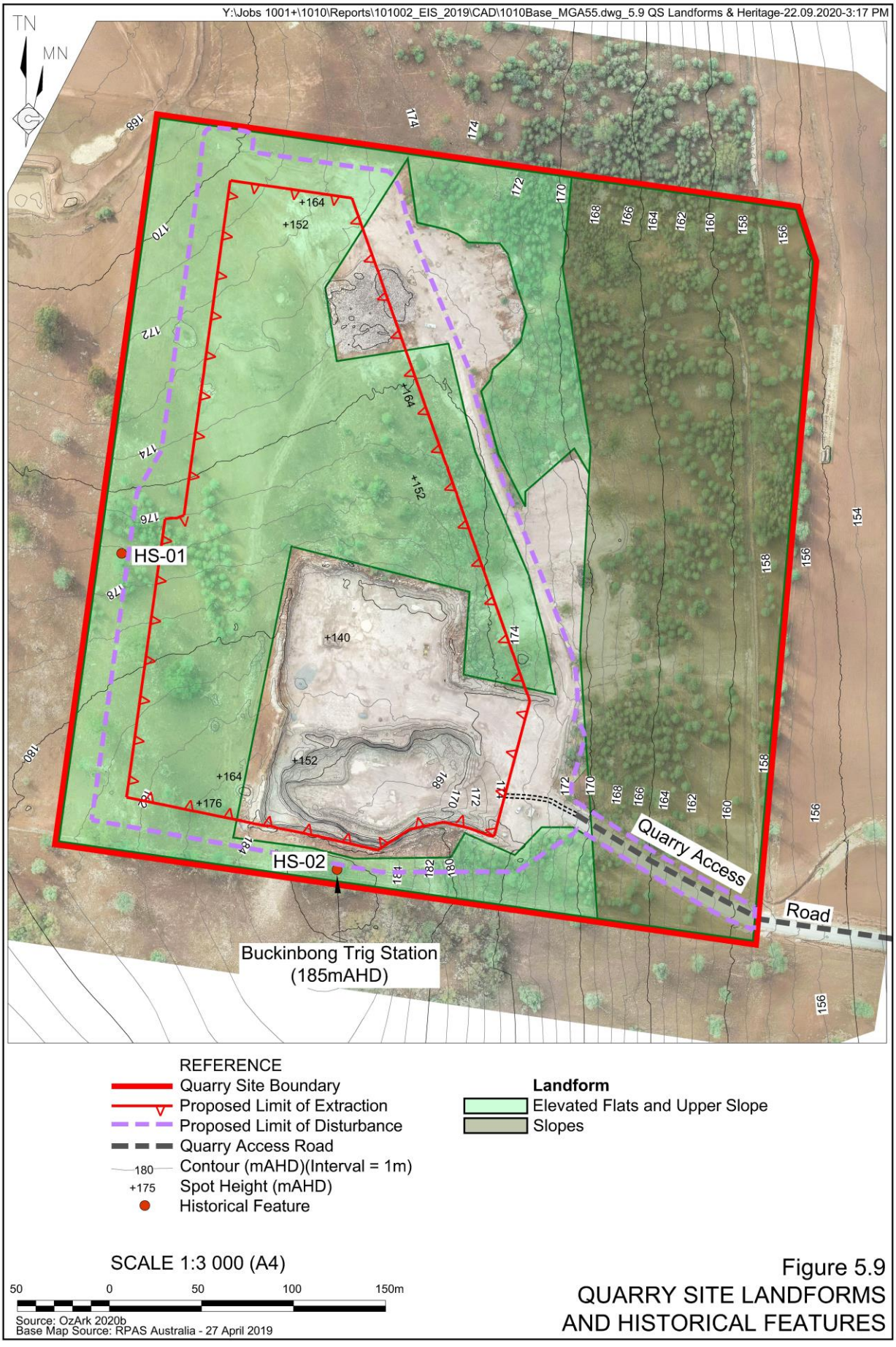


Figure 5.9
QUARRY SITE LANDFORMS
AND HISTORICAL FEATURES

5.7 Soil and Land Resources

5.7.1 Introduction

The SEARs for the Proposal require the EIS to include an assessment of potential impacts to land resources, including:

- potential impacts on soils and land capability (including erosion and land contamination) and the proposed mitigation, management and remedial measures (as appropriate);
- potential impacts on landforms (topography), paying particular attention to the long term geotechnical stability of any new landforms; and
- the compatibility of the development with other land uses in the vicinity of the development in accordance with the requirements in Clause 12 of *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries)* 2007.

The following subsections present a summary of the land resources for the Quarry Site, identifying specific constraints and opportunities that might affect the proposed design, establishment, operation and post-operative rehabilitation of the Proposal.

5.7.2 Site Soils

Mitchell Landscapes

The Quarry Site straddles the boundary between the Murrumbidgee-Tarcutta Channels and Floodplains and Cocoparra Ranges and Footslopes Mitchell Landscapes. The eastern part of the Quarry Site is located within the Murrumbidgee-Tarcutta Channels and Floodplains landscape which comprises the channels, floodplains and terraces of Murrumbidgee tributaries on Quaternary alluvium. Soils of the Murrumbidgee–Tarcutta Channels and Floodplains are characterised by undifferentiated organic sand and loam in the floodplain, with brown gradational loam and yellow texture-contrast soils on higher terraces.

The western part of the Quarry Site is located within Cocoparra Ranges and Footslopes landscape. The soils of the Cocoparra Ranges and Footslopes are represented by shallow sandy lithosols and acid neutral and calcareous red earths which are commonly identified on sloped landforms. Deep sandy alluviums are generally associated with creek lines.

Australian Soil Classification

The Quarry Site contains Kursols as defined by the Australian Soil Classification. Kurosols typically form from materials that are highly siliceous to intermediate in composition and generally have a clear or abrupt textural B Horizon which is acidic. Kurosols have low agricultural potential due to their strong acidity, low water-holding capacity and high sodicity and are often easily erodible.

Land and Soil Capability

The Quarry Site is located in an area with an estimated Land and Soil Capability (LSC) of Class 4. LSC Class 4 land is considered to have moderate to severe limitations for high-impact land uses with land generally more suited to grazing, restricted cropping, some horticulture, forestry and nature conservation. **Figure 5.10** displays the land and soil capability within and immediately surrounding the Quarry Site.

5.7.3 Management and Mitigation Measures

The Applicant's approach to vegetation clearing, soil stripping and stockpiling procedures have been discussed in Section 2.4.5. A summary of these and other soil management procedures and safeguards which would be implemented are provided as follows.

- Clearly mark areas for stripping and stockpiling.
- Refrain from stripping or placing soil during wet conditions.
- Strip soil from all areas of disturbance and place within designated rehabilitation areas or store in stockpiles no more than 2m high oriented parallel to the contours.
- Ensure that soil stockpiles are constructed with side slopes of 1:3 (V:H) or less.
- Ensure that the 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 cover crop on all soil stockpiles to facilitate revegetation.
- Signpost soil stockpiles and limit operation of machinery on stockpiles to minimise compaction and further degradation of soil structure.

5.7.4 Impact Assessment

Adherence to the recommended soil stripping, handling, stockpiling procedures and other management practices, together with appropriate rehabilitation practices, would result in minimal impacts to soils and land and soil capability within the Quarry Site.

Due to the elevation of the Quarry Site and surrounding area, it is not considered that the Proposal would contribute to any salinity in the area, nor impact access and quality of groundwater from existing bores.

Section 5.4.3 describes the erosion and sediment control measures that would be implemented to manage sediment-laden water within the Quarry Site. It is considered that, with the implementation of these measures, the risk of erosion and off-site sedimentation would be minimal.

As described in Section 4.3.2, the land surrounding the Quarry Site is principally used for grazing and dryland cropping. It is considered that the Proposal would not alter the productive use of this land. This is supported by the historical operation of the existing quarry operation alongside these land uses.

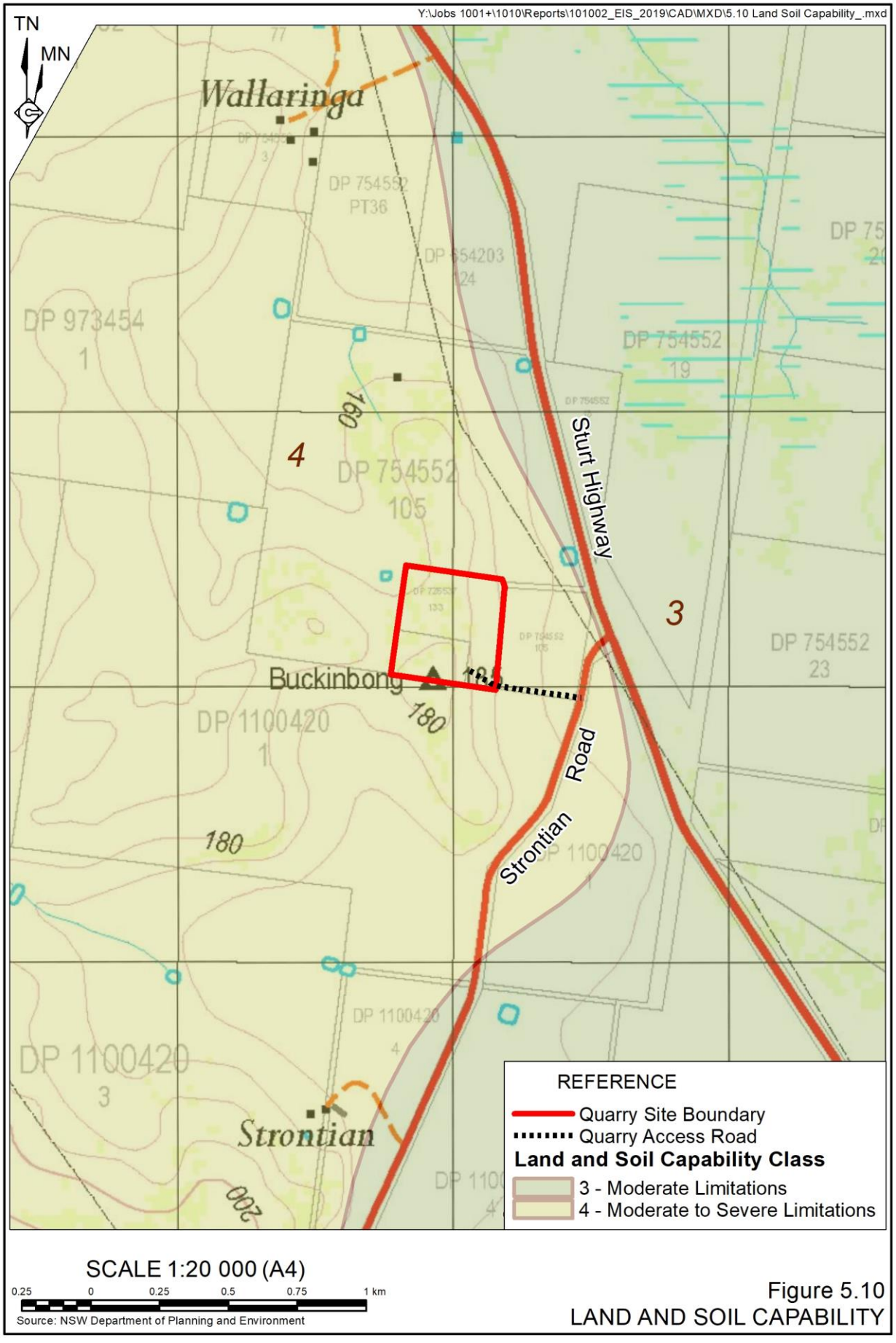


Figure 5.10
LAND AND SOIL CAPABILITY

Under the Proposal, the indurated sandstone resource would continue to be extracted from the topographic feature which comprises part of the outcropping Womboyne Formation (as described in Section 2.5 and displayed on **Figure 2.1**). The progressive removal of this material would result in changes to the surrounding topography and drainage. However, the Proposal would not substantially change the stability of the landform. Terminal faces within the extraction area would be retained at approximately 80° and would incorporate appropriate surface drainage to ensure the long-term stability. Furthermore, and as described in Section 2.12, the Applicant intends to develop a final landform that provides for biodiversity conservation and grazing that would blend with the surrounding landscape and remnant vegetation (the final landform is displayed on **Figure 2.7**).

5.8 Visibility

5.8.1 Introduction

The SEARs for the Proposal require the EIS to include an assessment of potential impacts to visual amenity, including:

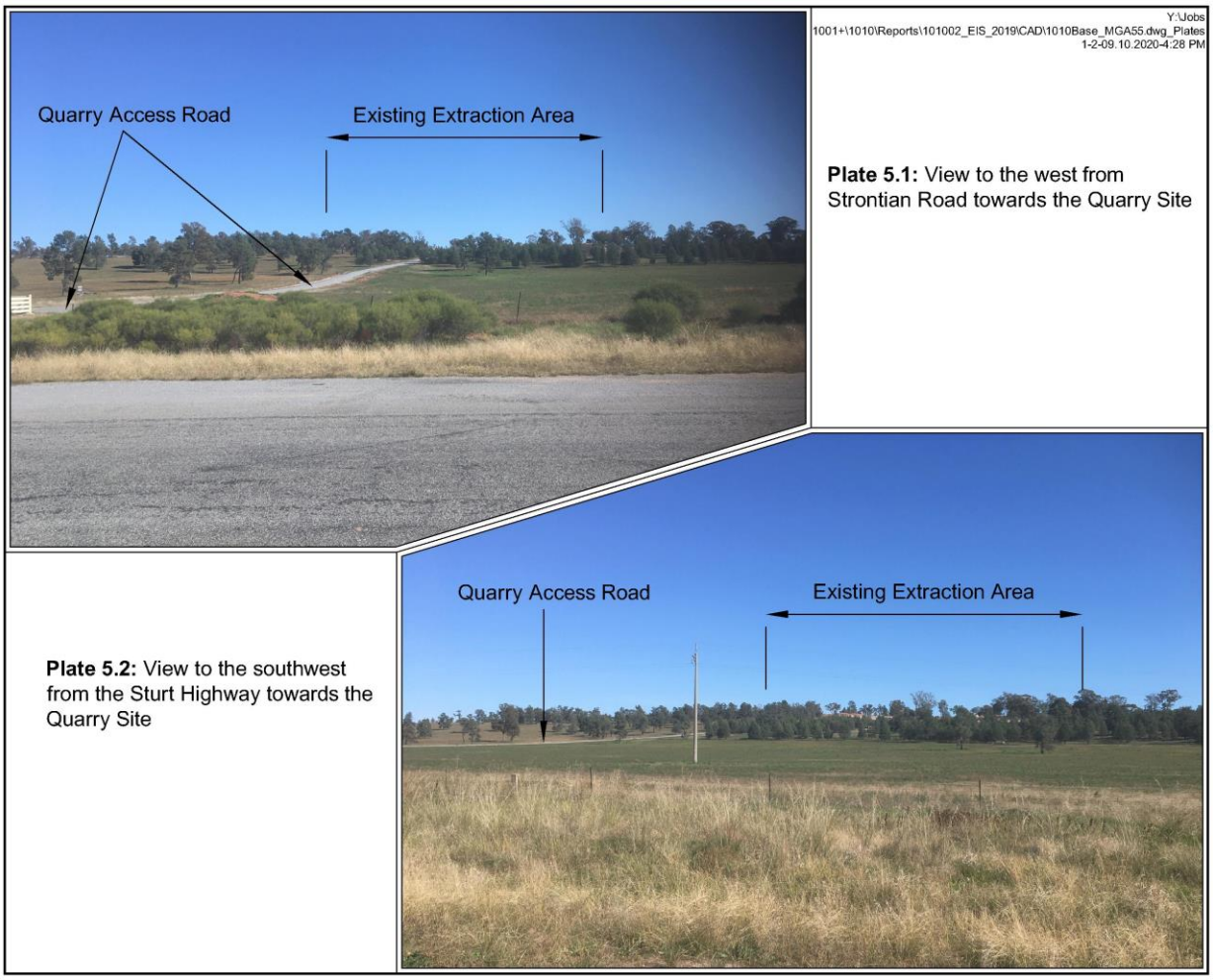
- an assessment of the likely visual impacts of the development on private landowners in the vicinity of the development and key vantage points in the public domain, including with respect to any new landforms.

The following subsection describes the visual environment and considers the visibility of the proposed activities throughout the life of the Proposal.

5.8.2 The Existing Visual Landscape

The existing visual landscape surrounding the Quarry Site varies significantly with the following features of the local setting.

- The Quarry Site is located in an area of variable terrain with low-lying land to the east and undulating, hilly terrain to the west and southwest (principally associated with the outcropping Womboyne Formation). Although located on a topographic high, the substantial vegetation surrounding the Quarry Site results in limited opportunities to view operational features from public vantage points.
- Infrastructure in the form of powerlines, local roads and the Sturt Highway are features of the local visual setting. Opportunities to view existing operations from local roads and the Sturt Highway are limited due to the vegetation surrounding the operational areas. **Plates 5.1** and **5.2** display views from the surrounding road network towards the Quarry Site. Views are largely restricted to the top of extraction faces and the safety perimeter bund around the existing extraction area.
- There is limited or no visibility of the Quarry Site from surrounding residences.



5.8.3 Management and Mitigation Measures

The Proposal has been designed to minimise potential impacts to visual amenity with any residual visual impacts to be mitigated through the implementation of a range of operational practices. The management and mitigation measures that would form part of the Proposal include the following.

- Remnant vegetation on the eastern slopes within the Quarry Site would not be disturbed to ensure views of operational areas from Strontian Road and the Sturt Highway are shielded as far as practicable.
- The perimeter safety bund around the extraction area and terminal benches would be progressively rehabilitated throughout the life of the Proposal to assist in providing a long-term acceptable view from public vantage points towards the final landform and obtain the ecological benefits of retaining a range of native species within the final landform. Areas of operational disturbance around the extraction area would also be rehabilitated following the completion of operations.

- Processing operations would be undertaken within the extraction area to provide a topographic barrier between mobile processing equipment and public vantage points. The extraction area would also assist in containing any dust generated during processing. It is noted that product loading and despatch activities would also be restricted to within the extraction area.
- Disturbed areas on the eastern slopes (Rehabilitation Areas 1 and 2) would be progressively rehabilitated to reinstate vegetation cover and improve visual amenity.

5.8.4 Changes to Visual Amenity

The Proposal would result in the creation of an approximately 5.2ha sized void in the landscape. This modification to the landform would, however, be largely screened from vantage points surrounding the Project Site by remnant and planted vegetation. The proposed rehabilitation of the Quarry Site has also been developed with an objective to minimise the visual intrusiveness of the operations and progressively generate a final landform which, to the greatest extent practicable, is in sympathy to the surrounding landforms and landscape.

The Applicant is cognisant of the need to manage the visual impact of the Quarry from surrounding vantage points and proposes to restrict processing operations, product stockpiling and loading and despatch activities to within the extraction area to further minimise visual intrusiveness.

5.8.5 Assessment of Impacts

There would be limited or no visibility of the Quarry Site from surrounding residences with the closest residences located approximately 3.9km from the Quarry Site.

The visibility of the Quarry Site from Strontian Road and the Sturt Highway is limited by remnant vegetation which acts as a screen. It is considered that remnant vegetation together with the proposed mitigation measures would continue to effectively screen the Quarry Site from local vantage points for the life of the Proposal resulting in minimal impacts to visual amenity.

5.9 Public Safety Hazards

5.9.1 Introduction

The SEARs for the Proposal require the EIS to include an assessment of potential hazards, including:

- an assessment of the likely risks to public safety, paying particular attention to potential bushfire risks, and the transport, storage, handling and use of any hazardous or dangerous goods.

The following subsections identify potential hazards associated with the Proposal and the management and mitigation measures that would be implemented to reduce any potential impacts.

5.9.2 Bush Fire Hazards

The Rural Fire Service (RFS) mapping tool, accessed on 11 February 2020, identifies that the Quarry Site is not located within a designated bush fire prone area which in turn means an assessment of bush fire risk is not required under Section 4.14 of the EP&A Act 1979.

Notwithstanding the above, it is recognised that some areas of the Quarry Site will remain vegetated and, therefore, it would be possible for bush fire to spread both within the Quarry Site and adjacent to the Quarry Site if management measures are not adopted to mitigate this hazard.

In terms of potential impacts, the assets considered at risk include employees and the local community. In order to protect these assets, a bush fire management plan would be documented in the Environmental Management Plan (EMP) for the Quarry. The bush fire management section of the EMP would include the following.

- A review of bush fire hazards and identification.
- A summary of controls and management measures including fire response equipment and locations.
- Emergency contact details.
- Training requirements.

Various activities that may increase the risk of fire on the Quarry Site and transport route, and the controls proposed to limit the risk posed by these are presented in **Table 5.14**

Table 5.14
Bush Fire Hazard – Activities and Controls

Activity	Possible Ignition Source	Safeguards and/or Controls
Refuelling	Spilt fuel or dry grass ignited by spark.	• Refuelling undertaken within cleared area of the Quarry Site. • Engines in all vehicles to be turned off during refuelling. • No smoking policy to be enforced in designated areas of the Quarry Site. • Fire extinguishers maintained within all site vehicles and mobile equipment.
General Activities	Cigarettes, Rubbish, e.g. glass, metal.	• No smoking policy to be enforced in designated areas of the Quarry Site. • No throwing cigarette butts from product trucks along the product delivery route. • Focus on housekeeping to be maintained by the Applicant. • Water cart available. • All site vehicles and mobile equipment to carry a fire extinguisher.

More general bush fire management measures to assist in the event of a local bush fire event are as follows.

- All employees would be trained in the proper use of the firefighting equipment on site.
- A water cart would be made available for firefighting purposes in the event of a bush fire.
- A protocol would be developed for restricting work in vegetated areas during high fire danger periods of the bush fire season (in accordance with the hazard category notifications).
- Procedures for hot works would be developed to prevent ignition sources for a bush fire.
- Firebreaks would be developed and maintained as required and in consultation with the local RFS.
- The local Rural Fire Service would be consulted regarding any controlled burns planned for asset protection and / or ecological management.
- Emergency and Evacuation Management Procedures would be developed that would include procedures in the event of a local bush fire.

5.9.3 Handling Storage and Disposal of Hydrocarbons

The specific hazard-related impacts that may result as a consequence of the Proposal relate primarily to the handling, storage and disposal of hydrocarbons. In order to minimise the potential for hydrocarbon contamination, the following controls and safeguards would be implemented.

- Hydrocarbons and hazardous materials would only be purchased from licensed suppliers for the transport of dangerous goods in accordance with *Dangerous Goods (Road and Rail Transport) Act 2008 No 95.*
- It is anticipated that diesel would be brought to site for refuelling in a self-bunded trailer, as required. However, in the event that diesel is stored at the Quarry Site, it would be stored in a self-bunded container and in accordance with *AS 1940 – 2017 The Storage and Handling of Flammable and Combustible Liquids*, or an updated or replacement standard.
- Hydrocarbon waste would be removed from site and disposed of by a licenced waste contractor at a licenced waste facility.
- Hydrocarbon spill kits would be appropriately located within the demountable office to ensure spill response and clean up can be carried out immediately following the detection of any spills.

- In the event of a hydrocarbon leak or spill, the Applicant would implement the following spill management procedure.
  - Phase 1 – Source Control: isolate the source of spill or leak and stop the leak either by maintenance or placing the leaking item within or over the fuel/oil storage area.
  - Phase 2 – Recovery: recover as much as possible at the source by pumping free hydrocarbon from the surface and excavating hydrocarbon-contaminated materials. Contaminated materials would be stockpiled on site under cover and on an impermeable surface, e.g. a high-density polyethylene sheet. This material would later be bio-remediated on site and/or transported to an approved waste facility.
  - Phase 3 – Remediation: transport the contaminated material to a facility licensed to accept and treat hydrocarbon contaminated material.
- Spills or leaks of other pollutants would be handled in accordance to the relevant Safety Data Sheet.

It is anticipated that with the proposed hydrocarbon management practices and the controls and safeguards, potential hazards as a result of hydrocarbon and hazardous materials to be used on the Quarry Site would be minimised.

5.10 Social and Economic

5.10.1 Introduction

The SEARs for the Proposal require the EIS to include an assessment of social and economic impacts, including:

- an assessment of the likely social and economic impacts of the development, including consideration of both the significance of the resource and the costs and benefits of the project.

This subsection describes the existing social and economic setting of the Quarry with focus on population, employment, and employment by industry statistics. Local amenity, regional history and tourism in the Narrandera LGA is also discussed. The potential social and economic costs and benefits associated with the Proposal and the mitigation and management measures that would be implemented by the Applicant along with any residual social and economic impacts are also described.

5.10.2 The Existing Social and Economic Setting

The Quarry Site is located within the Narrandera LGA, approximately 11km southeast of Narrandera, on Crown Land which has been leased to PA Woods & Co Pty Ltd (a part of the Milbrae Business Group). The area surrounding the Quarry Site is best described as rural with land uses principally comprising grazing and dryland cropping. A total of ten residences are located within a 7km radius of the Quarry Site.

Communities surrounding the Quarry Site include the following.

- Adjoining Landowners – includes the owners of properties that adjoin the land owned by the Applicant.
- The Local Community – includes nearby landowners and residents who are considered to have an interest in the Proposal due to their proximity to the Quarry Site.
- The Narrandera Community – both residents and businesses within the Narrandera LGA who are considered to have an interest in the ongoing economic development and amenity of the LGA.

The following subsections provide a brief overview of the social and economic setting in the Gillenbah State Suburb (SSC) and Narrandera LGA based on data provided in Australian Bureau of Statistics (ABS) 2016 Census data. These data are compared against ABS data for NSW. General information on the Narrandera LGA has been sourced from the Narrandera Visitor Information Centre website (Narrandera Tourism, 2020).

5.10.2.1 Population

Table 5.15 presents the population statistics for the Gillenbah SSC, Narrandera LGA and NSW collected from the 2016 Census data available from the ABS (2016). The Gillenbah SSC and Narrandera LGA populations exhibit a trend common in many regional areas, which is a lower proportion of the total population of young adult age and a higher proportion within the adult and retirement age groups. This is a common trend seen in many regional areas and is commonly considered to be the result of young adults leaving regional areas in search of further education or employment opportunities.

Table 5.15
Population Statistics (Gillenbah SSC, Narrandera LGA and NSW)

	Gillenbah SSC		Narrandera LGA		New South Wales	
Ages	**No.**	**%**	**No.**	**%**	**No.**	**%**
0-4 years	12	8.8	378	6.5	465 135	6.2
5-14 years	6	4.4	799	13.7	921 193	12.3
15-19 years	10	7.3	325	5.6	448 425	6.0
20-24 years	7	5.1	298	5.1	489 673	6.5
25-34 years	7	5.1	552	9.4	1 067 791	14.3
35-44 years	11	8.0	647	11.1	1 002 893	13.4
45-54 years	19	13.9	731	12.5	977 986	13.1
55-64 years	40	29.2	857	14.6	889 770	11.9
65-74 years	11	8.0	704	12.0	677 026	9.1
75-84 years	3	2.2	390	6.7	373 114	5.0
85 years +	5	3.6	204	3.5	167 506	2.2
Total	**137**	**100.0**	**5 853**	**100.0**	**7 480 512**	**100**
Median Age	50		44		38	

Source: Australian Bureau of Statistics – 2016 Census
Please note that the ABS makes small random adjustments to all cell values to protect the confidentiality of data. These adjustments may cause the sum of rows or columns to differ by small amounts from table totals.

5.10.2.2 Employment

Table 5.16 displays employment statistics for the Gillenbah SSC, Narrandera LGA and NSW collected from the ABS 2016 Census. The data indicate that as at 2016, both the Gillenbah SSC (49.6%) and Narrandera LGA (52.6%) have total labour force participation rates significantly lower than the State average for NSW which is 59.2%. This may be due, in part, to the higher proportion of the population aged over 65.

Table 5.16
Employment Statistics (Gillenbah SSC, Narrandera LGA and NSW)

	Gillenbah SSC		Narrandera LGA		NSW	
	No.	**%[1]**	**No.**	**%[1]**	**No.**	**%[1]**
Employed						
Full-time[2]	42	68.9	1488	60.2	2 134 521	59.2
Part-time	19	31.1	667	27.0	1 071 151	29.7
Employed, away from work[3]	0	0.0	105	4.2	174 654	3.0
Employed, hours not stated	0	0.0	69	2.8	67 003	1.8
Total	**63**		**2 325**		**3 380 332**	
Unemployed, looking for work						
Full-time work	0	0.0	107	4.3	123 987	3.4
Part-time work	0	0.0	39	1.6	101 567	2.8
Total	**3**		**150**		**225 546**	
Labour Force Participation						
Total labour force	61		2 472		3 605 881	
Not in labour force	32		1 708		2 088 240	
Labour force status not stated	32		511		399 773	
Total Persons	123		4 697		6 093 895	
Labour force participation	**49.6%**		**52.6%**		**59.2%**	

Note 1: Indicates percentage of total labour force

Note 2: Employed, worked full-time is defined as having worked 35 hours or more in all jobs during the week prior to Census Night.

Note 3: Comprises employed persons who did not work any hours in the week prior to Census Night.

Source: Australian Bureau of Statistics – 2016 Census
Please note that the ABS makes small random adjustments to all cell values to protect the confidentiality of data. These adjustments may cause the sum of rows or columns to differ by small amounts from table totals.

5.10.2.3 Industry of Employment

Table 5.17 displays the contribution of various industries to employment within Gillenbah SSC and the Narrandera LGA. Within the Gillenbah SSC, the Retail industry accounts for approximately 20.0% of employment with the Agriculture, Forestry and Fishing industry and Manufacturing industry accounting for approximately 14.5% and 12.7% of employment, respectively. Within the Narrandera LGA, the Agriculture, Forestry and Fishing industry contributes most to employment, accounting for approximately 19.2% of employment. The

Health Care and Social Assistance industry and Manufacturing industry account for approximately 11.7% and 10.6% of employment, respectively. Both Gillenbah SSC and the Narrandera LGA have relatively low levels of involvement from the population in Mining, Information Media and Telecommunications, Financial and Insurance Services, Rental, Hiring and Real Estate Services and Financial and Insurance Services.

Table 5.17
Industry Employment Statistics (Gillenbah SSC, Narrandera LGA and NSW)

	Gillenbah SSC		Narrandera LGA		NSW	
Industry	**No.**	**%**	**No.**	**%**	**No.**	**%**
Agriculture, Forestry and Fishing	8	14.5	451	19.2	72 625	2.1
Mining	0	0.0	13	0.6	31 736	0.9
Manufacturing	7	12.7	249	10.6	197 331	5.8
Electricity, Gas, Water and Waste Services	0	0.0	25	1.1	31 881	0.9
Construction	4	7.3	177	7.5	282 491	8.4
Wholesale Trade	3	5.5	58	2.5	103 722	3.1
Retail Trade	11	20.0	178	7.6	326 396	9.7
Accommodation and Food Services	0	0.0	132	5.6	239 222	7.1
Transport, Postal and Warehousing	3	5.5	106	4.5	158 760	4.7
Information Media and Telecommunications	0	0.0	4	0.2	73 398	2.2
Financial and Insurance Services	0	0.0	31	1.3	167 259	4.9
Rental, Hiring and Real Estate Services	0	0.0	19	0.8	59 652	1.8
Professional, Scientific and Technical Services	3	5.5	45	1.9	274 078	8.1
Administrative and Support Services	4	7.3	53	2.3	117 482	3.5
Public Administration and Safety	3	5.5	165	7.0	204 173	6.0
Education and Training	3	5.5	179	7.6	282 568	8.4
Health Care and Social Assistance	3	5.5	274	11.7	422 195	12.5
Arts and Recreation Services	0	0.0	14	0.6	51 775	1.5
Other Services	0	0.0	71	3.0	124 477	3.7
Inadequately described/Not stated	3	5.5	101	4.3	159 108	4.7
Total	**63**	**100.0**	**2 325**	**100.0**	**3 380 332**	**100.0**

Source: Australian Bureau of Statistics – 2016 Census
Please note that the ABS makes small random adjustments to all cell values to protect the confidentiality of data. These adjustments may cause the sum of rows or columns to differ by small amounts from table totals.

5.10.2.4 Sense of Local Community

There is a strong sense of community amongst residents in the area surrounding the Quarry Site with most residents having lived in the area for many years. There are number of active community groups in the local area including two rural fire brigades (Sandigo and Gillenbah), Strontian Landcare, Sandigo Tennis Club and the Sandigo Hall Committee. The Sandigo Hall Committee has applied for and received several government grants to fund various restoration projects on the Sandigo Hall. The committee also typically runs one or two functions a year with recent events featuring performances by bush bands. The committee is currently planning centenary celebrations for 2021.

5.10.2.5 Regional History, Amenity and Tourism

Narrandera is located adjacent to the Murrumbidgee River and was first settled by Europeans in 1863 as a livestock station at a point in the river where "overlanders" crossed their cattle (Narrandera Tourism, 2020). Narrandera was proclaimed a town in 1880 and, along with Leeton and Griffith, currently serves as an important regional centre within the Riverina Region. Narrandera LGA was formed in 1960 by an amalgamation of the previous Narrandera Municipality and Yanko Shire LGAs.

Narrandera LGA is known for its natural beauty and bucolic landscapes with some of the most popular attractions including agritourism, hiking, bird watching, boating, fishing and the region's various heritage items (Narrandera Tourism, 2020). The township of Narrandera also offers various boutique shopping and dining experiences.

5.10.3 Social and Economic Costs and Benefits of the Proposal

5.10.3.1 Social and Economic Costs

Impacts to the Lifestyle of Surrounding Landowners

The Quarry Site is situated within the southern part of the Narrandera LGA between approximately 300m to 350m to the west of the Sturt Highway. A number of homesteads are located within the area surrounding the Quarry Site with the closest being the Wilga (3.7km to the north), Booleroo (3.9km to the west) and Allambi (3.9km to the west). It is considered that dust and noise generated from on-site activities could potentially impact surrounding residences (without the implementation of recommended management and mitigation measures) although the large separation distances between the Quarry Site and surrounding sensitive receptors are expected to minimise any potential impacts.

Impacts of Road Transport and Network

As discussed in Section 2.7 and displayed in **Figure 2.6**, laden trucks departing the Quarry Site would utilise Strontian Road with approximately 85% of trucks expected to travel towards the Sturt Highway and 15% of trucks to travel south towards Boree Creek. As requested by Narrandera Shire Council, upgrades would be made to Strontian Road and the intersection of the Quarry Access Road and Strontian Road to ensure the ongoing safety of road users. In addition to these upgrades, the Applicant would pay a contribution levy to the Narrandera Shire Council, as specified in the *Narrandera Section 94A Development Contributions Plan 2014*. As such, impacts to the road network would be minimal.

Impacts to Tourism

The Quarry Site is located approximately 4.5km to the south of the Murrumbidgee River and is not located near any vantage points and/or areas of touristic significance. The Proposal would not significantly alter topography and would have limited visibility from surrounding residences and roads. Hence, adverse impacts to the local tourism industry are highly unlikely.

5.10.3.2 Social and Economic Benefits

Significance of the Resource

As discussed in Section 2.3.1**,** the Applicant has identified a further 2.97 million tonnes of indurated sandstone material adjacent to and beneath the approved extraction area which they

propose to extract. The ongoing extraction of indurated sandstone material would allow the Applicant to continue to provide a source of high-quality crushed indurated sandstone products for use in construction and infrastructure projects within the Narrandera LGA and the broader Riverina Region. This would positively impact the supply of indurated sandstone products in the Narrandera LGA and ensure competition in the construction materials sector is maintained.

Employment and Economic Stimulus

The Quarry currently provides employment for between three and five personnel during extraction and processing campaigns. The Applicant anticipates that these employment levels would be maintained as a result of the Proposal.

It is anticipated that the Applicant would spend approximately $1 million on employee wages, machinery, materials and consumables and all other purchases per year to operate the Quarry in the manner outlined in this document. The majority of these purchases would be sourced from the Narrandera LGA and the broader Riverina Region. The flow-on effects from employees living locally would also ensure ongoing contributions to other sectors, such as retail and healthcare, within the Narrandera LGA.

Tax Revenue

The Applicant would pay payroll tax to the State of NSW and income tax to the Federal government. A proportion of income taxes would be effectively received by the State of NSW and the local community through the Federal funding of infrastructure, health and education services.

5.10.4 Management and Mitigation Measures

The following management and mitigation measures would be implemented by the Applicant to ensure social and economic benefits arising from the Proposal are maximised and adverse impacts are minimised.

- Job opportunities at the Quarry would be advertised in local newspapers (e.g. the *Narrandera Argus*) to ensure suitably qualified candidates from within the Narrandera LGA are considered for any available position.
- Locally based employees and contractors would be encouraged to participate in training and education programs.
- Preference would be given to contractors and suppliers of equipment, services, and consumables located within the Narrandera LGA, wherever practicable.
- Engage with the community to provide updates regarding Quarry activities as required.
- Respond to community complaints in an expeditious and courteous manner.
- Implement the Driver's Code of Conduct to ensure that truck drivers remain aware of their responsibilities while driving.

5.10.5 Assessment of Impacts

The Applicant has been operating within the Narrandera LGA since 2012, positively impacting the LGA's economy through the employment of people and the supply of high-quality indurated sandstone products for use in construction and infrastructure projects. The Proposal would continue to generate positive flow-on effects from employee wages to other services in the region which would lead to positive impacts on the economy within the LGA. Sales from the Quarry would also ensure that competition in the supply of construction materials is maintained.

The Applicant intends to maximise social and economic benefit and minimise any adverse effects from the Quarry by implementing the mitigation and management measures described in Section 5.10.4. Given the current social and economic benefits of the Quarry, and considering the proposed mitigation and management measures, it is assessed that the Proposal would provide benefits that outweigh any residual impacts.

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