Gunlake Quarry Extension Project 1

Environmental Impact Statement

Prepared for Gunlake Quarries Pty Limited | April 2016

GUNLAKE QUARRIES

EMM

Volume 1

Main report

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ENVIRONMENTAL IMPACT STATEMENT CERTIFICATION

For submission of an environmental impact statement (EIS) under Part 4 of the NSW *Environmental Planning and Assessment Act 1979.*

EIS prepared by

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Proponent

Gunlake Quarries Pty Limited

Proposed development

Extension of existing quarry operations, including an increased extraction rate of 2 million tonnes per annum, and the following:

- operations to continue for 30 years from the date of approval of the extension project;
- an increase in truck movements to an average of 440 movements per day and a maximum of 690 movements per day;
- extension of the quarry pit footprint;
- an additional overburden emplacement to accommodate the increase in production;
- 24 hour per day primary crushing; and
- blasting twice weekly.

In addition, the approval for all aspects of the existing operations for Gunlake Quarry under Project Approval 07-0074 is being sought.

Land to be developed

715 Brayton Road, Brayton, NSW

Certification

In relation to this EIS (15 February 2016) we certify that:

- it has been prepared in accordance with Schedule 2, Clauses 6 and 7 of the NSW Environmental Planning and Assessment Regulation 2000;
- it has been prepared with all available information that is relevant to the environmental assessment of the development to which this EIS relates; and
- the information contained in this EIS is nether false nor misleading.

Andrew Wiltshire
Senior Environmental Scientist

Philip Towler
Associate Director

Executive Summary

ES1 Introduction

ES1.1 Overview

Gunlake Quarry is a hard rock quarry operated by Gunlake Quarries Pty Ltd (Gunlake). The existing quarry is approximately 7 kilometres (km) north-west of Marulan in the Goulburn Mulwaree local government area (LGA) (see Figure E.1).

Gunlake Quarry currently operates under New South Wales (NSW) Project Approval 07-0074 issued by the Minister for Planning in September 2008 under Part 3A of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). The project approval has been modified on three occasions. The current project approval permits the production of 750,000 tonnes of saleable product per year until 30 September 2038. The proposed Gunlake Quarry extension project (the extension project) would extend the quarry footprint and increase the quarry production rate.

This environmental impact statement (EIS) has been prepared to accompany an application under Division 4.1 of the EP&A Act to expand the current operations at Gunlake Quarry. This EIS describes the quarry's current operations; describes the proposed extension project; assesses the potential impacts of the extended quarry; and details measures to avoid, minimise or mitigate potential impacts.

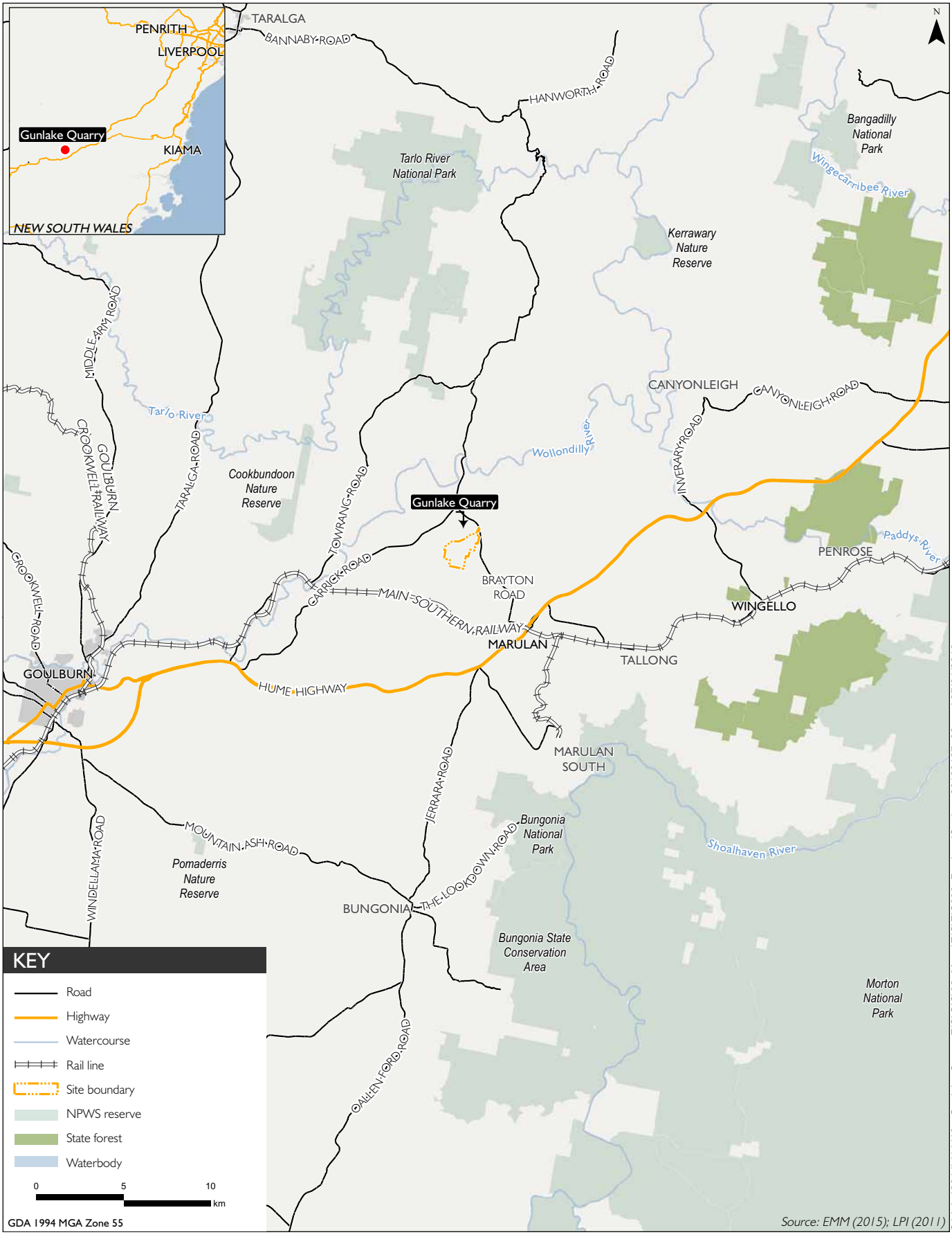
ES1.2 Quarry location

Gunlake Quarry is located at 715 Brayton Road, Brayton, (Figure E.1) and is wholly on Lot 13 DP 1123374 (the 'quarry site', within the 'site boundary'). This lot contains Crown road reserves. Gunlake has applied to the NSW Department of Primary Industries - Lands to purchase and close these Crown road reserves. The combined approved quarry footprint and the proposed extension area is referred to as the 'project area'.

ES1.3 Project summary

The proposed extension project seeks an increased quarry extraction rate to assist to meet the identified demand for construction materials, including quarried aggregate, for the local area and Sydney. The extension project includes the production of 2 million tonnes per annum (Mtpa) of saleable product for 30 years. Gunlake seeks a new project approval under Part 4, Division 4.1 of the EP&A Act that allows:

- operations to continue for 30 years from the date of approval of the extension project;
- 2 Mtpa of saleable products to be produced;
- an increase in truck movements to an average of 440 movements per day and a maximum of 690 movements per day;
- extension of the quarry pit footprint;
- an additional overburden emplacement to accommodate the increase in production;
- 24 hour per day primary crushing; and
- blasting twice weekly.



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Site location

Gunlake Quarry
Environmental Impact Statement

Figure E.1

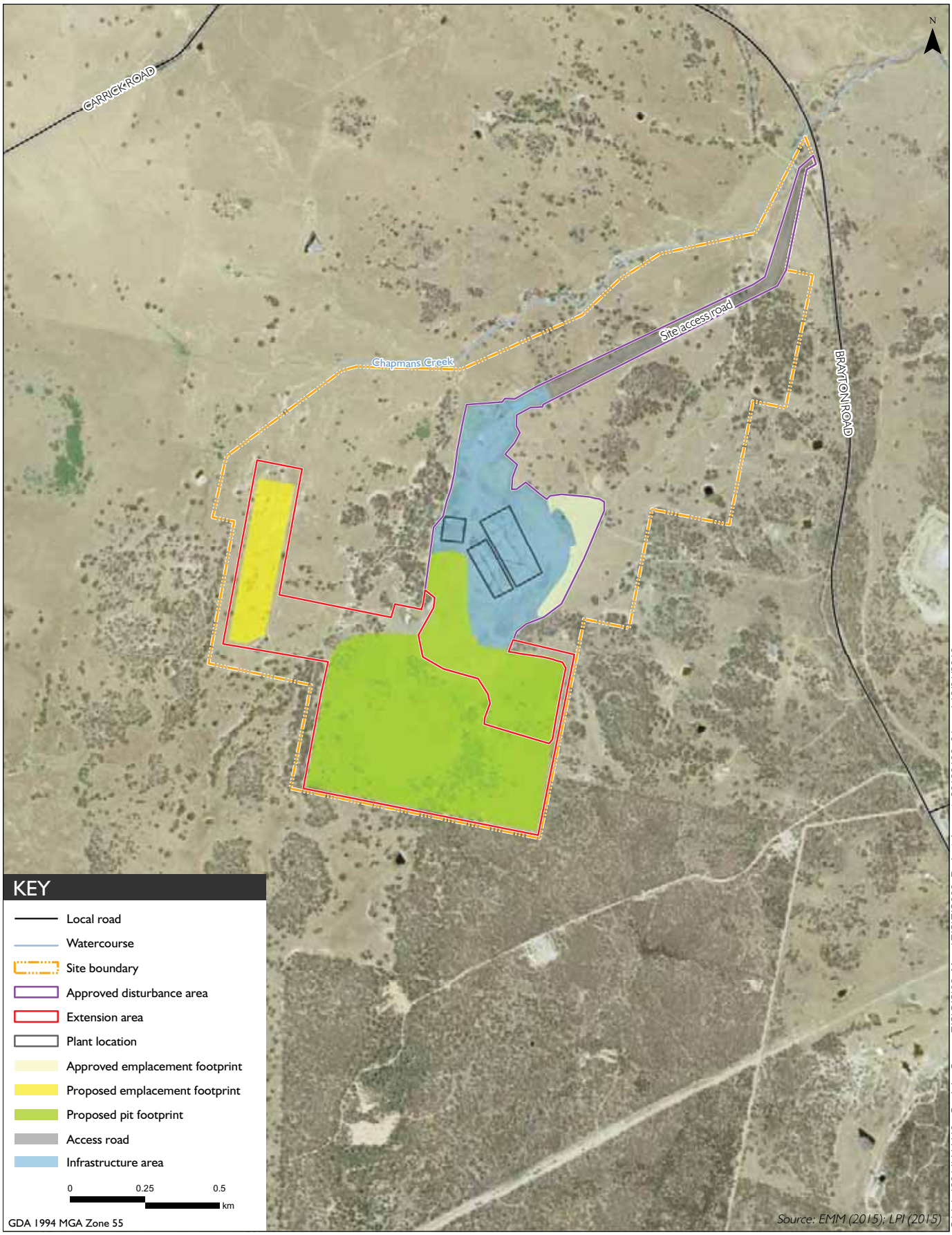
The current disturbance footprint is approximately 45 ha and the extension area footprint is approximately 54 ha, so the total disturbance footprint of the extended quarry would be 99 ha.

In addition, Gunlake seeks to maintain the approval for all aspects of the existing operations for Gunlake Quarry under Project Approval 07-0074.

A summary of the extension project is provided in Table E.1, and is shown in Figure E.2.

Table E.1 Project description

Project element	Currently approved	Proposed project
Quarrying method	Hard rock quarrying by open cut methods.	No change.
Resource	Approximately 180 million tonnes.	No change.
Disturbance area	Approved project footprint of 45 ha, as shown in Figure 2.1.	Extension of project footprint by 54 ha to approximately 99 ha as shown in Figure 1.2.
Saleable product	750,000 tonnes per annum.	Increase to 2 Mtpa.
Quarry life	30 years.	30 years from approval. There is sufficient resource (180 Mt) for quarrying to continue at 2 Mtpa for 90 years.
Beneficiation	Onsite crushing and stockpiling of quarried rock.	No change.
Infrastructure	As outlined in Section 2.4.	Upgrade infrastructure as required to produce 2 Mtpa of products.
Product transport	An average of 164 truck movements per day (averaged over each calendar month) with up to a maximum of 320 movements on any day in total on all routes. An average 25 truck movements per day (averaged over each calendar month) and a maximum of 38 truck movements on any day on Brayton Road between Bypass Road and the intersection of Brayton Road/George Street/Hume Highway interchange underpass.	An average of 440 truck movements per day (averaged over each calendar month) with up to a maximum of 690 movements on any day in total on all routes. No change to truck numbers on Brayton Road between Bypass Road and the intersection of Brayton Road/George Street/Hume Highway interchange underpass.
Operational workforce	25 on-site employees and 25 to 38 truck drivers (full-time equivalent).	Increase of approximately 27 employees to approximately 7 on-site site employees and 20 truck drivers.
Hours of operation	6:00 am Monday to 6:00 pm Saturday, including crushing between 7:00 am and 6:00 pm, Monday to Saturday and maintenance at any time, Monday to Saturday.	Modify existing hours of operation to allow crushing 24 hours a day (except Sundays and public holidays) and maintenance anytime (including Sundays and public holidays).
Capital investment value	-	$3.2 million



Indicative proposed project layout

Gunlake Quarry
Environmental Impact Statement

Figure E.2

ES2 Approvals history

Gunlake Quarry currently operates under project approval 07-0074 issued by the Minister for Planning in September 2008 under Part 3A of the EP&A Act. The project approval has been modified on three occasions:

- Modification 1 – Stage 2 southbound access;
- Modification 2 – Quarry expansion; and
- Modification 3 – Truck movements.

Modifications 1 and 3 were minor modifications to alter transport routes and truck numbers related to the quarry. Modification 2 included expansion of the quarry pit and overburden emplacement, an increase to truck movements equivalent to 750,000 tonnes per annum of saleable product and alteration of the approved hours of operation.

The approved quarry footprint covers an area of about 45 ha.

ES3 Planning and statutory framework

Approval for the extension project is required under the NSW EP&A Act and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). This EIS has been prepared in accordance with the assessment requirements of the NSW Department of Planning and Environment (DPE) and the Commonwealth Department of Environment (DoE).

The Secretary's Environmental Assessment Requirements (SEARs) for the project were first issued on 3 July 2015. The SEARs were revised and reissued on 13 October 2015. Supplementary environmental assessment requirements were received from DoE on 19 October 2015, following the submission of a referral under the EPBC Act on 4 September 2015 (EPBC reference 2015/7557) and the identification of referred aspects of the proposed extension as 'controlled actions'.

Accordingly, the project will be assessed under the assessment bilateral agreement with NSW.

ES4 Consultation

Gunlake has been actively engaging with stakeholders since 2008. The list of all stakeholders previously engaged was updated to include new stakeholders likely to be relevant to the extension project.

The stakeholder groups identified, and the engagement activities used for each group, are summarised in Table E.2. A range of formal and informal stakeholder engagement tools were used including phone calls, emails, face-to-face meetings, community information sessions and factsheet letter drops.

Table E.2 Key stakeholder engagement activities

Stakeholder	Engagement activities	Date
State government agencies	• project briefing and site inspection	14 July 2015
Goulburn Mulwaree Council	• project briefing and site inspection	14 July 2015
Landowners	• community information session	30 July 2015
	• factsheet	August 2015
	• face-to-face meetings	Ongoing
Local community groups	• community information session	30 July 2015
	• factsheet	August 2015
	• face-to-face meetings	Ongoing
Local businesses	• factsheet	August 2015
Aboriginal groups	• field surveys	27 and 28 July 2015
	• test excavation	6-10 October 2015
Media	• community information session	30 July 2015

Consultation with Aboriginal stakeholders was undertaken as part of the Aboriginal Cultural heritage assessment in accordance with the *Aboriginal Cultural Heritage Consultation Requirements for Proponents* 2010 (DECCW 2010a).

Gunlake will continue its stakeholder engagement program to ensure matters raised by the community and other stakeholders are understood and addressed.

ES5 Environmental assessment

A range of detailed technical assessments were prepared by leading professional specialists in accordance with relevant legislation, policies and guidelines. This EIS describes the assessment methods used, the existing environment (particularly within the extension area), the predicted impacts of the extension project and the proposed management measures that will be implemented by Gunlake.

ES5.1 Soils and rehabilitation

The soils and rehabilitation assessment describes the nature of the soils occurring in the Gunlake Quarry site and the area of approved and proposed disturbance (the project area), the potential impacts on those soils and how those potential impacts will be mitigated through rehabilitation. The assessment considered the previous soil survey for the site and existing soil profiles and mapping for the area.

There were two soil types indentified in the quarry site:

- Kurosol (44.1 ha); and
- Natric Kurosol (55 ha).

The Kurosols fall under the Yellow Podzolic Great Soil Group whereas the Natric Kurosol falls under Soloths. Soils in the site have a class 2 fertility (moderately low) and generally only support plants suitable for grazing. The Hydrologic Soil Group for the Kurosols is C (slow infiltration) and D (very slow infiltration) for Natric kurosols. Pre-mining soil land capability classes for the Natric Kurosols are 5 (severe limitations) and 6 (very severe limitations) for the Kurosols.

A number of project activities have the potential to impact soil resources, potentially reducing the capability and agricultural suitability of the soil and landscape through contamination, compaction and erosion. Mitigation measures have been provided to minimise impacts with a focus on runoff, erosion and sediment control.

Progressive revegetation will use stabilisation species and native trees once the final landform is shaped. The proposed final land use will be restricted to grazing other than the final void which will have no agricultural potential. Landform stability, topdressing, water quality and vegetation will be closely measured as part of a monitoring program. Maintenance activities may include weeding, re-topsoiling and applying soil amendments.

ES5.2 Surface water

The surface water assessment describes the existing surface water environment at the quarry, the proposed surface water management strategy, water balance results, predicted surface water impacts, water licensing requirements, proposed monitoring and potential contingency measures. The assessment considered the existing environment, and the potential impacts of the proposed extension project using a water balance model and a surface water management strategy for the site.

The extension project will require additional surface water controls to manage potential impacts and to provide a reliable water supply for quarry operations. The proposed surface water management strategy will mitigate potential water quality and quantity impacts and the extension project will not impact on downstream water users. Water balance model results indicate that the quarry's process water requirements will be met under most climatic conditions and there are available contingencies if there are water shortfalls.

ES5.3 Groundwater

The groundwater assessment describes the existing groundwater regime, water licensing requirements, the results of groundwater modelling, and mitigation or management measures required to prevent or minimise predicted environmental impacts. An analytic element groundwater flow model was used to predict the potential groundwater impacts from the extension project.

A groundwater drawdown of 2 m is predicted to extend up to 1.5 km from the edge of the pit footprint by Year 30 of the extension project. Groundwater inflows to the pit of up to 37 ML/year are predicted and licences will be required to 'take' this volume. There is sufficient water volume within the market or within the next controlled allocation to allow the required water access licence(s) WAL(s) to be obtained.

Nine groundwater springs have been identified within a 1.5 km radius of the centre of the extension area. Possible impacts to springs include a declined flow rate at two springs and ceasing of flow at two springs. The springs do not support groundwater dependent ecosystems (GDEs) and are not considered to hold significant environmental value.

The Box Gum Woodland in the zone of predicted drawdown does not rely on groundwater from within the hard rock strata in this area and no impacts are predicted on the alluvial aquifer. Therefore, the Box Gum Woodland is not predicted to be impacted by groundwater drawdown as a result of the extension project.

Groundwater inflows to the pit are not predicted to reduce baseflows to the ephemeral watercourses in the area (Chapmans Creek and Jaorimin Creek). No impacts to registered groundwater works are predicted and a neutral impact on water quality in the hydrological catchment is predicted.

ES5.4 Biodiversity

The biodiversity assessment describes the biodiversity impacts of the extension project and identifies measures to avoid, mitigate and/or offset any potential impacts. The assessment focuses on the extension area as the majority of the approved footprint has been previously assessed and subsequently cleared. The assessment was prepared in accordance with the OEH *Framework for Biodiversity Assessment* (OEH 2014c).

The project area consists of the approved disturbance area that has been previously assessed and has been largely cleared and the extension area that contains exotic and native vegetation that was the focus of the biodiversity assessment. The extension area has limited habitat due to the wide-spread removal of native vegetation for agriculture. However, some remnant vegetation occurs in the extension area, particularly along Chapmans Creek and its tributaries. In these areas, the vegetation is considered to meet the description of Box Gum Woodland, an endangered ecological community (EEC) listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act). The woodland form of this community meets the listing criteria for the critically endangered ecological community (CEEC) listed under the Commonwealth EPBC Act.

Remnant vegetation within the extension area provides habitat for the threatened Speckled Warbler, Diamond Firetail, Square-tailed Kite, Eastern Bentwing Bat, Eastern False Pipistrelle and Little Bentwing Bat, which were recorded during the surveys. It also contains potential habitat for the Little Lorikeet, Square-tailed Kite, Speckled Warbler, Diamond Firetail, Striped Legless Lizard, Little Eagle, Southern Myotis, Scarlet Robin, Brown Treecreeper and Varied Sittella.

During the project planning phase, Gunlake investigated a range of options to avoid and minimise impacts on remnant vegetation. The proposed emplacement will be located in an area which is predominantly pasture to minimise impacts on woodland vegetation.

The extension project will require the removal of 12.2 ha of woodland and 41.9 ha of grassland vegetation. This includes 8.4 ha of Box Gum Woodland (listed under the TSC Act and EPBC Act) and 7 ha of Box Gum Woodland derived native grassland (DNG, listed under the TSC Act). Quarrying also has the potential to result in indirect impacts on biodiversity, including erosion and sedimentation, weed invasion and changes in hydrology. Biodiversity mitigation and management measures have been proposed to minimise and/or mitigate potential biodiversity impacts from the extension project.

The impacts of the extension project have been quantified using the FBA and Major Proposals Calculator. A total of 1,521 ecosystem credits are required to compensate for the unavoidable impacts of the extension project. There are sufficient additional offset areas available for addition to the existing Gunlake offset package to compensate for these impacts.

Gunlake propose to provide a total offset package of approximately 155.6 ha that will compensate for the unavoidable impacts on biodiversity. It will comprise of:

- approved Box Gum Woodland offset (woodland and DNG): 78.8 ha;
- additional Box Gum Woodland offset (woodland and DNG): 24.2 ha;
- additional Stringybark community (to total 860 credits):
    - Stringybark community woodland: approximately 40.4 ha; and
    - Stringybark community DNG: 12.2 ha.

Only the credits required to compensate for the impact will be included in the final offset package. The final configuration of the offset areas and the balance of woodland versus DNG will be finalised as part of the biodiversity package. The offset areas will be reconfigured to ensure that previous offset commitments and new offset requirements will be met.

ES5.5 Transport

i Transport options assessment

The feasibility of quarry products transport alternatives was reviewed in response to Council and community concerns regarding the increased truck movements on the primary haul route. A range of seven potential road and rail transport options for the transport of quarry products to customers in the Sydney region were considered in detail.

An economic analysis of the three rail/road options determined that none of them considered are economically efficient, even at the lowest range potential capital cost estimates. The road-only options have a much lower capital cost than the rail/road options.

With the exception of Option 1, the other six options would require construction of transport infrastructure on land that would be otherwise undisturbed. This would result in additional impacts to biodiversity and/or Aboriginal heritage. The operation of these six options would also result in noise or air quality impacts in areas that are not currently impacted by quarry operations (and would not be impacted by the extension project). The road/rail options would result in impacts in the vicinity of the required intermodal facility in Sydney.

There are extensive unresolved technical and design issues relating to the road and rail/road options considered (except for Option 1 — the ongoing use of the primary haul route), these include a route alignment for the full length rail siding option and identifying a suitable Sydney site for a Gunlake intermodal facility. There are also rail network capacity issues on the Main Southern Railway line and on other lines within the Sydney Metropolitan area and these are likely to increase.

Option 1 is proposed, ie to continue to transport quarry products by road using the primary haulage route (where truck volumes will increase) and the secondary haulage route (where truck volumes will be unchanged).

ii Transport assessment

The transport assessment describes the existing road, traffic and transport conditions, predicts the road traffic generated by the construction and operation of the extended quarry and cumulative traffic levels; assesses the potential traffic impacts on the capacity, condition, safety and efficiency of the local and State road network; and the mitigation measures or works required.

The transport assessment identified that the extension project related traffic would generally be accommodated within the existing road network.

The predicted daily traffic increases would not require any improvements to the road carriageway in order to accommodate the additional traffic. It is predicted that intersections will generally operate with a high level of service, with the exception of the Red Hills Road and Hume Highway intersection, where improvements are proposed.

The recent visual pavement condition assessment undertaken by EMM observed the road pavements of the product haulage route to be generally in good condition. The ongoing maintenance requirements for these roads will continue to be fully funded by Gunlake Quarry's Section 94 contributions. Gunlake Quarry's Section 94 contributions with reference to Council annual road maintenance costs are shown in Table E.3. Gunlake Quarry's Section 94 contributions will exceed the additional road pavement maintenance cost as a result of the use of local roads by quarry trucks.

Table E.3 Summary of previous and future Gunlake Quarries annual Section 94 contributions

Council costs and revenue per year	500,000 tonnes	750,000 tonnes	2,000,000 tonnes
Routine maintenance	$5,000	$7,500	$20,000
Annual cost for pavement rehabilitation and reconstruction at $45/$m^2$ allowing 7,000 m x 9 m = 63,000 m^2	$94,500	$141,750	$378,000
Proportion of the route reconstructed each year	$1/30^{th}$	$1/20^{th}$	$1/7.5^{th}$
Section 94 contributions payable by Gunlake	$135,000	$215,000	$618,000

At the intersection of Hume Highway and Red Hills Road, an additional 500 m long (including taper) left turn northbound acceleration lane will be constructed before 2025 in accordance with the relevant Austroads (2013) intersection design requirements.

The existing traffic management plan, which incorporates the driver code of conduct, will be updated following project approval.

ES5.6 Noise and vibration

A noise model was developed to assess noise levels from currently approved and proposed operations. The model adopted sound power levels of key acoustically significant plant and equipment from site measurements conducted by EMM, the noise assessment completed for the previous modification or from a database of similar equipment.

Operational noise levels for the proposed extension project are predicted to be above the current project approval limits and Power Sound Noise Levels at most assessment locations (R2, R4, R7 and R8). The proposed extension project is predicted to have a moderate to significant residual noise impact at locations R2, R4 and R7. Assessment locations where significant noise level impacts are predicted (R2 and R4) are entitled to voluntary land acquisition upon request in accordance with the VLAMP (NSW Government 2014) after all feasible and reasonable mitigation has been applied and if an alternate amenity agreement cannot be made. Assessment location R7, where a moderate residual noise level impact is predicted, is entitled to voluntary mitigation upon request in accordance with the VLAMP (NSW Government 2014) after all feasible and reasonable mitigation has been applied and if an alternate amenity agreement cannot be made. Gunlake is committed to provide potential receiver based mitigation to this property upon request of the relevant landowner.

Sleep disturbance criteria are predicted to be met by maximum noise level events at all assessment locations.

Cumulative noise from the extension project and other developments is likely to satisfy the relevant amenity criteria.

The privately owned lands assessment identified two privately owned land parcels (Lot 64 and Lot 72, DP750003) where recommended maximum amenity noise levels are exceeded on more than 25% of the individual land area. However, as these two land parcels are part of contiguous lots which form two large properties that are owned by the same landowners the potential exceedences do not trigger acquisition rights under the VLAMP. Furthermore, Gunlake currently has negotiated agreements with the relevant landowners.

Operational road traffic noise levels are predicted to satisfy the relevant RNP noise criteria and guidelines at all nearest assessment locations for all road sections of the transport route.

Blast overpressure and ground vibration levels are predicted to satisfy relevant EPA guidelines. Notwithstanding, the proponent will continue to actively manage and monitor blast overpressure and vibration in accordance with the site's blast management plan.

ES5.7 Air quality and greenhouse gases

The air quality assessment characterised the existing local air quality, potential emissions from the extension project including the existing operations and air dispersion modelling for total suspended particulates (TSP), PM_{10}, $PM_{2.5}$, respirable crystalline silica and dust deposition.

The dispersion modelling predicts that there will be no incremental or cumulative air quality impacts (ie exceedances of the impact assessment criteria at residences) as a result of the extension project. Current and proposed mitigation measures were incorporated into the modelling. Additional management measures for diesel emissions and blasting fumes will be implemented to enable Gunlake to continue to manage potential air quality impacts effectively:

The extension project will result in an increase in annual greenhouse gas emissions from the current operations due to increased diesel consumption and electricity demand for processing. At full production, the annual Scope 1 and Scope 3 emissions represent approximately 0.03% and 0.008% of total GHG emissions for NSW and Australia, respectively.

ES5.8 Aboriginal heritage

The Aboriginal cultural heritage values within the extension area were assessed through field survey, test excavation and consultation with Aboriginal people.

The field survey identified 15 Aboriginal sites within the extension area, all comprised of stone artefacts. The highest artefact frequencies were identified on a hill spur crest in the proposed emplacement area.

The archaeological test excavation (eight test pit transects with 42 one-metre-square test pits) characterised the subsurface archaeological deposit of known surface sites and surrounding landforms in the extension area that had limited ground surface visibility.

All Aboriginal sites identified were assessed to have low archaeological significance, except one which was assessed as having moderate significance.

Eleven Aboriginal sites will be impacted to some degree by the extension project. All of the impacted sites will be salvaged by surface artefact collection and detailed recording. The remaining four sites will be avoided.

ES5.9 Social

The extension project has the potential to generate some negative social impacts, particularly through perceived amenity and traffic impacts — although the actual impacts will generally not be significant. These perceptions will be addressed through the ongoing consultation program while actual impacts will be minimised through the implementation of the mitigation and management controls.

The extension project will generate a number of positive social impacts. It will create an additional 27 jobs at the quarry and for truck drivers, and will provide long-term employment for up to 90 people. This will provide an economic stimulus to the local area through the provision of wages and indirect or flow-on employment opportunities. It is anticipated that the additional employees will be sourced locally and, as such, the extension project will not generate any additional pressure on local housing supply and existing services and infrastructure. The project will also provide wider benefits through the supply of competitively priced products for the construction industry.

The social benefits will outweigh the negative social impacts to generate net positive benefits for the local community and the wider economy.

ES5.10 Economic

The extension project is estimated to have net social benefits to NSW of between $16 million and $27 million and hence is desirable and justified from an economic efficiency perspective. Environmental, social and cultural impacts of the extension project have been minimised through project design, and mitigation, offset and compensation measures. The value of residual impacts is considered to be negligible from an aggregated economic efficiency perspective.

The input-output analysis estimated that the extension project would make an annual incremental contribution to the economy for 22 years (ie in addition to the contribution from the approved operation until the end of the currently approved operations) of up to:

- $40 million in annual direct and indirect regional output or business turnover;
- $10 million in annual direct and indirect regional value added;
- $3 million in annual direct and indirect household income; and
- 60 direct and indirect jobs.

For the additional eight years of the project life the contribution to the economy would be up to:

- $68 million in annual direct and indirect regional output or business turnover;
- $22 million in annual direct and indirect regional value added;
- $6 million in annual direct and indirect household income; and
- 150 direct and indirect jobs.

The extension project would provide economic benefit to the Australian, NSW and regional economies. Accordingly, no economic mitigation measures are considered necessary.

ES5.11 Other matters

iii Hazards

The potential hazards from the proposed extension were assessed to determine if the project is a potentially hazardous or offensive development according to *State Environment Planning Policy 33 – Hazardous and Offensive Development*. An assessment of the storage and transport of hazardous materials against *Applying SEPP 33* determined that the quarry is not a potentially hazardous industry. Based on the findings of this EIS, the extension project will not result in unacceptable levels of pollution. Significant and moderate noise emissions are predicted at three residences which will be offered mitigation and/or acquisition rights in accordance with the VLAMP. Therefore, the quarry is not a potentially offensive industry.

The Goulburn-Mulwaree Council Bushfire Prone Land Map identifies land within the site boundary as Category 1 Vegetation, Category 2 Vegetation, and Buffer Zone. The extension project would not alter the bushfire risk of the existing quarry, as it does not involve the construction of additional structures within bushfire prone land that would require bushfire risk management, and there are no habitable structures currently within bushfire prone land.

iv Visual

Existing topography, together with areas of vegetation, generally screens quarry activities. The quarry is visible from the residence approximately 1.2 km north-west of the infrastructure area, and isolated parts of surround properties have long distance views of generally more than 5 km. Vehicles on Brayton Road and Carrick Road have transient views of the site.

Permanent lighting is currently installed at the infrastructure area to ensure safe operating conditions. This lighting is positioned downwards and away from sensitive receptors in order to minimise emissions and nuisance impacts to surrounding landowners and road users. Lights are only used as required.

v Historic heritage

Searches of the National, Commonwealth, and State heritage registers, the NSW Section 170 heritage registers and the Goulburn Mulwarree Local Environmental Plan were completed. No historic heritage sites were identified within the project area so no impacts to historic heritage will result from the proposed extension project.

ES6 Project justification and conclusion

There is a sound and broadly-based justification for the extension project. It will expand the existing Gunlake Quarry to provide additional competitively priced construction products and will contribute to the economy directly and indirectly. Accordingly, the extension project will increase the economic and social benefits of the quarry in the local area and to NSW.

A range of commitments are provided in this EIS to meet environmental standards during construction and operations. The proposed measures will be further detailed in Gunlake Quarry EMS that will be updated should the project be approved.

The costs of most of the potential environmental and social impacts of the extension project are internalised and other quantified impacts are estimated to be less than $1 million. The project's net social benefits are between $21 million and $32 million (the latter incorporating the benefits of employment), and hence the extension project is desirable and justified based on the CBA that considers the environment, social and economic costs of the project.

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1 Introduction

1.1 Overview

Gunlake Quarry is a hard rock quarry operated by Gunlake Quarries Pty Ltd (Gunlake). The existing quarry is approximately 7 kilometres (km) north-west of Marulan in the Goulburn Mulwaree local government area (LGA) (see Figure 1.1).

Gunlake Quarry currently operates under New South Wales (NSW) Project Approval 07-0074 issued by the Minister for Planning in September 2008 under Part 3A of the *NSW Environmental Planning and Assessment Act 1979* (EP&A Act). The project approval has been modified on three occasions. The current development consent permits the production of 750,000 tonnes of saleable product per year for 30 years.

This Environmental Impact Statement (EIS) has been prepared to accompany an application under Division 4.1 of the EP&A Act to expand the current operations at Gunlake Quarry. This EIS describes the quarry's current operations; describes the proposed extension project; assesses the potential impacts of the extended quarry; and details measures to avoid, minimise or mitigate potential impacts.

1.2 Quarry location

Gunlake Quarry is located at 715 Brayton Road, Brayton (Figure 1.1) and is located wholly on Lot 13 DP 1123374 (the 'quarry site', within the 'site boundary'). This lot contains Crown road reserves. Gunlake has applied to the NSW Department of Primary Industries – Lands to purchase and close these Crown road reserves. The combined approved quarry footprint and the proposed extension area is referred to as the 'project area'.

1.3 Surrounding environment

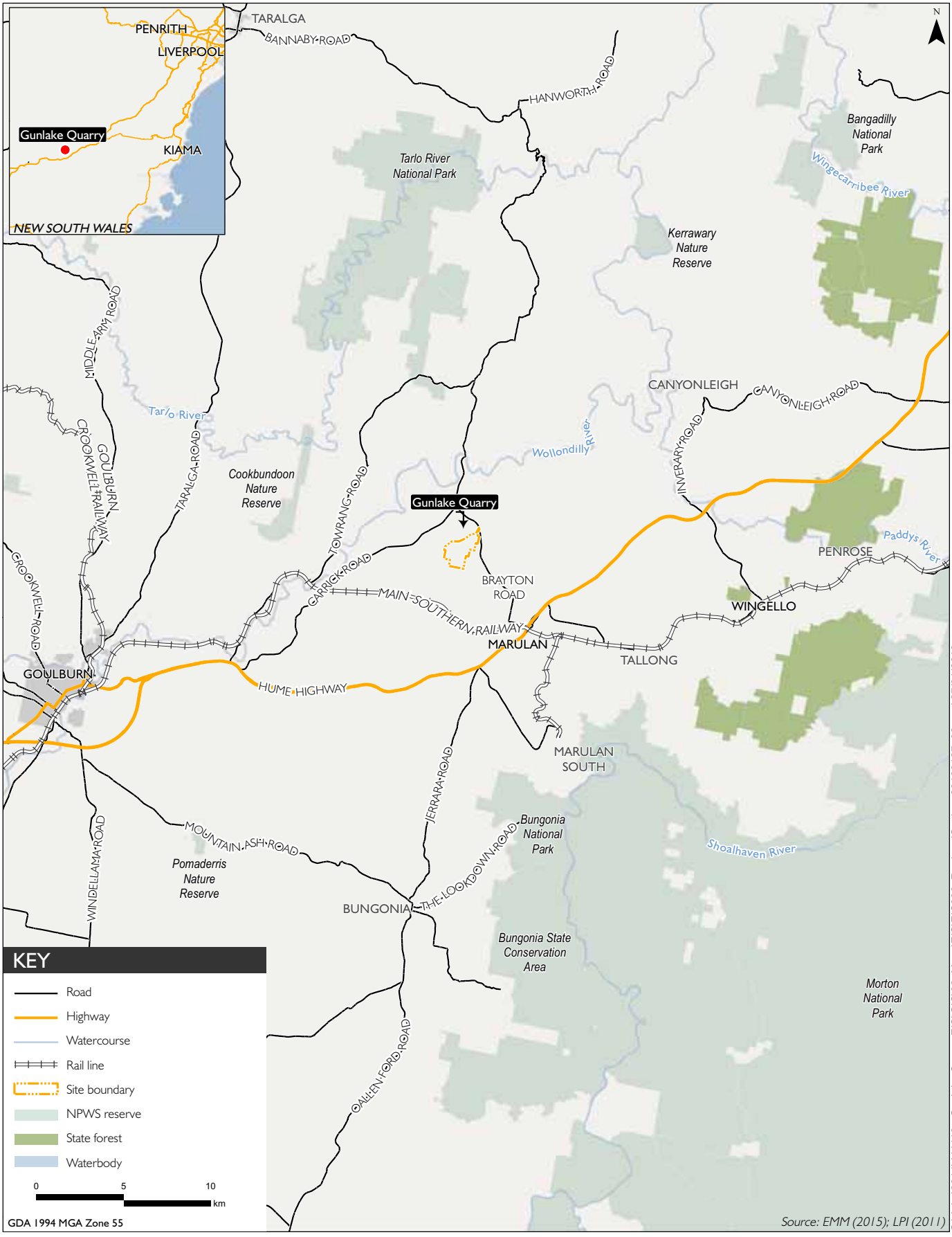
Land surrounding the project area is predominately used for agriculture, generally grazing (see Photograph 1.1). Built features immediately surrounding the project area include dams, access tracks and fences.

There are four residences within 1 km of the site boundary, two of which are owned by Gunlake. There are about 25 rural residences within 3 km of the site boundary or the primary road transport route, Brayton Road–Bypass Road–Red Hills Road. The nearest town is Marulan, about 5 km south-east of the site boundary.

The Johnniefelds and Lynwood quarries, operated by Holcim, are also in the vicinity of the project area. Gunlake Quarry is to the west of Brayton Road.

The native vegetation in the project area and surrounds has been highly modified by historic clearing and grazing. Vegetation in the project area and surrounds is generally native and improved and with patches of remnant native vegetation. The patches of remnant vegetation largely occur in drainage lines. There are some large blocks of native vegetation south and south-east of the quarry site.

There are two creek systems in the quarry site, Chapmans Creek and an unnamed tributary of Chapmans Creek. Chapmans Creek is an ephemeral watercourse located on the northern site boundary. Chapmans Creek flows north-east into Joarimin Creek. Joarimin Creek is also ephemeral and drains to the Wollondilly River, approximately 8.6 km north-east of the project area. The Wollondilly River is a perennial river and is a key tributary in the Warragamba Dam catchment area.



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Site location

Gunlake Quarry
Environmental Impact Statement

Figure 1.1

Photograph 1.1 Surrounding environment

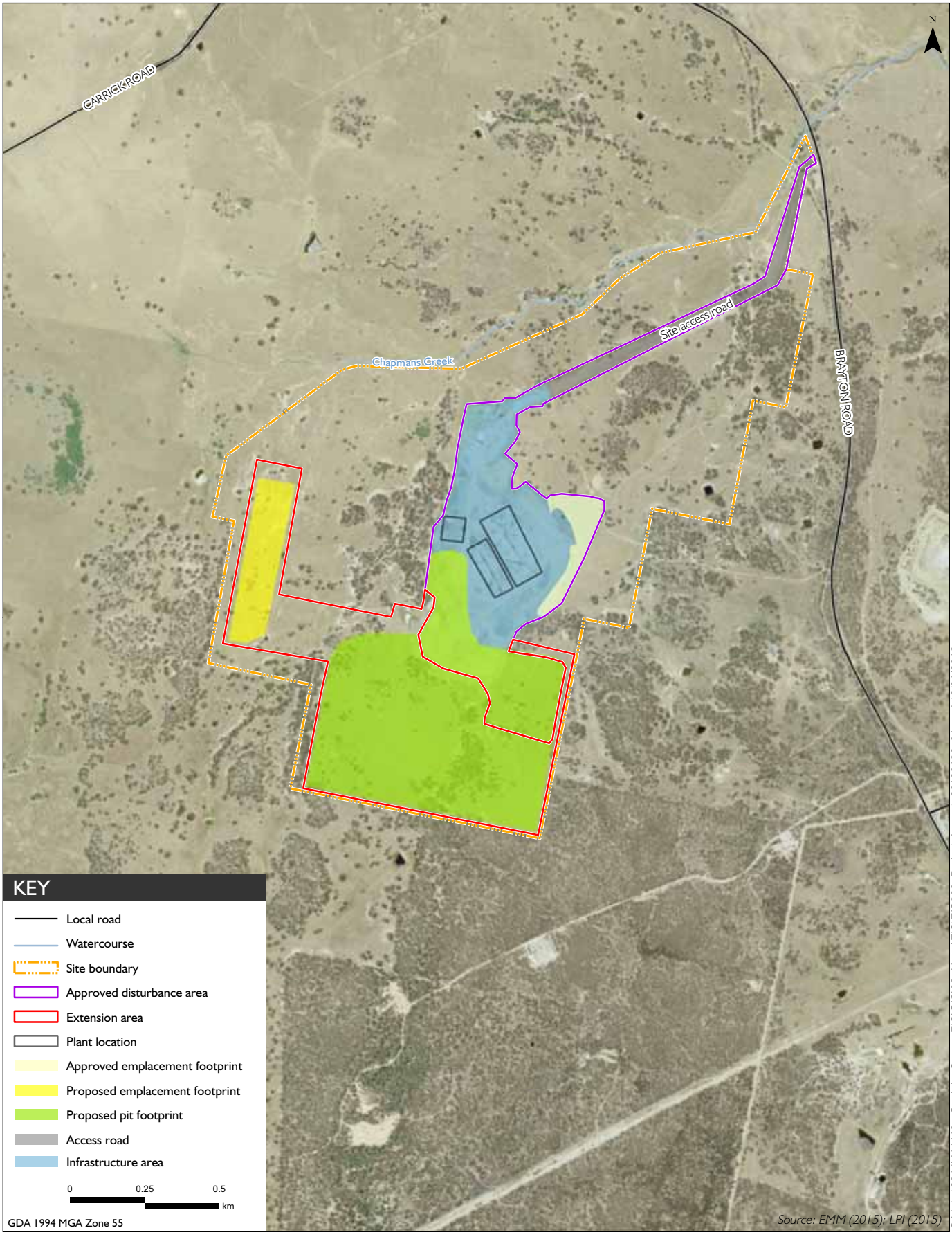
1.4 Project summary

The extension project seeks an increased quarry extraction rate to assist in meeting the identified demand for construction materials, including quarried aggregate, for the local area and Sydney. The extension project includes the production of 2 million tonnes per annum (Mtpa) of saleable product for 30 years. Gunlake seeks a new project approval under Part 4, Division 4.1 of the EP&A Act that allows:

- operations to continue for 30 years from the date of approval of the extension project;
- 2 Mtpa of saleable products to be produced;
- an increase in truck movements to an average of 440 movements per day and a maximum of 690 movements per day;
- extension of the quarry pit footprint;
- an additional overburden emplacement to accommodate the increase in production;
- 24 hour per day primary crushing; and
- blasting twice weekly.

In addition, Gunlake seeks to maintain approval for all aspects of the existing operations for Gunlake Quarry, as approved under Project Approval 07-0074 and described in detail in Chapter 2, as part of this application. Should the new project approval be granted, the current Project Approval 07-0074 would be surrendered within six months of commencing quarry extension activities. The proposed extension area is shown in Figure 1.2.

The current disturbance footprint is approximately 45 ha and the extension area footprint is approximately 54 ha, so the total disturbance footprint of the extended quarry would be 99 ha.



Indicative proposed project layout

Gunlake Quarry
Environmental Impact Statement

Figure 1.2

1.5 Purpose of the EIS

This EIS accompanies an application for a State Significant Development (SSD) in accordance with the EP&A Act. The NSW Minister for Planning is the decision maker, although the Minister's determination role for SSD projects is currently delegated to the Planning Assessment Commission or the Secretary of Department of Planning and Environment.

The EIS's first purpose is to provide information on the proposed quarry activities to allow NSW government agencies to assess the proposal's merits and to make recommendations to decision makers as to whether or not to approve the project and if so, what conditions should be attached to the approval.

The EIS's second purpose is to inform the public about the proposed quarry activities so that they can make submissions on its merits or impacts. Such submissions are an important information source for the governmental assessment process.

The study team for the EIS is provided in Appendix A.

1.6 Secretary's environmental assessment requirements

Gunlake submitted a request for Secretary's environmental assessment requirements (SEARs) to the Department of Planning and Environment (DPE) on 23 June 2015, along with supporting documentation describing the project, stakeholder engagement, key matters to be addressed in the EIS and the proposed assessment methods. The SEARs were first issued on 3 July 2015. The SEARs were later revised and reissued on 13 October 2015. The revised SEARs are summarised in Table 1.1 and provided in Appendix B.

Table 1.1 Summary of SEARs

Requirement	EIS reference
General requirements	
The Environmental Impact Statement (EIS) for the development must comply with the requirements in Clauses 6 and 7 of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000.*	-
The EIS must include:	
• a full description of the development, including:	
- the need for the development;	Section 3.10.3
- the resource to be extracted, including the amount, type and composition, having regard to DRE's and EPA's requirements;	Section 1.1
- the site layout and extraction plan, including cross-sectional plans;	Section 1.1/1.2
- the production process and processing activities, including the in-flow and out-flow of materials and points of discharge to the environment;	Section 2
- surface infrastructure and facilities (including any infrastructure that would be required for the development, but the subject of a separate approvals process);	Section 2.8
- a waste (overburden, rejects, tailings etc) management strategy, having regard to EPA's requirements;	Section 2.9
- a water management strategy, having regard to EPA's and DPI's requirements;	Section 7.3.1
- a rehabilitation strategy to apply during, and after completion of, extraction operations, and proposed final use of site; and	Chapters 6–16
- the likely interactions between the development and any other existing, approved or proposed extractive industry development in the vicinity of the site (including adjacent Petersons Quarry) [sic].	
• A list of any approvals that must be obtained before the development may commence;	Section 4.2

Table 1.1 Summary of SEARs

Requirement	EIS reference
• an assessment of the likely impacts of the development on the environment, focusing on the specific issues identified below, including: - a description of the existing environment likely to be affected by the development, using sufficient baseline data; - an assessment of the likely impacts of all stages of the development, including any laws, environmental planning instruments, guidelines, policies, plants and industry codes of practice; - a description of the measures that would be implemented to mitigate and/or offset the likely impacts of the development, and an assessment of: ▪ whether these measures are consistent with industry best practice, and represent the full range of reasonable and feasible mitigation measures that could be implemented; ▪ the likely effectiveness of these measures; ▪ whether contingency plans would be necessary to manage any residual risks; and - a description of the measures that would implemented to monitor and report on the environmental performance of the development if it is approved.	Outlined in technical chapters (6–16)
• a consolidated summary of all the proposed environmental management and monitoring measures, identifying all the commitments in the EIS;	Section 2.12
• consideration of the development against all relevant environmental planning instruments (including Part 3 of the *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007*); and	Section 4.3
• the reasons why the development should be approved having regard to biophysical, economic and social considerations, including the principles of ecologically sustainable development.	Section 18
In addition to the matters set out in Schedule 1 of the *Environmental Planning and Assessment Regulation 2000,* the development application must be accompanied by a signed report from a suitably qualified expert that includes an accurate estimate of the:	
• capital investment value (as defined in Clause 3 of the *Environmental Planning and Assessment Regulation 2000*) of the development, including details of all the assumptions and components from which the capital investment value calculation is derived; and	Section 3
• jobs that would be created during each stage of the development.	Section 2.11 (or 3)
Key issues	
The EIS must address the following specific matters:	
Land Resources – including a detailed assessment of:	
• potential impacts on soils and land capability (including potential erosion and land contamination);	Section 6.3
• potential impacts on landforms (topography), paying particular attention to the long-term geotechnical stability of any new landforms (such as overburden dumps); and	Section 6.3
• 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.	Sections 1.3 and 18.3

Table 1.1 Summary of SEARs

Requirement	EIS reference
Traffic and transport – including:	
• accurate predictions of the road traffic generated by the construction and operation of the development, including cumulative traffic levels associated with Johnniefelds Quarry to the east and Lynwood Quarry to the south and a description of the types and maximum numbers of vehicles likely to be used for transportation of quarry products, the public roads in the Goulburn Mulwaree LGA likely to be so used and the times during which those roads would be so used;	Section 11.3
• a detailed assessment of potential traffic impacts on the capacity, condition, safety and efficient of the local and State road network (as identified above), having regard to the requirements of the Goulburn Mulwaree Council and RMS; and	Section 10.3
• a detailed description of the measures or works (including concept plans) that would be used and/or implemented to upgrade, maintain and improve the capacity, efficiency and safety of the road network used by the development.	Section 10.4
Blasting and vibration – including:	
• proposed hours, frequency, methods and impacts; and	Section 11.3
• an assessment of the likely blasting impacts of the development on people, buildings, animals, infrastructure and significant natural features having regard to the relevant ANZECC guidelines.	Section 11.3
Air quality – including a quantitative assessment of potential:	
• construction and operational impacts, with a particular focus on dust emissions including $PM_{2.5}$ and PM_{10};	Section 12.3
• dust generation from blasting and processing, as well as diesel emissions and dust generated from the transportation of quarry products;	Section 12.3
• reasonable and feasible mitigation measures to minimise dust and diesel emissions; and	Section 12.4
• monitoring and management measures, in particular, real-time air quality monitoring.	Section 12.4
Noise – including a quantitative assessment of potential:	
• construction, operational and off-site transport noise impacts in accordance with the *Interim Construction Noise Guideline, NSW Industrial Noise Policy* and the *NSW Road Noise Policy* respectively;	Section 11.3
• reasonable and feasible mitigation measures to minimise noise emissions; and	Section 11.4
• monitoring and management measures, in particular real-time and attended noise monitoring.	Section 11.4
Water – including:	
• a detailed assessment of potential impacts on the quality and quantity of existing surface and groundwater resources, including impacts on the regional water supply, having regard to the requirements of DPI;	Section 7.3 & 8.3
• a detailed site water balance and an assessment of any volumetric water licensing requirements, including a description of site water demands, water disposal methods (inclusive of volume and frequency of any water discharges), water supply infrastructure and water storage structures;	Section 7.3.2 & 8.2
• an assessment of proposed water discharge quantities and quality against receiving water quality and flow objectives;	Section 7.4.1 &
• identification of any licensing requirements or other approvals under the *Water Management Act 2000*;	Section 8.2.2
• 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);	Sections 7.3 & 8.3
• an assessment of potential risks to surface and groundwater from construction and operation, demonstrating clear consideration of the principle of achieving a neutral or beneficial effect on water quality in the Sydney Drinking Water Catchment, consistent with SEPP (Sydney Drinking Water Catchment) 2011. The EIS must include a framework for the avoidance, mitigation, management and monitoring of water quality impacts during construction and operation.	Sections 7.4 & 8.4

Table 1.1 Summary of SEARs

Requirement	EIS reference
• a description of the measures proposed to ensure the development can operate in accordance with the requirements of any relevant WSP or water source embargo, having regard to the requirements of DPI; and	Sections 7.4 & 8.4
• a detailed description of the proposed water management system (including sewage), water monitoring program and other measures to mitigate surface and groundwater impacts.	Section 7.4 & 8.4
Biodiversity – including:	
• an assessment of the likely biodiversity impacts, having regard to OEH's and DPI's requirements;	Section 9.4.2
• an offset strategy (depending on the outcomes of the assessment of biodiversity impacts) to ensure the development maintains and improves the biodiversity values of the region in the medium to long -term; and	Section 9.3.4
• an assessment of potential downstream impacts on water quality and aquatic habitats in Chapmans Creek.	Section 9.3.5
Heritage – including an assessment of the likely Aboriginal and historic heritage (cultural and archaeological) impacts of the development, having regard to OEH's requirements.	Section 13 & 16.2
Visual - 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, paying particular attention to the creation of any new landforms (noise bunds, etc.).	Section 16.1
Greenhouse gas - including an assessment of the likely greenhouse gas emissions of the development, dealing with the EPA's requirements.	Section 12
Hazards - including an assessment of the likely risks to public safety, paying particular attention to potential bushfire risks and the transport, handling and use of any dangerous goods.	Section 9.4.3
Social and economic – including:	
• an assessment of potential impacts on local and regional communities including impacts on social amenity;	Section 14.4
• a detailed description of the measures that would be implemented to minimise the adverse social and economic impacts of the development, including any infrastructure improvements, or contributions and/or voluntary planning agreement or similar mechanism; and	Section 14.5
• a detailed assessment of the costs and benefits of the development as a whole, and whether it would result in a net benefits for the NSW community.	Section 18.1
Rehabilitation – including the proposed rehabilitation strategy for the site having regard to the key principles in the *Strategic Framework for Mine Closure*, including:	
• rehabilitation objectives, methodology, monitoring programs, performance standards and proposed completion criteria;	Section 6.4
• nominated final land use, having regard to any relevant strategic land use planning or resource management plans or policies; and	Section 6.4
• the potential for integrating this strategy with any other rehabilitation and/or offset strategies in the region.	Section 6.4
Consultation	
During the preparation of the EIS, you must consult with relevant local, State and Commonwealth Government authorities, service providers, Aboriginal stakeholders, community groups and affected landowners.	Section 5

Table 1.1 Summary of SEARs

Requirement	EIS reference
In particular, you must consult with the :	
• Office of Environment and Heritage (including the Heritage Branch);	Section 5.3
• Environment Protection Authority;	Section 5.3
• Division of Resources and Energy within the Department of Trade and Investment, Regional Infrastructure and Services;	Section 5.3
• Department of Primary Industries (including the NSW Office of Water, NSW Forestry, Agriculture and Fisheries sections and Crown Lands division);	Section 5.3
• Roads and Maritime Services;	Section 5.3.2
• NSW Rural Fire Service;	Section 5.3.4
• South East Local Land Services;	
• Goulburn Mulwaree Council; and	Section 5.3.2
• community groups, including but not limited to Red Hills Road Residence and Surrounding Areas Committee.	Section 5.5
The EIS must:	
• describe the consultation process used and demonstrate that effective consultation has occurred;	Section 5
• describe the issues raised by public authorities, service providers, community groups and landowners;	Section 5.5.5
• identify where the design of the development has been amended in response to issues raised; and	Section 3.10
• otherwise demonstrate that issues raised have been appropriately addressed in the assessment.	Chapter 6-17

A referral under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) was submitted to the Commonwealth Department of Environment (DoE) on 4 September 2015 (EPBC reference 2015/7557). The referral indentified the proposed activities as a potential 'controlled action' due to the presence of White Box-Yellow Box-Blakely's Red Gum Grassy Woodland, listed as a Critically Endangered Ecological Community under the EBPC Act.

On 15 October 2015, DoE determined that the proposed activities are a controlled action, with the relevant controlling provision being "[l]isted threatened species and communities (Sections 18 & 18A)". The project will be assessed under the assessment bilateral agreement with NSW.

The supplementary environmental assessment requirements listed in Table 1.2 were received from DoE on 19 October 2015 and are provided in Appendix B.

Table 1.2 Summary of supplementary assessment requirements

Requirement	EIS reference
On 15 October 2015 it was determined that the Gunlake Extension Project will impact upon the following matters of national environmental significance (MNES) protected under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act): • threatened species and communities.	Appendix I Section 5.4
The project will be assessed in accordance with the NSW Assessment Bilateral Agreement (2015). These guidelines do not stand alone but are a supplement to the Secretary's Environmental Assessment Requirements issued on 3 July 2015 and must be addressed in conjunction with these requirements. The Guidelines are intended to ensure there is sufficient information in the assessment report relevant to MNES such that the Commonwealth decision maker may make a determination on whether or not to approve the action.	Appendix I Section 5.4
The proponent must undertake an assessment of all the protected matters that may be impacted by the development under the controlling provision identified in item 1. A list of protected matters that the Department of the Environment considered likely to be significantly impacted is provided at Attachment A to these Guidelines. Note that this may not be a complete list and it is the responsibility of the proponent to ensure any protected matters under this controlling provision, likely to be significantly impacted, are assessed for the Commonwealth decision-maker's consideration.	Appendix I Section 5.4
General requirements	
The EIS must address the following issues:	
The precise location and description of all works to be undertaken (including associated offsite works and infrastructure), structures to be built or elements of the action that may have impacts on matters of national environmental significance (MNES).	Chapter 3 Appendix I Section 5.4
An assessment of the likely impacts of the development on each EPBC Act-listed species and/or ecological community where there is likely to be a significant impact from the proposed development.	Section 9.3.7 and Appendix I Section 5.4
Key issues - Biodiversity	
The EIS must address the following issues in relation to Biodiversity including: • identification of all EPBC Act listed threatened species and communities likely to be located in the project area or in the vicinity; and	Section 9.2.4ii and Appendix I
• identification of all EPBC Act listed threatened species and communities likely to be significantly impacted by the development in accordance with the Matters of National Environmental Significance - Significant Impact Guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999 (Significant Impact Guidelines).	Section 9.3.7 and Appendix I
For each of the relevant EPBC Act listed threatened species and communities likely to be significantly impacted by the development the EIS must provide: • a description of the environment (including identification and mapping of suitable breeding habitat, suitable foraging habitat, important populations and habitat critical for survival), with consideration of, and reference to, any relevant Commonwealth guidelines and policy statements including listing advice, conservation advice and recovery plans;	Appendix I Section 5.4
• details of the scope, timing and methodology for studies or surveys used and how they are consistent with (or justification for divergence from) published Australian Government guidelines and policy statements; and	Appendix I Section 2.2
• Specifically: - detailed mapping identifying the extent and quality of the EPBC Act listed critically endangered White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grasslands in accordance with the EPBC Act listing criteria and policy statement for that community for both the impact site and proposed offset site.	Appendix I Section 3.2.3 Chapter 5 and 7

Table 1.2 Summary of supplementary assessment requirements

Requirement	EIS reference
For each of the relevant EPBC Act listed threatened species and communities likely to be significantly impacted by the development the EIS must provide a description of the impacts of the action having regard to the full national extent of the species or community's range including: • a detailed assessment of the extent, nature and consequence of the likely direct, indirect and consequential impacts – refer to the Significant Impact Guidelines for guidance on the various types of impact that need to be considered; • a statement whether any relevant impacts are likely to be unknown, unpredictable or irreversible; and • a description of any likely cumulative impacts, where potential project impacts are in addition to exiting impacts of other activities (including known potential future expansions or development by the proponent and other proponents in the region and vicinity).	Appendix I Chapter 5
For each of the relevant EPBC Act listed threatened species and communities, likely to be significantly impacts by the development, the EIS must provide information on proposed avoidance and mitigation measures to manage the relevant impacts of the action including: • a description of proposed avoidance and mitigation measures to deal with relevant impacts of the action; • assessment of the expected or predicted effectiveness of the mitigation measures; and • a description of the outcomes that the avoidance and mitigation measures will achieve.	Appendix I Chapter 4
For each of the relevant EPBC Act listed threatened species and communities, likely to be significantly impacts by the development, the EIS must provide reference to, and consideration of relevant Commonwealth guidelines and policy statements including conservation advice, recovery plans, threat abatement plans and wildlife conservation plans.	Appendix I Chapter 5 and Appendix B
For each of the relevant EPBC Act listed threatened species and communities, likely to be significantly impacts by the development, the EIS must provide: • identification of significant residual adverse impacts likely to occur after the proposed activities to avoid and mitigate all impacts is taken into account; • details of how the current published NSW Framework for Biodiversity Assessment (FBA) has been applied in accordance with the objects of the EPBC Act to offset significant residual adverse impacts; and • details of the offset package to compensate for significant residual impacts including details of the credit profiles required to offset the development in accordance with the FBA and/or mapping and descriptions of the extent and condition of the relevant habitat and/or threatened communities occurring on proposed offset sites.	Appendix I Section 5.1 Chapter 7 Chapter 7
Any significant residual impacts not addressed by the FBA may need to be addressed in accordance with the *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offset Policy*.	Section 7.5
Environmental record of person proposing to take the action	
The information provided must include details of any proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources against the person proposing to take the action; and for an action for which a person has applied for a permit, the person making the application.	
If the person proposing to take the action is a corporation, details of the corporation's environmental policy and planning framework must also be included.	Section 2.12 and Appendix C

1.7 Structure of EIS

The EIS provides an overview of the project, given in Volume 1, which is supported by the technical specialist studies given in Volumes 2 to 3. Volume 1 is structured as follows:

- Main report
  - Chapter 1 – Introduction: provides an overview of the proposed extension project;
  - Chapter 2 – Existing operations: provides a description of the current operations at Gunlake Quarry;
  - Chapter 3 – Proposal: provides a description of the proposed extension project;
  - Chapter 4 – Planning and statutory framework: provides a description of the relevant planning and environmental approvals at a Commonwealth, State and local government level for the proposed extension project;
  - Chapter 5 – Stakeholder engagement: provides an outline of the consultation process with stakeholders, including the local community and government agencies, and the matters raised during this consultation;
  - Chapters 6 to 16: provide details on the environmental, social and economic impacts of the proposed extension project in relation to:
    - land resources and rehabilitation;
    - surface water;
    - groundwater;
    - biodiversity;
    - transport;
    - noise and vibration;
    - air quality and greenhouse gases;
    - Aboriginal heritage;
    - social;
    - economics; and
    - other matters.
  - Chapter 17 – Statement of commitments: provides a summary of the measures Gunlake will implement to avoid or mitigate potential adverse environmental impacts of the extension project; and
  - Chapter 18 – Justification and conclusion: provides a justification for the extension project.

- Appendix A: Study team
- Appendix B: Environmental assessment requirements
- Appendix C: Gunlake Quarry Environmental Management System
- Appendix D: Transport options review
- Appendix E: Community consultation materials
- Appendix F: Land resources and rehabilitation study
- Appendix G: Surface water assessment

Volume 2 is structured as follows:

- Appendix H: Groundwater assessment
- Appendix I: Biodiversity assessment
- Appendix J: Transport assessment
- Appendix K: Noise and vibration assessment

Volume 3 structured as follows:

- Appendix L: Air quality and greenhouse gases assessment
- Appendix M: Aboriginal cultural heritage assessment
- Appendix N: Economic assessment

1.8 Impacts of approved and proposed activities

As described in Section 1.4, this application seeks approval for the currently approved operations and the proposed extension project operations.

The assessment approach for the approved and extension project operations are summarised in Table 1.3.

Table 1.3 Approved and extension project operations assessment approach

Aspect	Approach
Land resources and rehabilitation	The approved project land resources and rehabilitation impacts are assessed in SEEC (2008). The extension project land resources and rehabilitation impacts are assessed in Appendix F.
Surface water	The combined approved and extension project surface water impacts are assessed in Appendix G.
Groundwater	The combined approved and extension project groundwater impacts are assessed in Appendix H.

Table 1.3 Approved and extension project operations assessment approach

Aspect	Approach
Biodiversity	The approved project biodiversity impacts are assessed in Ecotone (2008a and 200b) and Biosis (2014). The extension project biodiversity impacts are assessed in Appendix I. The biodiversity offsets required for the unavoidable combined approved and extension project impacts are provided in Appendix I.
Transport	The approved project transport impacts are assessed in Transport and Urban Planning (2014). It is not proposed to change the number of truck movements through Marulan. Therefore the transport impacts in Marulan are unchanged. These impacts have been summarised in Section 10.2.8. However the rest of the Transport and Urban Planning (2014) assessment has been superseded by the assessment in Appendix J. The combined approved and extension project transport impacts are assessed in Appendix J.
Noise and vibration	The combined approved and extension project noise and vibration impacts are assessed in Appendix K.
Air quality and greenhouse gases	The combined approved and extension project noise and vibration impacts are assessed in Appendix L.
Cultural heritage	The approved project cultural heritage impacts are assessed in AASC (2008) and CHCMA (2014), and Section 4B.11 in Olsen (2008) and Section 5.7.6 in Olsen (2014). The extension project cultural heritage impacts are assessed in Appendix M.
Economic	The combined approved and extension project economic impacts are assessed in Appendix N.
Social	The combined approved and extension project social impacts are assessed in Chapter 14.

2 Existing operations

2.1 Introduction

This chapter describes the existing approved Gunlake Quarry operations.

Gunlake Quarry currently operates under project approval 07-0074 issued by the Minister for Planning in September 2008 under Part 3A of the EP&A Act. The project approval has been modified on three occasions:

- Modification 1 – Stage 2 southbound access;
- Modification 2 – Quarry expansion; and
- Modification 3 – Truck movements.

Modifications 1 and 3 were minor modifications to alter transport routes and truck numbers related to the quarry. Modification 2 included expansion of the quarry pit and overburden emplacement, an increase to truck movements equivalent to 750,000 tonnes per annum of saleable product and alteration of the approved hours of operation.

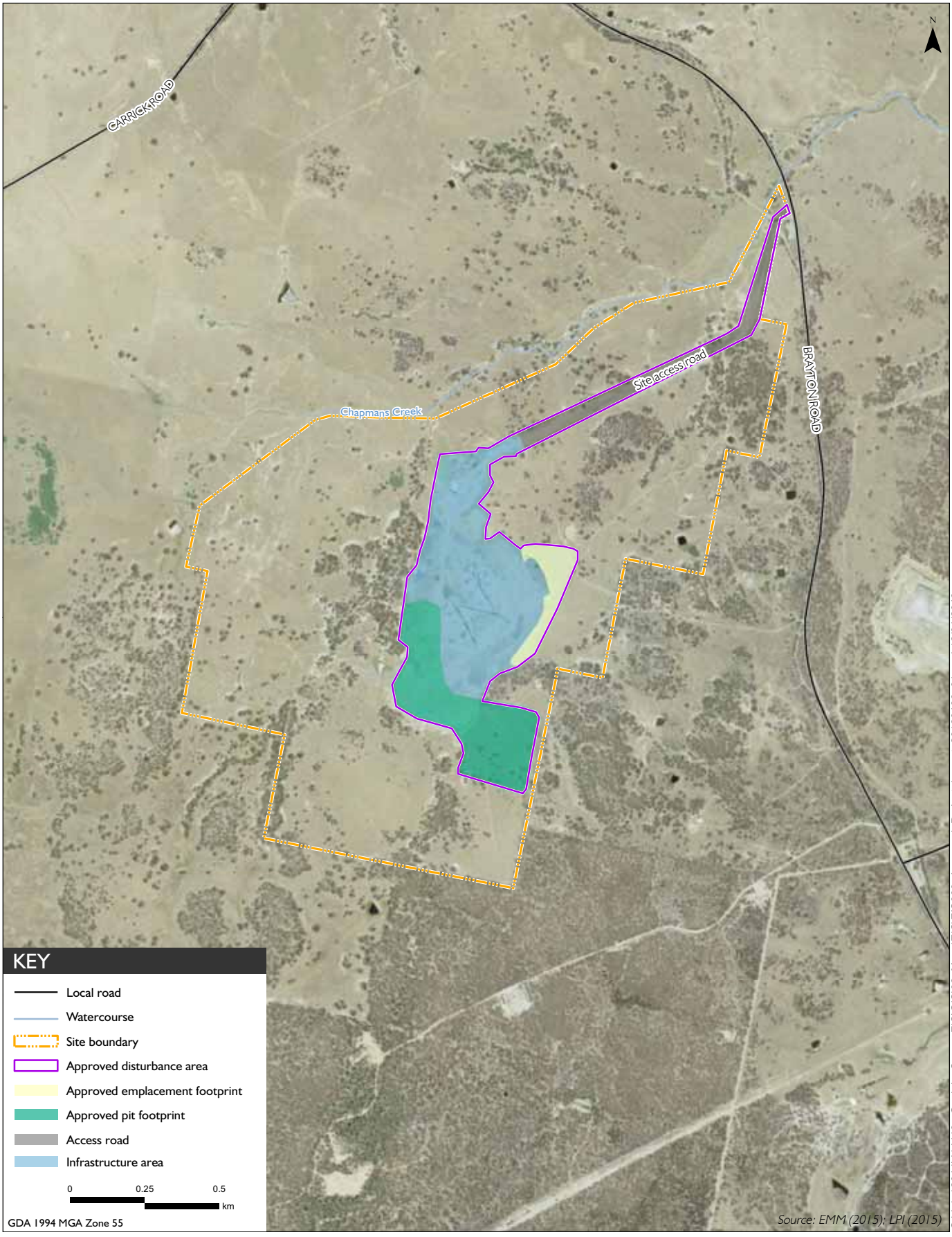
The approved project layout is shown in Figure 2.1. The approved quarry footprint covers an area of about 45 ha.

2.2 Resource

The rock resource is within the Devonian Bindook Volcanic Complex. The Complex comprises a north-northeast trending series of volcanic units located north of the intrusive Marulan Granite. Gunlake Quarry is located on a proven rock resource of approximately 180 Mt of tuffaceous rhyodacite. The igneous rock deposit continues well over 100 m below the surface.

The hard rock is suitable for uses in a range of quarry products including concrete and sealing aggregates, rail ballast, manufactured sand and road bases.

To date, only a small proportion (about 0.9 Mt) of the 180 Mt of the resource has been quarried. Under the current project approval, about 11% (19 Mt) of the resource will be quarried over the project life.



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Approved project layout

Gunlake Quarry
Environmental Impact Statement

Figure 2.1

2.3 Quarry components

Key components of the existing quarry include:

- a quarry pit providing access to hard rock resources (see Photograph 2.1 and Photograph 2.2);
- overburden and excess product emplacement areas;
- drilling and blasting to release the rock material;
- crushing and screening of the quarried rock;
- truck loading and transport of hard rock; and
- ancillary infrastructure to support operations including offices, amenity buildings and other minor infrastructure.

Photograph 2.1 Northern base of existing quarry pit (2015)

Photograph 2.2 View north across the existing quarry pit (2015)

2.4 Quarrying

2.4.1 Quarry progression

Quarrying at Gunlake Quarry has generally been progressing from north to south. Based on the currently approved operations, the quarry would be confined to the first bench until about mid 2016 with access via the haul road at the northern end of the quarry. Once the full horizontal extend of the first bench is complete, the second bench will commence and so on to the base of the pit. Additional haul roads would be constructed within the quarry pit to allow access to each bench as quarrying progresses.

2.4.2 Vegetation clearing

Vegetation within the approved quarry footprint is cleared in progressive campaigns. In each campaign, the extent of clearing is just sufficient for the subsequent months of quarrying.

Prior to any major vegetation clearing and surface disturbance, the following erosion and sedimentation prevention measures are implemented as required:

- construction of a temporary diversion bank upslope of the area to be cleared to divert clean water into natural drainage lines or designated storage dams; and
- construction of catch drains or banks down slope of the area to be cleared to direct runoff to sediment basins or storage dams for use in dust suppression.

2.4.3 Soil removal and stockpiling

Topsoil and subsoil are stripped and replaced directly onto completed sections of the final landform. Where this is impractical and stockpiling is necessary, the topsoil and subsoil are stockpiled separately.

2.4.4 Overburden removal and emplacement

Overburden is removed using an excavator and loaded to 50-tonne dump trucks. Overburden is removed progressively in front of the quarry bench, about two months in advance of drilling for hard rock blasting.

An overburden emplacement bund east of the infrastructure area provides a permanent storage location for the overburden material (see Photograph 2.3). The overburden emplacement bund will be extended to the north and south and will eventually have a footprint of about 3.21 ha.

The overburden emplacement bund has been located to maximise its acoustic and visual screening properties. It has been designed to enable the external walls of the bund to be progressively rehabilitated. This rehabilitation is underway (see Photograph 2.4).

Photograph 2.3 Northern section of current overburden emplacement bund (2015)

Photograph 2.4 Rehabilitation of current overburden emplacement bund (2015)

2.4.5 Blasting

The resource is blasted to form quarry rock faces approximately 13 m tall.

Drilling in preparation for blasting is undertaken using a hydraulic drill. Approximately 30,000 tonnes of hard rock is prepared by each blast. Blasting occurs approximately once a fortnight.

2.4.6 Rock extraction

Rock from the base of the blasted face is loaded to off-road haul trucks using a front end loader. The rock is hauled to the primary crusher in the infrastructure area via the haul road in the north of the quarry pit.

The following quarrying equipment is operated on-site:

- excavator (Caterpillar 345BL);
- excavator (Hitachi 450LC);
- dump truck (Cat 773);
- dump truck (Cat 769D);
- dump truck (Cat 771D);
- wheeled loader (Cat 988);
- front end loader (Cat 980H);
- front end loader (Cat 980K);
- drilling rig (Atlas Copco Hydraulic rig);
- grader (Caterpillar 12H);

- dozer (Komatsu 375);
- water trucks;
- backhoe (Case 580);
- tip truck; and
- maintenance trucks.

2.4.7 Rock processing

The quarry rock is processed in the infrastructure area to the north of the pit (see Photograph 2.5), which contains the following:

- Plant 1:
  - jaw crusher;
  - secondary crusher; and
  - screens.
- Plant 2:
  - tertiary crusher;
  - nutcracker crusher;
  - impact crusher; and
  - screens.
- main screen;
- interconnecting conveyors; and
- product stockpiles.

The infrastructure area has a prepared hard surface of crushed rock material. This area is also used for stockpiling products.

The processing plant is equipped with atomised water dust suppression systems at all discharge points.

Photograph 2.5 Rock processing area and product stockpiles

2.4.8 Dispatch

Stockpiled quarry products are loaded by a front end loader to road haul trucks for delivery to markets (see Section 2.6).

2.5 Quarry products

The material produced at Gunlake quarry is suitable for use in the following products:

- concrete and sealing aggregates;
- rail ballast;
- manufactured sand; and
- road base.

Typical finished products from the processing plant include aggregates with diameters less than 20 mm, 14 mm, 10 mm and 7 mm.

2.6 Product transport

2.6.1 Transport routes

All saleable products from the quarry are transported by truck to Sydney and other markets north and south of Marulan. Gunlake Quarry currently has approval for 82 laden truck movements per day. This equates to an average of 3.4 truck movements per hour. There are also a small number of transport movements associated with employee travel, fuel deliveries and service vehicles.

Access to the quarry is via the quarry access road off Brayton Road, north-west of Marulan (see Photograph 2.6).

Photograph 2.6 Gunlake Quarry access road

Products for markets north of the quarry are transported along Brayton Road to the purpose built Bypass Road that connects Brayton Road to Red Hills Road and the northbound lanes of the Hume Highway — the primary haul route. This primary haul route is 7 km long and it takes trucks 7.5 to 9.5 minutes to traverse the route. There are 13 residences within 600 m of the primary haul route. Two of these are closer to the Hume Highway than to the primary haul route.

Products for markets south of the quarry are transported along Brayton Road, through the northern edge of Marulan to the Brayton Road/George Street/Hume Highway interchange — the secondary haul route. Gunlake currently have approval for an average of 25 southbound laden trucks per day (maximum of 38 trucks per day) to use the secondary haul route.

All trucks returning to the quarry use Red Hills Road, the Bypass Road and Brayton Road. Quarry trucks returning from the north are required to turn at the South Marulan Road interchange, approximately 3.5 km south-west of Marulan, and travel north along the Hume Highway to the Red Hills Road intersection.

At present, about 89% of truck movements (ie laden and empty trucks) are along the primary haul route and about 11% of truck movements are along the secondary haul route through Marulan.

In response to community feedback on safety, trucks have recently been instructed to travel at a maximum speed of 80 km/h between Gunlake Quarry and the Hume Highway.

2.6.2 Road upgrades

Gunlake Quarry and Goulburn Mulwaree Council (the Council) have a road maintenance and capital improvement agreement to cover impacts associated with the movement of saleable product along the designated transport routes. To the end of the 2014/15 financial year, Gunlake spent $3.3 million on local roads (Table 2.1). This included the construction of the Bypass Road and upgrading the Red Hills Road and Hume Highway intersection (at a cost of about $2.3 million to Gunlake plus $0.95 million for the purchase of land). The Bypass Road was dedicated back to Council and is a public road. In addition, Brayton Road continues to be upgraded by the Council using Gunlake's contributions under Section 94 of the EP&A Act.

This allows the majority of haul trucks (89% of truck movements) to avoid passing through the northern part of Marulan.

Table 2.1 Gunlake Quarries roadwork contributions

Financial year	s94 Contribution	Capital works	Road section
2010/11	$35,962	$100,650	Brayton Road from Gunlake to Johnniefelds Quarry
2011/12	$47,917	-	
2012/13	$62,937	-	
2012/13	-	$1,695,120	Bypass Road
2013/14	$81,418	$338,516	Hume Highway intersection
2013/14	-	$230,715	Red Hills Road from Bypass Road to Hume Highway
2014/15	$87,376	$607,200	Brayton Road from Johnniefelds Quarry to McClura Drive
Sub-total	$315,610	$2,972,201	
Total s94 and capital costs	**$3,287,811**		

The section of Brayton Road between Gunlake Quarry and Johnniefelds Quarry was upgraded by the Council in the second half of 2015.

2.7 Quarry life

Gunlake Quarry currently have approval to undertake quarrying operations until 30 September 2038.

2.8 Rehabilitation and decommissioning

Gunlake uses a progressive approach to rehabilitation at the site where possible. As described in Section 2.4.1, each quarry bench is fully developed before progressing to the next bench level. Therefore, there is no opportunity to progressively rehabilitate the quarry pit. However, progressive rehabilitation of the overburden emplacement bund has commenced with land forming and revegetation works completed in some areas.

The Quarry Closure Plan (Olsen 2010) describes the closure of the quarry based on the design originally approved.

2.9 Site infrastructure and services

2.9.1 Site buildings

The existing quarry site infrastructure includes the following:

- site office (see Photograph 2.7);
- toilet and ablution facilities;
- weighbridge (see Photograph 2.8);
- truck wash;
- crib hut;
- hardstand and truck parking area;
- light vehicle parking area;
- bunded fuel bay;
- maintenance workshop and wash bay (see Photograph 2.8); and
- light vehicle parking facilities.

Photograph 2.7 Site office

Photograph 2.8 Weighbridge and maintenance workshop

2.9.2 Water supply

The quarry has a surface water management system that includes dirty and clean water dams (see Photograph 2.9). This water is used for the processing plant and haul road dust suppression.

Photograph 2.9 Example of a water supply dam and rainwater tank

Currently, net water use in the plant is 18.2 L per tonne of product that is processed, primarily for dust suppression. This is consistent with typical values for a hard rock quarry. For the current production rate of 750,000 tpa, the processing plant requires 13.7 ML of water per annum.

The haul road linking the truck parking area, the quarry and the processing area requires watering for dust suppression. An average of about 43 ML of water is used for haul road dust suppression.

Currently, runoff volumes from the dirty water catchments and the pit exceed the volume of process water required in median and wet years (see Section 7.3.2). This results in overflows from the process water dam. During median and dry years, water is harvested from cleanwater dams to supplement process water supply from the pit sump and process water dam. During dry years, there are periods of water shortages. When these shortages occur, water is imported from external sources or is obtained from existing farm dams.

When there is excess water on-site, Gunlake has the option to irrigate an area of approximately 10 ha of agricultural land. Using this option, up to 60 ML of water per annum can be disposed. To date, irrigation of excess water has not been required.

Runoff from the site office and maintenance workshop roofs is collected in rainwater tanks (see Photograph 2.9). This is used for non-potable uses such as toilet flushing. The tanks are supplemented with imported potable water during periods of water shortages. Drinking water is brought to site.

2.9.3 Electricity

Gunlake Quarry is powered by electricity from the state supply grid. Overhead and underground cables supply electric to the site office workshop area and the processing plant. Annual electricity consumption at a peak annual production of 750,000 tpa at the quarry is approximately 127 kWh.

2.9.4 Communications

A combination of phone and fax lines, mobile phones and 2-way radios are used at the quarry for off-site and on-site communications. Internet access is available at the site.

2.9.5 Fuel

Diesel fuel is used to power all mobile plant on-site. Fuel is stored within a 50,000 L self-bunded fuel tank. The fuel storage and a refuelling bay are located adjacent to the maintenance workshop. Up to 5,000 L of oil is stored on-site in self-bunded containers.

2.9.6 Explosives

All explosives required for blasting are stored off-site and are delivered to the quarry as required.

2.10 Waste management

The principle wastes generated at Gunlake Quarry are:

- overburden from quarry development;
- general domestic-type wastes from the on-site buildings and routine maintenance consumables;
- fencing material;
- oils and greases;
- sewage;

- potentially contaminated water from the maintenance workshop, washdown pad and fuel storage areas; and
- tyres.

There are existing waste management procedures for the waste generated on-site (see Section 2.9).

2.10.1 General waste management

Waste is segregated into the following streams on-site for off-site recycling or disposal off-site by licensed contractors:

- 'domestic' waste including putresibles;
- waste paper and cardboard;
- metals;
- hydrocarbons;
- potentially contaminated water from the maintenance workshop interceptor trap; and
- tyres.

No waste is disposed at site with the exception of overburden (see Section 2.4.4), sewage (see Section 2.10.2) and cured concrete (see Section 2.10.3).

2.10.2 Sewage

All domestic waste water is treated on-site in a purpose built waste water treatment and disposal system. In addition, Gunlake uses a council-approved septic system for secondary treatment of effluent to make it suitable for use in irrigation.

2.10.3 Cured concrete

The quarry may receive and store up to 30,000 tonnes of cured concrete waste on the site in each calendar year. The volume of cured concrete waste held on the site must not exceed 2,500 tonnes at any one time. The cured concrete waste is used as a road base material within the quarry. This uses an off-site waste, diverting it from landfill.

2.11 Hours of operation

The approved hours of operation vary according to the activity being undertaken, as listed in Table 2.2.

Table 2.2 Approved hours of operation

Activity[1]	Day	Time
Overburden removal and drilling	Monday to Saturday	7 am to 6 pm
	Sundays and public holidays	None
Blasting	Monday to Friday	9 am to 5 pm
	Sundays and public holidays	None
Quarrying and processing (excluding tertiary crushing)	Monday to Saturday	7 am to 6 pm
	Sundays and public holidays	None
Tertiary crushing	Monday to Saturday	24-hours except 6 pm Saturday to 2 am Monday
	Sundays and public holidays	None
Loading and dispatch	Monday to Saturday	24-hours except 6 pm Saturday to 2 am Monday
	Sundays and public holidays	None
Product transportation – Bypass Road	Monday to Saturday	24-hours except 6 pm Saturday to 2 am Monday
	Sundays and public holidays	None
Product transportation – Brayton Road to Marulan	Monday to Saturday	6 am to 7 pm
	Sundays and public holidays	None
Maintenance	Monday to Saturday	Anytime
	Sundays and public holidays	None

Note: 1. For Stage 2 (ie current) operations.

2.12 Employment

Gunlake currently has 25 on-site employees and 25 to 38 full-time equivalent truck drivers. These truck drivers are a mix of Gunlake employees and private contractors.

2.13 Environmental management

2.13.1 Environmental policy and planning framework

Gunlake's environmental policy and planning framework are documented in the Gunlake Quarry Project Environmental Management Strategy (EMS) (Gunlake Quarries 2015). The Gunlake Quarries EMS is provided in Appendix C.

The key environmental objectives of Gunlake Quarries are:

- to satisfy all statutory requirements;
- to be recognised as a company that operates the Gunlake Quarry Project in an environmentally responsible manner with due consideration for its role and responsibilities in the community; and
- to ensure the provision of a consistent and uniform approach to environmental management, including high standards of environmental protection.

The EMS provides the quarry's planning framework including the quarry management structure; responsibilities and authorities; resources and training; inspection requirements; reporting requirements; process planning; communications; and execution and implementation.

2.13.2 Environmental management system

Gunlake Quarry operates according to the Gunlake Quarry Environmental Management System that has been approved by DPE and includes the following plans and programs:

- Aboriginal Heritage Management Plan;
- Air Quality Monitoring Program;
- Erosion and Sediment Control Plan;
- Groundwater and Surface water Monitoring Program;
- Landscape Management Plan (DPE approval pending);
- Noise and Blast Management Monitoring;
- Pasture Irrigation Monitoring Program;
- Quarry Closure Plan;
- Revegetation and Vegetation Offset Management Plan;
- Site Water Balance;
- Traffic Management Plan; and
- Water Management Plan.

2.13.3 Environmental record

Since commencement of operations in 2009, Gunlake has a record of responsible environmental management. The company has complied with the licence conditions of Environment Protection License 13012 and the conditions of project approval 07-0074, with the exception of two penalty infringement notices (PINs), issued 10 December 2013 and 1 July 2014.

The PIN received on 10 December 2013 was for failure to comply with operating hours stipulated for the project. The PIN received 1 July 2014 was for failure to comply with the daily number of truck movements and the operating hours approved for the project.

Gunlake has since implemented management measures to prevent the recurrence of these infringements.

3 Proposed operations

This chapter describes the proposed extension project.

The extension project will increase the rate of extraction and associated activities at Gunlake Quarry and increase the project footprint as follows:

- operations to continue for 30 years from the date of approval of the extension project;
- 2 Mtpa of saleable products to be produced;
- an increase in truck movements to an average of 440 movements per day and a maximum of 690 movements per day;
- extension of the quarry pit footprint;
- an additional overburden emplacement to accommodate the increase in production;
- 24 hour per day primary crushing; and
- blasting twice weekly.

In addition, Gunlake seeks to maintain the approval for all aspects of the existing operations at Gunlake Quarry under Project Approval 07-0074.

A summary of the extension project is provided in Table 3.1.

Table 3.1 Project description

Project element	Currently approved	Proposed project
Quarrying method	Hard rock quarrying by open cut methods.	No change.
Resource	Approximately 180 million tonnes.	No change.
Disturbance area	Approved project footprint of 45 ha, as shown in Figure 2.1.	Extension of project footprint by 54 ha to approximately 99 ha as shown in Figure 1.2.
Saleable product	750,000 tonnes per annum.	Increase to 2 Mtpa.
Quarry life	30 years.	30 years from approval. There is sufficient resource (180 Mt) for quarrying to continue at 2 Mtpa for 90 years.
Beneficiation	Onsite crushing and stockpiling of quarried rock.	No change.
Infrastructure	As outlined in Section 2.4.	Upgrade infrastructure as required to produce 2 Mtpa of products.

Table 3.1 Project description

Project element	Currently approved	Proposed project
Product transport	An average of 164 truck movements per day (averaged over each calendar month) with up to a maximum of 320 movements on any day in total on all routes. An average 25 truck movements per day (averaged over each calendar month) and a maximum of 38 truck movements on any day on Brayton Road between Bypass Road and the intersection of Brayton Road/George Street/Hume Highway interchange underpass.	An average of 440 truck movements per day (averaged over each calendar month) with up to a maximum of 690 movements on any day in total on all routes. No change to truck numbers on Brayton Road between Bypass Road and the intersection of Brayton Road/George Street/Hume Highway interchange underpass.
Operational workforce	25 on-site employees and 25 to 38 truck drivers (full-time equivalent).	Increase of approximately 27 employees to approximately 7 on-site site employees and 20 truck drivers.
Hours of operation	6:00 am Monday to 6:00 pm Saturday, including crushing between 7:00 am and 6:00 pm, Monday to Saturday and maintenance at any time, Monday to Saturday. See Table 2.2 for details.	Modify existing hours of operation to allow crushing 24 hours a day (except Sundays and public holidays) and maintenance anytime (including Sundays and public holidays).
Capital investment value	-	$3.2 million

3.1 Quarrying

3.1.1 Quarry progression

i Pit development

As described in Section 2.4.1, resource extraction has generally progressed from north to south. Future pit development will progress in four stages over a 30 year lifespan (Table 3.2) and as shown in Figures 3.1 to 3.5.

Table 3.2 Indicative staged quarry development

Stage	Timing (years)	Depth to quarry floor (m BGL)	Elevation of quarry floor (m AHD)
1	1–5	13	650
2	5–10	26	637
3	10–20	65	598
4	20–30	91	572

Notes: m BGL = metres below ground level.
M AHD = m Australian height datum.

Development of the pit will commence within the current quarry footprint and will expand to the south and south-east before expanding laterally to the west during the first five years of development. The pit depth will remain at approximately 650 m Australian Height Datum (AHD) for the first five years (Figures 3.1 and 3.2).

During Years 5 to 10 an additional bench will be extracted taking the elevation of the pit floor to approximately 637 m AHD (Figure 3.3). Over Years 10 to 20, the pit will be further deepened with the extraction of three benches (Figure 3.4). Over Years 20 to 30, the final two benches will be extracted taking the pit floor to a final elevation of 572 m AHD (Figure 3.5).

Access to the quarry pit will continue to be via a haul road to the north of the quarry pit. Additional haul roads will also be constructed within the quarry pit to allow access to each bench as quarrying progresses.

ii Overburden emplacement

The approved overburden emplacement bund east of the infrastructure area will not be able to accommodate the overburden from the extended pit. Therefore, an additional emplacement is proposed west of the current pit footprint (Figures 3.1 to 3.5).

The additional emplacement will comprise overburden and reject material from the crushing and screening process. The emplacement will be progressively shaped, with the northern extent being constructed first (Figure 3.1), and then progressing southward (Figures 3.2 and 3.3) to the final footprint. The emplacement will be stepped and shaped to blend with the current landform and will be progressively vegetated to stabilise the landform.

The proposed out-of-pit emplacement has been designed as a two-stepped emplacement, with batter angles of approximately 3:1 and an embankment height of between 5 m to 15 m above ground level to ensure a landform that is sympathetic with the surrounding topography. As with the existing overburden emplacement on the east of the quarry, the proposed emplacement will be progressively rehabilitated to provide a stable landform that also blends with the surrounding environment from a visual perspective.

3.1.2 Quarrying methods

The quarrying methods will not change from those described in Section 2.4.

It is proposed to continue to use the same quarrying equipment as is currently operated on-site (see Section 2.3.6) with increased utilisation.

3.1.3 Rock processing

The existing processing equipment (see Section 2.4.7) will continue to be used.

Additional plant, will be required to accommodate the increased production rate. This will consist of:

- two tertiary crushers;
- an impact crusher; and
- five screens.

It is proposed to install these items within the existing crushing cycle of the existing fixed plant.

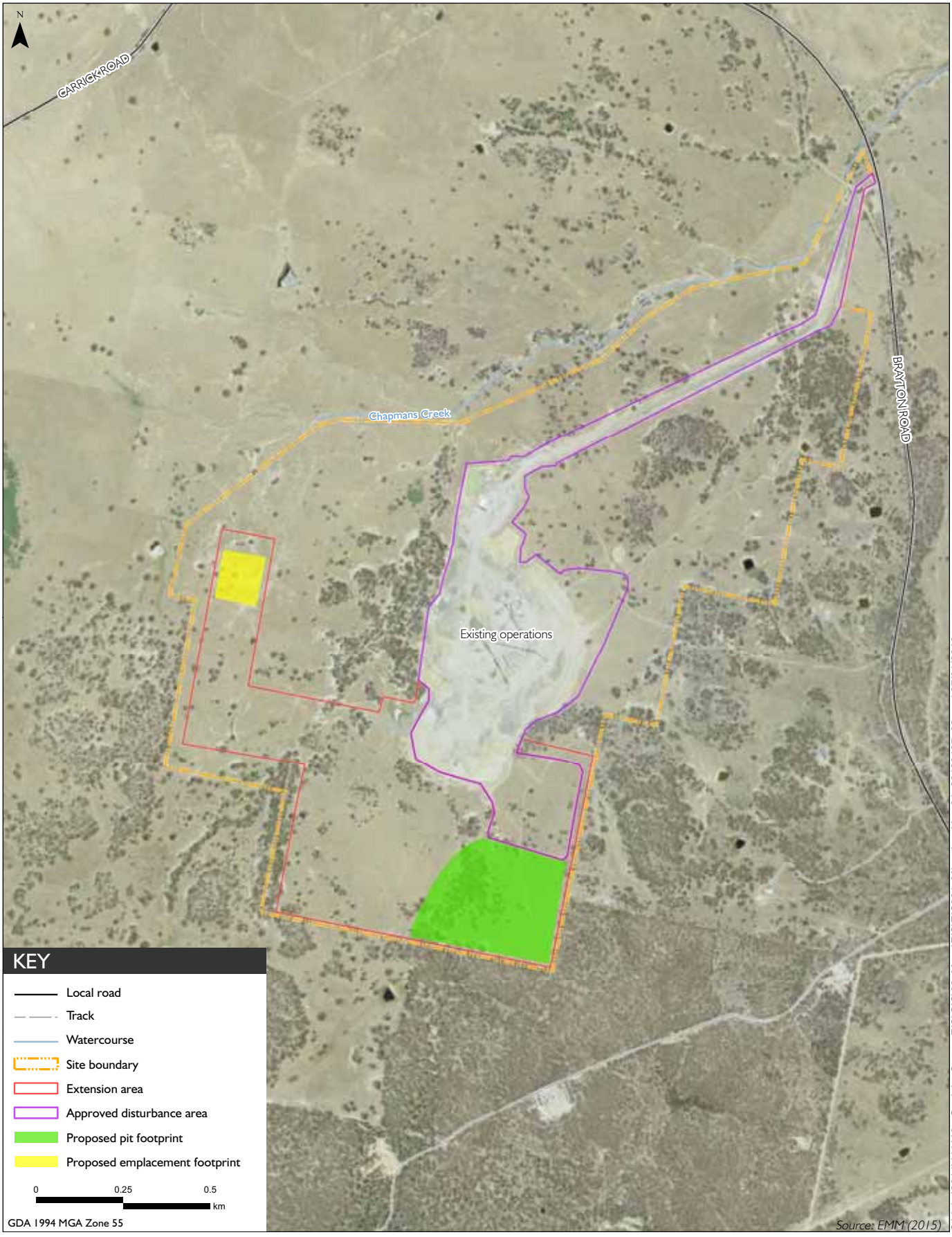
3.2 Quarry products

The proposed extension seeks to increase the annual production of the existing quarry from 750,000 tpa to 2 Mtpa.

No change to the quarry products produced is proposed.

3.3 Quarry life

The proposed extension seeks to extend the quarry life to 30 years from the date of approval.



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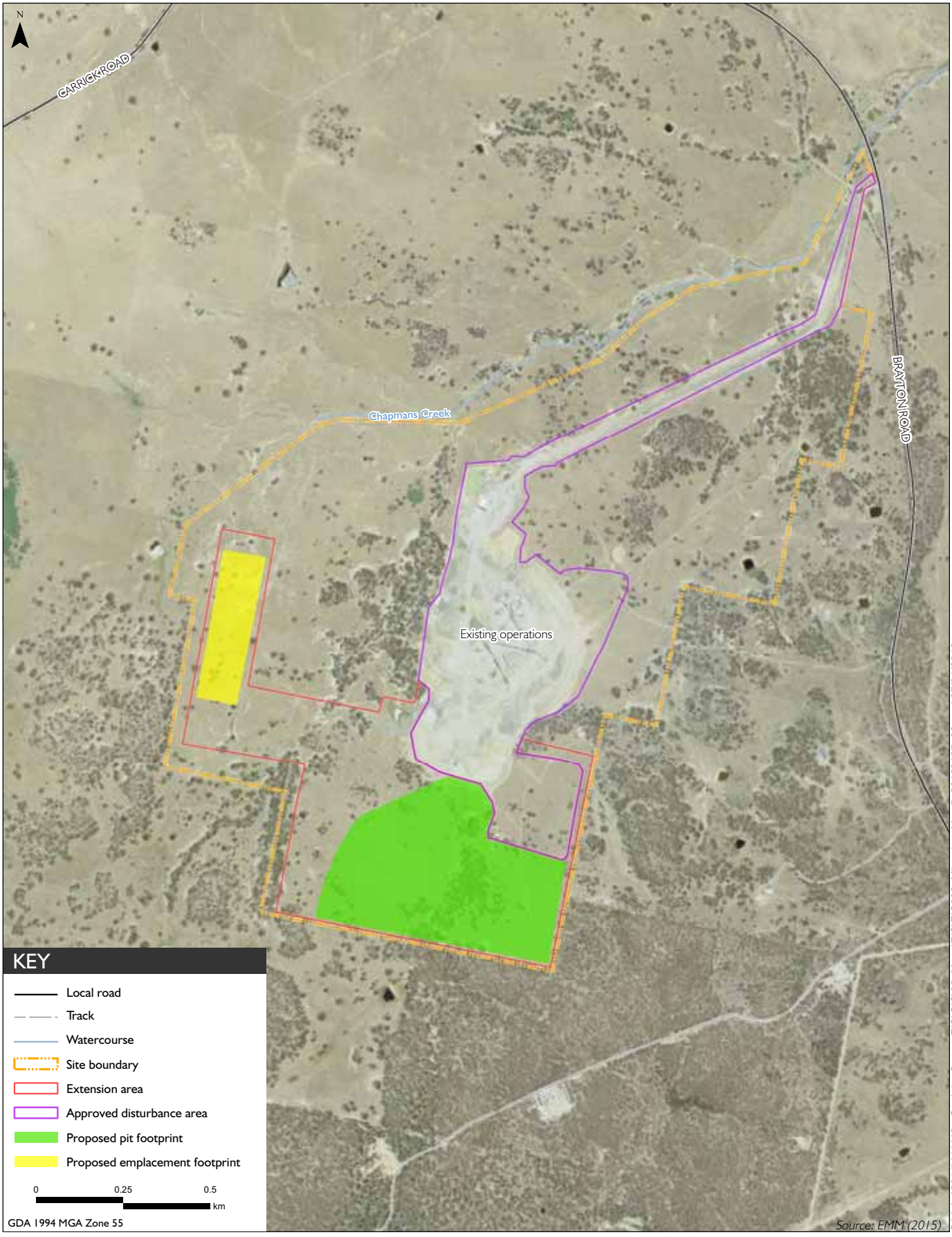
Indicative pit layout - Year 1

Gunlake Quarry
Environmental Impact Statement

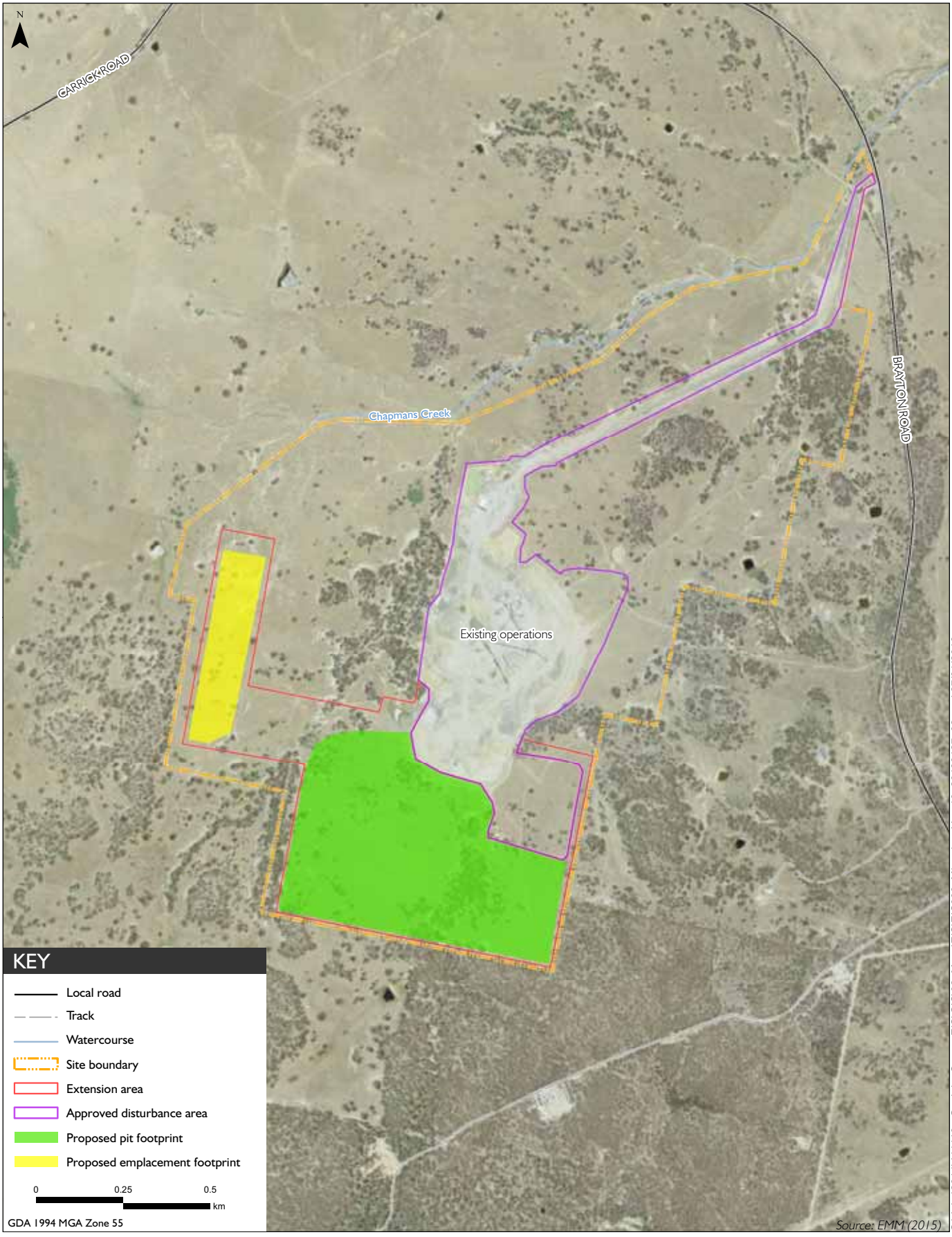
Figure 3.1



Indicative pit layout - Year 5

Gunlake Quarry
Environmental Impact Statement

Figure 3.2



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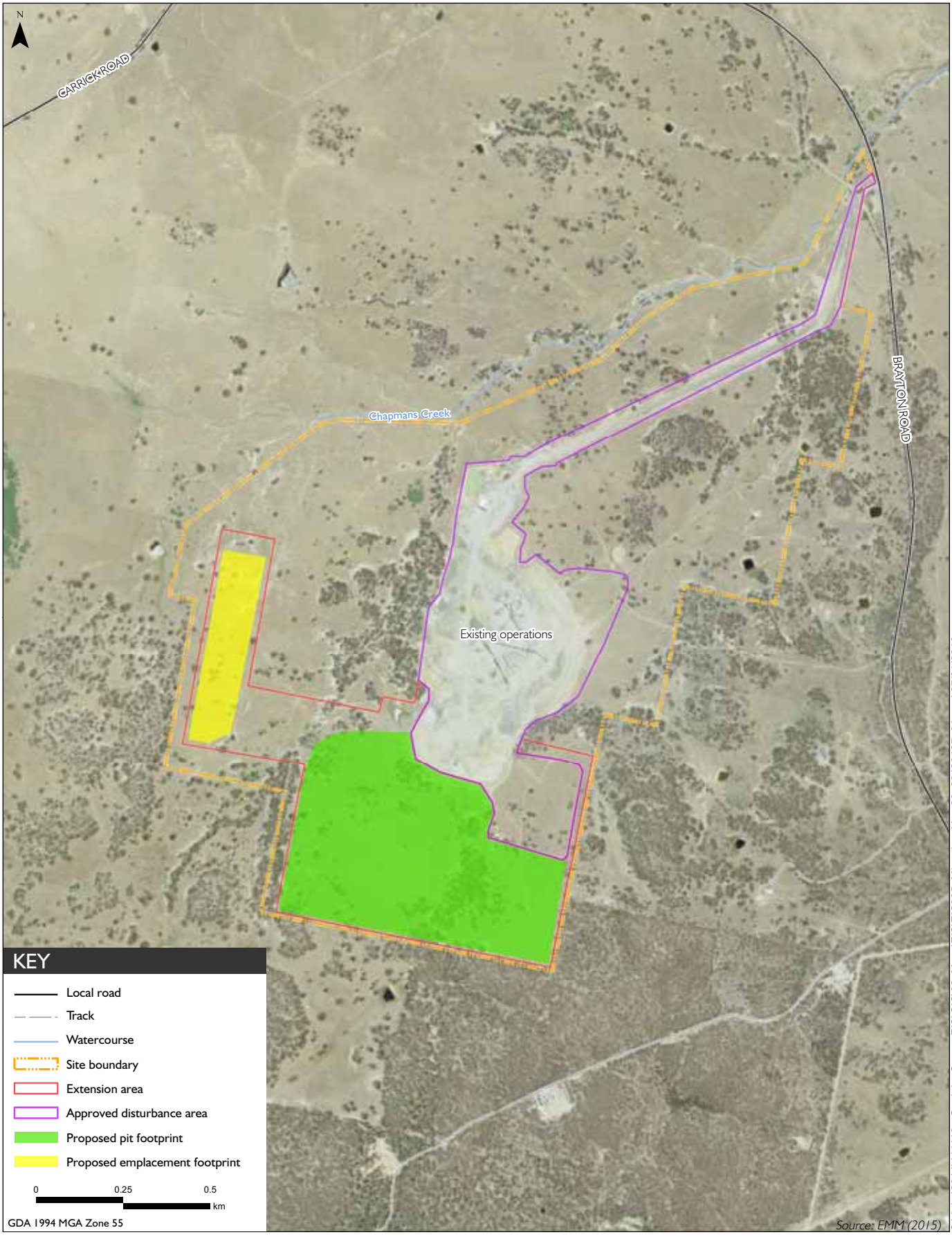
Indicative pit layout - Year 10

Gunlake Quarry
Environmental Impact Statement

Figure 3.3



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Indicative pit layout - Year 20

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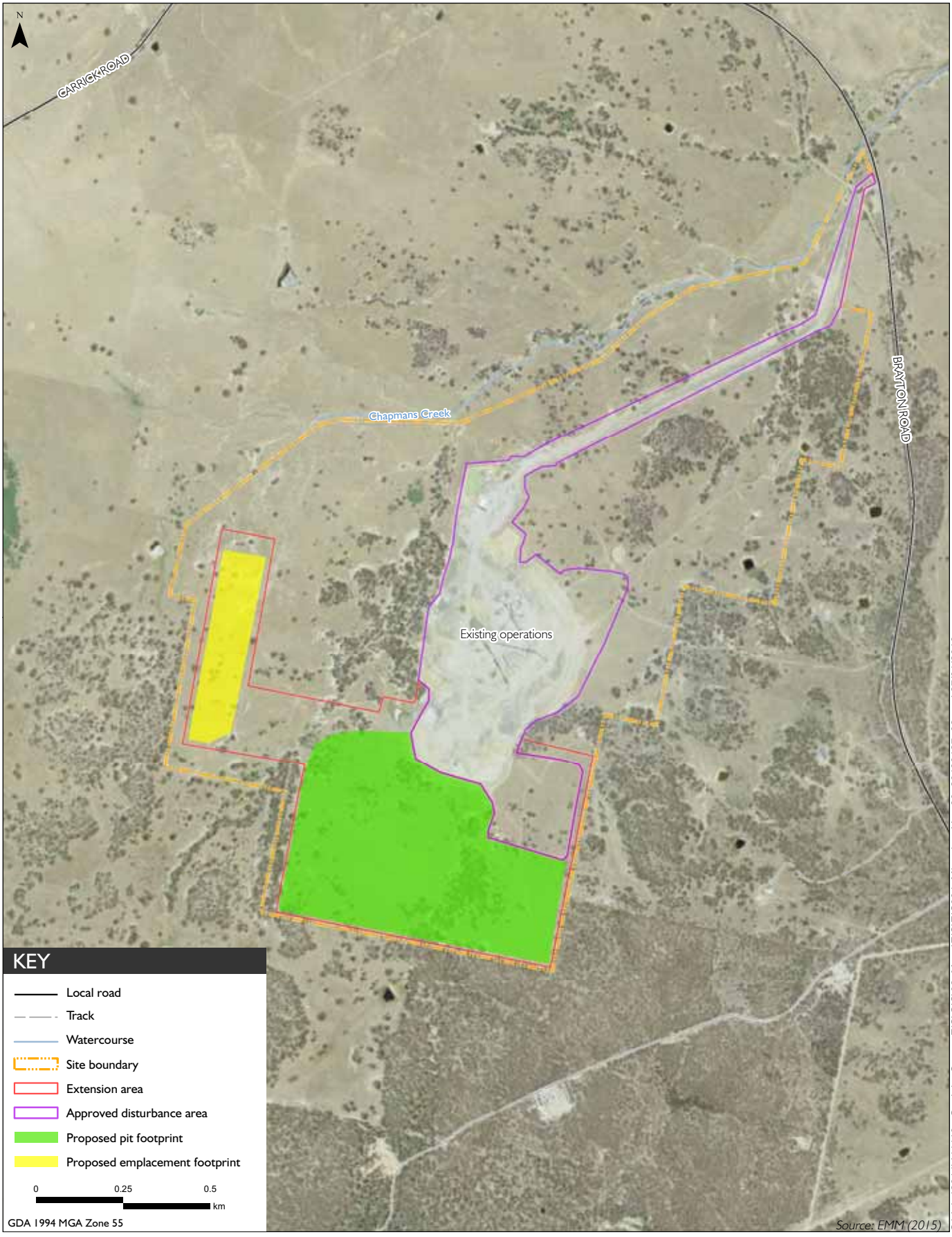
Environmental Impact Statement

Figure 3.4



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Indicative pit layout - Year 30

Gunlake Quarry
Environmental Impact Statement

Figure 3.5

3.4 Product transport

3.4.1 Transport options

The feasibility of a range of road and rail transport options were considered as summarised in Section 3.10.2 and discussed in detail in Appendix D. It was determined that the continuing use of trucks on the primary and secondary haul routes was the most economically feasible and is likely to result in the least environmental impacts of the options considered.

3.4.2 Transport routes

It is proposed to continue to use the same primary and secondary haul routes as are currently used.

The development proposes to increase the number of truck movements to an average of 440 movements per day, with a maximum of 690 movements per day. All of the additional trucks will travel on the primary haul route. Truck numbers will gradually increase over 5 to 10 years and Johnniefelds Quarry will be shut before full production (2 Mtpa) is reached at Gunlake Quarry.

It is not proposed to increase the number of trucks using the secondary haul route. Therefore, about 94% of truck movements will be along the primary haul route (Brayton Road/Bypass Road/Red Hills Road) and less than 6% of truck movements will be along the secondary haul route through Marulan.

Trucks will continue to be restricted to travelling 80 km/h between the quarry and the Hume Highway.

3.4.3 Road upgrades

The traffic assessment (Appendix J) found that the primary haul route roads are generally suitable for the proposed increased in truck numbers. However, the assessment found that a northbound acceleration and merging lane on the Hume Highway, approximately 500 m long including taper, at the Red Hills Road intersection would reduce the future Red Hills Road traffic delays at the intersection and eliminate any potential traffic safety related concerns. From the traffic capacity and Level of Service analysis, the additional intersection acceleration and merging lane would not be required until approximately 2025.

The contributions rate is currently paid at $0.0313 per kilometre per tonne of product transported by the project on all council roads plus the material public benefit recognised as a result of the Bypass Road.

Gunlake's Section 94 contributions to the Council are based on dollars per kilometre per tonne of product transported by the project on all council roads ($0.0313 $/km/tonne) so will increase in proportion to the amount of resource extracted and sold as product. Over the life of the extension project, these contributions will be approximately $19 million. It is estimated that the Council's cost to repair, maintain and rebuild the haul route roads over this time will be about $12 million (based on Council calculations). Therefore there will be sufficient Council funds to maintain and repair the haul route roads and an excess contribution of about $7 million.

3.5 Rehabilitation and closure

As described in Section 2.8, Gunlake will continue to rehabilitate progressively where possible. This EIS describes final rehabilitation and closure of the quarry once the extension project is complete (see Chapter 6).

3.6 Site infrastructure and services

No changes to the site infrastructure and services described in Section 2.3 are proposed, with the following exceptions.

3.6.1 Water supply

The quarry's process water requirements will be primarily met by the water management dams (see Section 7.3.2) although an external water source may be used if required due to abnormally dry conditions.

The quarry surface water management system will be upgraded as described in Section 7.3.1.

3.6.2 Electricity

Electricity will continue to be supplied from the state supply grid. Annual electricity consumption at a peak annual production of 2 Mtpa will be approximately 160 kWh per month.

3.6.3 Fuel

No changes to fuel storage are proposed.

3.7 Waste management

No changes to the waste management measures described in Section 2.10 are proposed.

3.8 Hours of operation

The proposed hours of operation for the extension project vary according to the activity being undertaken, as listed in Table 3.3.

Table 3.3 Proposed hours of operation

Activity	Day	Time
Overburden removal and drilling	Monday to Saturday	7 am to 6 pm
	Sundays and public holidays	None
Blasting	Monday to Friday	9 am to 5 pm
	Sundays and public holidays	None
Quarrying and processing (including tertiary crushing)	Monday to Saturday	7 am to 6 pm
	Sundays and public holidays	None
Loading and dispatch	Monday to Saturday	24-hours except 6 pm Saturday to 2 am Monday
	Sundays and public holidays	None
Product transportation – Bypass Road/Redhills Road	Monday to Saturday	24-hours except 6 pm Saturday to 2 am Monday
	Sundays and public holidays	None
Product transportation – Brayton Road to Marulan	Monday to Saturday	6 am to 7 pm
	Sundays and public holidays	None
Maintenance	Monday to Saturday	Anytime
	Sundays and public holidays	Anytime

3.9 Operational workforce

It is proposed to increase the workforce by approximately 7 on-site site employees and 20 truck drivers to 77 employees (including trucking contractors) in total.

3.10 Alternatives considered

The project design described above incorporated consideration of the following constraints:

- physical, such as the location of the hard rock resource, the location of the existing quarry elements and the quarry site topography;
- environmental, such as ecological and Aboriginal heritage sensitivities;
- social, such as the potential impacts on nearby residents; and
- economic, such as constraints on economic extraction and transport of the hard rock.

This section describes the alternatives that were considered, rejected or accepted during this process.

Quarrying cannot readily completely avoid impacts that are related to the disturbance of particular areas (eg native significant vegetation or areas of Aboriginal heritage significance), particularly areas above the resource to be quarried. However, potential impacts of the extension project have been avoided, where possible, as part of the quarry design process. The alternative quarry pit and emplacement footprints considered are described below. The upgraded infrastructure required will be within with existing infrastructure area and no alternative locations were considered.

3.10.1 Project footprint

A range of environmental factors were considered in the design of the extension project footprint. These are described below and illustrated in Figure 3.6.

i Overall footprint

The project footprint originally proposed (EMM 2015a) required the removal of an additional 65.1 ha of native vegetation, which included 10.8 ha of Box Gum Woodland (White Box Yellow Box Blakely's Red Gum Woodland EEC (*Threatened Species Conservation Act 1995* listing)/White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grasslands (EPBC Act listing). The revised project footprint presented in this EIS will require clearing of 54.1 ha native vegetation (12.2 ha of remnant woodland vegetation and 41.9 ha of native grassland). This represents a reduction in biodiversity impacts of approximately 17%. The proposed project footprint also minimises clearing of Box Gum Woodland to 8.4 ha, reducing impacts to the Box Gum Woodland by approximately 22%.

ii Pit layout

The main economic consideration regarding the extent of the pit is the location of the hard rock resource. The preliminary pit design considered a range of alternative layouts to maximise the hard rock resource available for extraction. The alternative pit layouts considered included:

- Extend the pit to the west of the current pit: this would require the removal of a section of the Chapmans Creek and surrounding vegetation (Box Gum Woodland). This is not proposed.

Generally there are two alternatives for overburden storage: the material may be placed back into the pit or in an out-of-pit emplacement. Returning the overburden to the pit sterilises the resource beneath the material returned to the pit.

At Gunlake Quarry, the full horizontal extent of each bench will be developed prior to starting to develop the next bench. This provides a working area on the extracted bench which will progress horizontally as the bench is developed. The pit access ramp running directly to the bench with the working area. This is a far simpler and safer operating method than extracting the resource from multiple benches simultaneously.

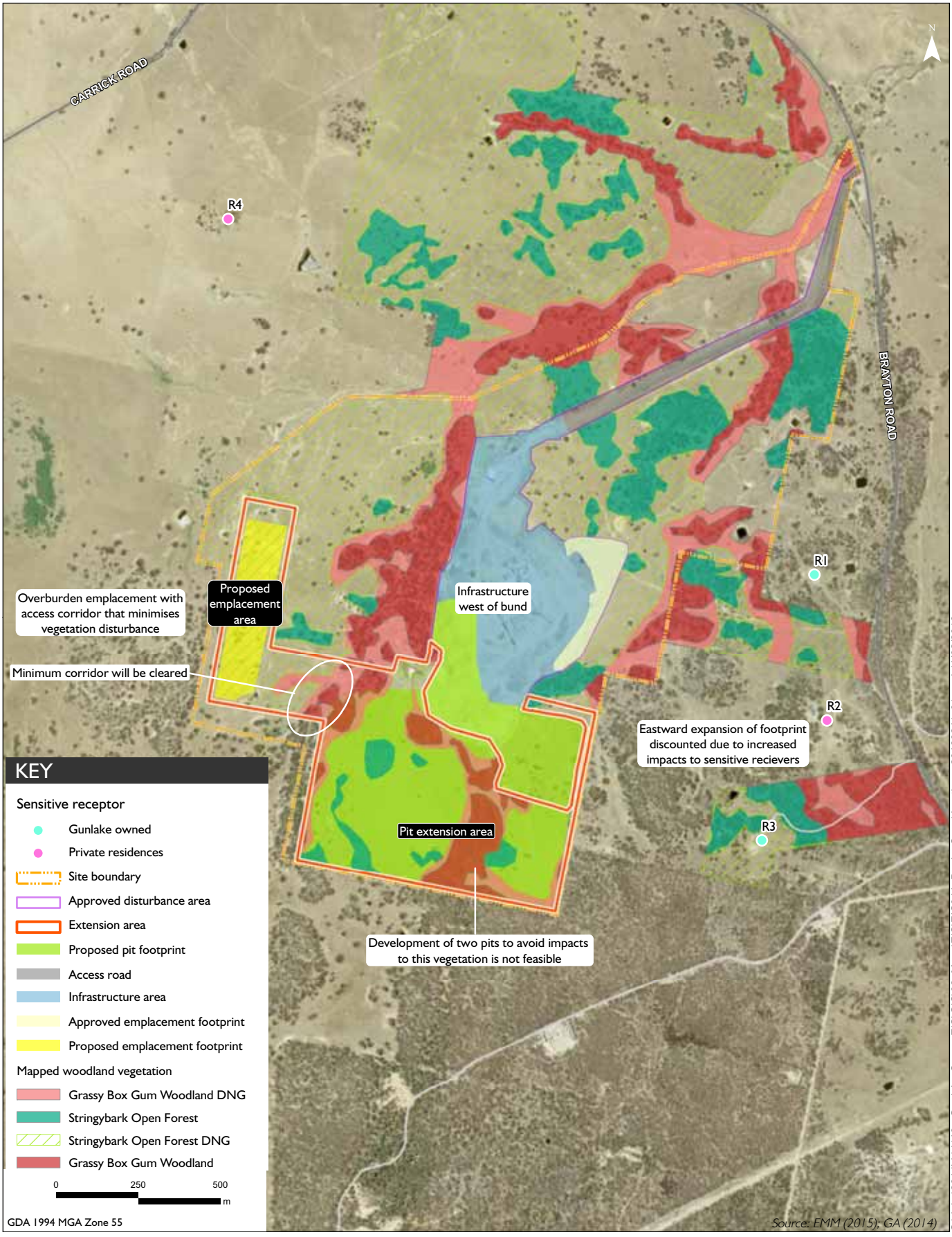
This application seeks approval to extract seven benches, although there is sufficient resource to deepen the pit further after the proposed 30 years project life, subject to approval. However, assuming that the quarry closes after completing the seventh bench, this bench will need to be extracted before overburden can be placed in the pit in about Year 25. If in-pit storage was pursued, overburden would need to be stored out-of-pit until in-pit emplacement was available. This would result in the same impacts as described for the proposed permanent emplacement. However after about 25 years, the well established vegetation on the overburden emplacement would need to be cleared, the material moved to the pit and the cleared emplacement area rehabilitated. In-pit emplacement would sterilise the resource below the seventh bench. In-pit placement of reject material is therefore not proposed.

b. Emplacement location

Unlike the location of the resource which is fixed, the location of overburden emplacements have greater flexibility. The approved overburden emplacement bund east of the infrastructure area will not be able to accommodate all of the overburden from the extended pit area because it is already at its maximum height and there is vegetation to the north and the south. Further, it would be uneconomic to haul overburden from the southern part of the pit to the emplacement north of the pit. Overburden emplacement to the south-west of the current pit was considered and will not significantly increase noise and dust impacts west of the quarry (see Section 11.3 and 12.3). Access to this area would be by a corridor, of the minimum required width, through existing vegetation.

There are two main potential environment constraints in the proposed overburden emplacement area: Aboriginal heritage (with a higher value towards the north of the overburden emplacement area) and biodiversity (with a higher value towards the south of the overburden emplacement area closer to Chapmans Creek).

The emplacement footprint covers, and will destroy, Aboriginal heritage sites GL14a, b, c and d (sites of moderate significance). However, the test excavation program at these sites did not recover significant subsurface archaeological deposits that would have warranted conservation. The emplacement could be located further south to avoid these sites but would need to extend into the Chapmans Creek and the riparian corridor to provide an area sufficient to store the projected overburden volume. This would impacting water flow (when the creek is flowing) and require clearing of a greater portion of the vegetation in this area than for the haul road alone. The emplacement could also impact water flow (when the creek is flowing). The impacts to Aboriginal heritage can be mitigated through the implementation of a Aboriginal heritage surface salvage collection program (see Section 13.4), while the impacts to biodiversity and the creek are harder to mitigate. Therefore, it is proposed to construct the emplacement in the northern section of the overburden emplacement area.



Project footprint design considerations

Gunlake Quarry
Environmental Impact Assessment

Figure 3.6

- Extend the pit to the north of the current pit: this would require relocating the infrastructure area which is currently visually and acoustically shielded from residences to the east of the quarry by the approved, and partly constructed overburden emplacement bund. The relocated infrastructure area would most likely need to be placed in a currently undisturbed area. Extracting the resource in this area is not currently economically viable. This is not proposed.

- Extend the approved pit to the east north-east of the approved pit: this is not currently economically viable, hence the selection of this area for the current overburden emplacement.

- Extend the approved pit to the east or south-east: this would extend the pit beyond the current site boundary onto land not owned by Gunlake. This would require the removal of part of the ridge along the eastern site boundary. This ridge prevents views to the quarry from Brayton Road and shields residences to the east of the quarry from project noise. There is generally more native vegetation east of the site boundary than within the quarry site so biodiversity impacts would be greater than for the proposed pit layout. This is not proposed.

- Extend the proposed pit further to the south: this would extend the pit beyond the current site boundary and would be on land that is not owned by Gunlake. Gunlake would therefore need to purchase the land. There is generally more native vegetation south of the site boundary than within the quarry site so biodiversity impacts would be greater than for the proposed pit layout. This is not proposed.

- Extend the proposed pit further to the west: this would require the removal of a section of the Chapmans Creek and more clearing of the Box Gum beside the creek. This is not proposed (the proposed layout will require a haul road through this area but the corridor requiring clearing will be minimised).

iii Dual pit configuration

It is proposed that the currently approved pit footprint is extended to the south. This extension will result in the clearance of an area of approximately 15.4 ha of Box Gum Woodland EEC, comprising 8.4 ha of woodland vegetation and 7 ha of derived native grassland. Avoiding this area of Box Gum Woodland EEC by adopting a dual pit layout for the southern extension area was considered during the design process and was discounted for the following reasons:

- a dual pit layout with batter heights of approximately 13 m would result in considerably reduced bench areas and, as a result, the sterilisation of approximately 39 Mt of hard rock resource; and

- it is unlikely that the remaining 'finger' of vegetation between the two pits would be ecologically viable as water in the soils would flow away from vegetation and into the dual pits.

Therefore, a single pit extension is proposed.

iv Overburden emplacement

a. In-pit and out-of-pit emplacement

As described in Section 3.3.1, the pit will expand laterally to the west during the first five years of development to reach its full horizontal extent. This will require the removal of approximately 500,000 m^3 of overburden. The pit will then be developed in a series of seven benches to reach a maximum depth of approximately 91 m BGL.

v Final void

At the end of the proposed quarry life the vast majority of material extracted from the pit (ie all material other than the overburden) will have been taken from the site as quarry product. At this stage, the quarry pit floor will about 572 m AHD (about 91 m below ground level). It is predicted that a lake will form in the pit (see Section 7.3.2). The surface of the lake will be at about 599 to 606 m AHD, approximately 40 to 45 m above the pit floor (see Section 7.3.2). The equilibrium level of the lake is predicted to be at least 35 m below the final void spill point (estimated to be between 640 and 650 m AHD), indicating that the final void lake is unlikely to ever spill to receiving waters.

The following alternatives to prevent the formation of a pit lake have been considered:

- In-pit placement of reject material: if all of established vegetation on the two emplacements was cleared and all of the material in the emplacements was moved to the completed pit, the base of the pit would be raised by about 2 m. This would be well below the water level and would have no benefit.

- Restrict the quarry depth: if the quarry depth was restricted to the top of the water table (about 640 m AHD), a lake would not form. This would require that the quarry stopped at the second or third bench and would sterilise the resource below this level. The material would need to be extracted from another quarry to meet the market need for aggregate material.

- Fill the void with other material: this would require a large source of material either as a by-product of another process (eg a very large construction project) or with material excavated specifically to fill the void. It is highly unlikely that there will be a need to dispose of large material volumes around the same time of the quarry closes. Extracting material from another location to fill the void would cause the environmental impacts generally associated with quarrying at the extraction location and would result in worse overall environmental outcomes.

The formation of a void lake is an inevitable consequence of the extraction of the resource over 30 years and appropriate management measures will be incorporated into the final landform to prevent access to the lake and ensure that the void is safe (see Section 6.4.4). The only alternative is to severely restrict the resource development which is effectively a ‘no project’ alternative.

3.10.2 Product transport

The feasibility of quarry products transport alternatives was reviewed in response to Council and community concerns regarding the increased truck movements on the primary haul route (Appendix J). A range of potential road and rail transport options for the transport of quarry products to customers in the Sydney region were considered.

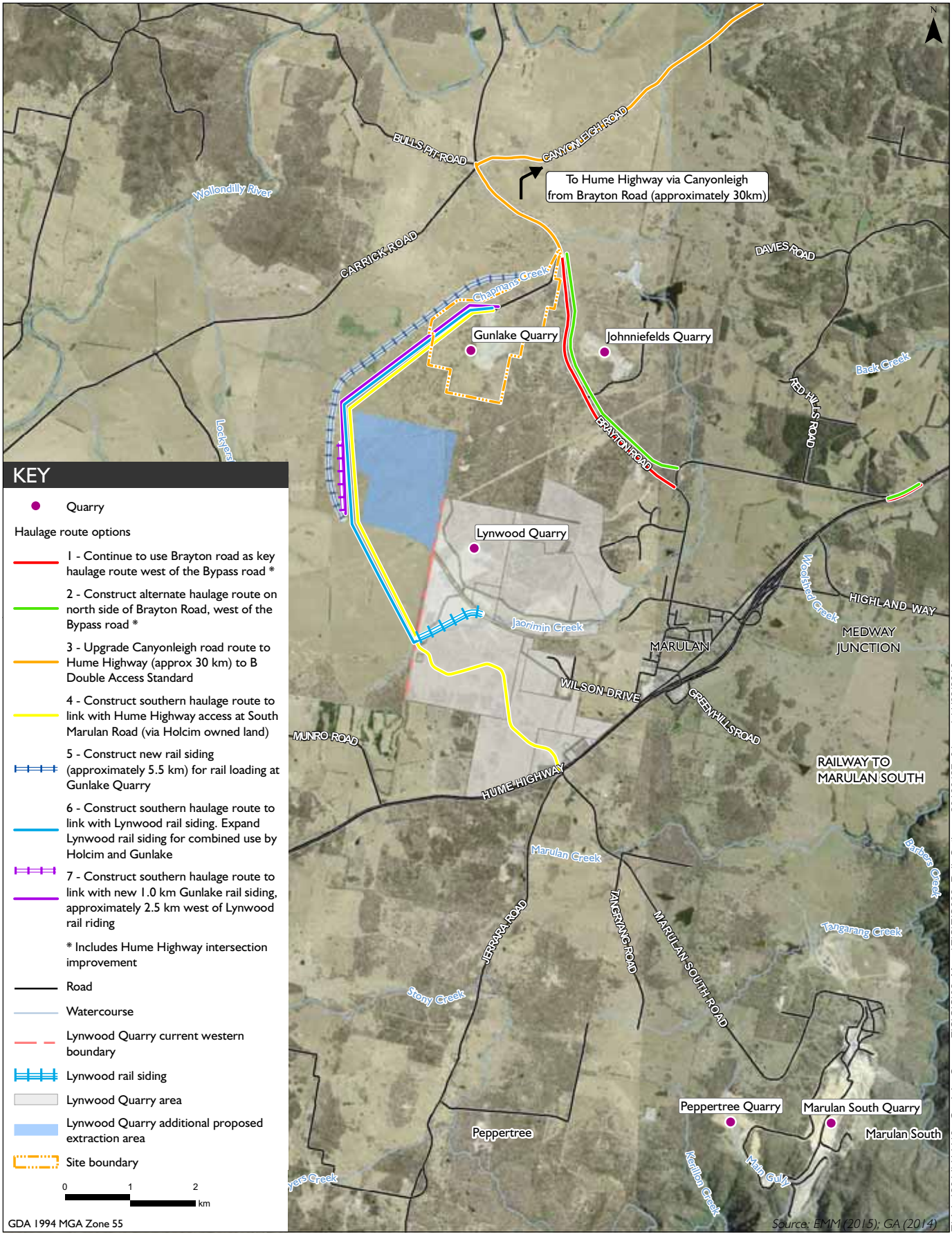
The road and road/rail options considered are listed in Table 3.4 which includes the likely capital costs and resulting transport, economic and environmental implications of each of the options. The local road and road/rail options are shown in Figure 3.7.

Table 3.4 Comparison of transport options

Option	Type	Option description	Likely capital cost range ($ million)	Mid-range capital cost estimate ($ million)	Key environmental and other considerations
1	Road only	Continuing to use Brayton Road as the key haulage route, west of the Bypass Road, including road shoulder widening and a northbound acceleration lane at the Red Hills Road (Bypass Road) Hume Highway access intersection.	$3 to $6	$4.5	Amenity and traffic noise impacts, particularly along the sections of Brayton Road, Bypass Road and Red Hills Road used by haul trucks. See Chapters 10 and 11.
2	Road only	Construct an alternative dedicated haulage route (4 km) on the east side of Brayton Road, north of the Bypass Road, including land acquisition costs and a northbound acceleration lane at the Red Hills Road (Bypass Road) Hume Highway access intersection.	$10 to $20	$15	Amenity and traffic related noise impacts, particularly along the private haul road sections and the sections of Brayton Road, Bypass Road and Red Hills Road used by haul trucks. Will require property acquisitions with associated local socio-economic impacts. Significant vegetation clearance (probably more than at the quarry site) would be required to clear the new road corridor to construct the dedicated haul route. Such vegetation clearance has the potential to generate impacts on biodiversity and Aboriginal heritage items and generate noise, dust, soil disturbance and erosion impacts during construction.
3	Road only	Upgrading the Canyonleigh Road route from Brayton Road to the Hume Highway (approximately 30 km) to B Double access standard as an alternative haulage route to Brayton Road and the Bypass Road.	$30 to $60	$45	Potential safety, amenity and traffic noise impacts along the section of Canyonleigh Road that would be used by haul trucks. There are more houses along this 30 km long road than along the Brayton Road/Bypass Road/Redhills Road route. Necessary road widening would cause significant road-side vegetation loss along the route, resulting in a loss of biodiversity, potential Aboriginal heritage impacts and cause soil disturbance and erosion.
4	Road only	Construct a new southern haulage route (7 km long including bridge) to link with the Hume Highway access at South Marulan Road, part of the route of which would travel via Holcim (Australia) owned land, south of the Lynwood quarry, including a new two lane road bridge crossing the main southern railway line.	$13.5 to $17	$15	New traffic noise and amenity impacts for the areas to the west of the quarry from operation of the quarry haul trucks using the new haulage route. Substantial land clearing would be required to establish a new road corridor resulting in potential impacts to biodiversity impacts and Aboriginal heritage sites along the new 7 km haulage route. An appropriate payment to Holcim (Australia) for the use of their South Marulan access road to the Hume Highway would need to be negotiated.

Table 3.4 Comparison of transport options

Option	Type	Option description	Likely capital cost range ($ million)	Mid-range capital cost estimate ($ million)	Key environmental and other considerations
5	Rail/road	Construct a new rail spur, approximately 5.5 km long for direct rail loading at the quarry. A new intermodal rail receival and distribution facility in Sydney would also be required.	$80 to $160	$120	Rail noise and amenity impacts to residential properties in areas to the west of the quarry. Potential biodiversity and Aboriginal heritage impacts along the new 5.5 km long rail spur corridor. Traffic, noise and dust impacts in the area within Sydney surrounding the intermodal-facility.
6	Rail/road	Construct a new southern haulage route (7 km including bridge) to link with the Lynwood Rail Siding and expand the capacity of the Lynwood Rail siding with an additional 1 km of rail track and loading facilities. A new intermodal rail receival and distribution facility in Sydney would also be required.	$43.5 to $77	$60	Haul road traffic noise, amenity and dust impacts in the areas to the west of the quarry. Potential biodiversity and Aboriginal heritage impacts along the new 7 km long haulage route. Visual impacts from a new road bridge over the Main Southern railway line. Traffic, noise and dust impacts in the area within Sydney surrounding the intermodal facility. Would require consent from Holcim (Australia), the owner of the Lynwood Quarry Rail Siding.
7	Rail/road	Construct a new southern haulage route (5 km long) to link with a new dual track Gunlake rail siding located on the north side of the rail line, approximately 2.5 km west of the Lynwood Rail siding. A new intermodal rail receival and distribution facility in Sydney would also be required.	$42.5 to $85	$64	Road and rail noise and dust impacts in the areas to the west of the quarry from the operation of the haul road and the loading of trains at the siding. Potential biodiversity and Aboriginal heritage impacts caused by clearing along the new 5.5 km long haul road and the rail siding facility. Potential soil disturbance and erosion impacts during land clearance. Traffic, noise and dust impacts in the area within Sydney surrounding the intermodal facility.



Road and rail transport options

Gunlake Quarry
Environmental Impact Statement
Figure 3.7

An economic analysis of the three rail/road options was undertaken to determine whether they are economically feasible (ie have a benefit:cost ratio greater than 1:1). As shown in Table 3.5, none of the rail/road transport options are considered economically efficient, even at the lowest range potential capital cost estimates.

Table 3.5 Preliminary economic feasibility analysis of rail transport options

Transport option	30 year total discounted benefits	Estimated project capital cost[1] (undiscounted $million)			Project benefit to cost ratio (for capital cost estimate)		
	$million	Low estimate	Medium estimate	High estimate	Low project capital cost	Medium project capital cost	High project capital cost
5	58.92	75.5	115.5	155.5	0.78	0.51	0.38
6	32.73	39.0	55.5	72.5	0.84	0.59	0.45
7	32.73	38.0	59.5	80.5	0.86	0.55	0.41

Note: 1. *The mid range cost estimate for the do minimum option (Option 1) has been subtracted from these costs.*

In addition to economic and financial feasibility constraints, there are extensive unresolved technical and design issues relating to the potential route alignment for the potential full length rail siding option for direct product loading at the quarry (Option 5) and identifying a suitable Sydney site for a Gunlake intermodal facility, together with securing an appropriate option to purchase and/or develop the site. There are also rail network capacity issues on the Main Southern Railway line and on other lines within the Sydney Metropolitan area and these are likely to increase. These constraints would also need to be further investigated and resolved prior to undertaking any further technical feasibility assessment of the project rail access options, although this preliminary analysis indicates that this not warranted.

Of the transport options considered, the road-only options have a much lower capital cost than the rail/road options. Environmental impacts within the locality are comparable between the options with the exception of Option 1 (the ongoing use of the primary haul route). With the exception of Option 1, Options 2 to 7 would require construction on land that would be otherwise undisturbed. This would result in additional impacts to biodiversity or Aboriginal heritage. The operation of Options 2 to 7 would also result in noise or air quality impacts in areas that are not currently impacted by the quarry (and would not be impacted by the extension project). The road/rail options would result in impacts in the vicinity of the intermodal facility in Sydney.

Option 1 is proposed, ie to continue to transport quarry products by road using the primary haulage route (where truck volumes will increase) and the secondary haulage route (where truck volumes will be unchanged).

3.10.3 No project alternative

The alternative to developing the project is for other quarry companies to supply additional hard rock to the construction market from existing quarries or from newly developed quarries.

Although there are significant areas of identified hard rock resources across NSW, including the Marulan area, it is important to consider the feasibility of quarrying these resources. There are many factors which determine the ability to quarry a hard rock resource including the volume of the resource present in the ground, environmental and financial constraints, availability of human and physical infrastructure and regulatory conditions. All of these factors are important in determining whether a hard rock reserve can be developed. Therefore, the volume of hard rock available to society is much smaller than the actual resources present.

The proposal is for the extension of an existing quarry. Therefore, the feasibility of quarrying the hard rock resource at Gunlake has already been proven. Continuation of the existing quarry is likely to result in better environmental outcomes than the development of a new quarry. In addition, the extension project will utilise existing infrastructure and so will involve less capital investment. The expansion of the quarry will also provide ongoing long-term employment to quarry employees and new employment positions.

Not proceeding with the extension project would result in an identified market opportunity not being met, or more likely, being met by another source. The hard rock resource available at the site would not be extracted, which would be contrary to the NSW State Government's objective to maximise rock resource utilisation in the Marulan area. This may also result in supply pressures in the Sydney region if hard rock cannot be sourced locally and economically. The jobs that the project would create would not eventuate, nor would the direct and indirect impacts of increased local spending associated with the job creation. The incremental environmental impacts of the extension project would not occur in the project area. However, there would be impacts at other sources of the hard rock required for the local and greater Sydney markets.

This EIS demonstrates that benefits of proceeding with the project will outweigh the potential impacts on the environment that may result.

4 Planning and statutory framework

4.1 NSW legislation

4.1.1 Environmental Planning and Assessment Act 1979

The EP&A Act defines the statutory framework for planning approval and environmental assessment in NSW. The EP&A Act is administered by the Minister for Planning, statutory authorities and local councils. An assessment of the proposal against the objects of the EP&A Act is given in Section 18.2.

The proposal is a State significant development (SSD) under the State Environmental Planning Policy (State and Regional Development) 2011 (SRD SEPP). Division 4.1 of Part 4 of the EP&A Act relates to the assessment of SSD. Applications made under Division 4.1 are required by Section 89H to take into consideration the relevant matters referred to in Section 79C of the Act which include:

(a) the provisions of:

(i) any environmental planning instrument, and

(ii) any proposed instrument that is or has been the subject of public consultation under this Act and that has been notified to the consent authority (unless the Secretary has notified the consent authority that the making of the proposed instrument has been deferred indefinitely or has not been approved),

(iii) any development control plan, and

(iv) any planning agreement that has been entered into under section 93F, or any draft planning agreement that a developer has offered to enter into under section 93F, and

(v) the regulations (to the extent that they prescribe matters for the purposes of this paragraph), and

(vi) any coastal zone management plan (within the meaning of the Coastal Protection Act 1979),

that apply to the land to which the development application relates,

(b) the likely impacts of that development, including environmental impacts on both the natural and built environments, and social and economic impacts in the locality,

(c) the suitability of the site for the development,

(d) any submissions made in accordance with this Act or the regulations,

(e) the public interest.

The above matters are considered below and throughout the EIS. However, Clause 11 of the SRD SEPP states that development control plans do not apply to SSD and, therefore, the Goulburn Mulwaree Development Control Plan 2009 has not been considered specifically.

A development application for a SSD must be accompanied by an EIS, prepared in accordance with the SEARs and Schedule 2 of the Environmental Planning and Assessment Regulation 2000. The Schedule 2 requirements, and where they are addressed in the EIS, are set out in Table 4.1.

Table 4.1 Schedule 2 requirements for an EIS

Requirement	Where contained in the EIS
Name, address and professional qualifications of the person(s) who prepared the EIS	Certification page
Name and address of the responsible person (the applicant)	Certification page
Address of land	Section 1.2
Description of development	Section 1.4 Chapter 3
Assessment of the environmental impact	Chapters 6 to 16
Declaration that the EIS has been prepared in accordance with this Schedule, contains all available information that is relevant to the environmental assessment of the development and that the information contained in the statement is neither false nor misleading	Certification page
Summary of the EIS	Executive summary
A statement of the objectives of the development	Section 2.12.1
An analysis of feasible alternatives, having regard to its objectives, including the consequences of not carrying out the development	Section 3.10
A full description of the development	Chapter 3
A general description of the environment likely to be affected by the development	Chapters 6 to 16
The likely impact on the environment of the development	Chapters 6 to 16
A full description of the measures proposed to mitigate any adverse effects of the development	Chapters 6 to 16
A list of any approvals that must be obtained under any other Act or law before the development, activity or infrastructure may lawfully be carried out	Sections 4.2 and 4.5
A compilation of the measures proposed to mitigate any adverse effects of the development	Chapters 6 to 16
The reasons justifying the carrying out of the development, activity or infrastructure in the manner proposed, having regard to biophysical, economic and social considerations, including the principles of ecologically sustainable development	Chapter 18

4.1.2 Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act 1997* (POEO Act) is the principle NSW environmental protection legislation. It is administered by the Environment Protection Authority (EPA). The POEO Act requires that scheduled activities, which are defined in Schedule 1 of the Act, operate under an Environment Protection Licence (EPL). Gunlake Quarry meets the requirements of a scheduled activity under Schedule 1 as it is a land-based extractive industry that extracts, processes or stores more than 30,000 tpa. Gunlake Quarry currently holds EPL 13012. The license authorises the carrying out of extracting, processing or storing up to 750,000 tpa of quarry material per year.

EPL 13012 will need to be amended to reflect the increase in annual production at the quarry. If project approval is granted under the EP&A Act, the EPL cannot be refused and must be substantially consistent with the project approval (Section 89K of the EP&A Act).

4.1.3 Water Act 1912 and Water Management Act 2000

The *Water Act 1912* (Water Act) and *Water Management Act 2000* (WM Act) provide for the management of groundwater and surface water resources in NSW. The WM Act applies to licences to use water once a water sharing plan for that water source has commenced. Alternatively, in those water sources where a water sharing plan has not yet commenced, the Water Act applies. Both the Water Act and the WM Act regulate water via granting of licences/approvals for taking and using water, and trading of both groundwater and surface water.

The Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources 2011 (Surface Water WSP) and the Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011 (Groundwater WSP) manage the water resources in the Gunlake area under the WM Act.

Under Section 89J of the EP&A Act, the following authorisations under the WM Act are not required for SSD:

- a water use approval under Section 89;
- a water management work approval under Section 90; or
- an activity approval (other than an aquifer interference approval) under Section 91.

A water access licence under the WM Act will be required for the interception of up to 37 ML per year from the Goulburn Fractured Rock Groundwater Source.

The licensing of monitoring bores continues to be regulated under the Water Act. Gunlake Quarry's monitoring bores will be licensed under the Water Act.

4.1.4 Threatened Species Conservation Act 1995

The *Threatened Species Conservation Act 1995* (TSC Act) aims to conserve biological diversity in NSW through the protection of threatened and endangered flora and fauna species and ecological communities. The extension project requires an increase in the area of disturbance for quarrying activities. This may impact upon threatened or endangered species. All potential impacts of the extension project on threatened species are assessed in the *Biodiversity Assessment* (Appendix I) and are summarised in Chapter 9.

4.1.5 National Parks and Wildlife Act 1974

The *National Parks and Wildlife Act 1974* (NPW Act) provides for nature conservation in NSW as well as the conservation of places, objects and features of significance to Aboriginal people. Under Section 90 of the NPW Act, a person must not harm or desecrate an Aboriginal object or place without an Aboriginal Heritage Impact Permit (AHIP).

The extension project will require an increase in the area of disturbance for quarrying activities. This may impact upon Aboriginal heritage items. However, an AHIP is not required for SSD (Section 89J of the EP&A Act). All potential impacts of the extension project on Aboriginal heritage are assessed in the *Aboriginal Cultural Heritage Assessment* (Appendix M) and are summarised in Chapter 13.

4.1.6 Native Vegetation Act 2003

The *Native Vegetation Act 2003* (NV Act) provides for the management of native vegetation in NSW by preventing broadscale clearing unless it improves or maintains environmental outcomes.

Section 12 of the NV Act states:

> Native vegetation must not be cleared except in accordance with:
>
> (a) a development consent granted in accordance with this Act, or
>
> (b) a property vegetation plan.

The proposal will increase the quarry footprint and will require some vegetation to be removed. However, an approval under Section 12 of the NV Act is not required for SSD (Section 89J of the EP&A Act).

4.1.7 Dams Safety Act 1978

The *Dams Safety Act 1978* (DS Act) requires that the NSW Dams Safety Committee (DSC) periodically review large dams that may constitute a hazard to human life and property. These dams are prescribed dams and are listed in Schedule 1 of the DS Act. At present, no dams at the quarry site are listed under Schedule 1 of the Act. The DS Act also requires any new prescribed dams be designed to the satisfaction of the DSC.

Consultation with the DSC will be undertaken as part of the approvals process to determine if any new dams will be prescribed dams under the DS Act.

4.1.8 Crown Lands Act 1989

The *Crown Lands Act 1989* provides for the management of Crown land in the eastern and central divisions of NSW. Crown land may not be sold, occupied, used, leased, dedication, reserved or otherwise dealt with unless given consent under the Crown Lands Act or the *Crown Land (Continued Tenures) Act 1989*.

The project area contains Crown roads that would be impacted by the proposal. Based on advice received from NSW Department of Primary Industries – Lands, Gunlake submitted an application on 3 March 2015 to close these Crown roads. If this process is not completed before the new application is made, consent from Crown Lands will be sought for the development of these areas as part of the application.

4.1.9 Roads Act 1993

The *Roads Act 1993* (Roads Act) regulates activities that may impact on public roads. Under the Roads Act, approval is required to carry out works in, or over, a public road and for works in a road reserve or that require the closure of roads.

Works associated with public roads or road reserves will require approval under the Roads Act.

4.2 NSW approvals required

In summary, the following approvals are required under NSW legislation:

- a development consent under Part 4, Division 4.1 of the EP&A Act;
- an amendment to EPL 13012 under the POEO Act to reflect the increase in extraction to 2 Mtpa and the project approval conditions;
- a water access licence under the WM Act for predicted take from the Goulburn Fractured Rock Groundwater Source; and
- approvals under Section 38 of the Roads Act for works associated with public roads or road reserves.

4.3 State Environmental Planning Policies

State Environmental Planning Policies (SEPPs) are environmental planning instruments that address planning issues significant to NSW. The following SEPPs have been considered in the assessment of the extension project:

- SRD SEPP;
- SEPP (Mining, Petroleum and Extractive Industries) 2007 (Extractive Industries SEPP);
- SEPP (Sydney Drinking Water Catchment) 2011 (SDWC SEPP);
- SEPP (Infrastructure) 2007 (Infrastructure SEPP);
- SEPP 33 – Offensive and Hazardous Development;
- SEPP 44 – Koala Habitat Protection; and
- SEPP 55 – Remediation of Land.

4.3.1 State Environmental Planning Policy (State and Regional Development) 2011

The SRD SEPP, amongst other matters, defines certain development as SSD. Clause 8 of the SRD SEPP states:

> (1) Development is declared to be State significant development for the purposes of the [EP&A] Act if:
>
> (a) the development on the land concerned is, by the operation of an environmental planning instrument, not permissible without development consent under Part 4 of the Act, and
>
> (b) the development is specified in Schedule 1 or 2.

The extension project is permissible with consent by virtue of the Extractive Industries SEPP (see Section 4.3.2) and Goulburn Mulwaree Local Environmental Plan 2009 (Goulburn Mulwaree LEP) (see Section 4.4.1).

Schedule 1 of the SRD SEPP defines a range of general SSDs, including extractive industries. Clause 7 (Extractive Industries) of Schedule 1 states:

(1) Development for the purpose of extractive industry that:

(a) extracts more than 500,000 tonnes of extractive materials per year, or

(b) extracts from a total resource (the subject of the development application) of more than 5 million tonnes, or

(c) extracts from an environmentally sensitive area of State significance.

The extension project will increase extraction to more than 500,000 tpa and, therefore, is development specified in Schedule 1.

The proposal meets both the requirements of clause 8 of the SRD SEPP and is therefore SSD. Development consent will be sought from the Minister for Planning.

4.3.2 State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007

The SEPP (Mining, Petroleum Production and Extractive Industries) 2007 (Extractive Industries SEPP) aims to provide for the proper management and development of mineral, petroleum and extractive material resources for the social and economic welfare of NSW. The policy establishes appropriate planning controls to encourage ecologically sustainable development. The proposal is consistent with the aims and controls of this policy (see Section 18.3).

The Extractive Industries SEPP also defines developments that are prohibited, exempt or complying developments. Clause 7(3)(a) permits the carrying out of an extractive industry with development consent on land on which development for the purposes of agriculture or industry may be carried out (with or without development consent). Development for the purpose of both agriculture and industry is permissible with consent on the quarry site under the provisions of the Goulburn Mulwaree LEP.

Part 3 of the Extractive Industries SEPP sets out a number of matters the consent authority must consider before determining a development application for the purposes of mining, petroleum production or extractive industry. Assessment of the proposal against the relevant matters has been undertaken as part of this EIS, as summarised in Table 4.2.

Table 4.2 Consideration of relevant Extractive Industries SEPP, Part 3 matters

Matter		Addressed in this EIS
12	**Compatibility of proposed mine, petroleum production or extractive industry with other land uses**	
Before determining an application for consent for development for the purposes of mining, petroleum production or extractive industry, the consent authority must:		-
(a)	consider:	-
	(i) the existing uses and approved uses of land in the vicinity of the development, and	Section 1.3 and Section 18.3
	(ii) whether or not the development is likely to have a significant impact on the uses that, in the opinion of the consent authority having regard to land use trends, are likely to be the preferred uses of land in the vicinity of the development, and	
	(iii) any ways in which the development may be incompatible with any of those existing, approved or likely preferred uses, and	
(b)	evaluate and compare the respective public benefits of the development and the land uses referred to in paragraph (a) (i) and (ii), and	Section 18.3
(c)	evaluate any measures proposed by the applicant to avoid or minimise any incompatibility, as referred to in paragraph (a) (iii).	Section 18.3
12A	**Consideration of voluntary land acquisition and mitigation policy**	
(2) Before determining an application for consent for State significant development for the purposes of mining, petroleum production or extractive industry, the consent authority must consider any applicable provisions of the voluntary land acquisition and mitigation policy and, in particular:		-
(a)	any applicable provisions of the policy for the mitigation or avoidance of noise or particulate matter impacts outside the land on which the development is to be carried out, and	Section 11.4(noise) Section 12.3.2 (air quality)
(b)	any applicable provisions of the policy relating to the developer making an offer to acquire land affected by those impacts.	Section 11.3.2 (noise)
(3) To avoid doubt, the obligations of a consent authority under this clause extend to any application to modify a development consent for State significant development for the purposes of mining, petroleum production or extractive industry.		Not applicable
(4) This clause extends to applications made, but not determined, before the commencement of this clause.		Not applicable
13	**Compatibility of proposed development with mining, petroleum production or extractive industry**[1]	
2) Before determining an application to which this clause applies, the consent authority must:		-
(a)	consider:	Section 1.3 and Section 18.3
	(i) the existing uses and approved uses of land in the vicinity of the development, and	
	(ii) whether or not the development is likely to have a significant impact on current or future extraction or recovery of minerals, petroleum or extractive materials (including by limiting access to, or impeding assessment of, those resources), and	
	(iii) any ways in which the development may be incompatible with any of those existing or approved uses or that current or future extraction or recovery, and	
(b)	evaluate and compare the respective public benefits of the development and the uses, extraction and recovery referred to in paragraph (a) (i) and (ii), and	Section 18.3
(c)	evaluate any measures proposed by the applicant to avoid or minimise any incompatibility, as referred to in paragraph (a) (iii).	Section 18.3
14 Natural resource management and environmental management		
1) Before granting consent for development for the purposes of mining, petroleum production or extractive industry, the consent authority must consider whether or not the consent should be issued subject to conditions aimed at ensuring that the development is undertaken in an environmentally responsible manner, including conditions to ensure the following:		-

Table 4.2 Consideration of relevant Extractive Industries SEPP, Part 3 matters

Matter		Addressed in this EIS
(a)	that impacts on significant water resources, including surface and groundwater resources, are avoided, or are minimised to the greatest extent practicable,	Chapter 7 and Chapter 8
(b)	that impacts on threatened species and biodiversity, are avoided, or are minimised to the greatest extent practicable,	Chapter 9
(c)	that greenhouse gas emissions are minimised to the greatest extent practicable.	Chapter 12
(2) Without limiting subclause (1), in determining a development application for development for the purposes of mining, petroleum production or extractive industry, the consent authority must consider an assessment of the greenhouse gas emissions (including downstream emissions) of the development, and must do so having regard to any applicable State or national policies, programs or guidelines concerning greenhouse gas emissions.		Chapter 12
(3) Without limiting subclause (1), in determining a development application for development for the purposes of mining, the consent authority must consider any certification by the Chief Executive of the Office of Environment and Heritage or the Director-General of the Department of Primary Industries that measures to mitigate or offset the biodiversity impact of the proposed development will be adequate.		Not applicable
15 Resource recovery		
(1) Before granting consent for development for the purposes of mining, petroleum production or extractive industry, the consent authority must consider the efficiency or otherwise of the development in terms of resource recovery.		Section 3.10.1
(2) Before granting consent for the development, the consent authority must consider whether or not the consent should be issued subject to conditions aimed at optimising the efficiency of resource recovery and the reuse or recycling of material.		-
(3) The consent authority may refuse to grant consent to development if it is not satisfied that the development will be carried out in such a way as to optimise the efficiency of recovery of minerals, petroleum or extractive materials and to minimise the creation of waste in association with the extraction, recovery or processing of minerals, petroleum or extractive materials.		-
16 Transport		
(1) Before granting consent for development for the purposes of mining or extractive industry that involves the transport of materials, the consent authority must consider whether or not the consent should be issued subject to conditions that do any one or more of the following:		-
(a)	require that some or all of the transport of materials in connection with the development is not to be by public road,	Section 3.10.2 and Chapter 10
(b)	limit or preclude truck movements, in connection with the development, that occur on roads in residential areas or on roads near to schools,	-
(c)	require the preparation and implementation, in relation to the development, of a code of conduct relating to the transport of materials on public roads.	Section 10.3.4
(2) If the consent authority considers that the development involves the transport of materials on a public road, the consent authority must, within 7 days after receiving the development application, provide a copy of the application to:		-
(a)	each roads authority for the road, and	-
(b)	the Roads and Traffic Authority (if it is not a roads authority for the road).	-
(3) The consent authority:		
(a)	must not determine the application until it has taken into consideration any submissions that it receives in response from any roads authority or the Roads and Traffic Authority within 21 days after they were provided with a copy of the application, and	-
(b)	must provide them with a copy of the determination.	-

Table 4.2 Consideration of relevant Extractive Industries SEPP, Part 3 matters

Matter		Addressed in this EIS
(4) In circumstances where the consent authority is a roads authority for a public road to which subclause (2) applies, the references in subclauses (2) and (3) to a roads authority for that road do not include the consent authority.		-
17 Rehabilitation		
(1) Before granting consent for development for the purposes of mining, petroleum production or extractive industry, the consent authority must consider whether or not the consent should be issued subject to conditions aimed at ensuring the rehabilitation of land that will be affected by the development.		Chapter 6
(2) In particular, the consent authority must consider whether conditions of the consent should:		-
(a)	require the preparation of a plan that identifies the proposed end use and landform of the land once rehabilitated, or	Figure 6.3
(b)	require waste generated by the development or the rehabilitation to be dealt with appropriately, or	Section 2.10
(c)	require any soil contaminated as a result of the development to be remediated in accordance with relevant guidelines (including guidelines under section 145C of the Act and the Contaminated Land Management Act 1997), or	Chapter 6
(d)	require steps to be taken to ensure that the state of the land, while being rehabilitated and at the completion of the rehabilitation, does not jeopardize public safety.	Chapter 6

Note: 1. This clause applies to an application for consent for development on land that is, immediately before the application is determined.

4.3.3 State and Environmental Planning Policy (Sydney Drinking Water Catchment) 2011

The SDWC SEPP applies to land within the Sydney Drinking Water Catchment (SDWC). The Wollondilly River sub-catchment, within which the extension project lies, is listed in Clause 7 of the SDWC SEPP as forming part of the SDWC.

Clause 10 of the SDWC SEPP states:

> (1) A consent authority must not grant consent to the carrying out of development under Part 4 of the Act on land in the Sydney drinking water catchment unless it is satisfied that the carrying out of the proposed development would have a neutral or beneficial effect on water quality.
>
> (2) For the purposes of determining whether the carrying out of the proposed development on land in the Sydney drinking water catchment would have a neutral or beneficial effect on water quality, the consent authority must, if the proposed development is one to which the NorBE Tool applies, undertake an assessment using that Tool.
>
> ***NorBE Tool*** means the tool titled *Neutral or Beneficial Effect on Water Quality Assessment Tool 2015* set out in Appendix 1 to the NorBE Guideline.
>
> ***NorBE Guideline*** means the document titled *Neutral or Beneficial Effect on Water Quality Assessment Guideline 2015* prepared by the former Sydney Catchment Authority as published in the Gazette on the same day as *State Environmental Planning Policy (Sydney Drinking Water Catchment) Amendment 2015* was published on the NSW legislation website.

An assessment of the extension project against the *Neutral or Beneficial Effect on Water Quality Assessment Guideline 2015* (Sydney Catchment Authority 2015) was undertaken as part of the surface water and groundwater assessments (see Appendices F and G). These determined that the proposed extension would have a neutral effect on water quality.

4.3.4 State Environmental Planning Policy (Infrastructure) 2007

Clause 104 of the SEPP (Infrastructure) 2007 (Infrastructure SEPP) directs the consent authority to give written notice of certain traffic generating developments (as defined in Schedule 3 of the SEPP) to Roads and Maritime Services (RMS) and to consider any comments made by them. The project may be considered a traffic-generating development as it will result in an increase of more than 2,000 motor vehicles (trucks and light vehicles) movements. Regardless, it will be referred to the RMS as part of the public exhibition process.

4.3.5 State and Environmental Planning Policy 33 – Offensive and Hazardous Development

The SEPP 33 – Offensive and Hazardous Development requires the consent authority to consider whether a proposal is a potentially hazardous or offensive industry. The existing operations at Gunlake Quarry are not classified as offensive or hazardous industry.

The proposal does not propose changes to the types or quantities of dangerous goods stored, handled or transported to the site. The proposal would not pose a significant risk in relation to the locality to human health, life or property, or the biophysical environment. Therefore, the proposal is not considered to be a potentially hazardous industry.

Potential polluting discharges, ie noise emissions, air pollutants and water pollutants, are summarised in Sections 11.3, 12.3 and 7.3 respectively. These discharges would not have a significant adverse impact in the locality or on the existing or likely future development on other land. Therefore, the proposal is not considered to be a potentially offensive industry.

4.3.6 State and Environmental Planning Policy 44 – Koala Habitat Protection

The SEPP 44 – Koala Habitat Protection applies to the extent that a consent authority is restricted from granting approval for a development proposal on land identified as core koala habitat without the preparation of a plan of management. The Goulburn Mulwaree LGA is listed in Schedule 1 of SEPP 44 as an area that could provide habitat for Koalas. The Biodiversity Assessment (Appendix I) found no areas of core Koala habitat within the quarry site (see Section 9.2.9).

4.3.7 State and Environmental Planning Policy 55 – Remediation of Land

State Environmental Planning Policy No 55 – Remediation of Land (2014) (SEPP 55) provides a state wide planning approach to the remediation of contaminated land, and aims to promote the remediation of contaminated land for the purpose of reducing the risk of harm to human and environmental health. Clause 7 of SEPP 55 requires contamination and remediation to be considered in determining development applications.

Clause 7(3) of SEPP 55 requires, where a change in land use is proposed, that the applicant carry out an preliminary investigation of the land concerned in accordance with the contaminated land planning guidelines. As the extension project does not involve a change of use, no such investigation is required. It is noted that extractive industries are listed as a potentially contaminating activity (*Managing Land Contamination Planning Guidelines, SEPP 55–Remediation of Land* Department of Urban Affairs and Planning, and EPA 1998). However, the likelihood of contamination resulting from the existing quarry operations is considered low as quarrying predominately removes rock and soil from the site, without introducing new material.

4.4 Other plans and policies

4.4.1 Goulburn Mulwaree Local Environmental Plan 2009

The project is within the Goulburn Mulwaree LGA. Under the provisions of the Goulburn Mulwaree LEP, the site is zoned RU1 Primary Production and RU2 Rural Landscape. Extractive industries are permitted with development consent in both of these land use zones. The proposal is consistent with the objectives of both land use zones and the Goulburn Mulwaree LEP.

4.4.2 Aquifer Interference Policy

The *NSW Aquifer Interference Policy* (AIP) clarifies the requirements for obtaining water licences for aquifer interference activities under NSW water legislation including the Water Act and WM Act. The AIP considers and defines minimal harm criteria for productive and less productive aquifers. Consideration of the project's impacts against the requirements of the AIP are summarised in Section 8.2.5 and detailed in Appendix H.

4.4.3 Voluntary Land Acquisition and Mitigation Policy

The Voluntary Land Acquisition and Mitigation Policy (VLAMP) applies to SSD applications for mining, petroleum and extractive industry development. The VLAMP has been considered in the noise and air assessments (Appendices J and K). Noise levels at the private residence closest to the site boundary are defined as 'significant' based on the VLAMP. Therefore the owner(s) of this residence will be entitled to voluntary acquisition upon request in accordance with the VLAMP (see Section 11.2.4).

4.4.4 Sydney to Canberra Corridor Strategy

The Sydney to Canberra Corridor Regional Strategy (SCCRS) outlines the future strategic planning direction of the region extending between Sydney and Canberra. This region is experiencing steady growth and has important economic and environmental values for NSW. The Strategy aims to manage sustainable housing- and job-growth while protecting the local environment. Gunlake Quarry is located within the corridor and therefore the Strategy applies to the development.

The Strategy specifically identifies the economic importance of extractive and mineral resources to areas within the corridor. Gunlake Quarry contributes to economic growth in the region and provides employment opportunities for the local population. These are provided in a manner that minimises adverse impacts on surrounding land uses, including agriculture. Therefore, Gunlake Quarry and the proposed extension project are consistent with the objectives of the Strategy.

4.4.5 Goulburn Mulwaree Strategy 2020

The Goulburn Mulwaree Strategy 2020 is a strategic planning document for the future growth and development of the LGA until 2020. The Strategy aims to promote the sustainable land management of the LGA and guide land use decisions.

The Strategy identifies Marulan as a centre for future population and economic growth. This will require employment generating activities in the surrounding area. The Strategy promotes industrial land uses to the south and west of the town to support mining and extractive industries in the region.

Gunlake Quarry, located 7 km north-west of Marulan, generates economic activity and provides employment opportunities for the area. The Gunlake Quarry extension proposal is consistent with the Goulburn Mulwaree Strategy.

4.4.6 Goulburn Mulwaree Community Strategic Plan 2030

The Goulburn Mulwaree Community Strategic Plan 2030 outlines the community's priorities and expectations for the LGA for the long-term. The Plan provides six key directions identified by the local community: infrastructure; business and industry; community needs; environment; culture and leisure; and image influence.

The Plan identifies the promotion of a healthy and strong economy, which will enhance the general wealth of the community, as a key objective. Gunlake Quarry is an important local economic activity in the area, contributing to the local economy and providing employment. Therefore, the proposal is consistent with the objectives of the Goulburn Mulwaree Community Strategic Plan.

4.4.7 Goulburn Mulwaree Section 94 Development Contributions Plan 2009

The Goulburn Mulwaree Section 94 Development Contributions Plan 2009 applies to all "extractive industries, mines and like development" within the LGA. The Plan requires such developments to contribute to a road maintenance levy for the upgrade and maintenance of roads within the LGA. The Plan includes a method to calculate the contribution for each tonne of material transported.

Gunlake Quarry currently pays a Section 94 contribution levy to Goulburn Mulwaree Council at $0.0313 per kilometre per tonne of product transported by the project on all council roads (see Section 2.5.2).

The extension project will increase the daily truck movements (see Section 3.4.2). Gunlake will continue to pay the Section 94 contribution levy of $0.0313/km/tonne, increasing its total contributions in proportion to the increase in truck movements.

4.5 Commonwealth legislation

The EPBC Act aims to protect matters deemed to be of national environmental significance (MNES) including:

- world heritage properties;
- places listed on the National Heritage Register;
- Ramsar wetlands of international significance;
- threatened flora and fauna species and ecological communities;

- migratory species;
- Commonwealth marine areas;
- nuclear actions (including uranium mining); and
- actions of development for coal seam gas or large coal mining on water resources.

If an action would, or is likely to, have a significant impact on any MNES, it is deemed to be a Controlled Action and requires approval from the Commonwealth Environment Minister or the Minister's delegate.

A referral under the EPBC Act was submitted to DoE on 4 September 2015 (EPBC reference 2015/7557). The referral indentified the proposed activities as a potential Controlled Action due to the presence of White Box-Yellow Box-Blakely's Red Gum Grassy Woodland, listed as a Critically Endangered Ecological Community under the EBPC Act.

On 15 October 2015, DoE determined that the proposed activities are a controlled action, with the relevant controlling provision being "[l]isted threatened species and communities (Sections 18 & 18A)". The project will be assessed under the assessment bilateral agreement with NSW.

Supplementary environmental assessment requirements were received from DoE on 19 October 2015 (see Section 1.6).

5 Consultation

5.1 Overview

This chapter summarises the stakeholder consultation program used for the extension project in the preparation of this report. It provides an overview of the stakeholder engagement process used, a description of the engagement activities undertaken and a summary of the findings that have been incorporated into the impact assessments carried out for this EIS.

5.2 Stakeholder engagement process

5.2.1 Stakeholder identification

Gunlake has been actively engaging with stakeholders since 2008. To identify stakeholders for consultation regarding the extension project, the list of all stakeholders previously engaged was updated to include new stakeholders who were likely to be relevant to the extension project. The stakeholder list continues to be regularly reviewed and updated.

The broad stakeholder groups identified include State government agencies, Goulburn Mulwaree Council, landowners surrounding the project areas, local community members and businesses, special interest groups, Aboriginal groups and the media.

5.2.2 Stakeholder engagement

All of the stakeholder groups identified, and the engagement activities used for each group, are presented in Table 5.1. A range of formal and informal stakeholder engagement tools were used including phone calls, emails, face-to-face meetings and community information sessions.

Table 5.1 Stakeholders and engagement activities

Stakeholder	Engagement activities	Date
State government agencies	• project briefing and site inspection	14 July 2015
Goulburn Mulwaree Council	• project briefing and site inspection	14 July 2015
Landowners	• community information session	30 July 2015
	• factsheet	August 2015
	• face-to-face meetings	Ongoing
Local community groups	• community information session	30 July 2015
	• factsheet	August 2015
	• face-to-face meetings	Ongoing
Local businesses	• factsheet	August 2015
Special interest groups		
Aboriginal groups	• field surveys	27 and 28 July 2015
	• test excavation	6–10 October 2015
Media	• community information session	30 July 2015

5.3 Government consultation

5.3.1 Agency project briefing and site inspection

Prior to the SEARs being issued for the project, an agency project briefing and site inspection was held on 14 August 2015. The briefing and site inspection was attended by representatives of the following agencies:

- DPE;
- OEH;
- EPA; and
- NSW Water.

Representatives from Gunlake, EMM and IEC were also present.

5.3.2 Letters appended to SEARs

The following State and local government agencies provided responses to the request for SEARs.

- DPE;
- DRE;
- EPA;
- OEH;
- WaterNSW;
- DPI;
- RMS; and
- Goulburn Mulwarree Council.

Matters raised in the agency responses have been considered in the preparation of the EIS.

5.3.3 Agency correspondence

A number of State and local government agencies were consulted to identify key issues for the EIS to consider and to seek guidance on assessment approaches and government policies that apply to the extension project. Key matters raised during consultation with government agencies regarding the proposed extension project are given in Table 5.2, together with a reference identifying where each matter is addressed in the EIS.

5.3.4 Matters raised

The matters raised by each of the agencies and Council during the preparation of the EIS and where they are addressed in this EIS are summarised in Table 5.2.

Table 5.2 Matters raised during agency consultation

Agency	Matters raised	EIS reference
NSW DPE	No matters raised.	
NSW OEH	Resolution of residual site-related ecological matters as part of the project, including the extent and composition of vegetation types.	Addressed as part of this assessment process.
	Potential for cooperation on offset commitments with other quarries in the area.	Section 9.3
NSW EPA	Feasibility of rail transport of quarry product.	Section 3.10.2 and Appendix D
NSW Water	Existing water covenant on the land parcel.	Addressed separately to this EIS.
South East Local Land Services	No matters raised.	
Goulburn Mulwaree Council	Overall impacts on Tarreen, a nearby property subject to existing impacts from quarries in the area.	Not specifically address.
	Impacts on groundwater salinity at adjacent properties.	Section 8.2.7

5.4 Aboriginal stakeholders consultation

Consultation with Aboriginal stakeholders was undertaken as part of the Aboriginal Cultural heritage assessment in accordance with the *Aboriginal Cultural Heritage Consultation Requirements for Proponents* 2010 (DECCW 2010a).

Twenty-nine register Aboriginal Parties (RAPs) registered their interest in the project. The RAPs were consulted on:

- the assessment method and survey;
- the test excavation method; and
- the draft Aboriginal cultural heritage assessment.

The EMM archaeologist, Ryan Desic, was accompanied by five Aboriginal site officers, during the archaeological survey on 27 and 28 July 2015.

The EMM archaeologists were accompanied by up to five Aboriginal site officers on each day, during the archaeological test excavation from 6 to 10 October 2015. All RAPs were invited to provide a representative according to a roster.

Details of Aboriginal stakeholders consultation are provided in Appendix A of the ACHA (Appendix L).

5.5 Community consultation

A range of consultation methods were used to inform the community about the proposed extension project and to seek their feedback. These included:

- a community information session;
- project factsheet mail outs;
- briefing the Gunlake Quarry Community Consultative Committee (CCC); and
- one-on-one meetings with residents and landholders.

These are summarised in sections 5.5.1-5.5.5.

The SEARs require consultation with community groups, including the Red Hills Road Residence and Surrounding Areas Committee. This group could not be found and or contacted. . The community consultation summarised below, included consultation with residents of Red Hills Road and surrounding areas (see Figure 5.1) achieved the objective of this assessment requirement.

5.5.1 Community information session

A community information session on Thursday 30 July 2015 at 5-7 pm at the St Stephen's Uniting Church Hall at 95 George Street, Marulan. The session was planned to be a drop-in session, with posters and maps providing information regarding the extension project, current operations and the company itself, and representatives of Gunlake and EMM on hand to answer any specific questions.

Approximately 40 members of the community from Marulan and surrounds, including Towrang and Big Hill attended the session. Upon the request of a number of community members, the information session became a public meeting.

The following key matters were raised by the community:

- traffic movements and road network;
- noise impacts of the operations and trucks;
- air quality impacts; and
- community consultation and engagement.

A contact register was made available to the attendees of the session to register their details for future consultation.

5.5.2 Project factsheets

As part of Gunlake's ongoing commitment to community consultation, a Project factsheet (Factsheet 1) was prepared following the community information session. Factsheet 1 (provided in Appendix E) addressed the specific matters raised by the community at the information session, including transport and road safety, and noise and air quality impacts. In addition, the factsheet provided details of Gunlake's operations and ongoing economic contribution to the local areas, particularly with respect to s94 contributions, and Gunlake's contact details to aid future consultation.

Approximately 700 copies of Factsheet 1 were distributed residents in the Marulan, Red Hill, Carrick, Big Hill and Towrang areas (Figure 5.1).

Gunlake received a single, positive, response to the distribution of the factsheet.

A second Project factsheet will be produced and distributed concurrent to the public exhibition of the EIS, outlining the opportunities for community members to comment.

5.5.3 Community Consultative Committee

Following a period of inactivity resulting from a lack of community interest and awareness, the Gunlake Community Consultative Committee (CCC) has become active, following the community information session, as part of Gunlake's stakeholder engagement efforts associated with the extension project.

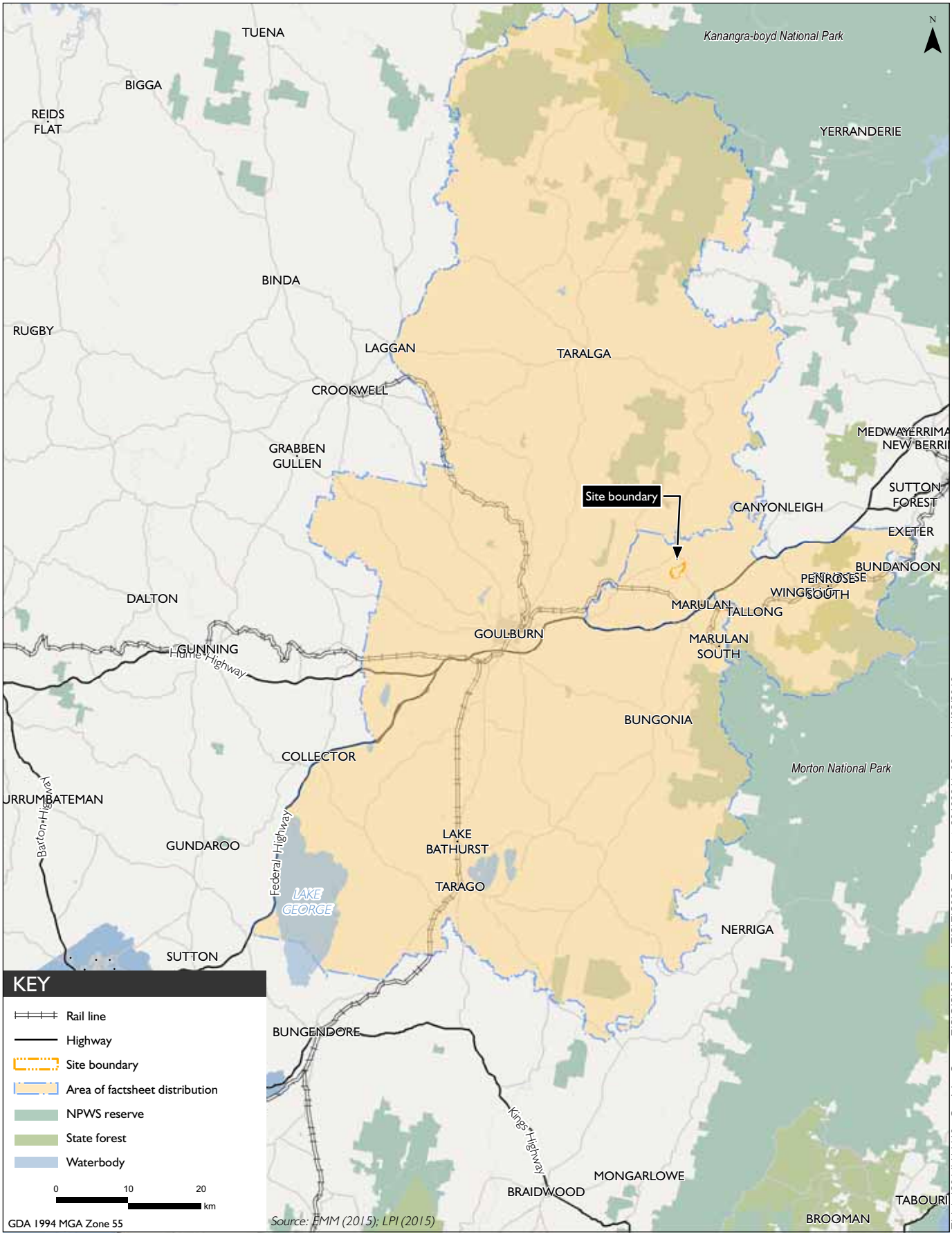
The current CCC was formed in late 2015, and meetings held on 15 November and 16 December 2016. Matters discussed include ongoing CCC protocols and current and proposed operations at the quarry. The minutes and a workbook of actions from each meeting is publically available on Gunlake's website.

5.5.4 Face-to-face meetings

Following the community information session, quarry owner/manager Ed O'Neil committed to organising face-to-face meetings with community members and groups should they be requested.

A number of face-to-face meetings with individuals and community groups have been held between August 2015 and January 2016. Matters discussed include current operations and environmental performance at the quarry, along with the proposed extension project.

An email has also been sent to all community groups in the area inviting any interested stakeholder to contact Mr O'Neil to organise a meeting, should they wish to.



Factsheet distribution area

Gunlake Quarry
Environmental Impact Statement

Figure 5.1

5.5.5 Matters raised

Matters raised during community consultation and where they are addressed in this EIS are summarised in Table 5.3.

Table 5.3 Matters raised during community consultation

Matters raised	Key points	EIS reference
Traffic movements and road network		
Increase in truck movements along Brayton Road/Bypass Road/Red Hills Road	Increased traffic movements pose increased road safety risk, particularly to school bus route and learner drivers.	Sections 10.2.6, 10.3.6 and 10.3.7
	The feasibility of transport of product by rail.	Section 3.10.2 and Appendix D
	The construction of a private haul road to the Hume Highway.	Section 3.10.2 and Appendix D
Road conditions	The current condition of Brayton Road, Bypass Road and Red Hills Road is a major concern. Increased traffic movements will exacerbate this.	Sections 10.2, 10.3.2, 10.3.3 and 10.3.5
	Trucks hugging the shoulder as they accelerate out of Red Hills Road on to the Hume Highway is causing damage to the road in this area and presents a safety issue.	Sections 10.2.6 and 10.4
	Trucks using Bypass Road to avoid weigh station.	Sections 10.2.6 and 10.4
Noise impacts		
Noise impacts of increased production	Noise impacts associated with increased crusher operation hours. Enclosure of crusher may alleviate concerns regarding noise impacts.	Section 11.3.2
	Propagation of low frequency noise to residences up to 8 km away.	Section 11.2
Road traffic noise impacts	Increased road traffic noise as a result of increased traffic movements, residents along Brayton Road particularly concerned.	Section 11.3.7
Air quality impacts		
Dust impacts	Dust impacts (amenity and health) at nearby residences. Beattie (275 Brayton Road) complained of silica dust in water supply, and being unable to open windows (due to dust and noise).	Section 12.3
	Absence of AQ monitors to the east of the quarry.	Sections 12.2 and 12.4

Table 5.3 Matters raised during community consultation

Matters raised	Key points	EIS reference
Traffic movements and road network		
Community consultation and engagement		
Lack of information	Lack of information provided to the community regarding the project. In particular, the lack of public knowledge (and short notice) of the community information session and the exclusion of particular areas (Towrang and Big Hill) for letterbox drops.	Sections 5.5 and 5.6, and Chapter 17

5.6 Ongoing stakeholder consultation

Gunlake will continue its stakeholder engagement program to ensure matters raised by the community and other stakeholders are understood and addressed. Principal engagement and consultation activities will include:

- producing and distributing a Project factsheet (Factsheet 2) summarising the key outcomes of the assessment process and outlining the opportunities for stakeholders to review the EIS, once lodged;
- the Gunlake CCC will continue to meet, in accordance with the project approval;
- ongoing participation in local stakeholder briefings and meetings, when requested; and
- regularly updating and promoting information sources, including Gunlake's website, with information on environmental monitoring and management, local community initiatives and other relevant information.

The Annual Environmental Return, summarising Gunlake's activities and performance in key areas, will continue to be prepared in accordance with the project approval and made publically available on the website.

5.7 Consultation outcomes

This EIS has considered the key matters raised during consultation with a range of stakeholders including government agencies, community and special interest groups, and potentially affected landowners. Consultation has been completed in accordance with the SEARs.

6 Land resources and rehabilitation

6.1 Introduction

This chapter provides a summary of the land resources assessment and rehabilitation strategy prepared by EMM, which is presented in full in Appendix F.

The assessment was completed with reference to the following guidelines and policies:

- *Guidelines for Surveying Soil and Land Resources* (NCST 2008);
- *the Australian Soil Classification System* (Isbell 2002);
- *Agricultural Impact Assessment Guidelines and Agfact AC25: Agricultural Land Classification* (NSW Agriculture) (DP&I 2012);
- *the Land and Soil Capability Assessment Scheme: Second Approximation* (NSW OEH 2012) (LSC assessment scheme); and
- *Strategic Framework for Mine Closure* (ANZMEC & MCA 2000).

6.2 Existing environment

6.2.1 Topography

The quarry site is typified by undulating rises and valleys between low hills with slopes ranging from 2 to 10% and rising to 680 m Australian Height Datum (AHD) in the south-west corner of the quarry site. There are rock outcrops on crests and a high density of surface cobbles in some areas. The aspect varies with ridge lines and contours.

6.2.2 Soil survey

A soil survey was previously completed for the project area by Strategic Environmental and Engineering Consulting Morse McVey (SEEC) in 2008. SEEC described eight soil test pits that included laboratory analysis, across the project area to confirm the extent and boundary of the soil landscape units mapped by DLWC/SCA (2002). The SEEC assessment determined the following general features of soils in the project area (ie topsoil and subsoil):

- soils are dispersive and are moderately to highly erodeable;
- soils are moderately acidic in the A horizon (topsoil);
- soils are non-saline to slightly saline;
- soils have a low to moderate cation exchange capacity;
- the ratio of calcium to magnesium infers calcium deficiency in soils;
- soils have very low Phosphorus levels; and
- soils have a very low to moderate Potassium level.

Australian soil classifications for sample locations were not determined by SEEC (2008).

6.2.3 Soil landscapes

The *Soil Landscapes of the Sydney Catchment Authority Hydrological Catchments* mapping (DLWC/SCA 2002) identifies four soil landscapes across the project area. These comprise:

1. Bindook Road: undulating low hills on Devonian Bindook Porphry, occurring in the Canyonleigh hills physiographic region;

2. Garland: low lying rises and valleys between hills in granitic terrain;

3. Midgee: rolling low hills in Ordovician metasediments terrain; and

4. Wyangala: soils developed on rolling low granitic hills with slopes ranging from 10–30%.

Further descriptions of the soil landscape units are provided in Table 6.1.

6.2.4 Great soil groups

Great Soil Group mapping of NSW (OEH 2014a), with reference to Isbell (2002), indicates soil types for the project area comprise Soloths and Yellow Podzolic soils (less fertile). The following describes the general characteristics of each of these Great Soil Groups:

- Soloths: Similar to a solodic soil (ie soils have a strong contrast between the texture of the A and B horizons and a bleached A2 horizon), but acidic throughout the profile. Tends to be a more typical soil of the humid regions where the exchangeable cations in the B Horizon of the solodised soils have been leached out; and

- Yellow Podzolic soils (less fertile): These soils are texture contrast soils with a light textured A horizon overlying a heavier textured, structured B horizon. A distinct pale A2 horizon is usually, but not always present and the profile is acidic. The B horizons are characterised by moderate polyhedral or angular blocky structure and tend to be friable when moist.

Common relationships between soil landscapes and Great Soil Groups in the project area are given in Table 6.1.

Table 6.1 Soil landscapes in the quarry site

	Soil landscapes			
	Bindook Road	**Garland**	**Midgee**	**Wyangala**
Landscape	Low hills and rises on Bindook Porphyry (quartz porphyry) in the Moss Vale Tablelands, Canyonleigh Hills, Wollondilly Gorge and Wombeyan Hills. Local relief 10–50 m; altitude 541–965 m; slopes 3–12%; rock outcrop 2–10%. Extensively cleared open forest.	Low hills on Wollogorong Granite (granite) in the Baw Baw Hills. Local relief 10–70 m; altitude 648–943 m; slopes 5–15%; rock outcrop 2–10%. Extensively cleared woodland.	Rolling low hills and hills on undifferentiated Ordovician and Silurian sediments including sandstone, siltstone, greywacke, phyllite, shale, slate and quartzite. Local relief 30–100 m; altitude 600–900 m; slopes 10–30%.	Low hills to rolling hills south-east of Cowra. Local relief 40–140 m; altitude 300–600 m; slopes 10–20%; rock outcrop.

Table 6.1 Soil landscapes in the quarry site

	Soil landscapes			
	Bindook Road	**Garland**	**Midgee**	**Wyangala**
Common Australian Soil Classification (Great Soil Group)	Brown Kurosols (Red and Yellow Podzolic Soils), Natric Kurosols (Soloths). Subangular rock outcrops common.	Bleached Orthic Tenosols (Lithosol), Red Kurosols (Red Podzolic Soils), Brown/Yellow Kurosols (Yellow Podzolic Soils), Red/Yellow Kandosols (Red and Yellow Earths), and Brown Sodosols/Natric Kurosols (Solodic Soils/Soloths).	Yellow Earths and Yellow Podzolic Soils most common; some Red Podzolic Soils; Lithosols, Soloths and Red Earths.	Red Podzolic Soils, Siliceous Sands, Non-calcic Brown Soils, Yellow Podzolic Soils, Yellow Solodic Soils. Extensive granite outcrops.
Vegetation	Dry sclerophyll forest with shrub understorey. Mostly cleared. Dominant trees include *Eucalyptus macrorhyncha* (Red Stringybark), *E. Amplifolia* (Cabbage Gum), *E. Mannifera* (Brittle Gum), *E. Melliodora* (Yellow Box), *E. Blakelyi* (Blakely's Red Gum) and *E. Cinerea* (Argyle Apple) with occasional *E. Pauciflora* (Snow Gum) and *E. Rubida* (Candlebark).	Savannah woodland, with native grasses wholly or partly replaced with introduced or nonendemic species. Mostly cleared. Dominant trees include *Eucalyptus blakelyi* (Blakely's red gum), *E.dives* (broad-leaved peppermint), *E.melliodora* (yellow box), *E. Bridgesiana* (apple box) and *E.mannifera* (brittle gum) on poorer soils and *E. Pauciflora* (snow gum) in colder hollows and on exposed windy sites.	Dry sclerophyll forest with shrub understory. Mostly cleared. Dominant trees include *Eucalyptus macrorhyncha* (Red Stringybark) and *E. Haemastoma* (Scribbly Gum).	White box community on higher areas and a grey box-yellow box community in valleys along the major creeks and rivers. Mostly cleared. Red ironbark and red stringybark are found on steep ridges. Associated species include Blakely's red gum, apple box and roughbarked apple.
Land capability	LSC: V (VI); grazing limitation – moderate to high; and cultivation limitation – high to very high.	LSC: V (VI); grazing limitation – moderate to high; and cultivation limitation – high to very high.	LSC: IV	LSC: IV–VI
Limitations to land capability	Localised steep slopes; localised salinity; and widespread low fertility.	Localised waterlogging; localised salinity; and widespread low fertility.	Localised salinity; and widespread low fertility.	Localised salinity; localised steep slopes; and widespread low fertility.

6.2.5 Australian soil classification

Soils identified from NSW Government mapping (OEH 2014a) and with reference to Isbell (2002) for the project area comprise: Kurosols and Natric Kurosols. The following describes the general characteristics of each of these Australian Soil Classifications:

- Kurosol: these soils have a clear or abrupt textural change at the A to B horizon boundary. The upper B2 horizon is strongly acidic ie less than pH 5.5 in water; and
- Natric Kurosol: as per Kurosol but the major part of the upper 0.2 m of the B2 Horizon is sodic.

The relationship between Australian Soil Classification, soil landscape and Great Soil Group is summarised in Table 6.2.

Table 6.2 Relationship between Australian Soil Classification, soil landscape and Great Soil Group

	Australian Soil Classification	
	Kurosol	**Natric Kurosol**
Soil landscape	Bindook Road, Wyangala	Bindook Road
Great Soil Group	Yellow Podzolic soils (less fertile)	Soloths
Area (of project area)	44.1 ha	55 ha

6.2.6 SPADE soil analysis

The SPADE soil profile database search identifies information on a number of soils profiles in the greater project area. Two soil profiles occur adjacent to the project area, within a 1 km radius (OEH 2014b):

- Profile 77 – Solodic Soil (Great Soil Group), noting that Solodic and Soloth Great Soil Groups are very similar**;** and
- Profile 96 – Red Podzolic Soil (Great Soil Group), noting that the only difference between Red Podzolic Soil and Yellow Podzolic Soil Great Soil Groups is colour.

Both SPADE profiles are located on the Bindook Road soil landscape.

6.2.7 Inherent soil fertility

The inherent fertility of soils in NSW mapping (OEH 2014a) identifies soils at the project area as having Moderately Low (2) fertility. Moderately Low (2) includes soils with low fertilities, such that, generally, only plants suited to grazing can be supported. Large inputs of fertiliser are required to make the soil useable for arable purposes.

6.2.8 Hydrologic soil group

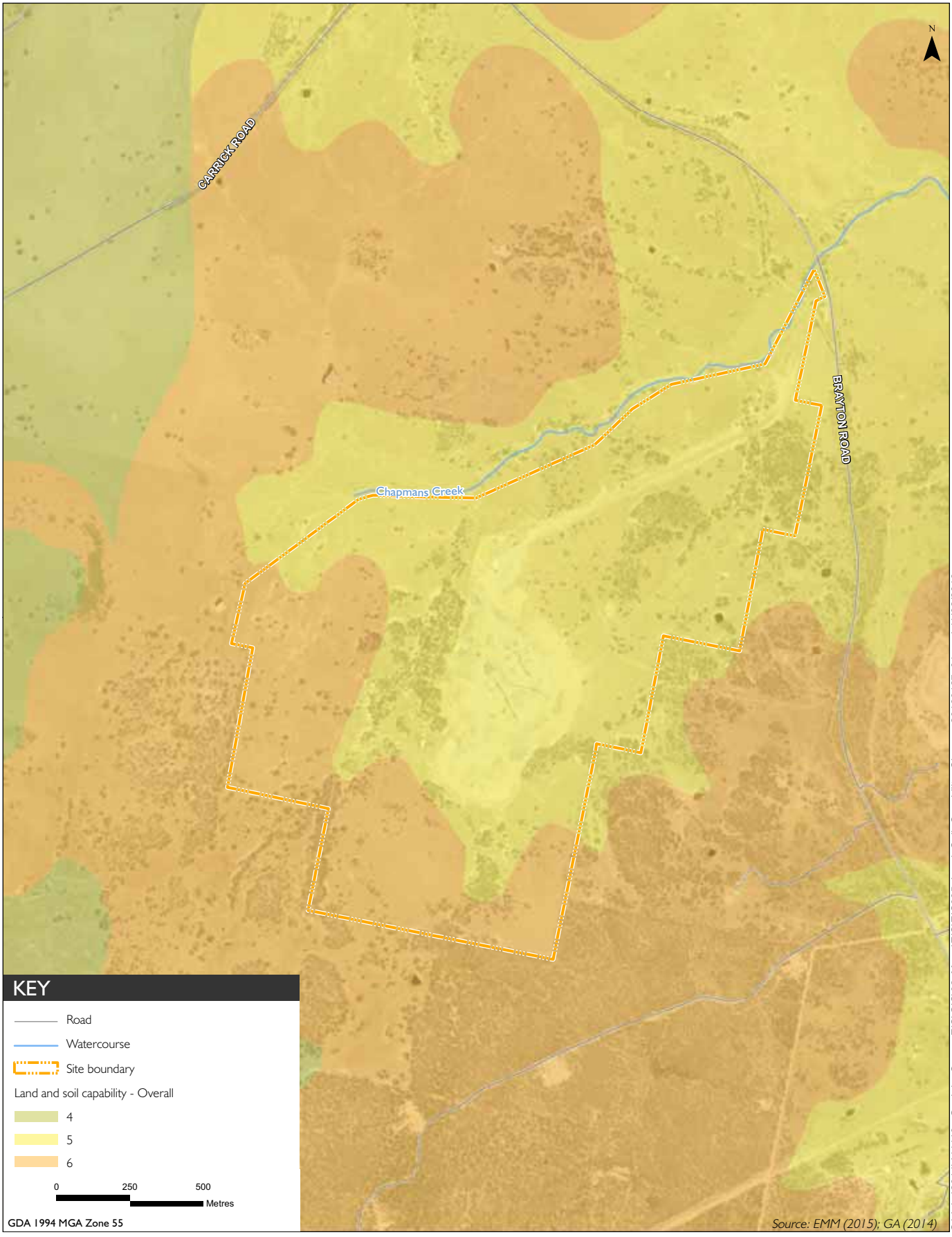
The hydrologic soil group mapping in NSW (OEH 2014a) identifies soils at the quarry site as predominantly D – very slow infiltration (55 ha) with some C – slow infiltration (44.1 ha):

- C: soils having slow infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water, or soils with moderately fine to fine texture. These soils have a slow rate of water transmission.

- D: soils having very slow infiltration rates when thoroughly wetted and consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very slow rate of water transmission.

6.2.9 Land and soil capability

The quarry site is mapped in the *Land and Soil Capability Mapping of NSW* (OEH 2013b) as predominantly LSC Class 5 – Severe limitations (55 ha) and Class 6 – Very severe limitations (44.1 ha). Figure 6.1 shows the spatial distribution of Class 5 and Class 6 land within the quarry site.



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Land and soil capability classes

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Figure 6.1

6.3 Impact assessment

Potential impacts of the project on soil resources are associated with temporary loss of land due to operation of quarry infrastructure and permanent loss of land due to open cut quarrying. Activities that may impact on soil physical and chemical properties and post quarrying land uses include:

- excavation of soil to access the resource;
- permanent storage of overburden;
- temporary to long-term storage of soil in stockpiles;
- compaction of soil by machinery and infrastructure placement;
- contamination of soil resulting from storage of fuel and chemicals and refuelling activities; and
- loss of soil through wind and water erosion.

These activities can reduce the capability of land and soils and also reduce its quality as agricultural land.

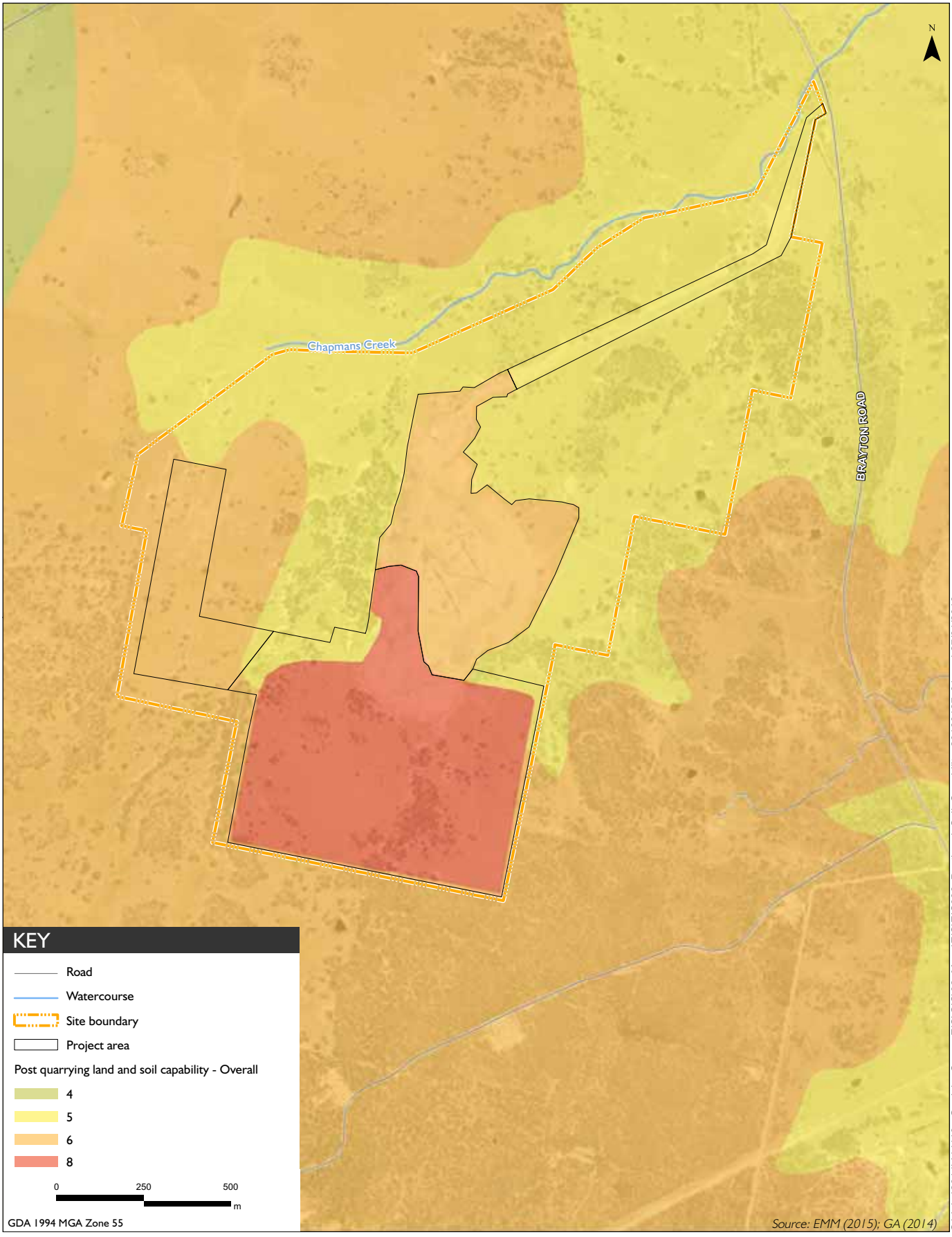
6.3.1 Post quarrying land and soil capability

Potential changes to LSC of the project area following mining and rehabilitation are presented in Table 6.3 and Figure 6.2.

Table 6.3 Changes to land and soil capability

ASC	Pre-mining LSC	Area (ha)	Post-mining LSC	Area (ha)	Comment
Kurosol	6	44.1	6	14.0	Some land consumed by quarry.
			8	30.1	
Natric Kurosol	5	55.0	5[1]	10.9	Some land consumed by quarry.
			6	26.0	
			8	18.1	

Notes: 1. Assuming the roads are rehabilitated.



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Post quarrying land and soil capability classes

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Figure 6.2

6.4 Rehabilitation management and mitigation

6.4.1 Objectives

The overall objectives of rehabilitation of the project area are to:

- stabilise all earthworks, drainage lines and disturbed areas no longer required for quarry-related activities to minimise erosion and sedimentation;
- reduce the visibility of the activities from surrounding properties and the local road network;
- provide a low maintenance, geotechnically stable and safe landform, which is commensurate with the future land uses on and around the project area;
- blend the created landforms within the project area with the surrounding landform as far as possible; and
- revegetate the disturbed areas in the project area with native tree, shrub and grass species and/or pasture species to a meet a final land use of light grazing.

6.4.2 Scheduling of works

Rehabilitation will be progressively staged as soon as possible after final completion of works is determined. Staging of rehabilitation activities will require identification of timelines for decommissioning of pits, buildings and other supporting infrastructure. A more detailed schedule of works will be developed 12 to 24 months prior to the confirmed closure.

6.4.3 Decommissioning

At closure, Gunlake will decommission and remove the quarry plant operational area, various fuel storages, workshop and site buildings, and roads not to be retained in the final landform.

6.4.4 Final landform

Following rehabilitation there will be four domains comprising of:

- the overburden emplacement bund;
- the void representing the quarry pit;
- access roads, tracks and other disturbed areas; and
- water management structures.

The rest of the quarry site will retain its current landform and will be managed for flora and fauna conservation and light grazing.

i Overburden emplacement area

The overburden emplacement area will be retained and will provide shelter and light grazing for livestock. Final slopes of the overburden emplacement area will typically be up to a maximum 2.5 (H):1 (V) grade.

Contour banks will be progressively installed on the rehabilitated landform. The dimensions of the individual banks will be determined on the basis of the individual sub-catchment areas, but will be typically less than 0.7 m high and less than 3.0 m in cross-sectional area. Drop structures will be constructed on the slopes of the final landform within the overburden emplacement area to assist in controlling the flow of water off these slopes.

ii Void

The void will contain standing water (RHDHV 2015) and the walls above the water will be largely rock. It is unlikely to provide any ongoing grazing potential and may provide opportunity for future storage or deposition of a wide range of materials. The slopes of the quarry will be close to vertical as shown in Figure 6.3. Crushed rock will be placed on the upper walls to provide a plant growth medium on the benches and available topsoil will be returned if it is available and deemed necessary at the time of rehabilitation.

A safety bund will be placed around the perimeter to the pit to prevent accidental vehicle access. A fence will be installed around the quarry void. Signs instructing people to stay out of the void due to steep slopes and deep water will be installed.

iii Access roads, tracks and other disturbed areas

At the end of the quarry life, Gunlake will:

- remove, rip or otherwise rehabilitate all on-site roads not required for post-quarry landuses;
- rip the compacted rock on hardstand areas, grade the ripped areas to promote laminar flow of surface water, replace previously stockpiled subsoil and topsoil and apply seed and fertilizer;
- install appropriate drainage controls; and
- install fencing and gates at appropriate locations.

Access roads, tracks and other disturbed areas will have a final land use of light grazing.

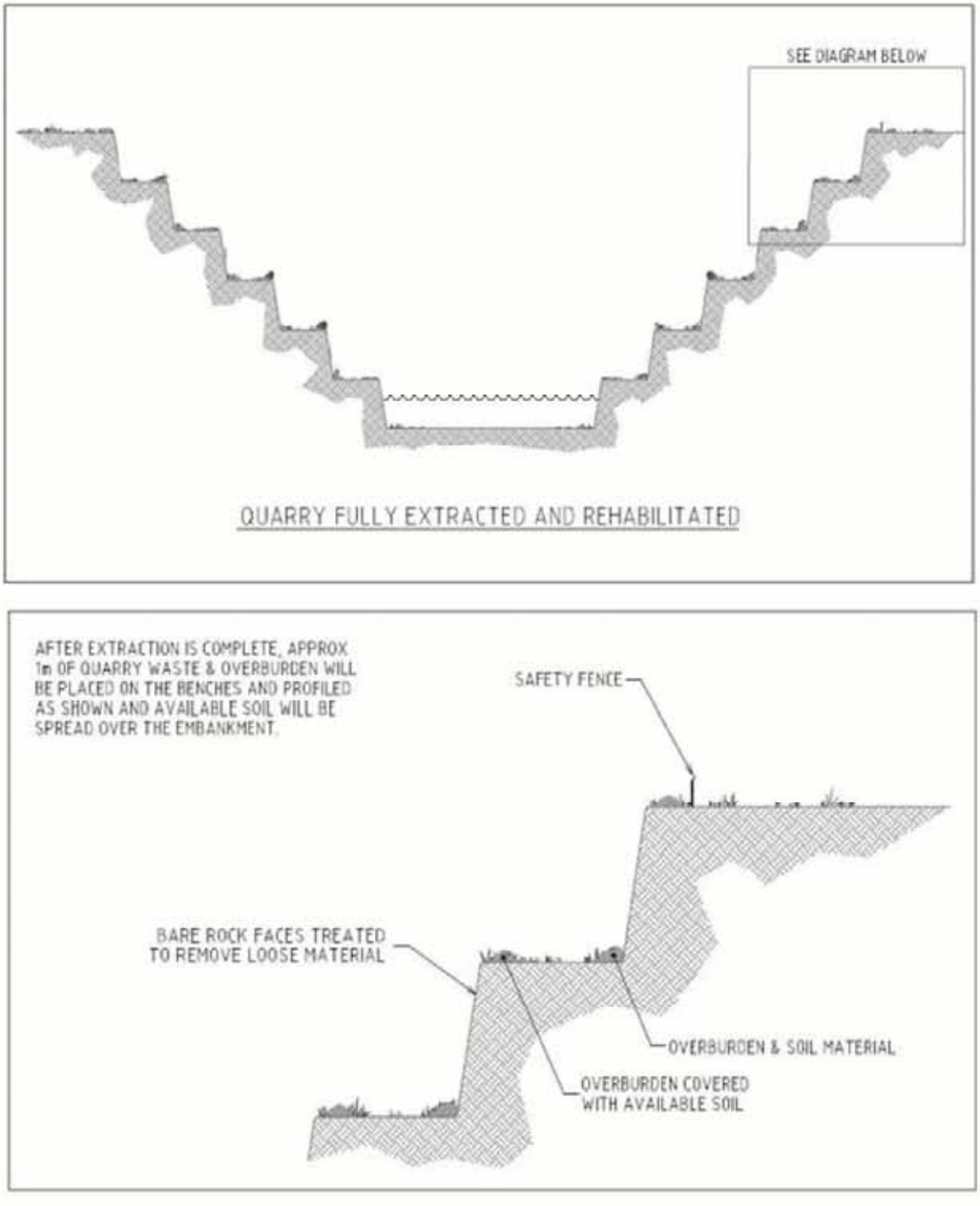


Figure 6.3 Conceptual rehabilitated quarry landform

iv Water management structures

Where practicable, water management structures such as contour banks and drains will be constructed with longitudinal gradients, which permit the transfer of water at non-erosive velocities, ie <1 (V):200 (H). Consequently, specialised rehabilitation treatments will generally not be required. Similarly, drop structures constructed on the slopes of the overburden emplacement area will be retained and allowed to revegetate naturally. However, in the event that unacceptable levels of erosion are observed, fast growing species identified as having a particular soil conservation application and/or specialised treatments such as bitumen/jute meshing or rock lining will be implemented.

6.4.5 Management of soil

Soil resources in the project area will generally be managed through:

- installing appropriate erosion and sediment control measures (ESC) prior to undertaking any disturbance on the quarry;
- identifying and quantifying the soil requirements for rehabilitation works over the quarry life based on quarry progression information and the nature of quarry activities;
- identifying and mapping soil resources (including topsoil and soil with specific management requirements) and locations of stockpiles across the quarry and managing this information via appropriate systems and databases;
- optimising the recovery of topsoil and useable subsoil during stripping operations;
- stockpiling soil appropriately and managing stockpiled soil to minimise resource degradation (including installation of ESCs and application of amelioration measures where required); and
- carrying out rehabilitation works in appropriate conditions to minimise deterioration of the soil resource and to maximise rehabilitation success.

Appendix F provides greater detail on the above general soil resource management practices.

6.4.6 Erosion and sediment control

ESC measures will be defined in an Erosion and Sediment Control Plan to be implemented throughout the life of the project. ESC measures will be area-specific within the project area to maximise effectiveness and will be consistent with the practices described in *Managing Urban Stormwater: Soils and Construction – Volume 2E Mines and Quarries* (DECC 2008). Reference may also be made as appropriate to *Selection of Top Dressing Material for Rehabilitation of Disturbed Areas in the Hunter Valley* (Elliott and Veness 1981).

6.4.7 Revegetation

The overburden emplacement embankment, void and other disturbed land will be stabilised following construction of the final landform with a non-persistent cover crop and pasture seed, such as those given in Appendix F. The actual seed and fertiliser mix will be determined in conjunction with agronomists from the local Department of Primary Industries – Agriculture (DPI-Agriculture).

A selection of locally occurring tree species will then be planted in these domains. Seed will be collected from trees occurring in the Marulan district. The seed will be used to raise nursery tube stock for planting. A list of suitable tree species is included in Appendix F. These species were identified in the Flora and Fauna Impact Assessment as being suitable for revegetation. Subject to the extent of establishment of natural vegetation from replaced topsoil, seed of locally occurring shrub species may also be broadcast to encourage the re-establishment of the shrub layer.

6.4.8 Weed management

Gunlake will take the necessary precautions to prevent excessive development of weeds within rehabilitated areas. When appropriate, this will include campaign weed spraying prior to the stripping of topsoil. The appropriate noxious weed control or eradication methods and programs will be undertaken in consultation with the DPI-Agriculture and/or the local Goulburn Mulwaree Council Noxious Weeds Inspector.

6.4.9 Final land use

The area selected for quarrying has low agricultural potential and is predominantly limited to restricted grazing. The overburden emplacement bund wall will have low agricultural potential and the void left at the completion of quarrying will have negligible agricultural potential. Final slopes of the overburden emplacement area will typically be up to a maximum 2.5 (H):1 (V) grade, which will allow the areas to be used for grazing.

6.4.10 Rehabilitation monitoring

Gunlake will undertake an ongoing monitoring program throughout and beyond the operation of the project. Areas being rehabilitated will regularly be inspected and assessed against the short and long-term rehabilitation objectives outlined in Section 6.4.1.

During regular inspections, aspects of rehabilitation to be monitored will include:

- evidence of any erosion or sedimentation from areas that are in the vegetation establishment phase;
- success of initial vegetation cover establishment;
- success of tree and shrub plantings and direct seeding;
- adequacy of drainage controls; and
- general stability of the rehabilitation site.

It is envisaged that rehabilitation monitoring will be undertaken for at least 2 years following the completion of all rehabilitation. The exact period would reflect seasonal conditions during that period. In any event, maintenance will continue until such time as the objectives have been achieved.

Further detail on rehabilitation monitoring is provided in Section 6.4.10.

6.4.11 Rehabilitation maintenance

Where rehabilitation success appears limited, maintenance activities will be initiated. These may include re-seeding, and where necessary, re-topsoiling and/or the application of specialised treatments such as composting mulch to areas with poor vegetation establishment. Tree guards will be placed around planted seedlings should grazing by native animals be excessive. If drainage controls are found to be inadequate for their intended purpose, or compromised by grazing stock or wildlife, these will be replaced and/or temporary fences installed to exclude grazing of native vegetation by native or domestic fauna.

Should areas of excessive erosion and sedimentation be identified, remedial works will be undertaken. These works include importation of additional fill, subsoil or topsoil material or redesigning of water management structures to address erosion.

6.4.12 Completion criteria

The preliminary completion criteria and monitoring program for the project is provided in Appendix F. The criteria outline the rehabilitation elements and indicators to determine the success of the rehabilitation of the project area. The monitoring criteria provide the measurable elements to be surveyed. The criteria will be reviewed and finalised with Goulburn Mulwaree Council at the time of submitting a final rehabilitation plan.

6.5 Conclusions

DLWC/SCA mapping identified four soil landscapes across the quarry site: Bindook Road, Garland, Midgee and Wyangala. There were two soil types indentified in the proposed project area, namely:

- Kurosol (44.1 ha); and
- Natric Kurosol (55 ha).

The Kurosols fall under the Yellow Podzolic Great Soil Group whereas the Natric Kurosol falls under Soloths. Soils at the site have a class 2 fertility (moderately low). Generally only plants suitable for grazing can be supported. The Hydrologic Soil Group for the Kurosols is C (slow infiltration) and D (very slow infiltration) for Natric kurosols. Pre-mining soil land capability classes for the Natric Kurosols are 5 (severe limitations) and 6 (very severe limitations) for the Kurosols.

Activities related to operations that have the potential to impact soil resources include the excavation of soil, permanent storage of overburden, temporary to long-term storage of soil in stockpiles, machinery usage and the storage of fuel and chemicals. These activities have the potential to reduce the capability and agricultural suitability of the soil and landscape through contamination, compaction and erosion. LSC for the post-mining landscape will range from 6–8 for the Kurosols and 5–8 for the Natric Kurosols. Mitigation measures have been recommended to minimise impacts with a focus on runoff, erosion and sediment control.

Revegetation will occur through the use of stabilisation species and native trees once the final landform is shaped. The proposed final land use will be restricted grazing other than the final void which has no agricultural potential. Landform stability, topdressing, water quality and vegetation will be closely watched as part of a monitoring program. Maintenance activities that may be required include weeding, re-topsoiling and applying soil amendments.

7 Surface water

7.1 Introduction

This chapter provides a summary of the surface water assessment prepared by Royal Haskoning DHV, which is presented in full in Appendix G.

The chapter describes the existing surface water environment at the quarry, the proposed surface water management strategy, water balance results, predicted surface water impacts, water licensing requirements, proposed monitoring and potential contingency measures.

The assessment was completed with reference to the following guidelines and policies:

- the SDWC SEPP and *Neutral or Beneficial Effect on Water Quality Assessment Guideline 2015* (Sydney Catchment Authority 2015);
- *Australian Rainfall and Runoff* (IEAust 1987);
- *Managing Urban Stormwater: Soils and Construction – Volume 1* (Landcom 2004) (the 'Blue Book');
- *Managing Urban Stormwater: Soils and Construction, Volume 2E – Mines and Quarries* (DECC 2008);
- *Liquid Chemical Storage, Handling and Spill Management: Review of Best Practice Regulation* (DECC 2005);
- *Storing and Handling Liquids: Environmental Protection: Participant's Manual* (DECC 2007a);
- *Australian Guidelines for Water Quality Monitoring and Reporting* (ANZECC and ARMCANZ 2000b);
- *NSW Water Conservation Strategy* (DLWC 2000); and
- *NSW Guidelines for Controlled Activities on Waterfront Land* (NOW 2012).

7.2 Existing environment

7.2.1 Climate

A representative long-term rainfall time series for water balance modelling was prepared using daily rainfall records from the Marulan (Johnniefelds and George Street) and Brayton (Longreach) weather stations.

The pan evaporation rate is approximately double the average annual rainfall.

7.2.2 Local watercourses

The quarry is within the upper reaches of Chapmans Creek Catchment (see Figure 7.1). Chapmans Creek is an ephemeral watercourse that drains to the north-east, flowing into Jaorimin Creek approximately 3 km downstream of the quarry. Jaorimin Creek then flows in a northerly direction to its confluence with the Wollondilly River, approximately 8.6 km downstream of the quarry. The Wollondilly River is the major river in the region and is one of the key tributaries to Warragamba Dam, which is 65 km north-east of the quarry. Johnniefelds Dam is on Jaorimin Creek upstream of its confluence with Chapmans Creek and does not receive runoff from Chapmans Creek, or the quarry site.

The extension project will directly disturb two second order watercourses that are tributaries to Chapmans Creek. Information provided by DPI Water indicates that there are no licensed surface water users relying on extraction from either Chapmans or Jaorimin creeks, immediately downstream.

7.2.3 Surface water quality

A surface water monitoring program was established by Gunlake in February 2007, prior to the establishment of the quarry. A total of 49 monitoring rounds have been completed between February 2007 and May 2015. Monitoring has been undertaken at three locations, Sites I, O and D (see Figure 7.1).

The following trends were observed from the surface water monitoring data:

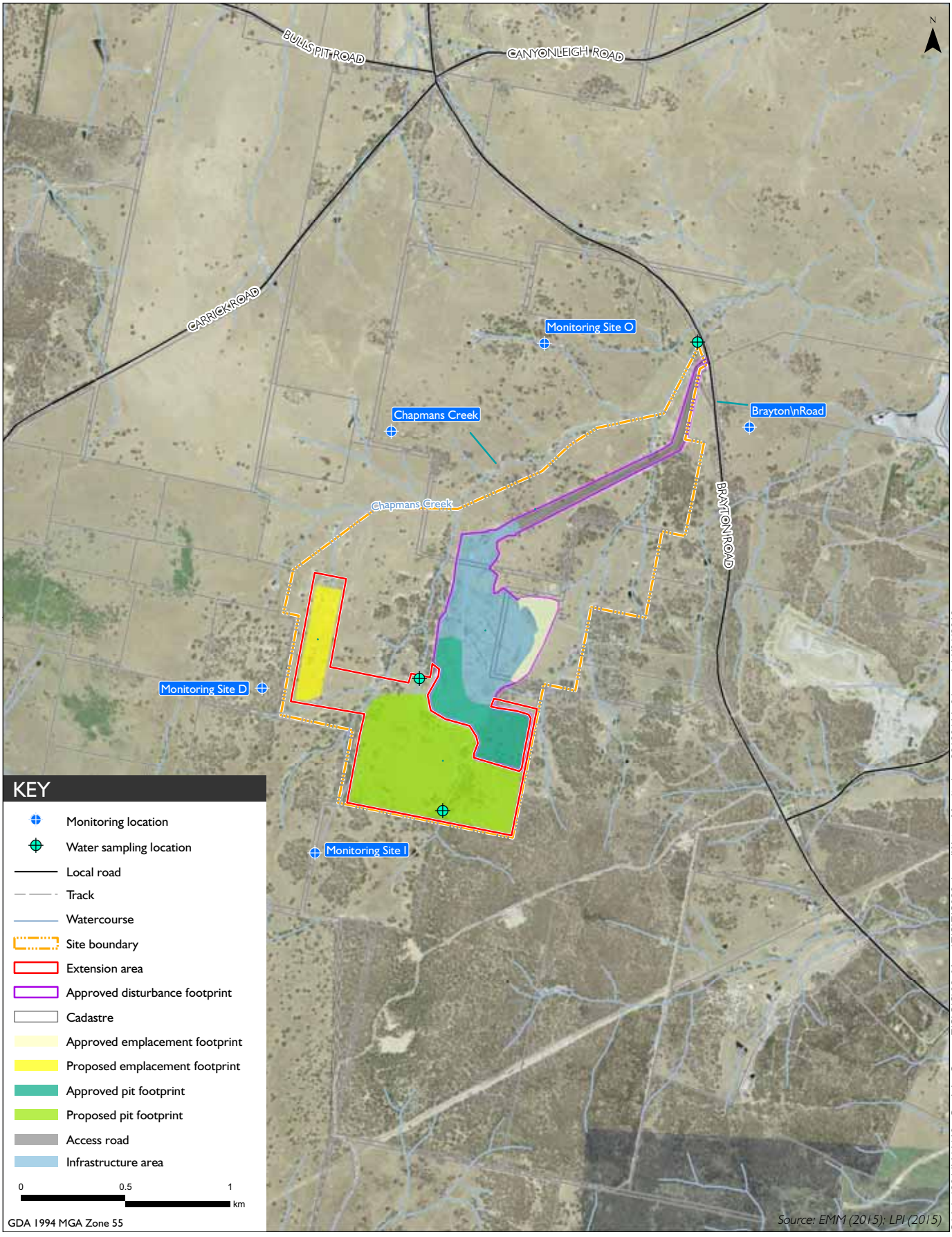
- Electrical conductivity (EC, an indicator of salinity) was generally substantially higher downstream of Chapmans Creek Weir (Site O) than adjacent to the quarry site (Site D). The elevated EC adjacent to the quarry site is likely to be due to the historically degraded state of Chapmans Creek and possible soil sodicity, which may lead to the leaching of salts from sodic sub soils followed by the concentration of salts through evaporation in shallow pools in the creek.

- Total suspended solid (TSS) concentrations downstream of the Chapmans Creek Weir (Site O) were generally below 20 mg/L indicating that the quarry operation is not contributing sediment laden water to downstream receiving waters.

- Nutrient concentrations (total nitrogen and total phosphorus) were consistently 5 to 10 times above the ANZECC and ARMCANZ (2000a) default trigger values for upland fresh water streams. It is noted that some of the highest concentrations recorded were in 2007 prior to the commencement of quarry operations. This indicates that the elevated levels are associated with historic agricultural land uses.

- Average concentrations of arsenic and manganese concentrations with ANZECC trigger values for 95% protection of freshwater species were generally below trigger values although some elevated manganese were recorded.

- Limited sampling was undertaken south of the quarry at monitoring Site I as the creek was dry at this point during most sampling events.



Local watercourses and monitoring locations

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Figure 7.1

7.3 Impact assessment

7.3.1 Surface water management strategy

The expansion of the quarry pit and increased use of process water will require additional surface water controls to prevent or minimise potential impacts and to provide a reliable supply of water. Surface water within the quarry site has been differentiated into five categories (clean water, dirty water, process water, wastewater and potable water) based on water quality and intended use.

The proposed surface water management strategy is diagrammatically described in Figure 7.2. The key features of the strategy and the resultant impacts are described in the following sections.

i Water quality

Runoff from dirty water catchments will be collected in either the Process Water Dam or one of the sedimentation dams. All dams will be designed and constructed to provide adequate sedimentation treatment in accordance with the methods recommended in *Managing Urban Stormwater: Soils and Construction, Volume 2E – Mines and Quarries* (DECC 2008).

Water will enter the pit as rainfall runoff from the pit area and from groundwater inflows. During and following heavy rain, substantial volumes of water will accumulate in the pit. As a result, the pit will need to be dewatered using a pit sump. Water will be pumped to the Pit Dewatering Dam, a 30 ML turkey nest dam. Controlled release of water from the Pit Dewatering Dam will be required during water surplus conditions. All released water will be treated by sedimentation in the dam and Gunlake will monitor the water quality of water prior to release. Additional treatment, such as pH adjustment or flocculation will be provided if required.

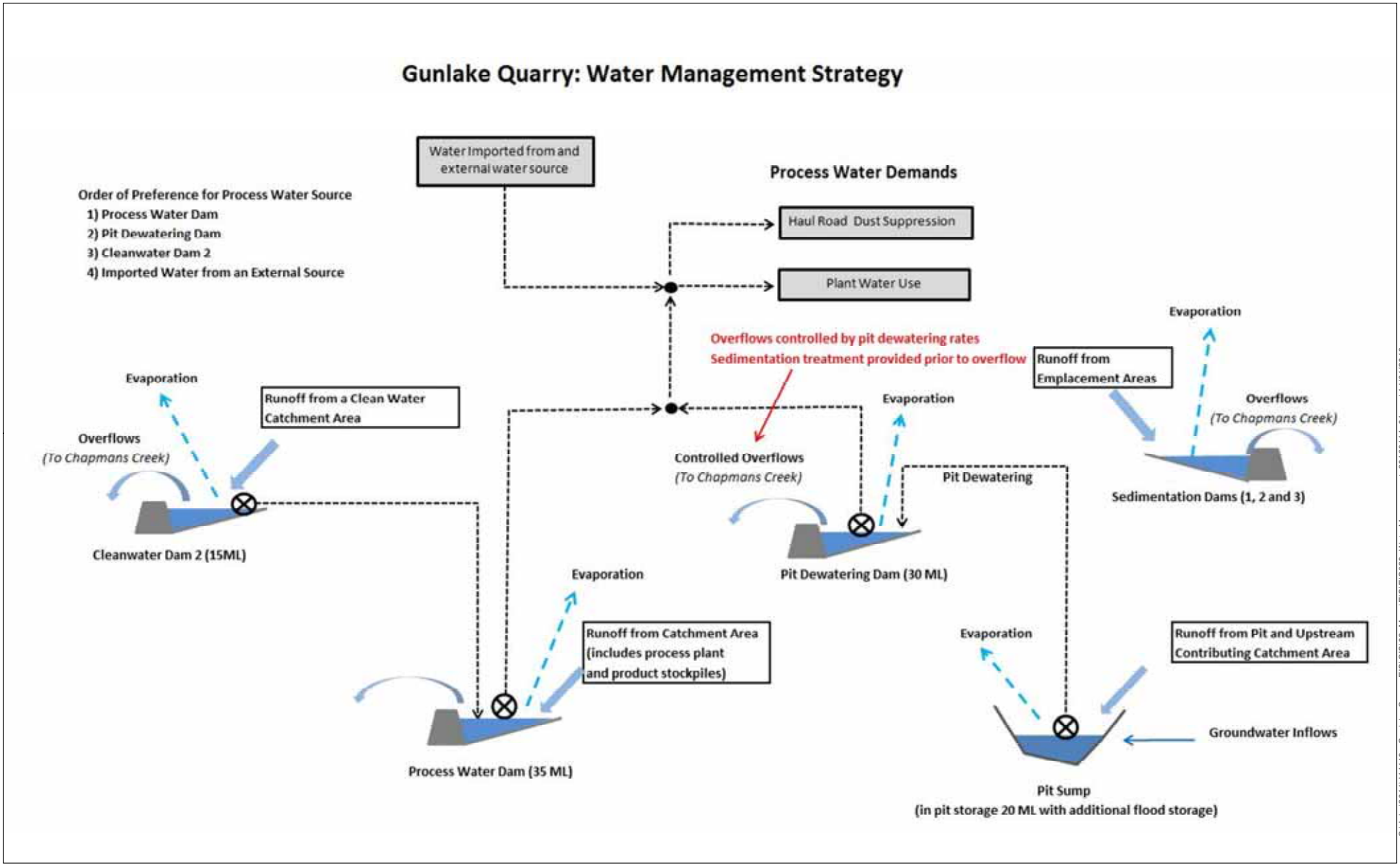
Gunlake will implement a surface water monitoring program and will progressively improve the surface water management system to mitigate any underperformances identified by the monitoring.

The extension project will have a neutral effect on surface water quality as it will satisfy the relevant criteria within the *Neutral or Beneficial Effect on Water Quality Assessment Guideline 2015* (Sydney Catchment Authority 2015).

ii Water quantity

The extension project will unavoidably result in some changes to the hydrologic regime of Chapmans Creek. These impacts will vary depending on the climatic conditions. Stream flow reductions will be offset by overflows from the Process Water Dam and sedimentation dams and controlled releases from the Pit Dewatering Dam. The impacts are expected to be negligible downstream of the confluence of Chapmans and Jaorimin Creek, due to the size of the quarry's surface water management system footprint (135 ha) relative to the contributing catchment areas of Chapmans and Jaorimin Creeks, which have a collective area of 4,100 ha.

No impacts to existing surface water users are predicted as there are no licensed surface water users immediately downstream of the quarry.



Proposed surface water management strategy

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Figure 7.2

EMM

iii Water usage

The expanded quarry is expected to use up to 110 ML of process water per year, largely for dust suppression on the haul road and in the processing plant. Water balance model results (Appendix G) indicate that the quarry's process water requirements will be primarily met by the water management dams. If water shortfalls occur for a period of time, contingencies will include:

- reducing water usage through the use of chemical dust suppressants;
- seeking an external water source and tanker water to the quarry (groundwater availability is described in Section 8.3.2); or
- temporarily reduce the scale of the operation to ensure the dust management objectives are being achieved.

Rainwater tanks currently collect runoff from the administration office and maintenance shed roofs. Harvested water is used for non-potable uses such as toilet flushing. The tanks can be filled with imported potable water during periods of water shortages. Drinking water is imported to the site and is provided in all facilities. The current water supply arrangements for site amenities will continue under the extension project.

The quarry currently operates an onsite waste water treatment and disposal system to manage all waste water produced from the quarry's amenities. Following approval of the extension project, Gunlake will review the adequacy of this system and will upgrade or replace the system if additional capacity is required due to increased staffing levels.

7.3.2 Water balance

i Methodology

A water balance model was developed for the extension project using a Visual-Basics program. The model applies a continuous simulation methodology that simulates the performance of the surface water management plan (SWMP) for the approved operations, each stage of the extension project, and post closure under a range of climatic conditions.

ii Approved operations

The water balance results for the approved operation indicate that:

- runoff volumes from the dirty water catchments DW-1 and the pit exceed the process water use volumes in median and wet years resulting in overflows from the Process Water Dam; and
- during median and dry years, water is harvested from Cleanwater Dams 1 and 2 to supplement process water supply from the pit sump and Process Water Dam. Model results indicated that during dry years, there will be periods of water shortages and externally soured water is likely to be required to supplement process water demand.

iii Extension project

The water balance model results for the extension project indicate that:

- both the frequency and volume of overflows from the Process Water Dam will significantly reduce due to the Process Water Dam being expanded from a 10 to 35 ML storage volume and the expected higher rate of process water extraction from the dam;
- dam releases will be required in 55 to 85% of years, depending on the stage of the quarry plan;
- the frequency and volume of dam releases will increase as the quarry plan progresses due to the pit footprint increasing, resulting in higher runoff volumes accumulating in the pit sump;
- during the initial year of the quarry plan, the operation will be vulnerable to water shortages, with water imports predicted if below average rainfall conditions occur. This is due to the process water demand increasing in line with the production increase and the catchment area of the pit being limited to 29 ha (compared to 53 ha once fully developed). In addition, no groundwater inflows into the pit are predicted in Quarry Year 1; and
- the risk of water shortages will decline significantly as the pit is developed to its ultimate footprint and groundwater inflows increase. Results indicating shortages are unlikely to occur post Quarry Year 10.

In summary, water balance model results indicate that the quarry's process water requirements will be primarily met by extraction from the proposed water management dams. Contingencies during water shortfalls were described in Section 7.3.1.iii.

iv Post closure

Dewatering will be discontinued following the completion of quarrying operations. The final void will continue to receive runoff from direct rainfall and a relatively small contribution from groundwater inflows. Water loss from the void will occur solely through evaporation.

The final void water balance results indicate that the final void is expected to slowly accumulate water for the initial 60 to 70 years following closure of the quarry operation. Equilibrium between long-term evaporation losses and runoff inflows is expected to be achieved when the lake level reaches the RL 599 to RL 606 m AHD range, approximately 40 to 45 m above the pit floor. The equilibrium level is predicted to be at least 35 m below the final void spill point (estimated to be between 640 and 650 m AHD), indicating that the final void lake is unlikely to ever spill to receiving waters.

Runoff from the 53 ha pit footprint will be permanently captured within the final void, resulting in a permanent reduction in stream flows in the downstream waterways in proportion the pit footprint compared to the total catchment under consideration. For example, at the confluence of Chapmans and Jaorimin Creek the reduction in flow will be less than 1.3% not allowing for the infiltration of runoff that will occur across the catchment. No water quality impacts are expected as no spillage from the final void to receiving waters is likely to occur.

7.4 Management and mitigation

7.4.1 Water licensing requirements

Water take from the following surface sources for the extension project will be regulated by the WM Act:

- clean water capture – runoff from clean water catchment areas that are captured in water management dams.
- sedimentation dam capture – water captured in the sedimentation dams.
- pit dewatering (surface runoff) – water dewatered from the pit that originated from runoff from within the pit catchment area.

Sedimentation dam capture and pit dewatering are excluded works under the Water Management (General) Regulation 2011. Clean water captured in water management dams will be licensed in accordance with the WM Act, with consideration given to excluded works in the Water Management (General) Regulation 2011 and Gunlake's harvestable rights (a total of 17 ML/year with only 1 ML/year currently allocated). Cleanwater Dam 2 will hold 15 ML. Hence, capture of runoff from this catchment is considered to be within Gunlake's available harvestable rights allocation of 16 ML and no water access licenses (WALs) will be required.

Should water need to be imported during extended dry periods (as indicated by the water balance results), Gunlake will seek appropriate required water licences once the preferred external water source has been identified. There is sufficient unallocated groundwater in the region to ensure that was will be available (see Section 8.3.1).

7.4.2 Surface water monitoring plan

It is proposed to modify the current surface water monitoring program to reflect the changes to the quarry's footprint and surface water management strategy. The modified program will comprise monitoring at the following locations:

- two receiving water sites on Chapmans Creek, downstream of the quarry; and
- the Process Water Dam and Pit Dewatering Dam.

Should the monitoring program indicate that the quarry is potentially adversely affecting water quality in Chapmas Creek, Gunlake will undertake an investigation to establish the likely cause and will implement necessary mitigation measures.

The Gunlake Water Management Plan will be updated following project approval. The monitoring plan framework and the proposed analytes are detailed in Appendix G.

7.5 Conclusions

The extension project will require additional surface water controls to manage potential impacts and to provide a reliable supply of water for quarry operations. The proposed surface water management strategy will mitigate potential water quality and quantity impacts and the extension project will not impact on downstream water users. Water balance model results indicate that the quarry's process water requirements will be met under most climatic conditions and there are available contingencies if there are water shortfalls.

8 Groundwater

8.1 Introduction

This chapter provides a summary of the groundwater assessment prepared by EMM, which is presented in full in Appendix H.

The chapter describes the existing groundwater regime, water licensing requirements, the results of groundwater modelling, and mitigation or management measures required to prevent or minimise predicted environmental impacts.

The assessment was completed with reference to the following guidelines and policies:

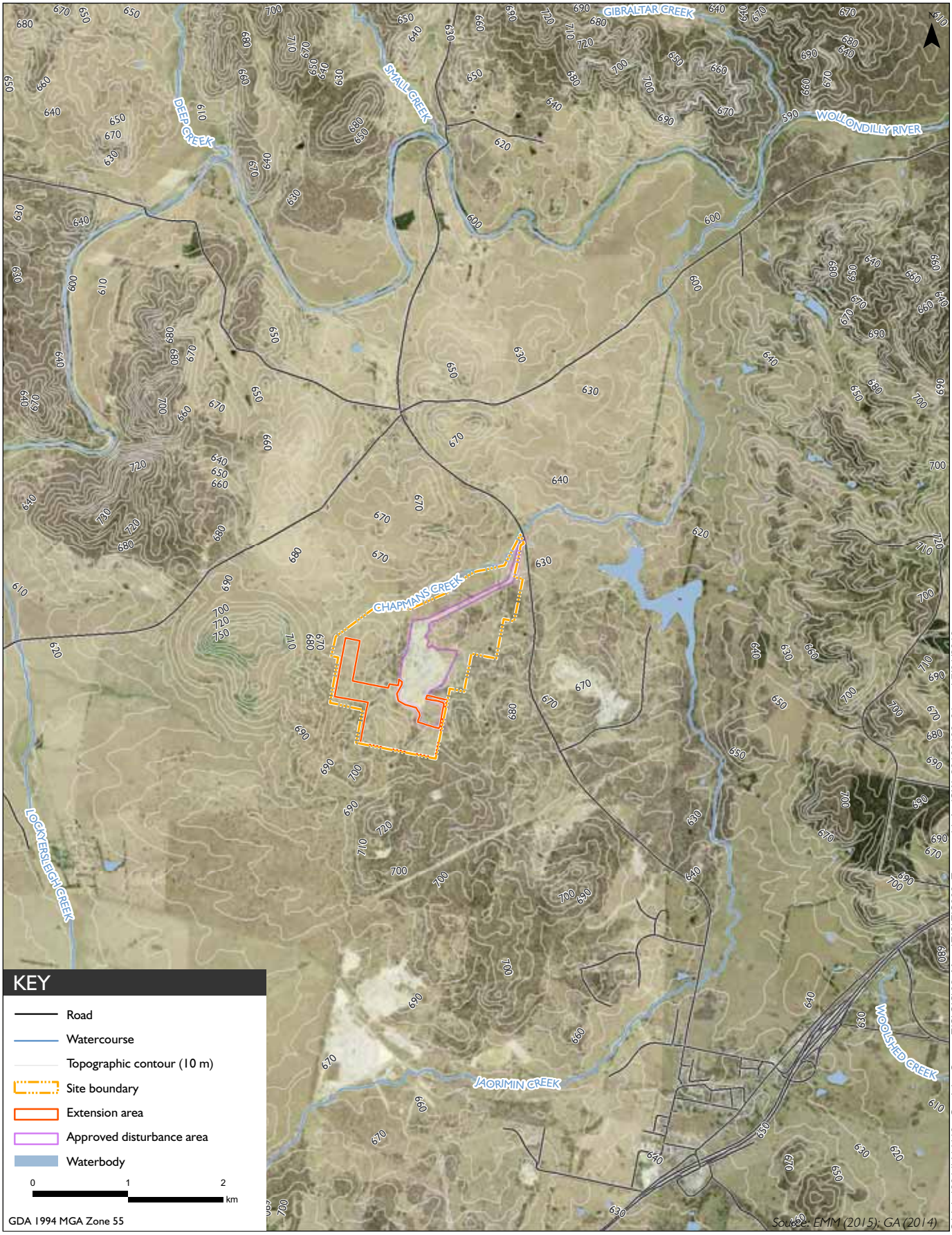
- the AIP;
- the SDWC SEPP and *Neutral or Beneficial Effect on Water Quality Assessment Guideline 2015* (Sydney Catchment Authority 2015);
- *NSW State Groundwater Policy Framework Document* (DLWC 1997), which comprises three policies:
  - *NSW State Groundwater Quantity Management Policy* (DLWC 2001);
  - *NSW State Groundwater Quality Protection Policy* (DLWC 1998);
  - *NSW State Groundwater Dependent Ecosystem Policy* (DLWC 2002);
- *NSW Water Conservation Strategy* (DLWC 2000);
- *Guidelines for Groundwater Protection in Australia, National Water Quality Management Strategy* (ANZECC and ARMCANZ 1995);
- *Australian Groundwater Modelling Guidelines* (SKM and NCGRT 2012); and
- National Water Quality Management Strategy *Australia and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC and ARMCANZ 2000a).

8.2 Existing environment

8.2.1 Surface water resources

As described in Section 7.2.2, there are two surface water resources in the immediate vicinity of the project boundary, Chapmans Creek and Jaorimin Creek (see Figure 8.1). Chapmans Creek and Jaorimin Creek are ephemeral watercourses that flow during, and immediately following, large rainfall events. Chapmans Creek flows north-east alongside the western boundary of the extension project and discharges to Joarimin Creek. Joarimin Creek is located to the east of the extension project and flows to the north.

Runoff from Chapmans Creek and Jaorimin Creek eventually discharges to the Wollondilly River (see Figure 8.1). The Wollondilly River is a major perennial river in the region and forms part of the Warragamba Dam catchment area.



Topography and surface water features

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Figure 8.1

The local surface water features in the vicinity of the project boundary are ephemeral and are not believed to receive large contributions from groundwater. The Wollondilly River may receive some baseflow contributions from groundwater.

8.2.2 Water sharing plans

As discussed in Section 0, there are two WSPs that manage water resources in the Gunlake area. Both the Surface Water WSP and Groundwater WSP cover an area of approximately 32,500 km^2 on the coast of NSW. The region includes rivers of the Illawarra and metropolitan Sydney, and the Hawkesbury and Shoalhaven Rivers. The extension project is within the Goulburn Fractured Rock Groundwater Source (GFRGS) within the Groundwater WSP. This water source covers an area of approximately 8,175 km^2. Up to 53,074 ML/year is available for extraction with only 12% of this currently being allocated.

8.2.3 Geology

The quarry is within the Palaeozoic Lachlan Fold Belt. The Lachlan Fold Belt is a Palaeozoic litho-tectonic assemblage which extends over much of central southern NSW. The quarry will continue to extract the hard rock resource from the Bindook Porphyry Complex — a sequence of folded and deformed, north to north-east trending Devonian volcanics. The Bindook Porphyry Complex is segregated into geological units (see Figure 8.2), with rock quarried from the Barralier Ignimbrite and Joaramin Ignimbrite.

8.2.4 Hydrogeology

There are two groundwater sources relevant to the extension project. An alluvial system associated with Chapmans Creek and a fractured rock system within the Bindook Porphyry Complex.

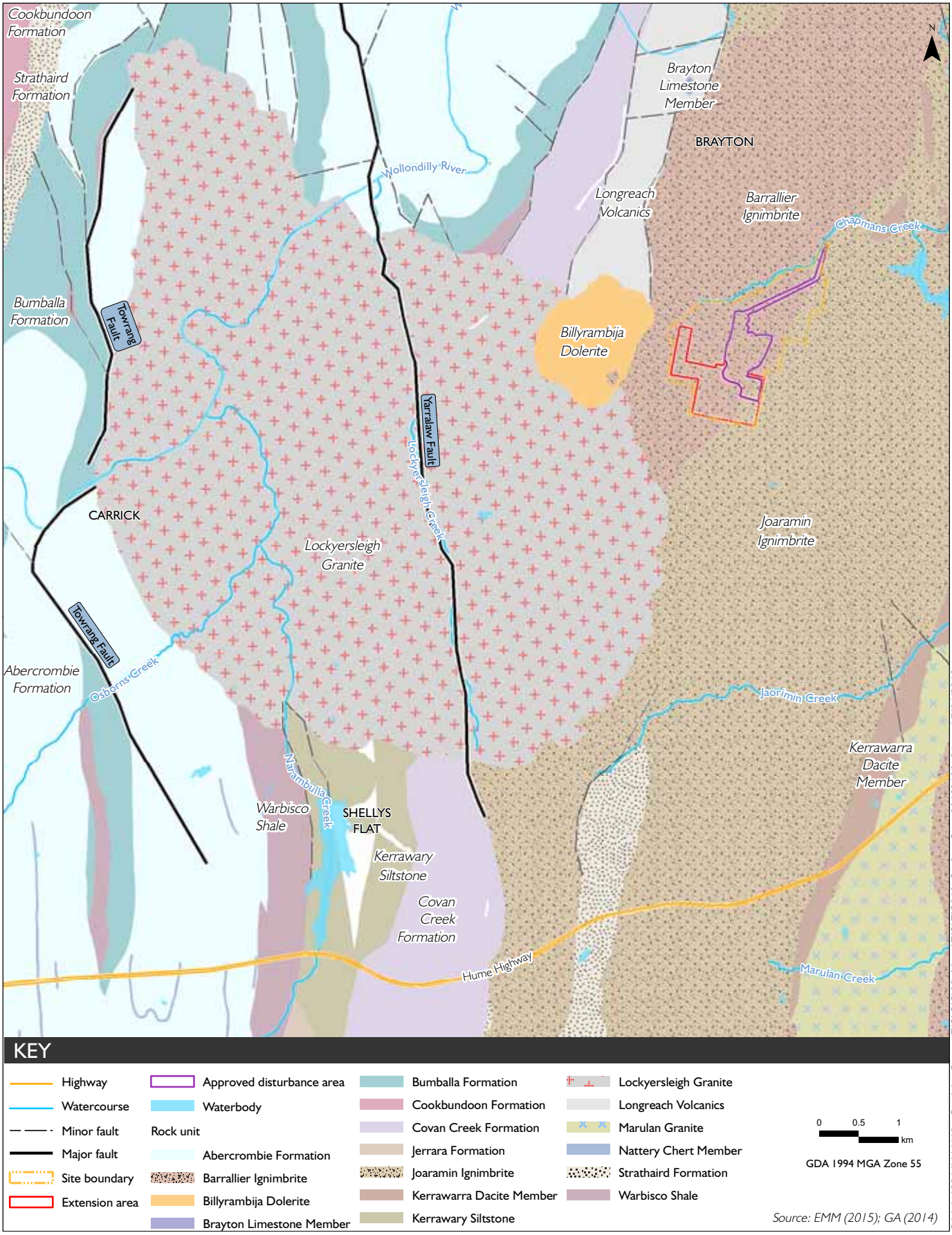
The poorly developed alluvial deposits along the alignment of Chapmans Creek and Joarimin Creek (and associated drainage channels) host an unconfined, perched water source. The alluvial deposits are typically less than 5 m thick with low storage (Dundon 2005). Groundwater residence time is low with rapid recharge and discharge following rainfall. The groundwater flow direction is consistent with the overlying surface water drainage features. The alluvium associated with Chapmans Creek is confined to a narrow band along the creek banks.

The alluvial sands and gravels are set within a matrix comprised of fine particles (clay and silt), reducing the permeability. Given the low permeability and limited extent (and therefore storage capacity), the alluvial aquifers are considered to be a marginal water source for extractive water supply. No registered groundwater users access this alluvial water source.

The porphyry rock mass hosts a fractured rock groundwater source with marginal extraction value (high EC and low yield). Regional groundwater flow is towards the north-east, with eventual discharge to the Wollondilly River. On a local scale, the groundwater flows north-east, following a muted reflection of topography. Groundwater flow may also follow structural discontinuities in the rock mass, as shown by spring discharges.

The groundwater systems are recharged via the infiltration of rainfall and overlying surface water sources where alluvium is located. Recharge rates to alluvium and low lying areas are expected to be higher than the fractured rock mass. This is because alluvium has a higher permeability than the porphyry rock mass and low lying areas receive more inundation with surface water flow.

Nine springs have been identified within a 1.5 km radius of the centre of the extension area (see Figure 8.3). The springs are associated with sub-vertical geological discontinuities which allow discrete groundwater discharge (fracture springs).



Surface geology and faults

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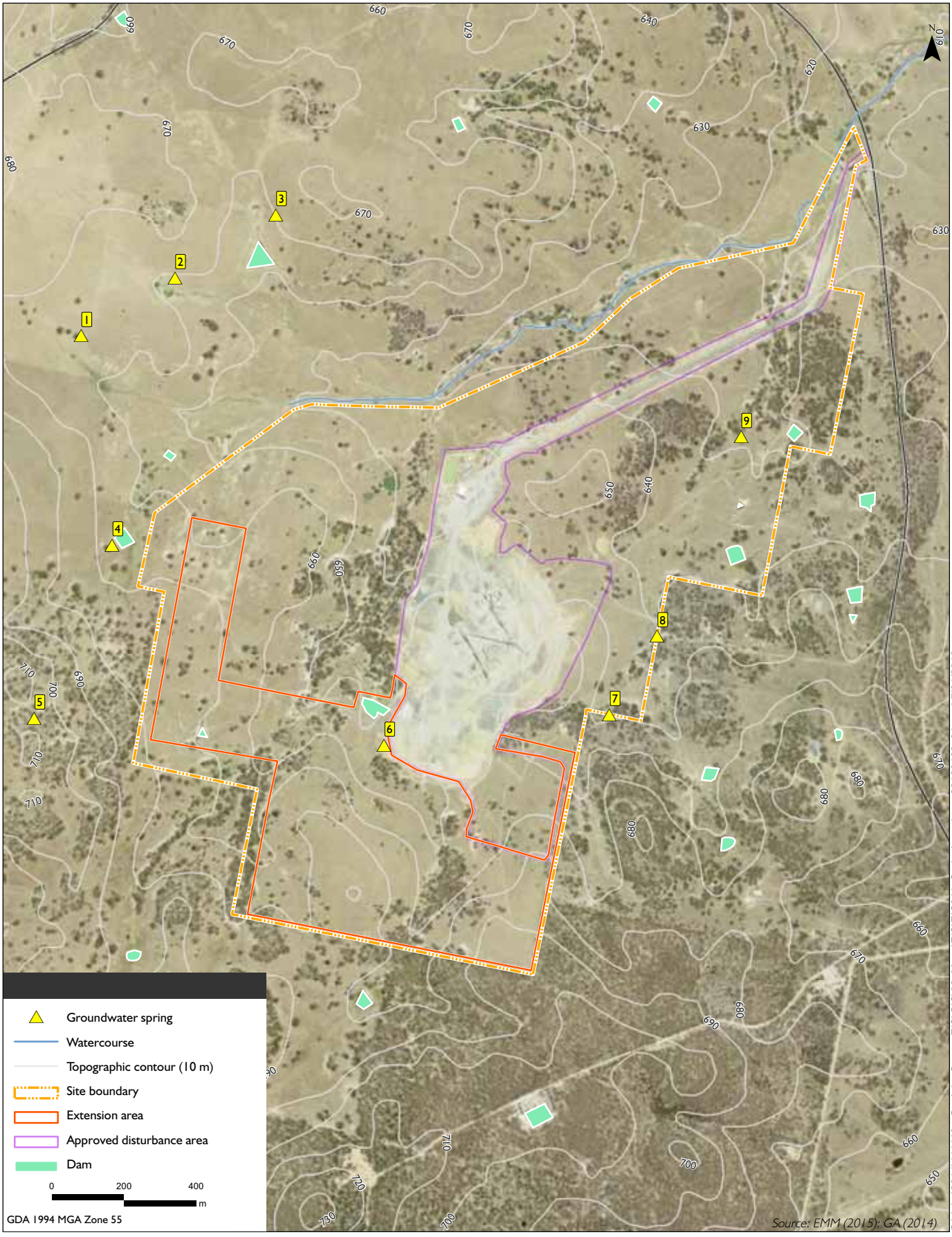
Figure 8.2



Spring locations

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Figure 8.3

8.2.5 Groundwater monitoring

Gunlake operates a network (Figure 8.4) of four standpipe piezometers (monitoring bores) (GM6, GM13, GM24 and GM36). These were installed into the Bindook Porphyry in April 2007. Groundwater monitoring of water level and water quality parameters (pH, EC and temperature) is undertaken quarterly at the monitoring bores.

Groundwater levels in the vicinity of the project boundary range from 634.9 to 659.5 m AHD (or 6.3 to 22.5 m below ground level). The groundwater level at GM6 fluctuates the most, rising following heavy rainfall events or sustained rainfall, and declining in dryer periods. More gradual or delayed and muted groundwater level fluctuations are observed in GM13, GM24 and GM36.

The receiving water catchment area, Warragamba Dam catchment, is a drinking water catchment. Therefore, the groundwater quality results were compared against the *Australian Drinking Water Guidelines* (drinking water guidelines) (NHMRC 2011) for Health and Aesthetic categories. Groundwater quality results were also compared against the ANZECC and ARMCANZ (2000a) trigger values for the 95% protection of freshwater species, and for moderately disturbed upland rivers (aquatic ecosystem protection guidelines).

Groundwater is generally of poor quality (as per the AIP total dissolved solids classification). The groundwater in the area is suitable for stock purposes based on the ANZECC and ARMCANZ (2000a) trigger values. A summary of the monitoring results is provided below.

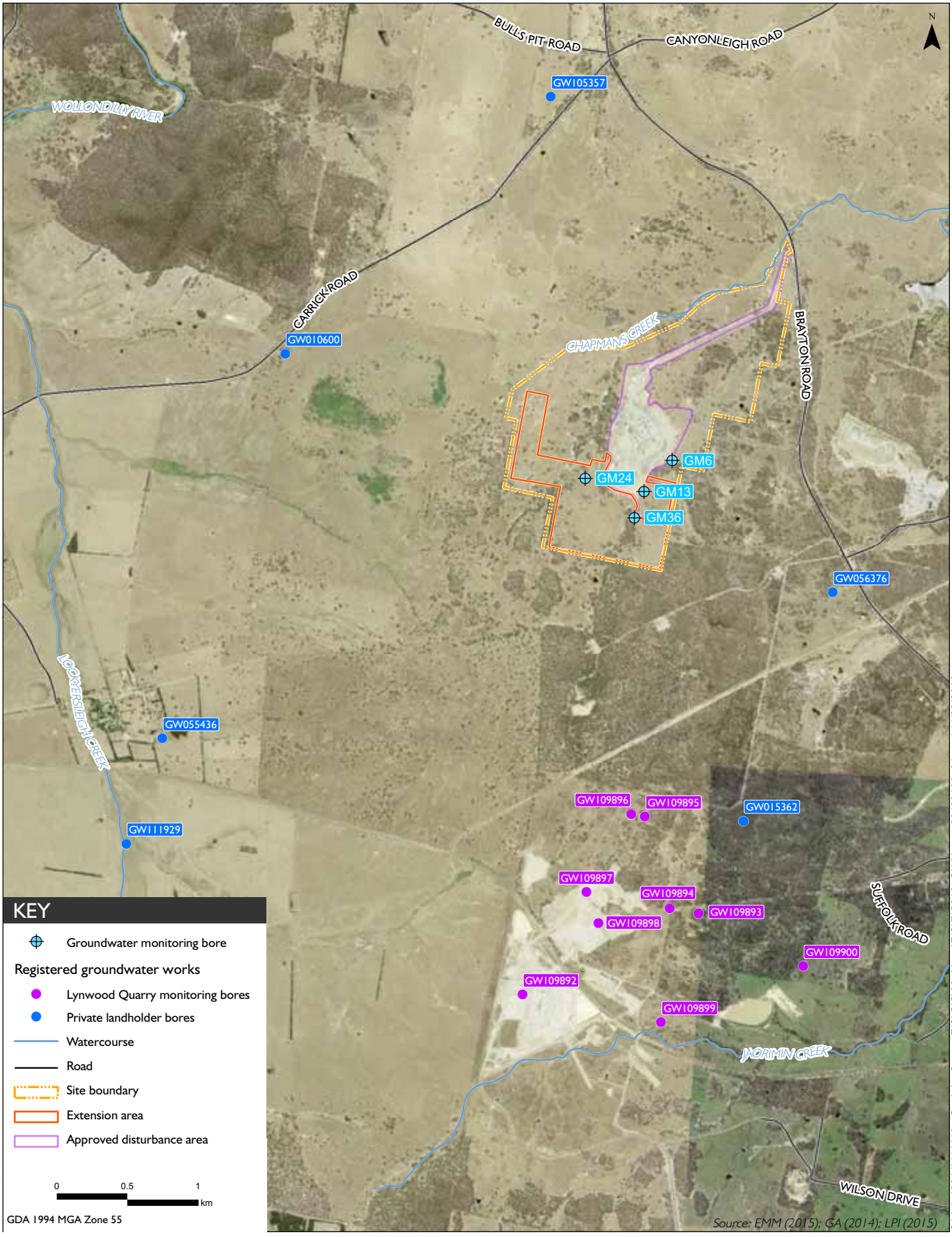
- The EC is generally brackish (1,600–4,800 µS/cm) however ranges from fresh (<800 µS/cm) to slightly saline (4,800–10,000 µS/cm). Salinity levels generally exceed the ANZECC and ARMCANZ (2000a) guideline trigger value.

- The pH ranges from neutral to slightly alkaline across the site with the notable exception of pH 9 recorded at GM6 in May 2015. This highly alkaline measurement is considered to reflect a compromised bore construction or incorrect sampling technique, not an indication of regional trends.

- The groundwater has an ionic composition typical of a mixed groundwater resource where rainfall is introduced to the system.

- Groundwater concentrations of dissolved arsenic, cadmium, chromium, lead and nickel were greater than the drinking water guidelines values. Concentrations of nickel and zinc were also greater than the aquatic ecosystem protection guidelines trigger values. Elevated concentrations of dissolved metals are not attributable to quarry activities.

- Groundwater concentrations of ammonia, nitrite, nitrate and phosphorous concentrations were greater than aquatic ecosystem protection guidelines values. The nitrate concentration was generally greater than the aquatic ecosystem protection guidelines value (0.015 mg/L) but below the drinking water guidelines value (50 mg/L). The maximum nitrate concentration (4.2 mg/L) was measured at GM6 in May 2015. The elevated nutrient concentrations can be attributed to anthropogenic land use practices within the groundwater catchment (eg farming).



Groundwater users

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Figure 8.4

8.2.6 Hydraulic conductivity

Rising and falling head tests (slug tests) were completed in June 2007 at eight shallow exploration boreholes at Gunlake Quarry. Results from the slug tests indicate that the weathered Bindook Porphyry has a low permeability with the derived hydraulic conductivity ranging from 0.01 to 0.78 m/day (Cook 2008). This range is consistent with results from hydraulic testing at the nearby Lynwood Quarry (0.005 to 0.38 m/day, Dundon 2005). The groundwater salinity is also suggestive of a low flow system, such that groundwater residence times are sufficient enough to result in brackish to slightly saline conditions down hydraulic gradient.

8.2.7 Groundwater users

A search of the DPI Water PINNEENA database (version 10.1) undertaken in June 2015 identified 15 groundwater works within a 5 km radius of the extension area (see Figure 8.4). Five local groundwater works are registered for private use (stock or domestic/stock purposes). GW056376 is the closest private groundwater work to the extension project, approximately 1.2 km east of the site boundary.

Nine of the identified groundwater works are Holcim groundwater monitoring bores as Holcim's Lynwood and Johnniefields quarries are groundwater users. Groundwater is accessed via inflows to the pit and used onsite for operational activities. The Johnniefields operation is concluding operations soon and will not require an ongoing groundwater supply. A maximum groundwater inflow rate of 14.1 ML/year is predicted at Lynwood Quarry (Scientific Systems 2015).

As mentioned in Section 8.2.4, no registered groundwater users access the alluvial water source.

8.2.8 Groundwater dependent ecosystems

Two ecosystem types potentially reliant on groundwater (groundwater dependent ecosystems/GDEs) have been identified within and surrounding the Proposal area:

- ecosystems potentially reliant on the surface expression of groundwater (ie creeks and springs); and
- ecosystems potentially reliant on the subsurface presence of groundwater.

The following surface water ecosystems identified by the *Atlas of Groundwater Dependent Ecosystems* (BoM 2015) potentially rely on the surface expression of groundwater:

- Chapmans Creek, within and directly north of the project area has a moderate potential for groundwater interaction;
- Jaormin River, south of the project area has a high potential for groundwater interaction;
- Lockyersleigh River, west of the project area has a high potential for groundwater interaction; and
- Wollondilly River, north of the project area has a high potential for groundwater interaction.

There are no high priority GDEs listed in the Groundwater WSP, for the GFRGS.

The potential impact of the extension project on GDEs is described in Section 9.3.6. The availability of water in the perched systems is not predicted to significantly decrease so no significant impacts to overlying vegetation are predicted.

8.3 Impact assessment

8.3.1 Groundwater modelling

An analytic element groundwater flow model was used to predict the potential groundwater impacts from the extension project. The model was developed in accordance with the Australian groundwater modelling guidelines and satisfies the requirements for a class 1 flow model (SKM & NCGRT 2012). The model was developed in AnAqSim (Fitts Geosolutions 2015).

The model domain encompasses a surface area of 6,190 ha, constrained by surface watercourses (Lockyerslegih Creek, Jaorimin Creek and Wollondilly River) represented in the model as head-specified boundaries. The head-specified model boundaries maintain a constant head to represent an inferred groundwater table within the underlying hard rock strata. The depth of the groundwater table in the hard rock was interpreted using available surface topography, water levels and surface water flow regimes. The model domain is divided into six sub-units and three layers providing a simplified representation of the geological complexities in the quarry site.

Hydraulic properties assigned to the model were based on the results from monitoring and hydraulic testing at Gunlake Quarry and groundwater studies completed in the area (Dundon 2005, Cook 2008 and Scientific Systems 2015). Minor adjustments to the hydraulic properties were made during calibration of the steady state model. The Bindook Porphyry is represented in all three layers and assigned hydraulic conductivities to represent the influence of the weathering profile and increased overburden pressure with depth.

To manage uncertainties resulting from the model being a simplified representation of a complex groundwater system, a sensitivity analyses was undertaken on the results and conservative model input parameters were used where there is uncertainty in the available data. Conservative model input parameters were used so predicted impacts are the 'worst possible scenario', ie the upper limit of adverse impacts. Actual impacts are anticipated to be within model predictions.

The groundwater assessment modelling included the following:

- a steady state model to simulate groundwater levels prior to any extraction or quarrying activity;
- four transient models to simulate staged expansion of the extension project (ie Stages 1–4); and
- a transient model run to simulate the final pit void with the recovery of groundwater level over 100 years.

8.3.2 Potential impacts

i Minimal impact considerations for porous and fractured rock sources

The AIP states that the assessment of an activity must address potential water table, water pressure and water quality impacts of aquifer interference activities. Combined, these are called 'minimal impact considerations'. The AIP requires that a plan is prepared that describes groundwater monitoring and mitigation of impacts should actual impacts exceed predicted impacts.

The AIP divides groundwater sources into two categories 'highly productive' and 'less productive.' The groundwater resource at Gunlake Quarry is classified as less productive with measured yields less than 5 L/s and marginal water quality (see Section 8.2.6). The minimal considerations for porous and fractured rock units of less productive groundwater systems were therefore adopted for this assessment.

The minimal impact considerations define a drawdown (water level or pressure) of 2 m as a significant impact requiring mitigation. Modelling predicted a 2 m drawdown extending up to 1.5 km from the edge of the pit footprint (Figure 8.5). This is referred to as the zone of predicted drawdown. The groundwater receptors within this zone required assessment and may require mitigation in accordance with the AIP. There are no works within the zone. The closest works (GW056376) are 800 m outside of the zone's boundary.

The only groundwater receptors within the zone of predicted drawdown are springs 5, 6, 7 and 8 and areas of Box Gum Woodland (see Figure 8.5). Groundwater springs 5, 6, 7 and 8 will receive reduced groundwater contributions and those closest to the extension project (ie springs 6 and 7) will cease to flow. The springs do not support GDEs or hold any significant environmental value and predicted reductions in flow are not considered to require mitigation.

The distribution of the Box Gum Woodland suggests the vegetation is reliant on rainfall and shallow perched groundwater systems within the alluvial deposits. Drawdown in the fractured rock is not expected to impact vegetation health, further discussion is provided in Section 9.3.4 and in the biodiversity assessment (see Appendix I).

Under natural conditions, Chapmans Creek loses baseflow to the underlying fractured rock water source. The rate of this loss is governed by the hydraulic conductivity of the strata underlying the creek. The extension project will not impact on the hydraulic conductivity of strata outside of the pit. Therefore, no impacts to baseflow at Chapmans Creek are predicted as a result of changes to the groundwater regime.

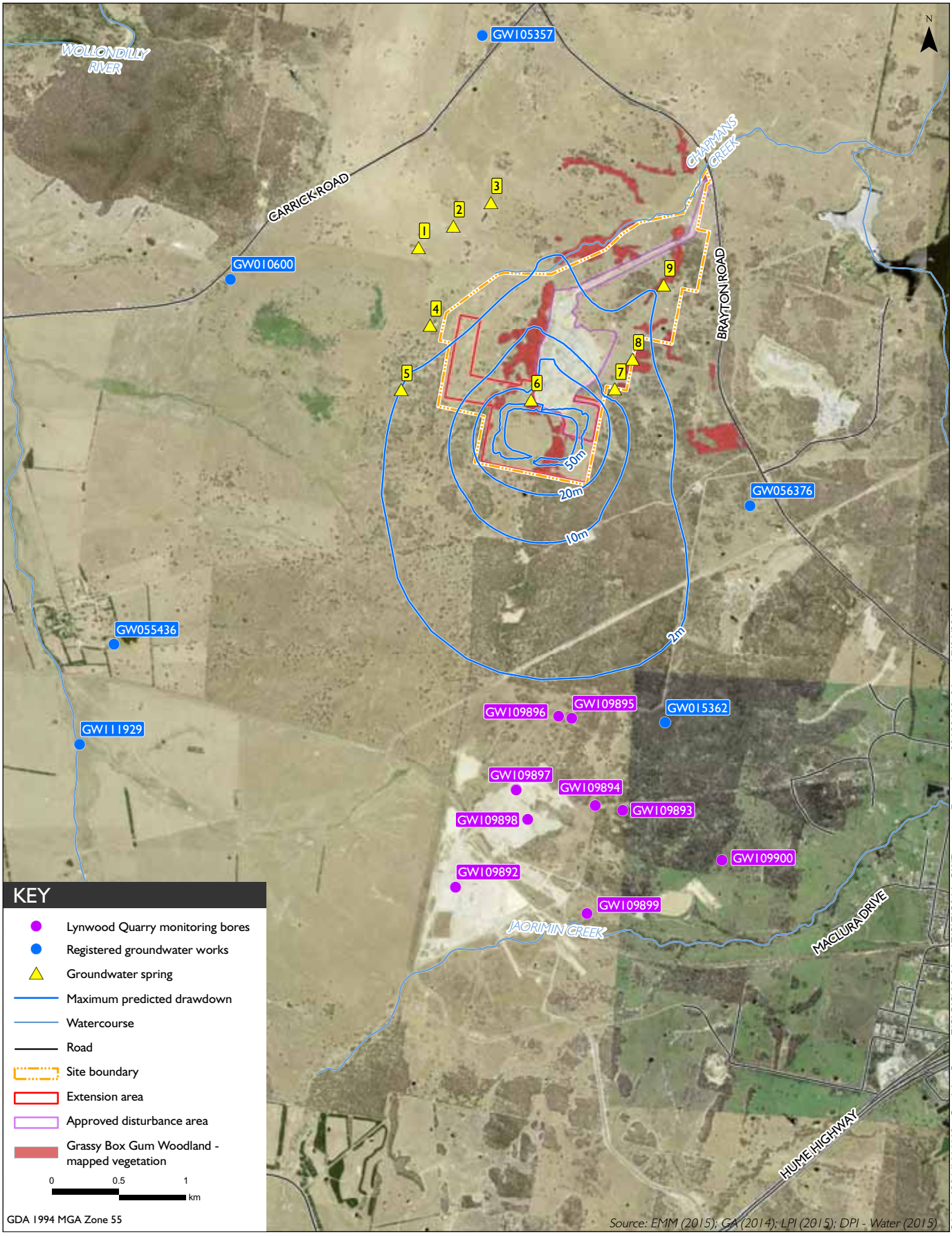
The perched aquifers within the poorly developed alluvial deposits are disconnected from the underlying fractured rock groundwater source. Depressurisation of the underlying strata will, therefore, have a negligible impact on the alluvial groundwater. However, the pit development will reduce the surface catchment runoff are and will reduce recharge to the alluvial system locally. No registered groundwater users access the alluvial water source (Section 8.2.4).

ii Groundwater inflows

As quarry extraction progresses below the water table, a hydraulic gradient will be created directing groundwater flow towards the depressurised strata and into the pit (groundwater inflow). A maximum inflow rate of 37 ML/year is predicted during Stage 3 of the extension project. The depth of extraction will progress to 598 m AHD during this stage, approximately 45 m below the pre-quarrying water level. Inflow rates are predicted to remain relatively constant as extraction progresses to a final depth of 572 m AHD and then gradually decrease as the strata around the pit is dewatered.

Gunlake will be required to hold a WAL (or WALs) within the GFRGS equivalent to the volume of water intercepted during each year of operation of the extension project. The licenses will be obtained by trading from other users or via a controlled allocation release. The maximum annual take of 37 ML is within the volumetric entitlements allocated for the GFRGS license pool.

Trading can occur from within the pool of 3,051 shares that currently exist. However, Gunlake may apply for an entitlement via an application under Section 65 of the WMA when the next controlled allocation order is announced by the NSW Government. This is likely to occur in mid 2016 as controlled allocation orders are generally undertaken every 18 months, and the last one was on 9 September 2014. Controlled allocation orders generally make available 5% of the remaining unallocated water, and the 9 September 2014 order made 2,273 share units available. Therefore, there is sufficient volume within the market or within the next controlled allocation order from which to obtain a WAL for the extension project.



Groundwater receptors and predicted drawdown

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Figure 8.5

iii Final void

As described in Section 7.3.2.iv, a lake will form in the void following closure. The elevation of the pit lake will remain below the pre-quarrying groundwater level and consequently, the final landform will form a perpetual evaporative sink. Groundwater levels in the surrounding strata will partially recover. However, a permanent depression will remain around the final void (see Figure 8.6).

Groundwater inflow to the final void is predicted at a rate of 75 m^3 per day (27 ML/year) at Year 30. The inflow rate will decline as the surrounding strata dewaters. Groundwater inflows are predicted to decline to insignificant rates 20 years after the completion of the extension project.

The final void will contain all captured surface water and groundwater following the completion of the extension project. The final landform will not discharge to the surrounding environment.

iv Water quality

Groundwater seepage to the pit is expected to have similar water quality to the established baseline groundwater quality data. Groundwater inflows and captured surface water will be stored and/or re-used onsite during the extension project (see Chapter 7).

Controlled release of surface water will be required at times. All released water will be treated by sedimentation, water quality will be monitored of water prior to release and additional treatment will be provided if required (see Section 7.3.1). Therefore, there will be negligible impacts to the groundwater quality.

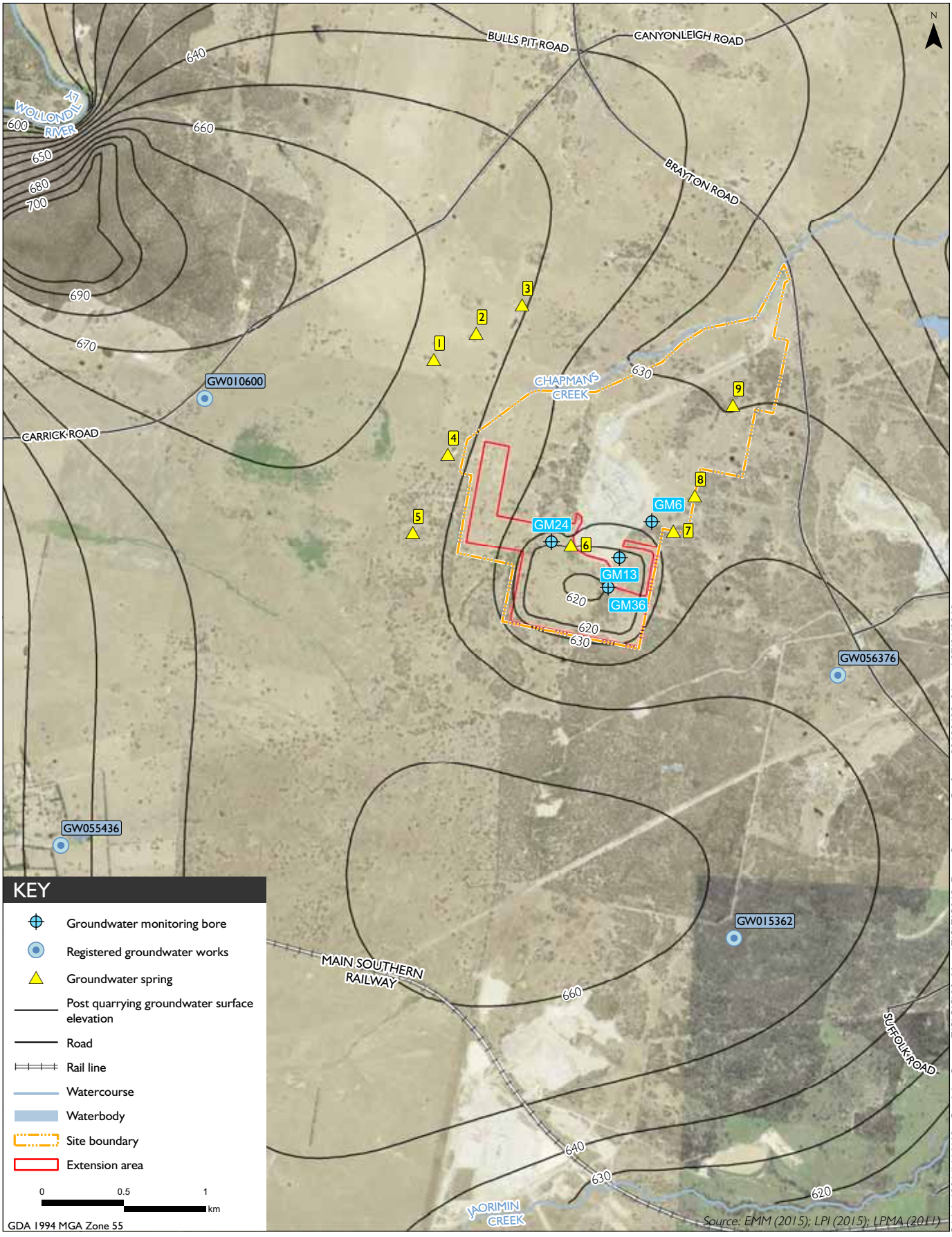
The final landform will create an inward hydraulic gradient preventing the discharge of water from the pit into the fractured rock groundwater source. The risk of contamination of the groundwater resource will be low with a neutral impact on the beneficial use class (stock).

The extension project will have a neutral effect on groundwater quality as it will satisfy the relevant criteria within the *Neutral or Beneficial Effect on Water Quality Assessment Guideline 2015* (Sydney Catchment Authority 2015).

v Cumulative impacts

The potential for cumulative impacts from simultaneous extraction at the extension project and the adjacent Holcim Lynwood Quarry was assessed. While the combined groundwater drawdown from the two quarries may create additional drawdown in the area between the adjacent operations, there are no groundwater receptors in this area so no additional impacts to receptors are predicted.

Each operation will licence their predictive groundwater take from within the GFRGS license pool. There is sufficient volume within the market for the predicted combined take from Gunlake Quarry and Lynwood Quarry of up to 48.1 ML/year.



Post quarrying groundwater surface elevation

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Figure 8.6

8.4 Management and mitigation

Gunlake Quarry has an approved water management plan detailing water management for the existing operations. If the extension project is approved, the water management plan will be updated to include:

- triggers values to facilitate the identification of groundwater impacts outside of predictions;
- the use of monitoring data to calibrate and update the model at significant project stages;
- quarterly groundwater quality and level monitoring to facilitate the early identification of adverse impacts and test model predictions;
- monitoring of spring flow in conjunction with the quarterly groundwater level and quality program;
- monitoring mapped areas of Box Gum Woodland;
- procedures for the re-use of site water; and
- response protocols and contingency mitigation measures to be implemented in the event of an unpredicted adverse impact.

As described in Section 8.3.2, Gunlake Quarry will obtain a WAL (or WALs) for the predicted groundwater take over the lifespan of extension project (up to 37 ML/year).

8.5 Conclusions

An analytic element groundwater flow model was used to predict the potential groundwater impacts from the extension project. Groundwater impacts are predicted to be minor and confined to an area immediately surrounding the pit. The impacts can be managed so as to not adversely impact on the surrounding environment.

A drawdown of 2 m is predicted to extend up to 1.5 km from the edge of the pit footprint by Year 30 of the extension project. Groundwater inflows to the pit of up to 37 ML/year are predicted and require licensing from within the unallocated water in the GFRGS under the WM Act. There is sufficient water volume within the market or within the next controlled allocation order to allow the required WAL (or WALs) to be obtained.

Possible impacts to springs include a declined flow rate at groundwater springs 5 and 8 and ceasing of flow at springs 6 and 7. The springs do not support GDEs and are not considered to hold significant environmental value (see Section 9.3.6).

The Box Gum Woodland within the zone of predicted drawdown does not rely on groundwater from within the hard rock strata in this area and no impacts are predicted on the alluvial aquifer. Therefore, the Box Gum Woodland is not predicted to be impacted by groundwater drawdown as a result of the extension project.

Groundwater inflows to the pit are not predicted to reduce baseflows to the ephemeral watercourses in the area (Chapmans Creek and Jaorimin Creek). No impacts to registered groundwater works are predicted and a neutral impact on water quality in the hydrological catchment is predicted.

9 Biodiversity

9.1 Introduction

This chapter provides a summary of the biodiversity assessment prepared by EMM, which is presented in Appendix I.

The assessment considers the biodiversity impacts of the extension project and identifies measures to avoid, mitigate and/or offset any potential impacts. The assessment focuses on the extension area as the majority of the approved footprint has been previously assessed and subsequently cleared.

The assessment was prepared in accordance with the OEH *Framework for Biodiversity Assessment* (OEH 2014c).

9.2 Existing environment

9.2.1 Desktop assessment

A range of maps, environmental assessment reports and relevant scientific literature were reviewed. These included:

- *Flora and Fauna Survey and Ecological Impacts Assessment Report: Proposed Hard Rock Quarry, Haul Road and Bypass Roads Near Marulan* (Ecotone 2008a);
- *Gunlake Quarry Proposal – Major Proposal Application 07-0074: Letter Report in Response to Comments by DECC* (Ecotone 2008b);
- *Extensions to Gunlake Quarry, Marulan: Supplementary Flora and Fauna Assessment* (Biosis 2014);
- *Gunlake Quarry Modification 2: Modification of Proposal Approval 07-0074 Response to Submissions* (EMM 2015a);
- *Threatened Species Profiles for the Hawkesbury Nepean CMA* (OEH 2013);
- *Terrestrial Vertebrate Fauna of the Greater Southern Sydney Region* (DECC 2007a); and
- *Native Vegetation of Southeast NSW* (Tozer et al 2010).

Database searches were conducted to identify threatened terrestrial and aquatic species and habitat in and surrounding the project area (Table 9.1).

Table 9.1 Database search details

Source	Date	Search area
Atlas of NSW Wildlife www.environment.nsw.gov.au/atlasapp	7 April 2015	10 km radius
Threatened and Protected Species Records Viewer www.dpi.nsw.gov.au/fisheries/species-protection/records/viewer	7 April 2015	Goulburn LGA
Protected Matters Search Tool www.environment.gov.au/webgis-framework-apps/pmst/pmst.jsf	7 April 2015	10 km radius
Critical Habitat Register www.environment.nsw.gov.au/criticalhabitat/CriticalHabitatProtectionByDoctype.htm	7 April 2015	Not applicable, as individual sites are listed as critical habitat in NSW
Australian Wetlands Database www.environment.gov.au/topics/water/water-our-environment/wetlands/112omm.112olou-wetlands-database	7 April 2015	Names of local wetlands were searched

9.2.2 Field survey

i Previous surveys

The quarry site and surrounds have been subject to a number of field surveys. These have included:

- comprehensive flora surveys of the originally proposed (and now approved) footprint on 15 and 16 January 2006 by Ecotone;
- comprehensive fauna surveys (Elliot trapping, hair tubes, diurnal bird census, diurnal reptile census, Koala scat search, dusk hollow watch, nocturnal playback and spotlighting, hand searches for frogs, harp trapping, ultrasonic call detection, and habitat tree census) of the originally proposed footprint by Ecotone over 5 days and 4 nights in January 2007;
- flora survey on 22 August 2014 in the proposed (and now approved) Modification 2 footprint by Biosis; and
- bird surveys on 22 August, 29 August and 1 September 2014 in the Modification 2 footprint by Biosis.

Data from the previous surveys were used to identify the likelihood of threatened species occurring in the study area. These also formed the basis for the refinement of existing vegetation mapping.

9.2.3 EMM surveys

The following sections detail the surveys undertaken by EMM in the study area between December 2014 and March 2015. The surveys were completed over three survey events as detailed in Table 9.2. Weather conditions during the surveys are also included in the table.

Table 9.2 Overview of EMM surveys

Dates	Survey type	Min temp[1]	Max temp[1]	Rainfall (mm)[2]
5 December 2014	Preliminary site assessment, rapid vegetation assessments	7.6°C	29°C	13.2
12–13 January 2015	Floristic plots, targeted flora searches and reptile active searches	14.1°C	25.8°C	12.8
10–13 March 2015	Floristic plots, diurnal bird surveys, nocturnal bird and mammal surveys, nocturnal amphibian surveys, active reptile searches, anabat call detection and harp trapping	12.3°C	30.4°C	1.6

Notes: 1. Temperature data – minimum and maximum over survey period from Goulburn TAFE weather station.

2. Rainfall data – total over survey period from Marulan (Johnniefelds) weather station.

i Preliminary site assessment

A preliminary site survey for the extension project biodiversity assessment was completed on 5 December 2014 to gain an appreciation of the vegetation and habitats present within the extension area. This involved driving around the quarry site and potential offset areas to identify the dominant species and habitat features present. The results of the preliminary site assessment informed the extension project field survey requirements.

ii Extension project current surveys

A range of field surveys were undertaken for the extension project. These included vegetation surveys using a combination of plot-based surveys, rapid assessment surveys and native/exotic vegetation transects. Threatened species surveys were also undertaken in the extension area in accordance with the NSW *Draft Guidelines for Threatened Species Assessment* (DEC&DPI 2005). The threatened species profiles, and the *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities – Working Draft* (DEC 2004) were also consulted. The surveys targeted threatened species that have previously been recorded or are considered likely to occur in the extension area. The fauna habitat types and condition were also surveyed across the extension area to determine appropriate locations for targeted sampling of fauna species.

The surveys for this assessment and previous survey effort in the study area are summarised in Table 9.3. They are described in detail in Appendix I.

Table 9.3 Summary of survey effort

Taxa group	Survey method	EMM survey effort	Previous survey effort
Flora	Plot and transect surveys	13 BioBanking plots	1 BioBanking plot (Biosis) 10 quadrats 20 x 20 m (Ecotone)
	Rapid vegetation assessments	Over 100 locations throughout the extension area and surrounds	No rapid vegetation assessments completed
	Targeted threatened flora searches	6 days targeted searches in flowering period for Hoary Sunray	1 day targeted searches (Biosis) 2 days targeted searches (Ecotone)

Table 9.3 Summary of survey effort

Taxa group	Survey method	EMM survey effort	Previous survey effort
Fauna	Habitat assessments and searches for signs	Surveys over 6 days by 2 people	Incidental observations over 5 days and hollow tree survey (Ecotone)
Frogs	Nocturnal searches and nocturnal call recognition	Surveys on 3 nights by 2 people	Surveys on 3 nights by 2 people (Ecotone)
Reptiles	Active search	Searches over 4 days by 2 people	1 hour diurnal survey (Ecotone)
Birds	Timed diurnal search	10 timed search areas over 3 days and incidental observations over 6 days by 2 people	Surveys on 3 days (Biosis) Nine 20 minute surveys (Ecotone)
Microchiropteran bats	Ultrasonic call detection	6 nights in 3 locations	4 nights in 8 locations (Ecotone)
	Harp trapping	6 trap nights in 3 locations	Up to 3 nights in 6 locations (Ecotone)
Koala	Spot assessment technique	Undertaken at each plot location with trees (8 spot assessments)	3 spot assessments (Ecotone)
Nocturnal birds, frogs and mammals	Call broadcasting and spotlighting	Call playback and spotlighting on 3 nights by 2 people	Dusk hollow tree watch and call playback on 3 nights by 2 people (Ecotone)
	Mammal trapping	No trapping undertaken	3 trap lines, each with up to 10 ground and 10 tree Elliot traps (Ecotone) 4 lines of hairtubes (up to 8 tubes per line) (Ecotone)

9.2.4 Native vegetation

The extension area and surrounds contain few areas of intact woodland vegetation, with most areas modified by historical agricultural use. The patches of remnant vegetation occur in drainage depressions and on slopes of lower agricultural utility. There are larger areas of native vegetation south and south-east of the quarry.

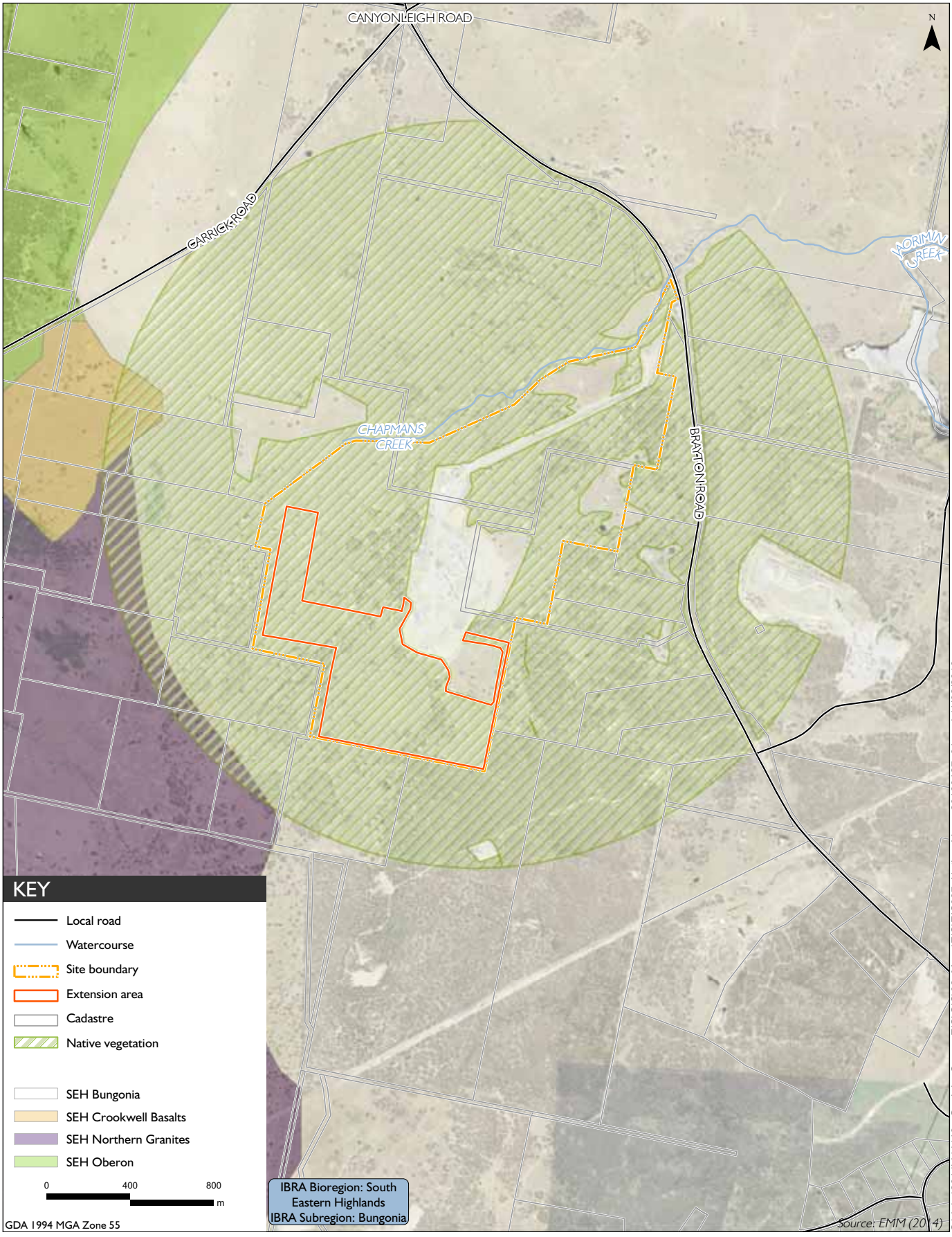
Two native vegetation communities have been identified in the study area, a stringybark community on the hillslopes and a remnant floodplain community. The majority of the remnant vegetation is derived from the stringybark community. Disturbed grasslands, which largely comprise native pasture, occur throughout the extension area. Profiles for the identified vegetation communities are provided in the following sections.

i Plant Community Types

Two Plant Community Types (PCTs) were recorded in the extension area (Figure 9.1):

- Yellow Box — Blakely's Red Gum Grassy Woodland and Derived Native Grasslands; and
- Broad-leaved Peppermint — Red Stringybark Grassy Open Forest and Derived Native Grassland.

Detailed descriptions of these PCTs are provided in Appendix I.



Native vegetation extent

Gunlake Quarry

Environmental Impact Statement

Figure 9.1

ii Vegetation zones

There are four vegetation zones in the extension area (Table 9.4).

Table 9.4 Vegetation zone summary

Vegetation zone	PCT	Condition class	Area (ha)
1	Yellow Box — Blakely's Red Gum Grassy Woodland (PCT1330)	Moderate/Good	8.40
2	Yellow Box — Blakely's Red Gum Grassy Woodland (PCT1330)	Moderate/Good Derived Native Grassland	7.00
3	Broad-leaved Peppermint — Red Stringybark Grassy Open Forest (PCT734)	Moderate/Good	3.80
4	Broad-leaved Peppermint — Red Stringybark Grassy Open Forest (PCT734)	Moderate/Good Derived Native Grassland	34.90

9.2.5 Endangered ecological communities

i NSW TSC Act listed communities

The quarry is within the Bungonia sub-catchment of the Hawkesbury Nepean Catchment Management Authority (CMA). There are four endangered ecological communities (EECs) listed under the TSC Act that have the potential to occur within the whole of the Bungonia sub-catchment (OEH 2015b). Only one of these communities, White Box Yellow Box Blakely's Red Gum Woodland (hereafter referred to as Box Gum Woodland) has the potential to occur within the quarry site.

The Yellow Box — Blakely's Red Gum Grassy Woodland PCT in the extension area was assessed against the NSW Scientific Committee final determination for the Box Gum Woodland. The Yellow Box — Blakely's Red Gum Grassy Woodland PCT and associated derived native grasslands in the extension area are considered to constitute this EEC.

ii Commonwealth EPBC Act listed communities

Three endangered and one critically endangered ecological community listed under the EPBC Act are predicted to occur within 10 km of the extension area. Of these, Natural Temperate Grassland of the Southern Tablelands of NSW and the ACT and White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grasslands have the potential to occur within the quarry site.

White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grasslands is listed as a Critically Endangered Ecological Community (CEEC) under the EPBC Act. The definition of the community listed under the EPBC Act is slightly different to the equivalent community listed under the TSC Act.

The woodland form of the Yellow Box — Blakely's Red Gum Grassy Woodland PCT in the extension area meets the criteria for the Commonwealth-listed White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grasslands (TSSC 2006) and is therefore a CEEC.

The derived native grassland form of the Yellow Box – Blakely's Red Gum Grassy Woodland PCT in the extension area does not meet the criteria for White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grasslands (TSSC 2006) and is therefore not a CEEC.

However, as these derived native grasslands are listed under the TSC Act, they have been included in the BioBanking calculations as part of the NSW-listed species and appropriate offsets have been identified to compensate for unavoidable impacts to these areas. The Yellow Box — Blakely's Red Gum Grassy Woodland PCT is hereafter referred to as Box Gum Woodland.

The derived native grasslands of both the Box Gum Woodland EEC and stringybark community (not threatened) were compared to the Commonwealth listing advice for Natural Temperate Grassland of the Southern Tablelands of NSW and the ACT (ESSS 2000) and the description of the community in the National Recovery Plan (Environment ACT 2005). The derived native grasslands in the extension area do not meet the listing criteria for Natural Temperate Grassland of the Southern Tablelands of NSW and the ACT.

9.2.6 Noxious weeds

A number of exotic species were recorded within the extension area including Serrated Tussock (*Nassella trichotoma*), African Lovegrass (*Eragrostis curvula*), Fireweed (*Senecio madagascariensis*) and Blackberry (*Rubus fruticosus* spp. Aggregate).

All of these are Class 4 noxious weeds within the Goulburn Mulwaree local control area. Landowners have a legal obligation to manage the growth and spread of Class 4 weeds under the *Noxious Weeds Act 1993.* Blackberry, Fireweed and Serrated Tussock are also listed as weeds of national significance (WoNS) due to their invasiveness, impacts on primary production and the environment, potential for spread and socio-economic impacts. Landowners also have an obligation to control and manage WoNS.

9.2.7 Threatened species

i Fauna and fauna habitat

Fauna diversity in the extension area is representative of an agricultural area, with the majority of species recorded being highly mobile such as birds and microbats. A total of 103 native fauna species have been recorded in the quarry site.

Three broad habitat types were identified within the extension area:

- Broad-leaved Peppermint – Red Stringybark Grassy Open Forest on slopes;
- Box Gum Woodland; and
- Native Grasslands.

Detailed descriptions of these habitat types, the resources they provide and the fauna species predicted to use them are provided in Appendix I.

9.2.8 Pest species

Several pest fauna species were recorded in the quarry site during the extension project surveys, including European Red Fox (*Vulpes vulpes*) and Rabbit (*Oryctolagus cuniculus*). Previous surveys also recorded Brown Hare (*Lepus capensis*) and small flocks of Common Starlings (*Sturnus vulgaris*).

Livestock grazing over much of the extension area is considered to be a greater impediment to improving biodiversity values than any of the pest species identified.

9.2.9 Previously recorded threatened species

A list of threatened species likely to occur in the extension area was compiled based on the results of the literature review, database searches and consultation.

A total of 51 threatened species have been recorded, or are predicted to occur within 10 km of the extension area:

- thirteen plant species;
- two fish species;
- one amphibian species;
- three reptile species;
- seventeen bird species; and
- fifteen mammal species.

The Ecotone (2008a) surveys in the quarry site identified two threatened birds (Speckled Warbler (*Chthonicola saggittata*) and Little Lorikeet (*Glossopsitta pusilla*)) and two threatened microbats (Eastern Bentwing Bat (*Miniopterus schreibersii oceanensis*) and Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)). The survey also recorded threatened species along the Bypass Road/Red Hills Road, including the Southern Myotis (*Myotis macropus*), Scarlet Robin (*Petroica 118omm.118olour*), Little Eagle (*Hieraeetus morphnoides*) and Varied Sittella (*Daphoenositta chrysoptera*).

Predictive modelling indicates that 13 flora species, 18 fauna species, 12 migratory species, and 5 EECs listed under the EPBC Act as matters of National Environmental Significance (mNES) have the potential to occur within 10 km of the extension area.

9.2.10 Ecosystem credit species

Six ecosystem credit species were identified during the EMM 2015 surveys of the extension area:

- Square-tailed Kite (*Lophoictinia isura*);
- a pair of Speckled Warblers (*Pyrrholaemus sagittatus*);
- a pair of Diamond Firetails (*Stagonopleura guttata*);
- Eastern Bentwing Bat (*Miniopterus schreibersii*);
- Eastern False Pipistrelle; and
- Little Bentwing Bat (*Miniopterus australis*).

Previous surveys also recorded ecosystem credit species comprising the Little Lorikeet, Southern Myotis, Scarlet Robin, Little Eagle and Varied Sittella. Of these, only the Little Lorikeet was recorded within the study area, while the others were recorded along the Bypass Road/Red Hills Road, about 3 to 6 km from the study area.

Potential habitat for other woodland bird species that were not recorded during the surveys, such as the Brown Treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*), also occurs within the study area.

A description of each of these ecosystem credit species and their recorded locations are provided in Appendix I.

9.2.11 Species credit species

No credit species were recorded in the extension area. However, potential habitat occurs in the extension area and surrounds for the Striped Legless Lizard (*Delma impar*). Despite targeted surveys, the Striped Legless Lizard was not identified on the site, however they are known to be cryptic and difficult to detect. A precautionary approach was taken for this species, and species credits were generated to compensate for any impact on potential habitat.

i Koala Habitat Assessment

State Environmental Planning Policy 44 – Koala Habitat Protection (SEPP 44) defines Koala habitat as:

- potential Koala habitat: areas of native vegetation where the trees of the types listed in Schedule 2 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component; and

- core Koala habitat: an area of land with a resident population of Koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population.

One type of feed tree, Ribbon Gum (*Eucalyptus viminalis*) listed in Schedule 2 of SEPP 44, occurs as an occasional tree in the Box Gum Woodland along the creek lines in the extension area. Ribbon Gums in these areas would not provide potential Koala habitat under the SEPP definition as less than 15% of the canopy is dominated by the species.

The extension area is within the Southern and Central Coast Koala Management Areas. The following species are listed as important feed species for the Koala in these areas:

- primary feed trees: Cabbage Gum (*E. Amplifolia*) and Ribbon Gum;

- secondary feed trees: Yellow Box (*E. Melliodora*), Apple-topped Box (*E. Bridgesiana*) and Bundy (*E. Goniocalyx*); and

- supplementary feed trees: Thin-leaved Stringybark (*E. Eugenioides*).

There are few potential Koala feed trees in the extension area but no Koalas were recorded during the surveys. In addition, there are no Koala records within a 5 km radius of the extension area. However, for assessment purposes, and due to the presence of suitable Koala habitat, it is considered likely that Koalas occur in low numbers, possibly using the extension area as a movement corridor during the breeding period.

An assessment against the Koala EPBC Act Referral Guidelines identified that the extension area is not considered to comprise habitat critical to the survival of the Koala (see Appendix I).

9.3 Impact assessment

9.3.1 Impact avoidance and minimisation

The extension project will result in the clearance of approximately 15.4 ha of Box Gum Woodland EEC (TSC Act listing), comprising 8.4 ha of woodland vegetation and 7.0 ha of derived native grassland. Quarrying cannot readily avoid biodiversity impacts without sterilising the hard rock resource, as the resource is in a fixed location. However, potential impacts of the extension project have been avoided as far as possible as part of the quarry design process by minimising the pit extension footprint (see Section 3.10.1) and by locating the proposed emplacement so as to minimise impacts to Box Gum Woodland EEC (see Section 3.10.1).

The proposed design avoids potential impacts on threatened flora and fauna species and communities as far as possible.

9.3.2 Impacts requiring offset

Approximately 12.2 ha of remnant woodland vegetation and 41.9 ha of native grasslands will be removed for the extension project. There will be progressive rehabilitation of some areas, such as the emplacement.

Nineteen hollow-bearing trees will be removed. Hollow sizes vary, but are generally small to medium size, suitable for small parrots or woodland birds.

The vegetation and habitat loss for threatened biodiversity is summarised in Table 9.5.

Table 9.5 Summary of vegetation and habitat loss for threatened biodiversity

Threatened biodiversity	Vegetation community impacted	Impact area	Area within the locality[1]	Percent cleared in locality
Box Gum Woodland EEC	Yellow Box — Blakely's Red Gum Grassy Woodland and Derived Native Grasslands	15.4 ha	756.6 ha[2]	2.0%
Woodland birds (Speckled Warbler, Diamond Firetail, Brown Treecreeper, Little Lorikeet, Flame and Scarlet Robins)	Yellow Box — Blakely's Red Gum Grassy Woodland Broad-leaved Peppermint — Red Stringybark Grassy Open Forest	12.2 ha	1,451.6 ha[3]	0.8%
Microbats	Yellow Box — Blakely's Red Gum Grassy Woodland Broad-leaved Peppermint – Red Stringybark Grassy Open Forest	12.2 ha	1,451.6 ha[3]	0.8%
Raptors	All vegetation communities	54.1 ha	2,430 ha[4]	2.2%
Striped Legless Lizard	Yellow Box — Blakely's Red Gum Grassy Woodland	8.4 ha	1,451.6 ha[3]	0.6%

Note: *1.The locality is defined as 5 km from the centre of the extension area.*

2. Areas mapped as containing GW p24 Tableland Grassy Box-Gum Woodland (Tozer et al 2010). Does not include derived native grassland as these have not been mapped.

3. All mapped native woodland vegetation in the locality (Tozer et al 2010).

4. All mapped vegetation in the locality (Tozer et al 2010).

Direct impacts to fauna species include loss of habitat, habitat fragmentation, edge and barrier effects, injury and mortality, and changed hydrology. Given the small reductions in vegetation and habitat in the locality (see Table 9.5) and the reduced habitat values from past clearing and grazing, the extension project is not expected to have a significant impact on biodiversity at the local or regional level.

Remnant vegetation in the extension area is already highly fragmented and in degraded condition from weed invasion. The extension project would not significantly isolate or further fragment any habitat in the locality. However, development of the pit will require the removal of tributaries of Chapmans Creek which currently provide a vegetative corridor to the habitat to the south.

The proposed offset areas will be enhanced, improving their connectivity over time.

9.3.3 Matters for further consideration under the Framework for Biodiversity Assessment

The SEARs require further consideration to be given to matters listed under the TSC Act in accordance with Section 9.2 of the *Framework for Biodiversity Assessment* (OEH 2014c). The matters requiring further consideration are addressed in Appendix I. Of these, only the Box Gum Woodland EEC required further assessment.

Box Gum Woodland EEC currently occurs as remnant vegetation along the drainage lines and depressions in the extension area. There are some patches of higher quality woodland but these are interspersed with areas of derived native grassland indicative of the community. An area of the community (15.4 ha of which meets the TSC Act listing criteria) will be removed. This has the potential to isolate the Box Gum Woodland EEC north of the extension area (and west of the infrastructure area) that will not be removed. Connectivity of the Box Gum Woodland west of the infrastructure area with similar vegetation to the north of this area will be maintained. This area forms part of the offset package which will enhance the quality of the Box Gum Woodland EEC.

Historic photography shows that most of the woodland to be removed has previously been cleared and therefore, the current woodland is largely regrowth. The Box Gum Woodland EEC to be cleared has been degraded by agricultural activities and therefore, is not considered important to the survival of the community in the locality.

No data are available on the Vegetation Information System (VIS) database for Yellow Box — Blakely's Red Gum Grassy Woodland PCT (Box Gum Woodland) regarding its distribution and extent in the IBRA subregion. Approximately 756.6 ha of Box Gum Woodland has been mapped within a 5 km radius of the extension areas, based on areas mapped as GW p24 Tableland Grassy Box-Gum Woodland according to Tozer et al (2010). The extension project will result in the removal of approximately 2.0% of the community in the locality (Table 9.5). It is therefore unlikely that the removal of the Box Gum Woodland on the edge of the quarry could have an adverse effect on the extent of the community, or potentially place it at risk of extinction in the locality.

The project could cause potential indirect impacts through increased edge effects, and particularly the introduction or spread of weeds. Weed control and monitoring will continue in the quarry site as described in the updated Gunlake Quarry Rehabilitation and Biodiversity Offset Management Plan (RBOMP) (Gunlake 2015) and as part of the offset package.

The impacts to Box Gum Woodland EEC are therefore unlikely to cause the local extinction or decrease the viability of the EEC in the locality. The proposed offset package will protect and enhance areas of Box Gum Woodland EEC that is currently unprotected.

9.3.4 Impacts not assessed under the Framework for Biodiversity Assessment

i Indirect impacts

Indirect impacts to fauna can result from erosion and sedimentation, the introduction of weeds, and increased noise and vibration.

Erosion and sedimentation has the potential to cause adverse impacts on the riparian habitat downstream on Chapmans Creek as well as vegetated remnants in depressions. The Gunlake *Quarry Erosion and Sediment Control Plan* will be updated and continue to be implemented to minimise this potential impact.

Soil disturbance may encourage weed growth. A majority of the extension area already contains weed species and so additional weed growth would not be expected to degrade habitat beyond existing levels. However, there is potential for the increased spread into adjacent remnant vegetation through edge effects. Measures to prevent the spread of weeds will be documented in the updated RBOMP, such as cleaning machinery prior to use on-site if coming from a weedy area.

Noise and vibration levels would be increased during the expansion of the quarry. This may result in behavioural changes of fauna including movement away from the noise and vibration. These impacts would be temporary and fauna would return when quarrying is completed.

ii Key threatening processes

Key threatening processes (KTPs) are events and processes that threaten, or could threaten, the survival or evolutionary development of species, populations or ecological communities. Table 9.6 lists the KTPs with the potential to be exacerbated as a consequence of the extension project and the likely impacts of the extension project on these KTPs.

Table 9.6 Key threatening processes and significance of threat

Key threatening process	Relevance to extension project
Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands	The project is not expected to increase the operation of this KTP. Refer to Section 9.3.6 on groundwater dependent ecosystems.
Bush rock removal	The extension project requires the removal of embedded rock in some areas. Relocation of such material into the offset areas is described in the updated RBOMP.
Clearing of native vegetation	Native vegetation (54.1 ha) of variable condition will be cleared within the extension area. Vegetation of conservation significance has been avoided where possible through footprint realignments. The emplacement areas and the upper sections of the pit walls will be rehabilitated.
Competition and grazing by Rabbits	While Rabbits occur within the extension area, their current impact appears to be minor. The proposed works will not significantly increase the level of this threat. Feral animal control will be undertaken in the quarry site (including rehabilitation areas), and offset areas.

Table 9.6 Key threatening processes and significance of threat

Key threatening process	Relevance to extension project
Loss of hollow-bearing trees	Hollow-bearing trees are currently a limiting habitat feature within the extension area. The loss of any hollow-bearing trees therefore represents a substantial threat to local hollow-dependent fauna. Hollow replacement measures will be implemented as described in the updated RBOMP.
Removal of dead wood and dead trees	The proposed works will remove dead wood and dead trees from the extension area. Such habitat features will be collected during clearing works and reinstated as described in the updated RBOMP.
Predation by Foxes	Foxes have direct impacts on a range of native animal species. They prey particularly on small to medium-sized, ground-dwelling and semi-arboreal mammals, and ground-nesting birds. The Speckled Warbler is known to nest low, in dense shrubs or in basal hollows. This species is considered to particularly susceptible to predation by the Fox. Pest species will be controlled in the quarry site and offsets as described in the updated RBOMP.

iii Critical habitat

The *National Recovery Plan for White Box — Yellow Box — Blakely's Red Gum Grassy Woodland and Derived Native Grassland* (DECCW 2010) identifies all areas that meet the Commonwealth listing advice (TSSC 2006) criteria as habitat critical to the survival of the community. The extension project will remove 8.4 ha of habitat critical to the survival of the community.

The Regent Honeyeater Recovery Plan (Menkhorst, Schedvin, & Geering 1999) recognises stands of Yellow Box growing at high quality sites where nectar production is copious as critical to the survival of the Regent Honeyeater. These stands include small, isolated patches growing in agricultural areas, as well as patches in extensive state forests or conservation reserves.

Two surveys (December 2014 and January 2015) were completed during the Yellow Box flowering period (September to March). Yellow Box trees in the extension area were in poor condition, and no flowering (ie nectar production) of the species was observed. In addition, Regent Honeyeaters have not been recorded in the extension area. Therefore, the extension area is not considered to contain habitat critical to the survival of the Regent Honeyeater.

iv Cumulative impacts

The Gunlake Quarry occurs in an agricultural setting. As such, much of the native vegetation in the local area has been cleared and modified for agricultural purposes.

On a local scale, the extension project will remove approximately 2.2% of native vegetation (see Table 9.4) and approximately 2.0% of the Box Gum Woodland EEC. This will be in addition to clearance of a larger area of approximately 72.4 ha of native vegetation including approximately 58.1 ha of the Box Gum Woodland EEC (approximately 7.7% of its extent in the locality) as a result of the proposed Modification 4 of the nearby Lynwood Quarry, located south of the study area (Umwelt 2014). This vegetation is described as being in a similarly disturbed state to that within the extension area (Umwelt 2014). Apart from ongoing agricultural land use, the Box Gum Woodland EEC is not under threat by any other significant major proposals in the locality, and as a result of the offset requirements that apply to both the extension project and Lynwood Quarry project, it is anticipated that cumulative impacts to threatened biodiversity are overall likely to be positive.

The extension project alone will conserve and enhance Box Gum Woodland and Broad-leaved Peppermint — Red Stringybark Grassy Open Forest through the offset package, which will add to the existing offset requirements for the Gunlake Quarry (refer Section 9.2). This will have positive outcomes for threatened biodiversity as it will add to the protected areas in the locality. Offsets associated with the Lynwood Quarry are likely to have similar positive outcomes.

9.3.5 Impacts on aquatic biodiversity

i Existing environment

The extension area is in the headwaters of Chapmans Creek (the creek). The creek sub-catchment is in relatively poor condition with little to no riparian vegetation, moderate to severe bank erosion, bed lowering and soil sodicity in most reaches (RHDHV 2015).

There are five unnamed tributaries of the creek's headwaters in the extension area:

- a 55 m stretch flowing north in the south-eastern corner of the extension area (T1);
- a 240 m stretch flowing north-west in the south-eastern corner of the extension area and a 170 m stretch flowing north-east in the western part of the extension area (T2);
- a 740 m stretch flowing north traversing through the centre of the extension areas (T3);
- a 380 m stretch flowing north-east in the western part of the extension area (T4); and
- a 90 m stretch flowing north in the far north-western part of the extension area (T5).

These waterways are ephemeral and heavily degraded with little to no riparian vegetation and actively eroding banks and undercutting. The creek beds are dominated by exotic flora or eroded materials in dry reaches and stagnant pools of water in wet reaches.

The creek and its tributaries are mapped as key fish habitat (KFH). From the visual inspection of the tributaries, these waterways are Type 3 KFH and Class 3 waterways for fish passage. The riparian buffer zone required for these waterways are 10–50 m as recommended in the *Policy and Guidelines for Fish Habitat Conservation and Management* (Fisheries NSW 2013).

The Protected Matters Search Tool (PMST) predicted two threatened fish species listed under the EPBC Act and the *Fisheries Management Act 1994* (FM Act) occur within 10 km of the extension project:

- Macquarie Perch (*Macquaria australasica*) – listed as endangered under the EPBC Act and the FM Act; and
- Australian Grayling (*Prototroctes maraena*) – listed as vulnerable under the EPBC Act and endangered under the FM Act.

No records for these species exist within the Goulburn Mulwaree LGA. The closest recorded location for the Macquarie Perch is approximately 45 km north-west of the quarry (DPI 2015).

ii Potential impacts and mitigation

The following project activities have the potential to impact on aquatic ecology:

- extension of the quarry pit directly in-stream and in adjacent areas; and
- development of fixed or temporary infrastructure including haul roads, and water storage and management dams.

Potential impacts from these activities and mitigation measures are presented in Table 9.7.

Table 9.7 Potential aquatic impacts and mitigation measures

Potential impacts	Mitigation measures
Loss of catchment area	Controlled discharges from the site (where water quality meets the release criteria) will be timed to coincide with natural flows when possible. This will mitigate the loss of catchment area and creek sections. Impacts will also be mitigated through long-term management and remediation of the catchment immediately downstream of the extension project as part of the offset package.
Decreased habitat	The updated *Surface Water Management Plan* (see the *Surface Water Assessment* (Appendix G)) will incorporate the monitoring and management of water quality and aquatic and riparian environments.
Changes to flow regimes	The project will alter surface flow regimes in the area and all practical mitigation measures will be in place to protect downstream water quality and flows including stream flow reduction offsets by water releases from onsite dams (Section 7.3.2, Appendix G and Appendix H).
Contamination downstream through spills and untreated runoff	Risks associated with the spillage of fuels and other contaminants will be avoided by: • undertaking vehicle maintenance, refuelling and storage of fuels, oils and batteries within bunded areas; • storage and handling of flammable and combustible liquids in bunded areas away from waterways and water bodies; • reporting all spills of contaminants are reported to the Quarry Manager (or delegated person); and • making appropriate spill containment kits available for the cleanup of spills. The kits will contain equipment for cleanup of both spill on land or in dry creek beds, and spills to water (such as floating booms).
Increased turbidity from erosion and sedimentation from vegetation clearing and earthworks	Mitigation measures to maintain water quality include runoff diversion and sediment treatment by the Pit Dewatering Dam. The water management system has been developed to ensure the impact to water quality is avoided or minimised (see Section 7.2.4 and Appendix G).

9.3.6 Groundwater dependent ecosystems

Two ecosystem types potentially reliant on groundwater have been identified within and surrounding the project area:

- ecosystems potentially reliant on the surface expression of groundwater (ie creeks and springs); and
- ecosystems potentially reliant on the subsurface presence of groundwater.

The following surface water ecosystems identified by the *Atlas of Groundwater Dependent Ecosystems* (BoM 2015) potentially rely on the surface expression of groundwater:

- Chapmans Creek, within and directly north of the project area has a moderate potential for groundwater interaction;
- Jaormin River, south of the project area has a high potential for groundwater interaction;
- Lockyersleigh River, west of the project area has a high potential for groundwater interaction; and
- Wollondilly River, north of the project area has a high potential for groundwater interaction.

These rivers and creeks may support native macroinvertebrates, fish and reptiles.

In addition to the surface water features, nine springs were identified in surrounding the project area (Appendix H). There are no swamps or swamp forests present in the area that would depend on the surface expression of groundwater from these springs and therefore, it is unlikely that surrounding vegetation is dependent on these springs.

The *Groundwater Dependent Ecosystems Atlas* (BoM 2015) identifies patches of Box Gum Woodland adjacent to the project area as potentially reliant on the subsurface presence of groundwater. Within the extension area, Box Gum Woodland and alluvium have been mapped as occurring along Chapmans Creek (Thomas et al 2013). Groundwater is inferred to be approximately five metres below the ground level in this area, which is within the root zone of trees in the Box Gum Woodland. The alluvium overlies a fractured rock porphyry. Following rainfall, water infiltrates the alluvium, with enhanced recharge along Chapmans Creek. Vertical leakage from the alluvium to the fractured rock porphyry comprises a minor component of this flow.

Box Gum Woodland in and adjacent to the project area may have some reliance on the subsurface presence of groundwater, where the community grows on alluvium and shallow groundwater is present.

Drawdown of the fractured rock porphyry has been modelled for Years 5, 10, 20 and 30 (see Section 8.3.1). Minor drawdown of 2–5 m at Chapmans Creek is predicted by Year 10. This drawdown is also predicted to occur in Years 20 and 30 (Figure 8.5). Aside from the areas immediately adjacent to the pit, drawdown in the fractured rock porphyry is not predicted to increase the component of vertical leakage from the overlying alluvium along Chapmans Creek. Therefore, drawdown is not predicted to significantly decrease the water availability in the perched system to the overlying Box Gum Woodland.

There are no high priority groundwater dependent ecosystems listed in the *Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources, Goulburn Fractured Groundwater Source 2011* (NOW 2011) which are applicable to the quarry (see Section 8.2.8).

9.3.7 Matters of National Environmental Significance

Two matters of mNES listed under the EPBC Act have been identified as potentially occurring within the extension area – the Striped Legless Lizard and Box Gum Woodland CEEC (8.4 ha).

Assessments of significance have been prepared for these matters (Appendix I).

Impacts on the Striped Legless Lizard are unlikely to be significant. A significant impact on Box Gum Woodland CEEC is likely.

Impacts to threatened species habitat listed under the EPBC Act will be offset in accordance with the FBA, with 'like for like' offsets provided in accordance with the *EPBC Act Environmental Offsets Policy* (SEWPaC 2012).

9.3.8 Quantification of impacts

The impacts of the extension project have been assessed according to the FBA and associated major projects calculator. This method allows for impacts on native vegetation and threatened flora and fauna to be quantified, so that suitable and proportionate offsets can be identified. The method details the offset requirements in terms of ecosystem credits and species credits.

Any areas that do not contain native vegetation or have a site value below 17 do not require offsets. This includes the active quarry site. However, all four vegetation zones identified within the extension area have site value scores >17. Therefore, offset requirements have been calculated for all vegetation zones.

Several ecosystem credit species were recorded or were identified as having a moderate–high potential to occur in the extension area and therefore have been assumed to be present. The calculations assume that the vegetation to be impacted contains suitable habitat for the Square-tailed Kite, Speckled Warbler, Diamond Firetail, Striped Legless Lizard, Eastern Bentwing Bat, Eastern False Pipistrelle, Little Bentwing Bat, Little Eagle, Little Lorikeet, Southern Myotis, Scarlet Robin, Brown Treecreeper and Varied Sittella (see Section 9.2.9). The threatened species with the highest multipliers were the Speckled Warbler and Eastern False Pipistrelle.

Table 9.8 Ecosystem credits

Vegetation zone	PCT	Area (ha)	EEC?	Site value score	Ecosystem credit species with the highest multiplier	Credits required to offset impact
1	Yellow Box — Blakely's Red Gum Grassy Woodland (PCT1330)	8.40	Yes	64.49	Speckled Warbler	454
2	Yellow Box — Blakely's Red Gum Grassy Woodland DNG (PCT1330)	7.00	Yes	31.88	Speckled Warbler	207
3	Broad-leaved Peppermint — Red Stringybark grassy open forest (PCT734)	3.80	No	67.39	Eastern False Pipistrelle	162
4	Broad-leaved Peppermint — Red Stringybark grassy open forest DNG (PCT734)	34.90	No	26.09	Eastern False Pipistrelle	698
	Total					1,521

A total of 1,521 ecosystem credits are required to compensate for the project's impacts on threatened species habitat. The assumed presence of the Striped Legless Lizard generates an additional 210 species credits.

9.4 Management and mitigation

9.4.1 Impact mitigation

The proposed biodiversity mitigation and management measures for the extension project are detailed in Table 9.8. These measures will be incorporated into the updated RBOMP for the quarry.

Table 9.9 Biodiversity mitigation and management measures

Impact	Mitigation and/or management measure	Responsibility	Timing
Direct impacts			
Loss or degradation of habitat	Work areas will be stabilised through progressive revegetation.	Gunlake	Progressive
Indirect impacts			
Erosion and sedimentation	Measures to control erosion and sedimentation will be documented in the updated Gunlake Quarry *Erosion and Sediment Control Plan*.	Gunlake	Within six months of project approval
Weed introduction and spread	Measures to prevent the spread of weeds will be documented in the updated RBOMP, such as cleaning machinery prior to use on-site if coming from a weedy area.	Gunlake	Ongoing[1] Immediately prior to works commencing in a given area
Feral animal invasion and spread during clearing works	Measures to minimise the invasion and spread of feral animals will be described in the updated RBOMP.	Gunlake	Ongoing[1]
Disturbance of vegetation outside impact areas	Rehabilitation areas and areas not disturbed by quarry activities will be managed for weeds, pest animals and access will be restricted, as described in the updated RBOMP. Designated exclusion zones where works are not required will be flagged and highlighted in contractor inductions.	Gunlake	Ongoing[1]
Removal of identified threatened fauna habitat	Habitat features important to threatened fauna species will be retained for reinstatement within offset or rehabilitation areas where possible as described in the updated RBOMP.	Gunlake	Prior to and during works[1]
Removal of hollow-bearing trees	The updated RBOMP will describe measures to minimise the impacts on fauna from the loss of hollow-bearing trees (eg relocation of hollows).	Gunlake	Prior to and during works[1]

Note: 1. RBOMP to be updated within six months of project approval.

9.4.2 Biodiversity offset strategy

The biodiversity offset strategy aims to identify suitable compensation for the extension project's unavoidable impacts on biodiversity using NSW and Commonwealth offset policies. The offsets strategy involves the following steps:

1. identifying if suitable credits are available on the market to meet offset requirements;

2. finding potential offset sites with the biodiversity values required to compensate for the project's impacts; and

3. in the absence of suitable offset credits or properties, applying the variation criteria rules of the FBA and finding suitable offsets to meet the requirements.

i Potential offset credits

The existing offset package will be extended to compensate for the additional impacts of the extension project. The potential offset areas are immediately north and east of the extension project (Figure 9.2) on land owned by Gunlake. Credit calculations for the potential offset areas have been completed using the FBA and Biobanking calculator (Table 9.10).

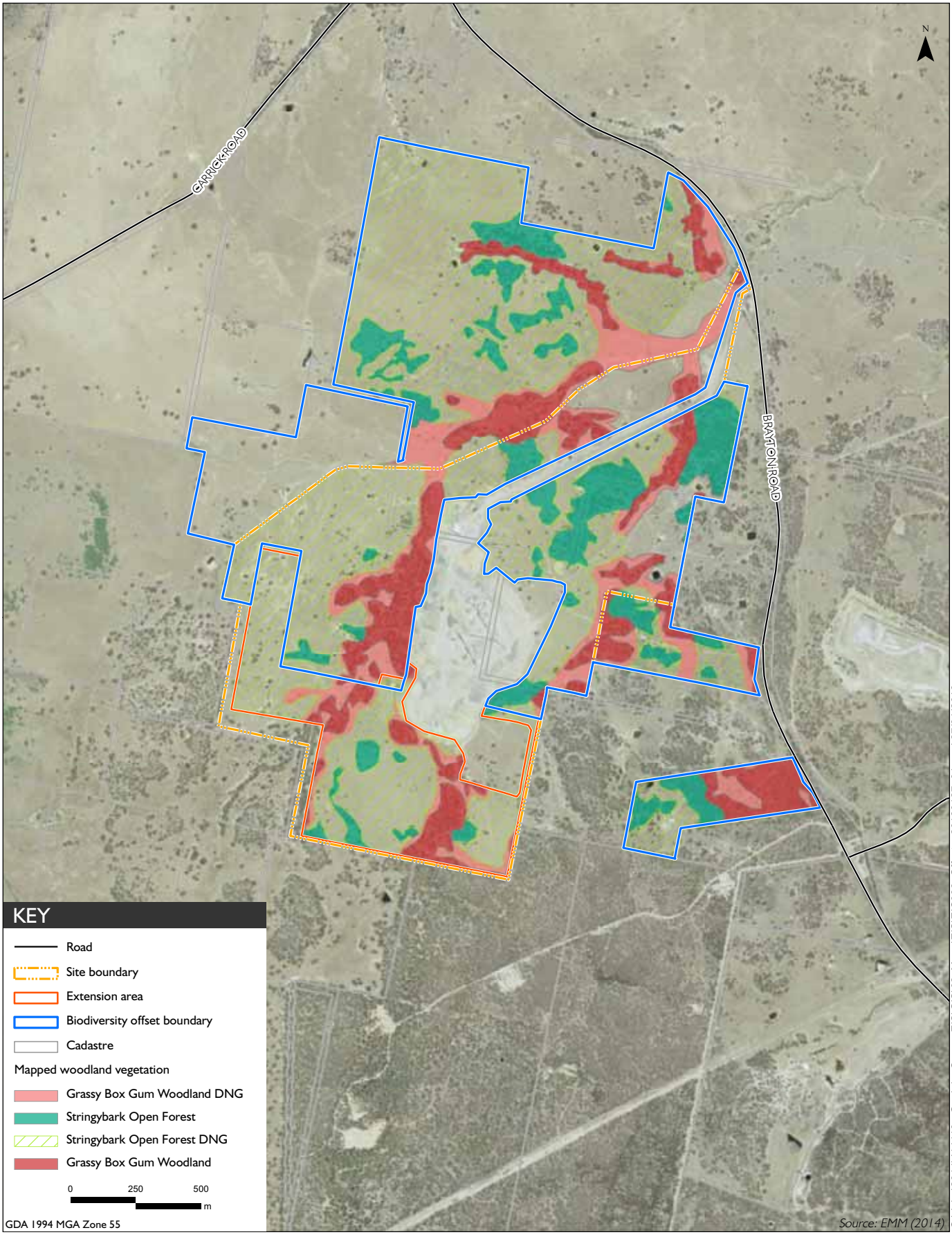
The Diamond Firetail and Speckled Warbler and the ultrasonic calls of the Eastern Bentwing Bat, Little Bentwing Bat and the Eastern False Pipistrelle were recorded within the potential offset areas. Given that it has been assumed that the Striped Legless Lizard occurs in the impacted areas, it has also been assumed that the Striped Legless Lizard occurs in the adjacent potential offset areas that are generally in better condition. Credits have been calculated for this species credit species.

Table 9.10 Credits generated by potential offsets

Vegetation type name	BVT/PCT	Condition	Potential offset area (ha)[1]	Total available credits for potential offset
Yellow Box — Blakely's Red Gum Grassy Woodland on the tablelands, South Eastern Highlands Bioregion	HN614/ PCT1330	Moderate/Good	9.73	62
Yellow Box — Blakely's Red Gum Grassy Woodland on the tablelands, South Eastern Highlands Bioregion	HN614/ PCT1330	Moderate/Good Derived grassland	31.00	580
Yellow Box — Blakely's Red Gum Grassy Woodland on the tablelands, South Eastern Highlands Bioregion	HN614/ PCT1330	Low	17.35	167
Broad-leaved Peppermint — Red Stringybark grassy open forest on undulating hills, South Eastern Highlands Bioregion	HN514/ PCT734	Moderate/Good	40.42	610
Broad-leaved Peppermint — Red Stringybark grassy open forest on undulating hills, South Eastern Highlands Bioregion	HN514/ PCT734	Moderate/Good Derived grassland	87.82	1,802
Total			186.32	3,221

Note: 1. All areas are on Gunlake-owned land. Does not include areas conserved as offsets as part of the previous approvals.

The potential offset areas generate a total of 3,221 ecosystem credits. As described in Section 9.3.7, a total of 1,521 ecosystem credits are required to compensate for the project's impacts on threatened species habitat and 210 species credits are required to compensate for the assumed presence of the Striped Legless Lizard in the impacted areas.



Approved and potential offset areas

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Figure 9.2

ii Available offsets

There are sufficient potential offset areas to meet the credits required to compensate for the project's impacts on Box Gum Woodland EEC, threatened species habitat and the stringybark community (Table 9.11).

Table 9.11 Credits generated by offsets for threatened species and ecological communities

Vegetation type name	Credits required to compensate for impact	Total credit created generated by potential offset areas	Can credit requirements be met?
Yellow Box — Blakely's Red Gum Grassy Woodland on the tablelands, South Eastern Highlands Bioregion	661[1]	809[3]	Yes
Broad-leaved Peppermint — Red Stringybark grassy open forest on undulating hills, South Eastern Highlands Bioregion	860[2]	2,412[4]	Yes
Striped Legless Lizard	210	287	Yes

Notes: *1. Box Gum Woodland (454 credits) plus Box Gum Woodland DNG (207 credits), see Table 9.8.*

2. Stringybark open forest (162 credits) plus Stringybark open forest DNG (698 credits), see Table 9.8.

3. Box Gum Woodland in Moderate/Good condition (62 credits) plus Box Gum Woodland DNG in Moderate/Good condition (580 credits) plus Box Gum Woodland in Low condition (167 credits), see Table 9.10.

4. Stringybark open forest (610 credits) plus Stringybark open forest DNG (1,802 credits), see Table 9.10.

iii Existing offset areas

The current Gunlake Quarry offset package (see Project Approval Schedule 3 Condition 27) will protect and enhance remnant vegetation and fauna habitat close to the quarry site. The existing Gunlake Quarry offsets package is summarised in Table 9.12.

Table 9.12 Existing Gunlake Quarry offset package

Offset area	Offset type	Minimum size (hectares)
Biodiversity Offset Area – existing vegetation to be enhanced and maintained	Existing vegetation to be enhanced and maintained as well as assisted regeneration of Box Gum Woodland EEC and Speckled Warbler habitat, including a minimum of 30.38 hectares of Box Gum Woodland EEC.	30.38
Biodiversity Offset Area – vegetation regeneration	A minimum of 46.16 hectares of cleared pasture to be regenerated and/or replanted using species representative of pre-clearing vegetation, including Box Gum Woodland EEC.	46.16
Additional Biodiversity Offset Area	Box Gum Woodland EEC to be enhanced and maintained.	2.28
Total		78.82

Source: *Project Approval 07-0074 Schedule 3 Condition 27, as amended in April 2015.*

During the vegetation mapping undertaken for Modification 2, it became apparent that the extent of Box Gum Woodland was over-estimated in the previous (2008 to 2014) vegetation mapping due to an assumption that all grassland was Box Gum Woodland DNG. However, as described in the Modification 2 application (C Thompson, EMM, pers comm., letter to P Duncan, DPE, 17 February 2015, and S Rose, Biosis, pers comm., letter to C Thompson, EMM (as provided to DPE)), the DNG did not meet the description of the listed community. The area of Box Gum Woodland removed as part of the original application was actually 7.8 ha and the area removed as part of the MOD2 application was 0.6 ha (ie a total of 8.4 ha).

Based on the original offset ratio of 3.8:1 used by Biosis (2014), 31.9 ha of Box Gum Woodland was actually required to offset the 8.4 ha removed as part of the original and Modification 2 project. The Modification 2 Project Approval requires 78.82 ha of Box Gum Woodland offsets (Table 9.12Therefore, an excess of 46.9 ha of Box Gum Woodland is included in the approved offset package.

A total of 661 credits are required (see Table 9.11) to offset the unavoidable impacts of removing 8.4 ha of Box Gum Woodland for the extension project[1]. Using a approximate area:credits ratio of 1:8.5, this equates to 71.1 ha of Box Gum Woodland as being required to offset the unavoidable impacts of the extension project on this EEC.

It is proposed that the excess Box Gum Woodland in the current offset package (46.9 ha) is used to meet part of the offsets required for this EEC the extension project (71.1 ha). This leaves 24.2 ha of Box Gum Woodland to be offset in additional offset areas to meet the FBA requirements. However as described in below, a greater area of Box Gum Woodland is required to meet Commonwealth offsetting requirements.

An assessment of the proposed offsets areas against the OEH principles for offsetting is provided in Appendix I.

iv Commonwealth offset calculations

A total of 8.4 ha of Box Gum Woodland CEEC will be removed as part of the extension project. Using the EPBC Offset Calculator, 44.2 ha offset is required to compensate for the unavoidable removal of this CEEC. The potential offset areas contain 58.1 ha of Box Gum Woodland and the approved offset areas contain an excess of 46.9 ha of Box Gum Woodland (see above). Therefore, there is sufficient Box Gum Woodland in the potential offset areas to meet Commonwealth requirements.

The calculation of the mNES offset area and an assessment of the potential offset areas against the Commonwealth offset principles is provided in Appendix I.

v Offset package

Gunlake propose to provide a total offset package of approximately 155.6 ha that will compensate for the unavoidable impacts on biodiversity. It will comprise of:

- approved Box Gum Woodland offset (woodland and DNG): 78.8 ha (31.9 ha of Box Gum Woodland to meet offset requirements of the original approval/MOD2 and 46.9 ha of Box Gum Woodland to meet 46.9 ha of the FBA offset requirements and 20 ha of the Commonwealth offset requirements for the extension project);

1. To avoid confusion, it is noted that it is a coincidence that 8.4 ha of Box Gum Woodland was removed as part of the original and Modification 2 project and that it is proposed to remove 8.4 ha of Box Gum Woodland as part of the extension project.

- additional Box Gum Woodland offset (woodland and DNG) to meet the remaining FBA and Commonwealth offset requirements: 24.2 ha;
- additional Stringybark community offset to meet the FBA requirement of 860 credits (assuming that woodland is used as an offset followed by DNG):
    - Stringybark community woodland: 40.4 ha (610 credits); and
    - Stringybark community DNG: 12.2 ha (250 credits).

Only the credits required to compensate for the impact will be included in the final offset package. The final configuration of the offset areas and the balance of woodland versus DNG will selected from the potential offset areas and will be finalised as part of the biodiversity package.

The offset areas will be reconfigured to ensure that previous offset commitments and new offset requirements will be met.

9.4.3 Offset management and monitoring

Offset areas will be secured where possible using a BioBanking agreement in accordance with the transitional arrangements under the *NSW Major Proposal Offset Policy*. Where this cannot be achieved, a suitable mechanism will be identified that follows the Policy's criteria.

The offset areas will be managed in accordance with the updated RBOMP. The plan will be completed and implemented within 12 months of project approval. It will include procedures to be applied for the management of the offset properties, the arrangements for conservation in perpetuity and regeneration works to be undertaken. This will include the procedures for:

- assisting the revegetation and regeneration in the offset areas, including establishment of canopy, understorey and groundcover in areas of native pasture where required;
- controlling weeds and feral pests;
- fencing and access arrangements;
- erosion control; and
- bushfire management.

An offset monitoring program will also be included within the updated RBOMP to monitor any changes to the condition of the offset areas.

9.5 Conclusions

The project area consists of the approved disturbance area that has been previously assessed and has been largely cleared and the extension area that contains exotic and native vegetation that was the focus of the biodiversity assessment. The extension area has limited habitat due to the wide-spread removal of native vegetation for agriculture. However, some remnant vegetation occurs in the extension area, particularly along Chapmans Creek and its tributaries. In these areas, the vegetation is considered to meet the description of Box Gum Woodland, an EEC listed under the TSC Act. The woodland form of this community meets the listing criteria for the CEEC listed under the EPBC Act.

Remnant vegetation provides habitat for the threatened Speckled Warbler, Diamond Firetail, Square-tailed Kite, Eastern Bentwing Bat, Eastern False Pipistrelle and Little Bentwing Bat, which were recorded during the surveys. It also contains potential habitat for the Little Lorikeet, Square-tailed Kite, Speckled Warbler, Diamond Firetail, Striped Legless Lizard, Little Eagle, Southern Myotis, Scarlet Robin, Brown Treecreeper and Varied Sittella.

During the project planning phase, Gunlake investigated a range of options to avoid and minimise impacts on remnant vegetation. The proposed emplacement will be located in an area which is predominantly pasture to minimise impacts on woodland vegetation.

The extension project will require the removal of 12.2 ha of woodland and 41.9 ha of grassland vegetation. This includes 8.4 ha of Box Gum Woodland (listed under the TSC Act and EPBC Act) and 7 ha of Box Gum Woodland derived native grassland (listed under the TSC Act). Quarrying also has the potential to result in indirect impacts on biodiversity, including erosion and sedimentation, weed invasion and changes in hydrology. Biodiversity mitigation and management measures have been proposed to minimise and/or mitigate potential biodiversity impacts from the extension project.

The impacts of the extension project have been quantified using the FBA and Major Proposals Calculator. A total of 1,521 ecosystem credits are required to compensate for the unavoidable impacts of the extension project. There are sufficient additional offset areas available for addition to the existing Gunlake offset package to compensate for these impacts.

Gunlake propose to provide a total offset package that will compensate for the unavoidable impacts of the previously approved project and for those of the extension project that will be approximately 155.6 ha and will comprise of:

- approved Box Gum Woodland offset (woodland and DNG): 78.8 ha
- additional Box Gum Woodland offset (woodland and DNG): 24.2 ha;
- additional Stringybark community (to total 860 credits):
    - Stringybark community woodland: approximately 40.4 ha; and
    - Stringybark community DNG: 12.2 ha.

The offset areas will be reconfigured to ensure that previous offset commitments and new offset requirements will be met. The resulting offset package will provide long-term protection and enhancement of habitat for threatened species and ecological communities.

10 Transport

10.1 Introduction

This chapter provides a summary of the transport assessment prepared by EMM, which is presented in full in Appendix J.

The assessment provides:

- a description of the existing road, traffic and transport conditions;
- a description of the types and maximum numbers of vehicle movements, the public roads likely to be used and the times during which those roads would be used;
- predictions of the road traffic generated by the construction and operation of the extended quarry and cumulative traffic levels;
- an assessment of potential traffic impacts on the capacity, condition, safety and efficiency of the local and State road network in accordance with Goulburn Mulwaree Council's and RMS's requirements; and
- a detailed description of the mitigation measures or works required.

A transport options review was also undertaken by EMM (see Appendix D) to assess potentially feasible options to reduce transport of quarry products on local roads. This is summarised in Section 3.10.2 and concluded that Option 1 (ie continuing to transport quarry products by road using the primary and secondary haulage routes) will provide the best economic and environmental outcomes.

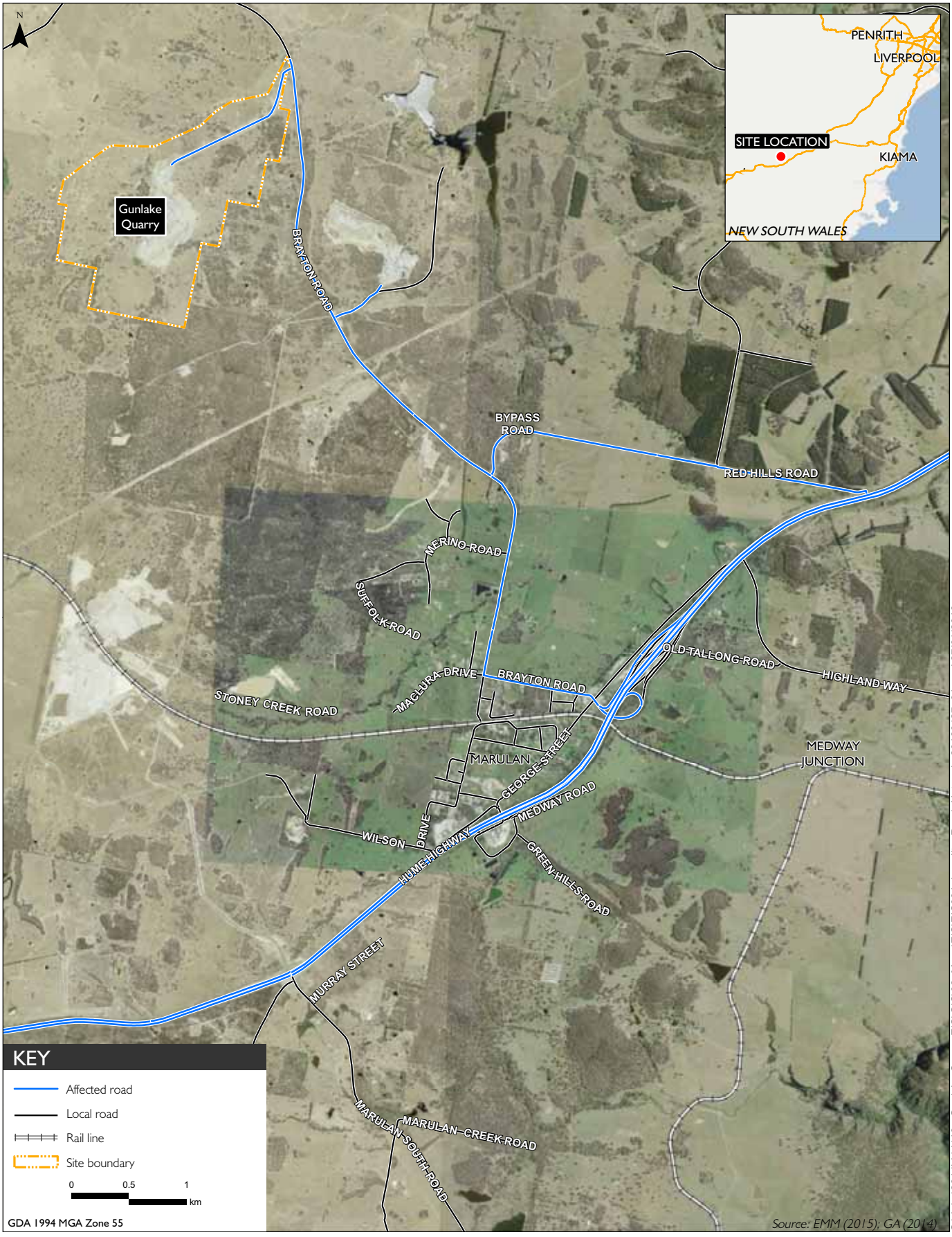
10.2 Existing environment

10.2.1 Road network

Roads that would be used by the quarry traffic are shown in Figure 10.1. The primary haul route includes the following roads:

- Hume Highway north of the South Marulan Road interchange;
- Brayton Road (classified as a collector road) between Bypass Road and the Gunlake Quarry access road;
- Bypass Road between Brayton Road and Red Hills Road; and
- Redhills Road between Bypass Road and Hume Highway.

The primary haul route between Gunlake Quarry and the Hume Highway is 7 km long and takes trucks 6 to 7 minutes to travel.



Existing road network

Gunlake Quarry
Environmental Impact Statement

Figure 10.1

The secondary haul route is only for trucks travelling southbound from the quarry and includes Brayton Road between the Gunlake Quarry access road and the Hume Highway, through Marulan. This route requires quarry traffic to cross at the intersections of Brayton Road and George Street and Hume Highway and South Marulan Road. Gunlake currently has approval for an average 25 southbound laden trucks per day (38 trucks per day) to use this route. This will not change for the extension project.

Quarry trucks returning from the north are required to turn at the South Marulan Road interchange, approximately 3.5 km south-west of Marulan, and travel north to Red Hills Road.

10.2.2 Traffic conditions

The existing peak hour and daily traffic volumes on the major and local roads considered were determined from intersection and tube traffic counts undertaken by EMM in August 2015 and RMS's annual average daily traffic (AADT) data. Hourly traffic volumes from the EMM 2015 local road traffic surveys are summarised in Table 10.1. Daily traffic volumes are presented in Table 10.2.

Daily traffic volumes on sections of the Hume Highway for 2005 and 2012 were determined from RMS traffic counts. Daily traffic volumes on the same sections of the Hume Highway were predicted for 2015 by applying a +2% annual increase to the 2012 RMS data. Daily traffic volumes for local roads were taken from the EMM 2015 surveys.

Table 10.1 Existing peak hourly traffic volumes

Road name	Hourly volume					
	Early morning	Morning peak	Morning peak	Early afternoon	Afternoon peak	Afternoon peak
	6–7 am	7–8 am	8–9 am	2–3 pm	3–4 pm	4–5 pm
Hourly volumes from tube traffic surveys						
Brayton Road (west of the Bypass Road)	51	55	56	55	46	53
Brayton Road (east of the Bypass Road)	41	39	28	33	27	21
Bypass Road (north of Brayton Road)	14	31	37	34	34	45
Hourly volumes from intersection traffic surveys						
Hume Highway (north of Red Hills Road)	752	1,092	1,302	1,278	1,383	1,395
Red Hills Road (at Hume Highway)	26	57	24	44	24	18
Brayton Road urban (at George Street)	58	74	86	86	101	93
George Street (south of Brayton Road)	57	104	135	150	153	156

Table 10.2 Existing average weekday and AADT traffic volumes and heavy vehicle proportions

Road name	Survey year	Average daily traffic		Proportion of heavy vehicles (%)[1]
		Total – all vehicles	Heavy vehicles	
Hume Highway Penrose – south of Illawarra Highway (RMS AADT Surveys)	2005	20,029	3,605	18%
	2012	21,300	3,835	18%
	2015	22,600	4,065	18%
Hume Highway Mittagong Bypass – north of Old Hume Hwy (RMS AADT Surveys)	2005	16,969	3,395	20%
	2012	19,700	3,940	20%
	2015	20,900	4,175	20%
Hume Highway Pheasants Nest – south of Picton Road (RMS AADT Surveys)	2005	29,660	4,450	15%
	2012	34,000	5,100	15%
	2015	36,000	5,400	15%
Brayton Road (west of Gunlake Quarry)	2015	278	45	16%
Brayton Road (west of Bypass Road)	2015	720	326	45%
Brayton Road (east of Bypass Road)	2015	448	99	22%
Brayton Road (west of George Street)[2]	2015	1,130	73	6%
George Street (south of Brayton Road)[2]	2015	1,750	107	6%
Bypass Road (north of Brayton Road)	2015	398	221	56%
Gunlake Quarry access road	2015	238	168	71%
Johnniefelds Quarry access road[3]	2015	160	112	70%

Notes: *1. The proportion of heavy vehicles for the Hume Highway was determined from the 6 hour period of the Bypass Road intersection traffic survey (EMM 2015).*

2. The estimated daily traffic volumes for the urban sections of Brayton Road and George Street at Marulan have been estimated from the peak hour intersection traffic surveys using the ratio between the peak hourly and the daily traffic volumes traffic (tube counts) which was determined from the nearest adjoining section of Brayton Road.

3. The daily traffic volume for Johnniefelds Quarry access road has been estimated from the differences between the other Brayton Road daily traffic surveys.

10.2.3 Traffic capacity

General maximum hourly traffic volume standards for major rural roads are defined in *Guide to Traffic Generating Developments* (RTA 2002) as Levels of Service A to F where A to C is considered satisfactory. On the rural sections of the Hume Highway north of Marulan, the estimated current (2015) daily traffic volumes are:

- Hume Highway at Penrose: 22,600 daily vehicle movements (Level of Service B);
- Hume Highway at Mittagong: 20,900 daily vehicle movements (Level of Service A); and
- Hume Highway at Pheasants Nest: 36,000 daily vehicle movements (Level of Service C).

The road width design standards for low volume (generally rural) roads are defined by the Austroads (2010) and are based on daily traffic volumes.

For roads with 150 to 500 vehicles daily, Austroads (2010) requires a 6–7 m wide seal (7 m wide if there are more than 15% heavy vehicles). This traffic volume standard is applicable to Bypass Road, Redhills Road between Bypass Road and Hume Highway, Brayton Road west of the Gunlake Quarry access road, and Brayton Road east of the Bypass Road intersection.

For roads with 500 to 1,000 vehicles daily, Austroads (2010) requires a 7–8 m wide seal. This traffic volume standard is applicable to the section of Brayton Road, between the Gunlake Quarry access road and the Bypass Road intersection.

The current sealed widths of all sections of the primary haulage route between the Gunlake Quarry access road and the Hume Highway meet the Austroads design standard for the existing traffic usage volumes listed in Table 10.2.

For the two quarry access roads, at Gunlake Quarry and Johnniefelds Quarry, the current daily traffic volumes are in the range of 200 to 250 vehicle movements daily, with substantial proportions of heavy vehicle traffic (Table 10.2). These roads are not public roads. However, on the approaches to the public roads, quarry access roads should be sealed for a minimum distance of 100 m with a 7 m wide seal. The Gunlake Quarry access road has recently been sealed to these requirements. This is beneficial for dust control purposes and also to minimise the potential tracking of dirt and gravel onto public roads via the tyre tracks of the quarry haulage trucks.

10.2.4 Road pavement

The overall road pavement condition of the 7.6 km primary haulage route between the Gunlake Quarry access road and the Hume Highway was observed to be in a satisfactory condition in September 2015, with no surface defects visible along most sections of this main haulage route. The only visible road defects or surface deformation were observed over a short eastbound section of the Bypass Road immediately to the north of the Brayton Road intersection, where the road curves sharply to the north for outbound trucks.

The assessment of overall road pavement condition, combined with the recent construction (or reconstruction) of most sections of the haulage route indicates that the road pavement along the route could reasonably be expected to have a minimum future serviceable life of at least 20 years, with only localised surface repairs being needed.

Gunlake has undertaken a number of road upgrades including the construction of Bypass Road and contributions to the upgrade of Brayton Road. Gunlake also contributes to other road upgrades in the local area through Section 94 contributions.

10.2.5 Intersection designs

The existing rural and urban intersections on the primary haulage route have generally been constructed to appropriate design standards given the traffic operating characteristics of the roads. The current design standard of the assessed intersections are summarised in Table 10.3.

Table 10.3 Existing intersection designs

Major road	Minor road	Intersection type	Existing intersection standard
Brayton Road	Gunlake Quarry access	Standard rural T-intersection	The Gunlake Quarry access road is sealed and has a speed hump and a Stop Sign. A left turn deceleration lane is provided for the quarry truck traffic.
Brayton Road	Bypass Road	Rural T-intersection	There are concrete islands on all three intersection approaches.
Hume Highway	Red Hills Road (Bypass Road)	Rural highway intersection	The intersection has recently had the median closed to prevent right turns and has a left turn deceleration lane on the Hume Highway.
Brayton Road	Stony Creek Road	Four-way urban intersection	There are no additional intersection turning lanes. The major traffic route turns from the east to the north at the intersection.
George Street	Brayton Road	Four-way urban intersection	There are no additional intersection turning lanes. To the east, the intersection provides access to the main Marulan urban area Hume Highway via ramps.
Hume Highway	South Marulan Road (east-side) interchange intersection	Four-way roundabout	The intersection is located off the Hume Highway. It provides access for local rural farm and Lynwood Quarry truck traffic and U-turn access for Gunlake Quarry truck traffic.
Hume Highway	South Marulan Road (west-side) interchange intersection	Four-way rural minor road intersection	The intersection is located off the Hume Highway. It provides access for local rural farm and Lynwood Quarry truck traffic and U-turn access for Gunlake Quarry truck traffic.

10.2.6 Traffic safety

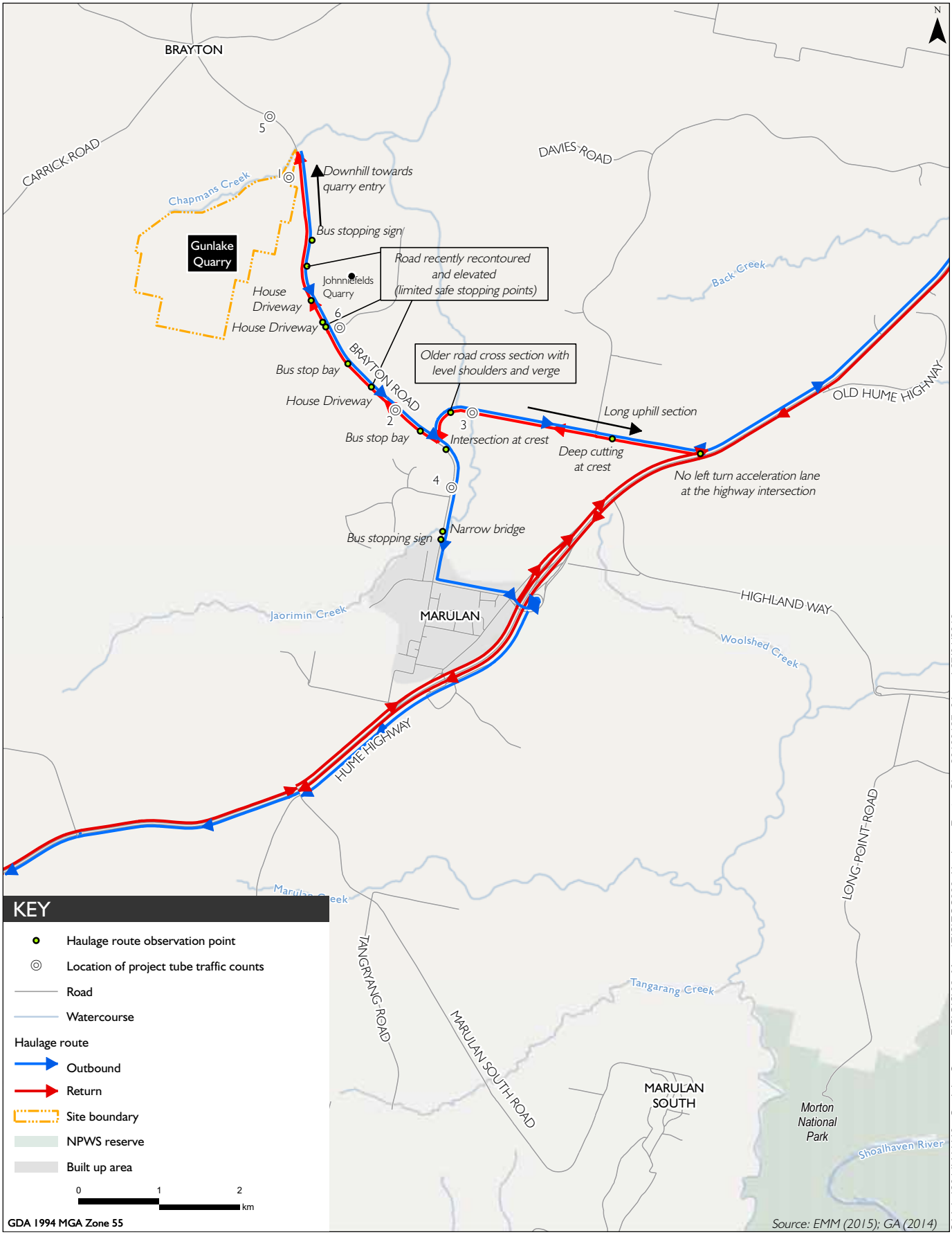
On Friday 4 September 2015, EMM inspected existing sections of the primary haulage route and measured truck travel times and intersection waiting times. The current locations of relevant road features noted during the inspection and potential safety-related features are shown in Figure 10.2. It was observed that the average speeds of quarry's trucks were below designated speed limits. Since this time, Gunlake have imposed an 80 km/h limit on trucks travelling between the Hume Highway and the quarry.

10.2.7 Public transport, pedestrian and cycling access

Marulan rail station has passenger rail services which are operated by NSW trains on a regular basis.

Local school bus services operate in the Marulan area via Brayton Road, which drop off and pick up their passengers at a number of locations between Marulan and the quarry access road. These locations are effectively individual rural residential property access driveways, of which four are located along the 3.4 km section of Brayton Road between the Gunlake Quarry access road intersection and the Bypass Road intersection.

Due to the distances between the project area and the nearest urban areas of Marulan (approximately 5 to 7 km), local pedestrian or cycling access from urban areas to the quarry is unlikely.



Haulage route observations

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Figure 10.2

10.2.8 Existing impacts from quarry on Marulan town

Gunlake has approval for an average 25 laden trucks per day to travel southbound between the quarry and the Hume Highway interchange, through Marulan town, as described in Section 10.2.1. There will be no change to these truck numbers as part of the extension project.

The impacts of truck movements through Marulan town were assessed in the *Transport Study of Proposed Gunlake Quarry, Brayton Road, Marulan* (Christopher Hallam and Associates 2008). The truck movements were assessed as having an insignificant impact on the traffic capacity of the road network or the level of service of the intersections along the southbound route.

10.3 Impact assessment

10.3.1 Traffic generation

The transport assessment assumed that the potential future peak hourly truck dispatch rates from the quarry will increase in direct proportion to the approved annual tonnage increase. This is a conservative assumption as there is considerable scope for increasing the overall weekly production at the quarry while only increasing the current peak hourly loading rates marginally.

Under the current quarry approval for 750,000 tonnes annual production, the quarry operates with an average of 164 truck movements (82 truck loads) each day and a peak hourly truck loading rate of 11 truck loads per hour, during either the morning (8.00 to 9.00 am) or the afternoon (4.30 to 5.30 pm) peak hourly traffic periods on the surrounding roads.

For the future quarry production of up to 2 Mtpa, the average daily number of quarry truck movements would increase to 440 (220 truck loads) and the maximum hourly truck loading rates during both the morning and afternoon peak hourly traffic, could also potentially increase to 29 truck loads per hour which is limited by the quarry's ability to load and dispatch laden trucks.

On busy future production days at the quarry, the potential maximum daily number of truck movements could increase to 690 (345 truck loads). However, on these days, the additional production rates would be achieved by increasing the actual quarry truck transport hours (still within the approved 24 hour quarry transport operating period on weekdays) and there would be no further increase above the anticipated future maximum truck peak hourly loading rate of 29 trucks per hour.

Construction stage activities and related traffic movements are anticipated to be minimal as the existing quarry infrastructure for product crushing and grading and the quarry truck loading facilities are generally adequate for the proposed increase in annual quarry production.

10.3.2 Short-term impacts

i Road carriageway

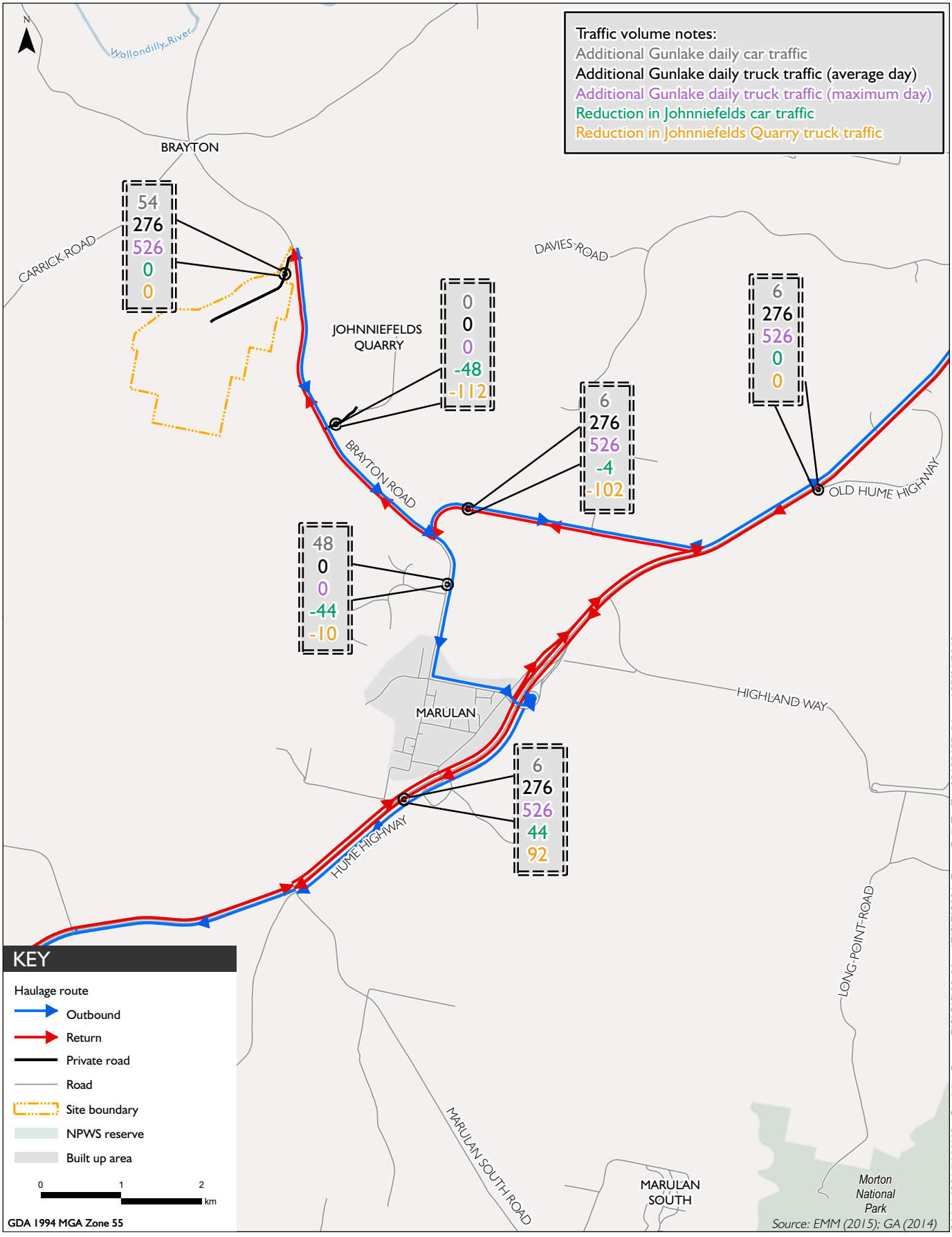
The changes in the daily traffic volumes from the future project operations, for both the average (440) and the maximum (690) daily truck traffic movements, and the future traffic reductions from the closure and relocation of production from the Holcim Johnniefelds Quarry, are shown in Figure 10.3.

The predicted traffic volume increases for the affected roads for short-term future project operations (based on the 2015 road network traffic volumes) are summarised in Tables 10.4 and 10.5 for average daily and maximum daily production, respectively, prior to any closure of the Johnniefelds Quarry. In reality, the traffic increases would not occur straight away, gradually increasing over 5 to 10 years in line with production, and Johnniefields Quarry would be shut before full production is reached.

Table 10.4 Average project daily traffic increases for each route (2015)

Road name	Average daily traffic[1]		Additional project daily traffic		Total daily traffic		Traffic increase (%)
	All traffic	Heavy vehicles	All traffic	Heavy vehicles	All traffic	Heavy vehicles	All traffic
Hume Highway at Penrose	22,600	4,065	282	276	22,882	4,341	1.2
Hume Highway at Mittagong Bypass	20,900	4,175	282	276	21,182	4,451	1.3
Hume Highway at Pheasants Nest	36,000	5,400	282	276	36,282	5,676	0.8
Brayton Road (west of the Bypass Road)	720	326	330	276	1,050	602	45.8
Bypass Road (north of Brayton Road)	398	221	282	276	680	497	70.9
Brayton Road (east of the Bypass Road)	448	99	48	0	496	99	10.7
Brayton Road (west of George Street)	1,130	73	48	0	1,178	73	4.2
George Street (south of Brayton Road)	1,750	107	48	0	1,798	107	2.7

Notes: 1. This traffic includes the existing quarry traffic movements for 750,000 tonnes per annum production.



Additional project daily traffic volumes (2015)

Gunlake Quarry
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Figure 10.3

Table 10.5 Maximum project daily traffic increases (2015)

Road name	Average daily traffic		Additional project daily traffic		Total daily traffic		Traffic increase (%)
	All traffic	Heavy vehicles	All traffic	Heavy vehicles	All traffic	Heavy vehicles	All traffic
Hume Highway at Penrose	22,600	4,065	532	526	23,132	4,591	2.4
Hume Highway at Mittagong Bypass	20,900	4,175	532	526	21,432	4,701	2.5
Hume Highway at Pheasants Nest	36,000	5,400	532	526	36,532	5,926	1.5
Brayton Road (west of the Bypass Road)	720	326	580	526	1,300	852	80.6
Bypass Road (north of Brayton Road)	398	221	532	526	930	747	133.7
Brayton Road (east of the Bypass Road)	448	99	48	0	496	99	10.7
Brayton Road (west of George Street)	1,130	73	48	0	1,178	73	4.2
George Street (south of Brayton Road)	1,750	107	48	0	1,798	107	2.7

The predicted volumes show that about 94% of truck movements would be along the primary haulage route (ie Brayton Road/Bypass Road/Red Hills Road) and less than 6% of truck movements would be along the secondary haulage route through Marulan. The predicted daily traffic increases would not require any improvements to the road carriageway in order to accommodate the additional traffic.

ii Intersection level of service

The project-generated intersection traffic impacts were assessed using SIDRA 5.1 intersection capacity analysis. The following intersection traffic scenarios were assessed:

- existing 2015 base peak hour traffic volumes, adjusted for the recently approved increases to project traffic for 750,000 tonnes annual production; and
- the corresponding 2015 intersection traffic volumes with a maximum of 29 trucks per hour travelling both to and from Gunlake Quarry, prior to any reduction in traffic on Brayton Road and the Bypass Road as a result of the closure of Holcim's Johnniefelds Quarry and the subsequent relocation of its production to Lynwood Quarry.

Summaries of the SIDRA intersection results, with and without the additional project traffic, are provided in Table 10.6. For all of the 2015 traffic scenarios considered, intersections would operate at a low or very low degree of saturation and with a high level of service (Level of Service A or B). The exception is the Red Hills Road and Hume Highway intersection where the left turn from Red Hills Road movement will have increased traffic delays (Level of Service C or D). In accordance with the RMS intersection capacity guidelines, where an intersection is operating at Level of Service D, additional accident and safety studies should be undertaken for the intersection. The additional truck turning delays and safety observations, which were undertaken by EMM at the intersection on Friday 4 September 2015, satisfy this requirement (see Section 10.2.6).

Table 10.6 Short-term intersection assessment

Intersection	Year	Peak hour	Traffic demand flow (vehicles)	Average delay (seconds)	LoS[1]	DoS[2]	Maximum queue length (m)
Brayton Road and Bypass Road	2015 base traffic conditions	Morning peak hour (8.00 to 9.00 am typically)	65	17.2	B	0.033	1
		Afternoon peak hour (4.30 to 5.30 pm typically)	64	14.5	A	0.017	1
	2015 with additional peak hourly project traffic	Morning peak hour (8.00 to 9.00 am typically)	116	19.8	B	0.102	5
		Afternoon peak hour (4.30 to 5.30 pm typically)	121	19.1	B	0.094	4
Red Hills Road and Hume Highway	2015 base traffic conditions	Morning peak hour (8.00 to 9.00 am typically)	1,379	27.2	B	0.221	3
		Afternoon peak hour (4.30 to 5.30 pm typically)	1,479	24.2	B	0.211	1
	2015 with additional peak hourly project traffic	Morning peak hour (8.00 to 9.00 am typically)	1,429	38.3	C	0.269	12
		Afternoon peak hour (4.30 to 5.30 pm typically)	1,536	50.5	D	0.332	14
South Marulan Road east-side	2015 base traffic conditions	Morning peak hour (8.00 to 9.00 am typically)	95	13.1	A	0.032	1
		Afternoon peak hour (4.30 to 5.30 pm typically)	126	14.4	A	0.029	1
	2015 with additional peak hourly project traffic	Morning peak hour (8.00 to 9.00 am typically)	120	13.9	A	0.065	3
		Afternoon peak hour (4.30 to 5.30 pm typically)	155	14.6	B	0.065	3
South Marulan Road west-side	2015 base traffic conditions	Morning peak hour (8.00 to 9.00 am typically)	78	10.7	A	0.043	2
		Afternoon peak hour (4.30 to 5.30 pm typically)	116	9.8	A	0.034	1
	2015 with additional peak hourly project traffic	Morning peak hour (8.00 to 9.00 am typically)	103	11.1	A	0.078	4
		Afternoon peak hour (4.30 to 5.30 pm typically)	144	11.4	A	0.069	3

Notes: *1. LoS = Level of service.*

2. DoS = Degree of saturation.

10.3.3 Long-term impacts

i Background traffic growth

Peak traffic generation from the operational phase of the project is predicted to be reached by 2025. The long-term operational phase traffic impact assessment for 2025 has assumed background traffic to have a linear growth rate of 2% per annum on Hume Highway (+20%) and equivalent traffic growth on the local roads at Marulan, excluding the existing truck traffic. The assessment has also assumed the current production of the Holcim Johnniefelds Quarry will have relocated to the Lynwood Quarry by 2025. This would lower base traffic levels on the local roads assessed, such as Brayton Road and Bypass Road. However, it would not generally reduce the Hume Highway traffic usage, other than at the intersection with Red Hills Road.

ii Road carriageway

The predicted traffic volume increases for the long-term scenario (based on the 2025 road network traffic volumes) are summarised in Table 10.7 and Table 10.8 for the average (440 truck movements) and maximum daily production (690 truck movements), respectively.

Table 10.7 Average long-term project traffic increases

Road name	Average daily traffic		Additional project daily traffic		Total daily traffic		Traffic increase (%)
	All traffic	Heavy vehicles	All traffic	Heavy vehicles	All traffic	Heavy vehicles	All traffic
Hume Highway at Penrose	27,120	4,878	282	276	27,402	5,154	1.0
Hume Highway at Mittagong Bypass	25,080	5,010	282	276	25,362	5,286	1.1
Hume Highway at Pheasants Nest	43,200	6,480	282	276	43,482	6,756	0.7
Brayton Road (west of the Bypass Road)	639	214	330	276	969	490	51.6
Bypass Road (north of Brayton Road)	327	119	282	276	609	395	86.2
Brayton Road (east of the Bypass Road)	464	89	48	0	512	89	10.3
Brayton Road (west of George Street)	1,287	63	48	0	1,335	63	3.7
George Street (south of Brayton Road)	2,025	107	48	0	2,073	107	2.4

Table 10.8 Maximum long-term project traffic increases

Road name	Average daily traffic		Additional project daily traffic		Total daily traffic		Traffic increase (%)
	All traffic	Heavy vehicles	All traffic	Heavy vehicles	All traffic	Heavy vehicles	All traffic
Hume Highway at Penrose	27,120	4,878	532	526	27,652	5,404	2.0
Hume Highway at Mittagong Bypass	25,080	5,010	532	526	25,612	5,536	2.1
Hume Highway at Pheasants Nest	43,200	6,480	532	526	43,732	7,006	1.2
Brayton Road (west of the Bypass Road)	639	214	580	526	1,219	740	90.8
Bypass Road (north of Brayton Road)	327	119	532	526	859	645	162.7
Brayton Road (east of the Bypass Road)	464	89	48	0	512	89	10.3
Brayton Road (west of George Street)	1,287	63	48	0	1,335	63	3.7
George Street (south of Brayton Road)	2,025	107	48	0	2,073	107	2.4

The assessed project daily traffic increases for Brayton Road (between Gunlake Quarry and the Bypass Road) would result in 52 to 91% increases to the 2025 daily traffic volumes on the average and the maximum transport days, respectively. These traffic increases would increase the total daily traffic usage of the road (on the maximum transport days) to within the range of 1,000 to 3,000 daily vehicle movements. In accordance with the Austroads (2010) *Rural Road Design Standards*, under these conditions, a 9 m wide sealed road, with appropriate safe road shoulders, would be required.

Road improvements on other sections of the primary road haul route would not be required to accommodate the predicted additional traffic. Improvements on the secondary haul route are also not required as movements along this route would not increase under the proposal.

iii Intersection level of service

The following intersection traffic scenarios were assessed using SIDRA 5.1 intersection capacity analysis:

- 2025 base traffic conditions – predicted peak hour traffic volumes allowing for traffic reductions associated with the closure of Holcim's Johnniefelds Quarry; and
- 2025 base traffic conditions with additional project traffic – predicted peak hour traffic volumes including additional project traffic volumes (maximum of 29 trucks per hour to and from Gunlake Quarry).

Summaries of the SIDRA intersection results are provided in Table 10.9.

Table 10.9 Long-term intersection assessment

Intersection	Year	Peak hour	Traffic demand flow (vehicles)	Average delay (seconds)	LoS	DoS	Maximum queue length (m)
Brayton Road and Bypass Road	2025 base traffic conditions	Morning peak hour (8.00 to 9.00 am typically)	59	16.7	B	0.025	1
		Afternoon peak hour (4.30 to 5.30 pm typically)	58	13.4	A	0.016	1
	2025 with additional project traffic	Morning peak hour (8.00 to 9.00 am typically)	109	19.9	B	0.093	4
		Afternoon peak hour (4.30 to 5.30 pm typically)	115	18.4	B	0.093	4
Red Hills Road and Hume Highway	2025 base traffic conditions	Morning peak hour (8.00 to 9.00 am typically)	1,648	28.9	C	0.265	3
		Afternoon peak hour (4.30 to 5.30 pm typically)	1,771	16.1	B	0.253	1
	2025 with additional project traffic	Morning peak hour (8.00 to 9.00 am typically)	1,703	50.2	D	0.345	15
		Afternoon peak hour (4.30 to 5.30 pm typically)	1,832	78.8	F	0.477	20
South Marulan Road East Side	2025 base traffic conditions	Morning peak hour (8.00 to 9.00 am typically)	119	12.8	A	0.042	2
		Afternoon peak hour (4.30 to 5.30 pm typically)	155	14.5	A	0.038	1
	2025 with additional project traffic	Morning peak hour (8.00 to 9.00 am typically)	144	13.7	A	0.076	4
		Afternoon peak hour (4.30 to 5.30 pm typically)	183	14.7	B	0.071	3
South Marulan Road West Side	2025 base traffic conditions	Morning peak hour (8.00 to 9.00 am typically)	106	10.9	A	0.051	2
		Afternoon peak hour (4.30 to 5.30 pm typically)	147	9.9	A	0.042	1
	2025 with additional project traffic	Morning peak hour (8.00 to 9.00 am typically)	132	11.4	A	0.086	4
		Afternoon peak hour (4.30 to 5.30 pm typically)	178	11.3	A	0.077	3

Notes: LoS = Level of service. DoS = Degree of saturation.

For all of the 2025 traffic scenarios considered, intersections would operate at a low or very low degree of saturation and with a high level of service (Level of Service A or B). The exception is the Red Hills Road and Hume Highway intersection where traffic delays at the left turn from Red Hills Road onto the Hume Highway would increase (Level of Service D or F) due to the growth in northbound traffic on the Hume Highway and project related traffic growth movement.

The most appropriate intersection traffic improvement to reduce the future Red Hills Road traffic delays at the intersection and eliminate any potential traffic safety related concerns with the current intersection operations, would be to construct a northbound acceleration and merging lane for the Red Hills Road traffic. This would need to be approximately 500 m long including taper, allowing northbound Hume Highway traffic to merge with minimal delays or changing of lanes required.

From the traffic capacity and Level of Service analysis, the additional intersection acceleration and merging lane would not be required until approximately 2025. However, there would be traffic safety benefits from an earlier implementation of these works at this location.

10.3.4 Traffic safety

The future project traffic safety impacts will be managed in accordance with the project's traffic management plan. This includes a Driver Code of Conduct for Heavy Vehicles (the code) for all truck drivers who are operating to and from the Gunlake Quarry. These documents have recently been updated based on the recommendations of the recent project conditions approval (Modification 2). The updated traffic management plan and the code (prepared on 31 August 2015) have been submitted to DPE for approval. Gunlake have also imposed an 80 km/h limit on trucks travelling between the Hume Highway and the quarry.

10.3.5 Road pavement and maintenance

The recent visual pavement condition assessment undertaken by EMM observed the road pavements of the product haulage route to be generally in good condition. The ongoing maintenance requirements for these roads will continue to be fully funded by Gunlake Quarry's Section 94 contributions. Table 10.10 identifies the current and likely future costs and revenues to the Council from the continued operation of the current Section 94 contributions for the haulage route maintenance.

Table 10.10 Summary of previous and future Gunlake Quarries annual Section 94 contributions

Council costs and revenue per year	500,000 tonnes	750,000 tonnes	2,000,000 tonnes
Routine maintenance	$5,000	$7,500	$20,000
Annual cost for pavement rehabilitation and reconstruction at $45/m^2 allowing 7,000 m x 9 m = 63,000 m^2	$94,500	$141,750	$378,000
Proportion of the route reconstructed each year	1/30th	1/20th	1/7.5th
Section 94 contributions payable by Gunlake	$135,000	$215,000	$618,000

Gunlake Quarry's capital works contributions on roads, including Section 94 contributions, have been $3.3 million to date. As documented in the Land and Environment Court of NSW Case number 11116 of 2008, Gunlake Quarry's Section 94 current contributions are more than adequate, as they already exceed the actual costs to Council to maintain the primary haulage route. Therefore, the adoption of $45/m^2 for future contributions is also considered more than adequate.

10.3.6 Public transport, pedestrian and cycling access

Additional car parking areas would be provided at the quarry to meet the identified demand for additional project workforce based at the quarry (approximately 27 persons).

No public transport access requirements are anticipated for the project. However, the existing school bus stopping points along the haulage route will be monitored and additional safe bus stopping bays constructed if a need is identified based on whether a given residence houses school children. The recent upgrades of Brayton Road will also improve safety for school buses.

Trucks are to travel at a maximum speed of 40 km/h when passing school buses picking up/dropping passengers, as required by law. Gunlake Quarry truck drivers have been reminded of this legal requirement through the driver's code of conduct.

Future access by the workforce using either cycling or walking is not envisaged to occur on a regular basis due to the comparatively remote nature of the quarry.

10.4 Management and mitigation

The road and intersection improvements detailed below are proposed to be implemented by Gunlake Quarry to mitigate the impacts of the increased project traffic.

At the intersection of Hume Highway and Red Hills Road, an additional 500 m long (including taper) left turn northbound acceleration lane will be constructed before 2025 in accordance with the relevant Austroads (2013) intersection design requirements.

The existing traffic management plan, which incorporates the driver code of conduct, will be updated following project approval.

Gunlake will continue to meet its obligations under Section 94 development contributions to Goulburn Mulwaree Council for the life of the project so that the Council can maintain and improve the haul routes.

10.5 Conclusions

The transport assessment identified that the extension project related traffic would generally be accommodated within the existing road network. Where traffic safety, Level of Service, road pavement and maintenance impacts were identified, road and intersection improvements have been proposed. Gunlake Quarry's Section 94 contributions would also more than adequately allow for maintenance of road pavements along the primary haulage route.

11 Noise and vibration

11.1 Introduction

This chapter provides a summary of the noise and vibration assessment prepared by EMM, which is presented in full in Appendix K.

The chapter describes the existing acoustic environment, predicted emissions, potential impacts at assessment locations, and management and monitoring measures.

The noise and vibration assessment was completed with reference to the following standards, guidelines and policies:

- the *NSW Industrial Noise Policy* (EPA 2000) (INP);
- the *Road Noise Policy* (DECCW 2011) (RNP);
- Australian Standard (AS) 1055-1997, Acoustics – Description and Measurement of Environmental Noise; and
- the Voluntary Land Acquisition and Mitigation Policy (VLAMP).

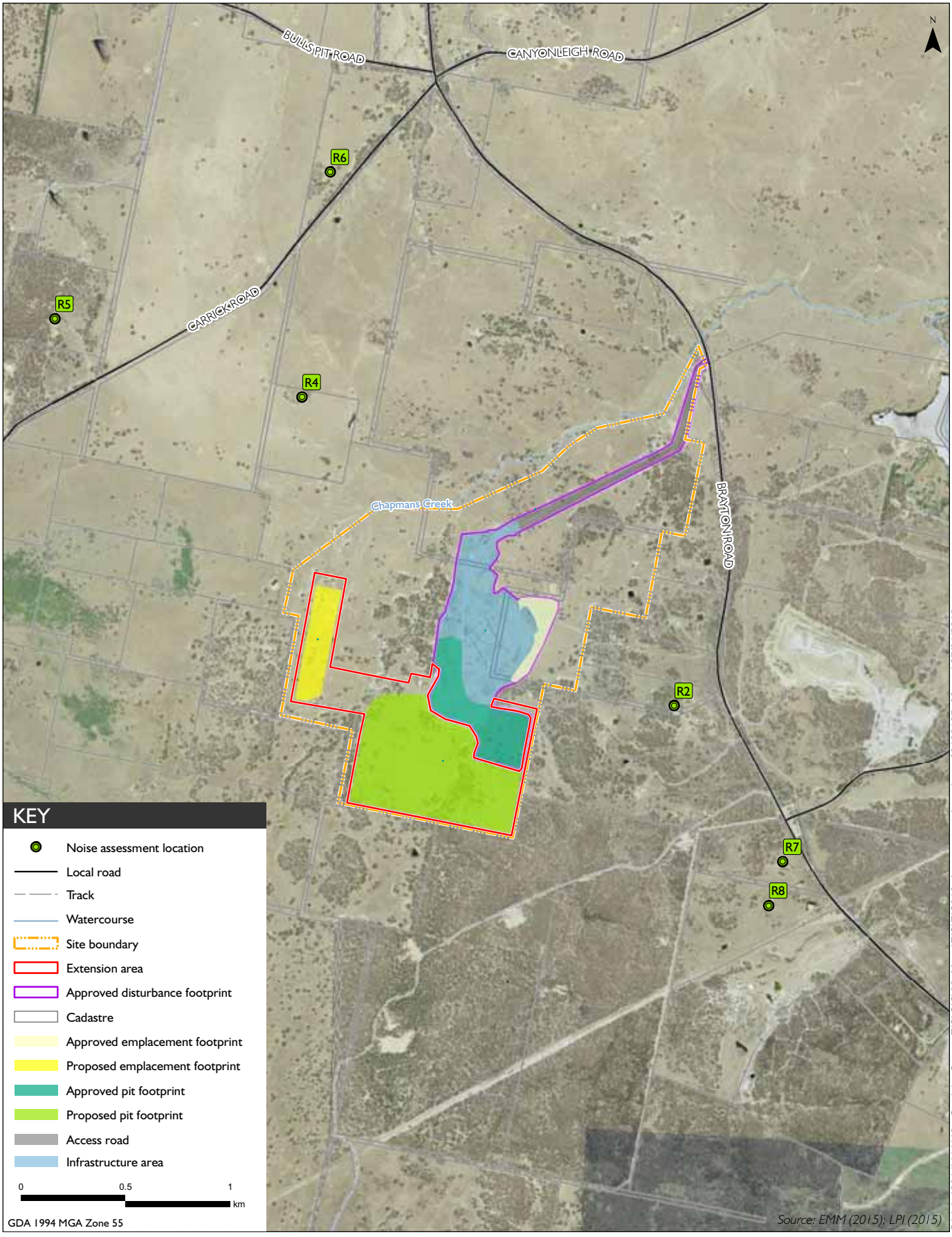
11.2 Existing environment

11.2.1 Existing site noise emissions

Site noise emissions and blasting are currently managed in accordance with the approved Noise and Blast Management Plan (Heggies 2009) which includes operator-attended noise monitoring on a yearly basis. A review of historical monitoring results showed that noise from quarry operations satisfied the noise criteria specified in project approval 07-0074 at all receiver locations. There have been 85 blasts at the quarry between July 2011 and July 2015. During this time, the ground vibration criterion (5 mm/s) has been met on all occasions, whereas the airblast overpressure criterion (115 dB, Lin Peak) has been marginally exceeded on two occasions at location R3 by 0.6 dB and 2.1 dB, in April 2012 and June 2013 respectively. Notwithstanding, these exceedances satisfy the allowable exceedance limit of 5% per total number of blasts over a period of 12 months. Furthermore, no blasts exceeded the upper criterion of 120 dB, Lin Peak at the assessment locations.

There are four residences within 1.5 km of the site, three residences to the east of the site on Brayton Road (R1, R2 and R3) and one residence to the north-west on Carrick Road (R4). Two of the residences to the east of the site (R1 and R3) are owned by Gunlake and, therefore, noise criteria do not apply at these residences. A topographic ridge lies between the quarry and residences on Brayton Road which provides an acoustic screen.

Four additional assessment locations (R5 to R8), further away from quarry operations, were assessed as quarry operations are moving further south and north-west of the currently approved footprint. The noise assessment locations are shown on Figure 11.1.



Noise assessment locations

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Figure 11.1

There are several residences along the primary haul route including on Brayton Road southbound of the quarry access road, and on Red Hills Road to the Hume Highway. These residences have the potential to be impacted by road traffic noise resulting from the proposed increase in transport volumes from the quarry (Figure 11.2).There will be no changes to transport volumes on Brayton Road through Marulan.

Adherence with noise criteria at these locations would indicate that noise criteria are met at other surrounding noise-sensitive locations.

11.2.2 Background noise levels

Historical long-term unattended noise data from the previous noise and vibration assessment (Pacific Environment 2014) was reviewed to determine background noise levels at assessment locations. Noise levels were verified by EMM using short-term operator-attended noise measurements.

The short-term attended noise monitoring results confirm that the background (L_{A90}) noise levels at residences on Carrick Road (near R4) are below the INP default Rating Background Level (RBL) of 30 dB. The background (L_{A90}) noise level at residences on Brayton Road (near R2) was measured at 33 dB. However, after filtering insect noise and other extraneous noise sources with high frequency characteristics (ie frequencies above 1.25 kHz) which are commonly considered atypical to annual background noise trends from the data, the L_{A90} noise level at these residences was calculated to be 30 dB. Therefore, an RBL of 30 dB has been adopted for the nearest sensitive receivers.

11.2.3 Meteorology

Noise propagation over distance can be significantly affected by the weather conditions. The INP specifies meteorological analysis procedures to determine the prevalent weather conditions that enhance noise propagation in a particular area, with a view to determining whether they can be described as a feature of the project area.

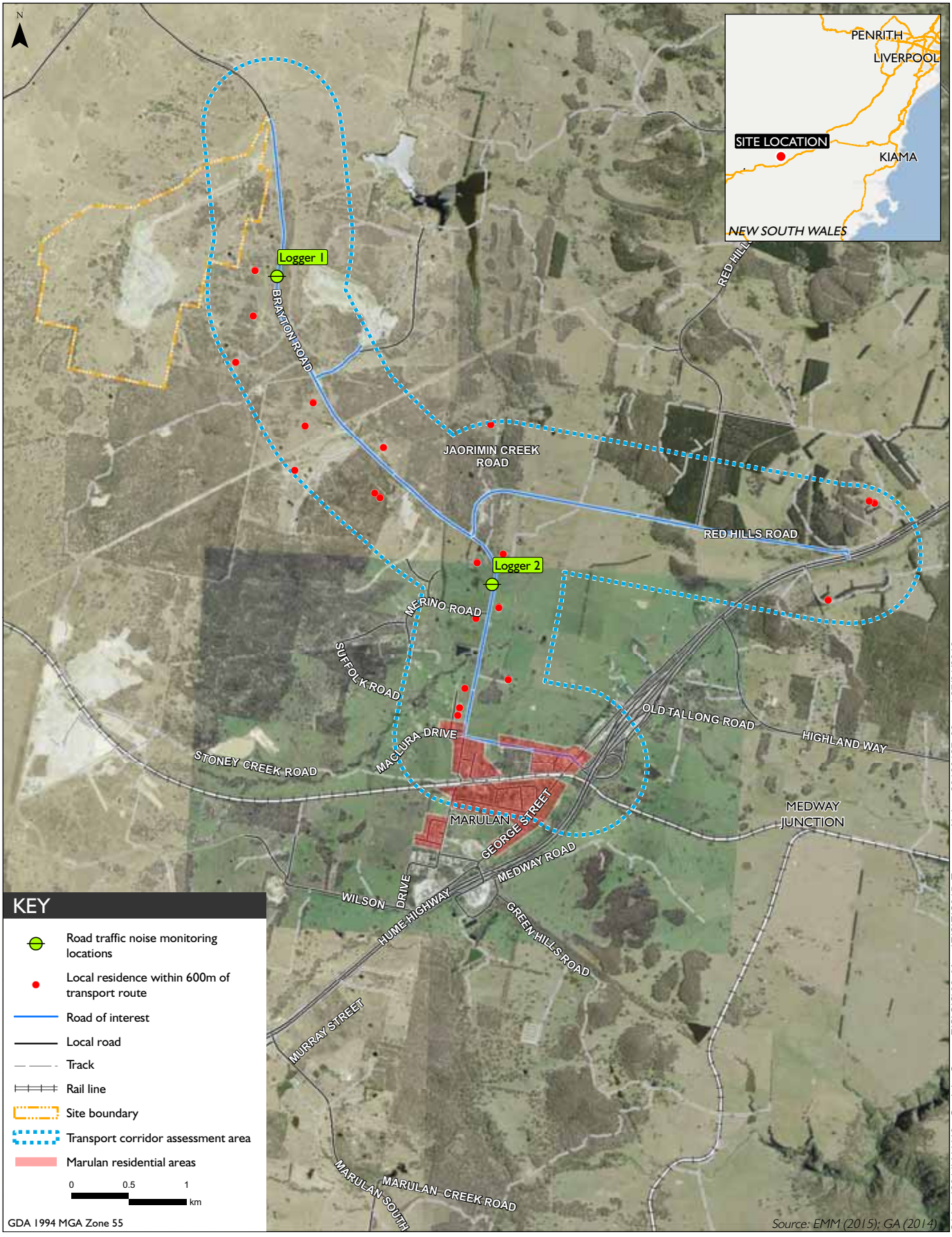
Detailed analysis of winds was undertaken using weather data from the Gunlake Quarry weather station on the north of the site. The analysis determined that prevailing winds were present during the night period ranging from the north to east-southeast (22.5° to 112.5° from north).

The frequency of temperature inversions was determined based on sigma-theta data obtained from the Gunlake Quarry weather station. Analysis of the data found that F class temperature inversions may occur for greater than 30% of the night-time period and, as such, has been considered in the prediction and assessment of noise emissions from Gunlake Quarry operations. This is consistent with past studies undertaken in the area.

11.2.4 Noise criteria

i Operational noise

Noise criteria for assessment locations R2 and R4 are specified in Condition 2, Schedule 3 of the current Project Approval (07-0074). Noise limits for all other assessment locations have been derived from the INP. The INP provides two separate criteria: intrusiveness criteria and amenity criteria. The project-specific noise levels (PSNLs) are generally the more stringent of the intrusive or amenity criteria. The PSNL for all assessment locations for day, evening and night periods is 35 dB $L_{Aeq(15\text{-}min)}$ which corresponds with the relevant intrusive criteria which is derived from the RBL plus 5 dB.



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Transport routes and noise monitoring locations

Gunlake Quarry
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Figure 11.2

ii Mitigation and acquisition rights

As detailed in Section 4.4.3, the VLAMP applies to the extension project as it is a SSD extractive industry. Voluntary mitigation and acquisition rights in the VLAMP are assigned to privately owned dwellings based on the level of predicted noise above the current project approval noise criteria or the PSNL. The VLAMP also assigns acquisition rights if the noise generated by a development contributes to an exceedance of the recommended maximum noise levels in Table 2.1 of the INP on more than 25% of any privately owned land, where a dwelling could be built on the land under existing planning controls.

iii Sleep disturbance

There are sleep disturbance ($L_{A1(1\text{-}min)}$) noise limits for R2 and R4 in the current Project Approval (07-0074). An assessment of sleep disturbance for all other assessment locations (R5, R6, R7 and R8) is also required in accordance with the INP and associated Application Notes. The INP suggests that the $L_{A1(1\text{-}min)}$ level of 15 dB above the RBL is a suitable screening criteria for sleep disturbance for the night-time period.

iv Cumulative noise

To limit continuing increases in industrial noise within a particular area, cumulative industrial noise should not exceed the amenity criteria levels specified in Table 2.1 of the INP. Holcim's Johnniefelds Quarry has the potential to impact residences R2, R7 and R8. Therefore, cumulative operational noise has been considered for these residences and compared against the INP acceptable and recommended maximum amenity criteria levels for rural areas.

Holcim Lynwood Quarry is a development currently under construction in the area, and is approximately 3 km south of the quarry and 4 km west of Marulan. Lynwood Quarry is expending further north of the currently approve footprint. It is noted however that Lynwood Quarry's infrastructure area, which includes the processing plant, is located approximately 3 km from the site's southern boundary. Therefore, given the distance between Lynwood Quarry and the nearest assessment locations (R7 and R8), it is anticipated that additional industrial noise emissions would not increase cumulative noise levels to above the relevant amenity criteria.

v Blasting

Airblast and ground vibration criteria are specified in Condition 6 and Condition 7, Schedule 3 of the current Project Approval. These are consistent with the ANZECC (1990) guidelines, *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration*.

vi Road traffic

The RNP (DECCW 2011) provides road noise assessment criteria to be applied based on the road category and surrounding land uses. The freeway/arterial/sub-arterial road type was adopted for residential land uses on Brayton Road (north and south of Bypass Road), Bypass Road/Red Hills Road and the Hume Highway. The RNP also states that where existing road traffic noise criteria are already exceeded, any additional increase in total traffic noise level should be limited to 2 dB, which is generally accepted as the threshold of perceptibility to a change in noise level.

In addition to meeting the assessment criteria, any significant increase in total traffic noise at residences (existing external traffic noise $L_{Aeq(15\text{-}hr)}$ plus 12 dB) should be considered for mitigation. It should be noted that the relative increase criterion does not apply to local roads, as per Section 2.4 of the RNP.

11.3 Impact assessment

11.3.1 Modelling methodology

Noise modelling was based on three-dimensional digitised ground contours of the surrounding land. Noise predictions were carried out using Brüel and Kjær Predictor Version 10.10 noise prediction software. 'Predictor' calculates total noise levels at assessment locations from the concurrent operation of multiple noise sources. Validation of the noise model was completed using attended measurements undertaken during a site visit in September 2015. On-site and off-site measurements, along with Gunlake weather station data recorded at the time of the measurements, were used to calibrate the noise model.

The existing and proposed operations at the quarry were modelled. Plant and equipment were modelled at locations and heights representing activities during quarry operations, including all adopted feasible and reasonable noise management and mitigation measures. The majority of equipment sound power levels were determined from on-site noise measurements. Where direct measurement was not possible, sound power data has been obtained from previous site surveys when the site was fully operational (Pacific Environment 2014) or from EMM's sound power database. The noise modelling conservatively assumed that all plant and equipment operate concurrently.

The noise emissions most likely to cause sleep disturbance were the front end loader loading the road trucks or the haul trucks unloading material into the primary crusher bin. The maximum noise level (L_{Amax}) measured from a haul truck unloading material into the primary crusher bin during the site visit was 124 dB. This was used to model maximum noise level events to assess sleep disturbance.

Predictions were made at the assessment locations under calm and F class inversion conditions during the night-time period.

11.3.2 Operational noise levels

Predicted noise emission levels from Gunlake quarrying operations at all assessment locations are provided in Table 11.1. Noise emission levels predicted to be above the existing project approval limits and PSNLs are indicated by shading.

Table 11.1 Predicted operational noise levels

Assessment location	Predicted operational $L_{Aeq(15\text{-}min)}$ noise levels, dB				Noise criteria $L_{Aeq(15\text{-}min)}$, dB
	Day	Evening/Night	Night	Night	
	Calm	Calm	Prevailing winds[1]	Inversion[2]	PA limit/PSNL
	Existing quarry operations				
R2	40	38	40	40	35
R4	39	37	39	39	35
R5	28	25	28	28	35
R6	29	27	29	29	35
R7	33	31	34	34	35
R8	32	30	33	33	35

Table 11.1 Predicted operational noise levels

Assessment location	Predicted operational $L_{Aeq(15\text{-}min)}$ noise levels, dB				Noise criteria $L_{Aeq(15\text{-}min)}$, dB
	Day	Evening/Night	Night	Night	
	Calm	Calm	Prevailing winds[1]	Inversion[2]	PA limit/PSNL
Year 1 quarry operations					
R2	41	42	44	45	35
R4	41	42	45	45	35
R5	29	31	34	34	35
R6	31	32	35	35	35
R7	34	35	37	38	35
R8	33	34	37	37	35
Year 5 quarry operations					
R2	41	42	44	45	35
R4	41	42	45	45	35
R5	30	31	34	34	35
R6	31	32	35	35	35
R7	34	35	38	38	35
R8	33	34	37	37	35
Year 10 quarry operations					
R2	41	42	44	45	35
R4	41	42	45	45	35
R5	29	31	34	34	35
R6	31	32	35	35	35
R7	34	35	38	38	35
R8	33	34	37	37	35
Year 20 quarry operations					
R2	41	42	44	44	35
R4	41	42	45	45	35
R5	30	31	34	34	35
R6	31	32	35	35	35
R7	34	35	38	38	35
R8	33	34	37	37	35
Year 30 quarry operations					
R2	41	42	44	44	35
R4	41	42	45	45	35
R5	29	31	34	34	35
R6	31	32	35	35	35
R7	34	35	38	38	35
R8	33	34	37	37	35

Notes: *1. Maximum predicted level based on wind speed of 2.3 m/s and wind directions from 0° to 112.5° (22.5° increments) based on data from the Gunlake Quarry weather station.*

2. F class inversion.

The predicted operational noise levels for the current operations and the proposed extension project are summarised as follows:

- No or negligible impacts (noise levels 0 to 2 dB above PSNLs) are predicted for the current operations at R5, R6, R7 and R8.
- No or negligible impacts (noise levels 0 to 2 dB above PSNLs) and predicted for the extension project operations at R5, R6 and R8.
- Moderate impacts (noise levels 3 to 5 dB above PSNLs) are predicted for the current operations at R2 and R4. These locations would be entitled to mitigation in accordance with the VLAMP.
- Moderate impacts (noise levels 3 to 5 dB above PSNLs) are predicted for the extension project operations at R7. These locations would be entitled to mitigation in accordance with the VLAMP.
- Significant impacts (noise levels >5 dB above PSNLs) are predicted for the extension project operations at R2 and R4. These locations would be entitled to mitigation and voluntary acquisition upon request in accordance with the VLAMP.

The noise levels that are above the criteria are mainly as a result of noise emissions from the quarry processing plant. Notwithstanding, noise levels from the extension project would be lower at receivers further away from the quarry (in particular the processing area). Noise levels at these further away receivers are predicted to satisfy the criteria during worst case meteorological conditions for all stages of the project.

11.3.3 Sleep disturbance

Predicted L_{Amax} noise levels at all assessment locations are provided in Table 11.2. The highest predicted L_{Amax} noise level (from front end loader or haul truck unloading operations) was 46 dB during F class temperature inversion at assessment location R2. This satisfies the current project approval limit and the adopted criterion at this location. The highest predicted L_{Amax} noise levels at all other assessment locations (R4 to R8) ranged between 36 dB and 43 dB during F class temperature inversion, and satisfy the EPA's strict screening target of background plus 15 dB .

Table 11.2 Predicted L_{Amax} noise levels

Assessment location	Night-time predicted operational L_{Amax} noise levels, dB		Relevant noise criteria, dB
	Calm	Inversion[2]	
R2	42–43	44–46	47
R4	31–39	34–42	45
R5	30–33	33–36	45
R6	29–34	31–36	45
R7	33–40	36–43	45
R8	30–40	33–43	45

Notes: 1. Maximum predicted level based on wind speed of 2.3 m/s and wind directions from 0° to 112.5° (22.5° increments) based on data from the Gunlake weather station.

2. F class inversion.

11.3.4 Cumulative noise

Cumulative noise levels were assessed at assessment locations potentially impacted by the extension project, Johnniefelds Quarry and Lynwood Quarry.

Johnniefelds Quarry only operates during the day-time and evening periods and has the potential to impact the nearest sensitive receivers R2, R7 and R8 during these periods. It is noted that predicted or existing noise levels from Johnniefelds Quarry are not documented in the public domain. Potential noise levels from Johnniefelds Quarry were, therefore, qualitatively reviewed.

The predicted $L_{Aeq(15\text{-}min)}$ extension project operational noise levels at R2, R7 and R8 during the day period are between 33 and 41 dB. Therefore, it is anticipated that $L_{Aeq(day)}$ operational noise levels would satisfy the INP acceptable recommended level of 50 dB at these locations. Additionally, given the predicted site $L_{Aeq(15\text{-}min)}$ noise levels at R7 and R8 during the evening and night periods (34–38 dB), it is anticipated that site $L_{Aeq(evening)}$ and $L_{Aeq(night)}$ noise levels will satisfy the INP acceptable recommended levels of 45 dB and 40 dB, respectively, at these locations.

The predicted extension project operational $L_{Aeq(15\text{-}min)}$ noise levels at R2 during the evening period (42 dB) is 3 dB below the INP acceptable $L_{Aeq(evening)}$ recommended level of 45 dB. This means that the $L_{Aeq(evening)}$ noise level from other industrial development(s) would have to be higher than site $L_{Aeq(evening)}$ noise level by at least 1 dB for cumulative $L_{Aeq(evening)}$ noise levels to exceed the INP acceptable recommended $L_{Aeq(evening)}$ level of 45 dB. This is considered unlikely.

Lynwood Quarry is located south of the extension project. Holcim (Australia) is seeking to modify the quarry consent (Modification 4) to expand further north of the currently approved footprint. The noise assessment prepared for Lynwood Quarry Modification 4 (Scientific Systems 2015) predicts that noise levels from the proposed modification at residences north-east of Lynwood Quarry (south of the extension project eg R7 and R8) would be less than 30 dB for all stages of the modification during worst-case meteorological conditions. Therefore, it is predicted that potential noise contributions from Lynwood Quarry (Modification 4) would not increase cumulative noise levels above the INP amenity criteria at all assessment locations for the extension project.

Cumulative noise from the extension project and surrounding developments is anticipated to satisfy the amenity criteria at all assessment locations.

11.3.5 Privately owned lands assessment

Several privately owned lands were identified surrounding the Gunlake Quarry consent boundary that could potentially be exposed to noise from the extension project and other industrial developments in the area. The results of the assessment indicate that predicted noise levels from the extension project when also accounting for noise from other surrounding quarries will exceed the relevant recommended maximum amenity noise level on more than 25% of two privately owned land parcels, identified at Lot 64 and Lot 72 of plan DP750003, during worst case night-time F class inversion conditions. Notwithstanding, these two land parcels are part of contiguous lots which form two large properties that are owned by the same landowners. The VLAMP defines privately owned land as "...the whole of a lot, including contiguous lots owned by the same landowner". Predicted noise levels over the entire privately owned land parcel including all contiguous lots is less than 25% and therefore does not trigger acquisition rights during worst case operational and meteorological scenarios. Furthermore, Gunlake currently has negotiated agreements in place with the relevant landowners of these two properties and therefore complies with the requirements of the VLAMP.

11.3.6 Overpressure and vibration

The blast overpressure and vibration calculations identify that a large range of MICs can be adopted based on the distance from the blast to the nearest assessment locations, along with other standard blasting practices as determined throughout the blast design process. A review of the quarry plans and proposed active quarry area shows that blasting may occur at 700 m from the nearest assessment location and a respective MIC of 290 kg along with other appropriate blast design practices will satisfy ANZECC limits. Conversely, where blasts are distanced further from assessment locations, a higher MIC along with other appropriate blast design practices can be adopted whilst still satisfying ANZECC limits. The proposed MIC blast patterns will be designed specifically to ensure compliance with the relevant criteria at the closest residence. Therefore, it is predicted that blast overpressure and vibration levels would satisfy ANZECC blasting limits at all privately owned residences.

11.3.7 Road traffic noise

The current project approval allows an average of 164 haul truck movements (82 truck loads) daily with maximum daily truck movements of 320 (160 truck loads). The extension project will increase average daily truck movements to 440 (220 truck loads), with a potential maximum daily truck movements of 690 (345 truck loads).

Two noise loggers (Class 1) were deployed at two locations on Brayton Road in August 2015 to measure road traffic noise from existing traffic movements. Tube traffic count surveys were undertaken simultaneously. The noise loggers were placed at the nearest residential property boundary to the road and were used to calibrate road traffic noise predictions at the residential facade facing to the road.

The Calculation of Road Traffic Noise (CORTN) (UK Department of Transport) method was used to calculate the total existing traffic noise emissions and to predict traffic noise levels at the nearest privately owned residences for the day and night assessment periods. The calculations accounted for differences in driving speed along different road sections of the transport route.

The calculated road traffic noise levels at the nearest privately owned receivers are presented in Table 11.3. The future (total) road traffic noise levels are predicted to satisfy the RNP day and night criteria at all nearest privately owned receivers on each section of the transport routes.

Table 11.3 Road traffic noise levels

Road section	Distance to nearest receiver (m)	Driving speed (km/h)	Existing total traffic noise (including Gunlake Quarry), dB(A)	Calculated extension project traffic noise, dB(A)	Future total traffic noise, dB(A)	Criteria, dB(A)	Difference between existing and future total traffic noise, dB
Day period							
Brayton Rd – west of Bypass Rd	108	100	47	45	49	60	2
Bypass/Red Hills Rd	400	100	38	38	41	60	3
Brayton Rd – east of Bypass Rd	62	100	47	43[1,2]	48[1,2]	60	1
Brayton Rd – east of Bypass Rd (Marulan)	16	50	50	44[1,2]	51[1,2]	60	1
Night period							
Brayton Rd – west of Bypass Rd	108	100	42	44	46	55	4
Bypass/Red Hills Rd	400	100	34	37	39	55	5
Brayton Rd – east of Bypass Rd	62	100	39	43[1,2]	44	55	5
Brayton Rd – east of Bypass Rd (Marulan)	16	50	43	44[1,2]	47	55	4

Notes: 1. Includes light vehicles only, as additional Gunlake heavy vehicles will leave and return to the quarry using the Bypass/Red Hills Road.

2. It was assumed that half of the additional Gunlake light vehicle traffic will be travelling within a single hourly period.

11.4 Management and mitigation

11.4.1 Current noise management

Gunlake currently undertakes operational noise and blast monitoring in accordance with the approved Noise and Blast Monitoring Program (Heggies 2009). Operator-attended monitoring is completed annually to quantify the quarry's noise contribution at the nearest residences. Noise monitoring is undertaken at the nearest residence R1 (owned by Gunlake), and the monitoring data is used to determine compliance at all other surrounding sensitive receivers.

Blast monitoring is undertaken for all blast events at the nearest potentially affected residence. All landowners within 2 km of the quarry are notified prior to a blast event.

A review of noise monitoring reports for the last three years found that noise emissions from the quarry are typically inaudible at the nearest residential locations or, if they are audible, are below the relevant noise limits.

The noise monitoring program will be continued and will include night-time noise monitoring to quantify the 24 hour operation of the processing plant.

11.4.2 Additional feasible and reasonable management and mitigation

As part of the proposed extension project the proponent has committed to reducing the mobile fleet during the evening and night periods which are represented in the noise model results.

Early noise model iterations identified the existing and upgraded processing plant to be the main contributor to offsite noise levels at assessment locations R2 and R4. Feasible mitigation measures were subsequently investigated including the construction of a 5 m earth bund west of the upgraded processing plant. The reduction in offsite noise levels at assessment location R4 was in the order of 1 dB. Such a reduction is considered acoustically negligible and would not be noticed by the resident (refer Appendix K). The implementation of a 5 m earth bund would come at a significant cost and present potential operational restrictions for the site. This measure was therefore deemed unreasonable and not considered further.

The noise benefit from adding sheet metal enclosures around the existing and upgraded processing plant and equipment was also reviewed. The overall reduction in offsite noise levels with this mitigation in place was in the order of 4 to 5 dB at R2, R4 and R7. This reduction was evaluated along with other economic and social factors and was deemed unreasonable for the project due to:

- the reduction is required to satisfy acquisition noise limits for two assessment locations, and mitigation noise limits for one assessment location;
- the significant overall cost to implement the measure along with ongoing maintenance restrictions would potentially deem the project economically unfeasible; and
- entering into an amenity agreement, or, offering voluntary acquisition rights for two locations and voluntary mitigation rights for one location would likely present a more economically sustainable outcome for the project.

11.5 Voluntary mitigation

Operational noise levels at assessment location R7 from the proposed extension project are predicted to moderately exceed (by 3 dB, ie between 3 to 5 dB) the current project approval limits and PSNLs during worst case meteorological conditions. This entitles the landowner to voluntarily mitigation upon request in accordance with the VLAMP. Potential mitigation would include receiver based treatment, for example, upgrade of the dwelling facade elements. Gunlake is committed to provide potential mitigation to assessment location R7 upon request from the relevant landowner, unless an alternate amenity agreement can be made.

11.6 Voluntary land acquisition

Operational noise levels from the proposed extension project at R2 and R4 are predicted to significantly exceed (by more than 5 dB) project approval limits and the PSNLs during the night-time period. Furthermore, the assessment identified that the implementation of other feasible mitigation measures would not achieve the required reduction to warrant this measure economically reasonable. Therefore, R2 and R4 would be entitled to voluntary acquisition rights upon request in accordance with the VLAMP. It is noted that an agreement has recently been negotiated between Gunlake and the landowner of assessment location R4, and therefore voluntary land acquisition is no longer relevant at this location.

Gunlake is committed to providing land acquisition upon request from the landowner of R2, if an amenity agreement with the landholder cannot be reached.

11.7 Conclusions

A noise model was developed to assess noise levels from the currently approved and the proposed extension project operations. The assessment predicted significant impacts at R2 and R4. Gunlake has recently negotiated an agreement with the landowner of assessment location R4 and therefore, voluntary land acquisition is only relevant to R2. Moderate impacts were predicted at R7 which will be offered voluntary mitigation upon request in accordance with the VLAMP.

Sleep disturbance criteria are predicted to be met by maximum noise level events at all assessment locations.

Cumulative noise from the extension project and other developments is likely to satisfy the relevant amenity criteria.

The privately owned lands assessment identified two privately owned land parcels (Lot 64 and Lot 72, DP750003) where recommended maximum amenity noise levels are exceeded on more than 25% of the individual land area. Notwithstanding, these two land parcels are part of contiguous lots which form two large properties that are owned by the same landowners. The VLAMP defines privately owned land as "...the whole of a lot, including contiguous lots owned by the same landowner". Predicted noise levels over the entire privately owned land parcel including all contiguous lots is less than 25% and therefore does not trigger acquisition rights during worst case night-time F class inversion conditions. Furthermore, Gunlake currently has negotiated agreements with the relevant landowners and therefore complies with this assessment in accordance with the VLAMP.

Operational road traffic noise levels are predicted to satisfy the relevant RNP noise criteria and guidelines at all nearest assessment locations for all road sections of the transport route.

Blast overpressure and ground vibration levels are predicted to satisfy relevant ANZECC guidelines.

12 Air quality and greenhouse gases

12.1 Introduction

This chapter provides a summary of the air quality and greenhouse gas assessment prepared by Ramboll Environ Australia Pty Ltd, which is presented in full in Appendix L.

This chapter describes the existing air quality environment, predicted emissions, potential impacts at assessment locations, and management and monitoring measures.

The air quality and greenhouse gas assessment was completed with reference to the following guidelines and policies:

- the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (the EPA Approved Methods, (EPA 2005); and
- the VLAMP.

12.2 Existing environment

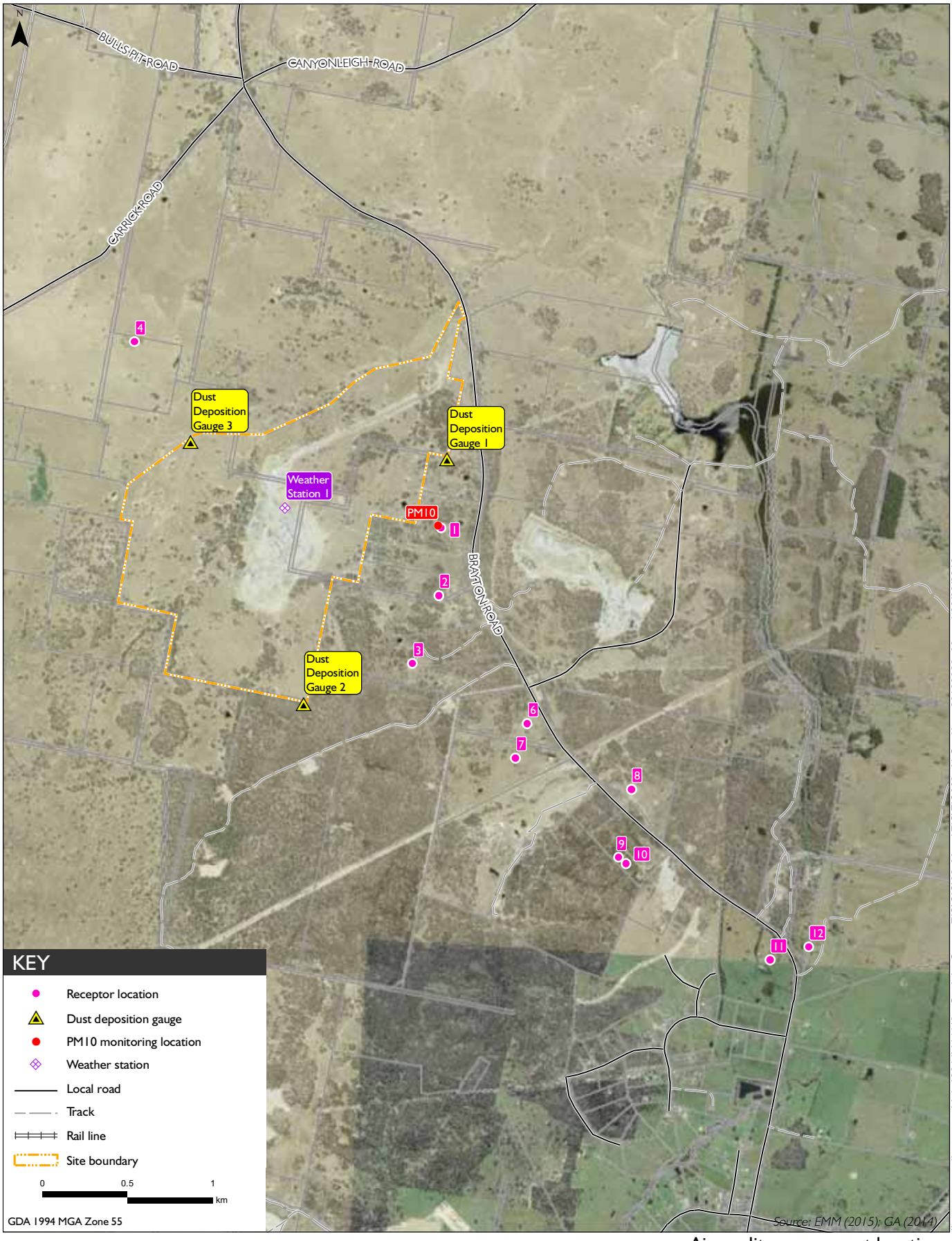
12.2.1 Assessment locations

The closest residences (receptors) are to the south-east along Brayton Road. Twelve receptor locations (Figure 12.1) were assessed for air quality impacts. Ten of these residences are privately owned and two (1 and 3) are owned by Gunlake.

12.2.2 Climate

A combination of on-site monitoring, regional observational data and meteorological modelling techniques were used to characterise the local meteorological. The meteorological analysis for the air quality assessment used data collected from Gunlake Quarry's meteorological monitoring station and the BoM weather station at Goulburn Airport and Moss Vale.

Atmospheric stability and mixing depths were generated by AERMET, the meteorological processor for the AMS/US-EPA regulatory dispersion model (AERMOD). Atmospheric instability increases during daylight hours meaning that potential for atmospheric dispersion of emissions is be greatest at night and lowest during the evening to early morning hours. Greater boundary layer depths are experienced during the day time hours, peaking in the mid to late afternoon. As turbulence increases so does the depth of the boundary layer generally contributing to high mixing depths and greater potential for atmospheric dispersion of pollutants.



Air quality assessment locations

Gunlake Quarry
Environmental Impact Statement

Figure 12.1

12.2.3 Air quality criteria

Particulate matter consists of dust particles of varying size and composition, which are referred to as deposited dust, total suspended particulate matter (TSP), and particles which have a diameter of 10 micrometres (µm) or less (PM_{10}) or 2.5 µm or less ($PM_{2.5}$).

Air quality goals are benchmarks set to protect the general health and amenity of the community. The air quality goals relevant to the study are outlined in the EPA Approved Methods (EPA 2005) and are summarised in Table 12.1. The NSW EPA currently does not have impact assessment criteria for $PM_{2.5}$ concentrations; however, the National Environment Protection Council (NEPC) has released a variation to the *National Environment Protection (Ambient Air Quality) Measure* (NEPM, NEPC 2003) to include advisory reporting standards for $PM_{2.5}$ (Table 12.1).

Table 12.1 Impact assessment air quality goals

Pollutant	Averaging period	Impact	Criterion
TSP	Annual	Total	90 µg/m^3
PM_{10}	Annual	Total	30 µg/m^3
	24 hour	Total	50 µg/m^3
Deposited dust	Annual	Incremental	2 g/m^2/month
		Total	4 g/m^2/month
$PM_{2.5}$	24 hours	-	25 µg/m^3
	Annual	-	8 µg/m^3
Carbon monoxide (CO)	15 minute	-	100 mg/m^2
Nitrogen dioxide (NO_2)	1 hour	-	246 µg/m^3
	Annual	-	62 µg/m^3

Source: *Approved Methods* (EPA 2005), *National Environment Protection (Ambient Air Quality) Measure* (NEPC 2003).

The VLAMP requires applicants to assess impacts in accordance with the EPA Approved Methods. Voluntary mitigation or acquisition rights may apply where, even with best practice management, the development contributes to exceedances of the criteria in Table 3 of the VLAMP at any residence or workplace. Voluntary acquisition rights may also apply where there are exceedances of the criteria on more than 25% of any privately-owned land where there is an existing dwelling or where a dwelling could be built under existing planning controls.

Crystalline silica is present in abundance on the earth's crust. Respirable crystalline silica (RCS) particles have been known to cause silicosis, an inflammation and scarring in the lungs reducing the capacity to absorb oxygen from air depending on the level of exposure. While the NSW EPA does not provide assessment criteria for RCS, the Victorian Environment Protection Authority (VEPA 2007) has developed an assessment criterion for RCS for mining and extractive industries. The VEPA annual average criterion of 3 µg/m^3 was used in the assessment of potential RCS impacts. The indicative silica content of extracted material at Gunlake Quarry is between 5 and 7%.

12.2.4 Baseline air quality

Sources of air pollution within 15 km of Gunlake Quarry include Holcim's Johnniefelds and Lynwood quarries and Boral's Marulan South and Peppertree quarries. A number of other background sources contribute to particulate matter emissions in the vicinity of the site such as vehicle movements generating dust and emissions (petrol and diesel), wind dust generated from exposed areas, and emissions from grass/bush fires and household wood burning.

Data from air quality monitoring resources at Gunlake Quarry, Lynwood Quarry, OEH's stations at Bargo and Camden, and the ACT Government's Monash station was collated to characterise the baseline air quality. Baseline air quality can be summarised as follows:

- Recorded 24-hour average PM_{10} concentrations fluctuate at all locations with exceedances of the relevant criterion experienced on occasion at stations, with the exception of Gunlake Quarry and one of the Lynwood Quarry stations. The annual average PM_{10} concentration is 12.5 µg/m^3.
- Recorded 24-hour average $PM_{2.5}$ concentrations fluctuate at all locations with exceedances of the NEPM reporting standard at the Monash station. The annual average $PM_{2.5}$ concentration is 6.7 µg/m^3.
- No local TSP monitoring data is available for the Marulan area. A background TSP concentration was derived by applying a PM_{10}/TSP ratio of 0.4 to the annual average PM_{10} concentration. Therefore, the annual average TSP concentration is 31.3 µg/m^3.
- Annual average deposition levels recorded are below the relevant criterion at all locations. The annual average dust deposition level is 1.7 g/m^2/month.

12.3 Impact assessment

12.3.1 Dispersion modelling

i Method

Atmospheric dispersion modelling used AERMOD with simulations undertaken for the 12 months of 2014 using AERMET to generate meteorological conditions based on meteorological monitoring. Four emission scenarios were modelled – current operations, production at 1 Mtpa, production at 1.5 Mtpa, and production at 2 Mtpa. No construction scenario was modelled as emissions from construction would be short-term and significantly less than from quarry operations.

Emission factors were applied to the proposed quarry activities to estimate the dust and diesel emissions. Emission reductions were applied to account for current and proposed air quality controls. Emissions from Holcim's Lynwood and Johnniefelds quarries were included in the atmospheric dispersion modelling and the cumulative assessment using annual emissions from air quality impact assessments undertaken for the quarries (PAE Holmes 2010). Cumulative 24-hour PM_{10} and $PM_{2.5}$ impacts were evaluated using a statistical frequency analysis approach which presents the likelihood of additional exceedances of the assessment criteria.

Emissions of nitrogen dioxide, sulphur dioxide, carbon monoxide and assorted volatile organic compounds would be generated by the combustion of diesel fuel at the quarry and along the product distribution route. Based on experience with similar-sized quarry operations, and the related air quality impacts from these pollutants, any potential impacts are anticipated to be minor and were not quantitatively assessed in the air quality assessment.

In addition to particulate matter emissions, blasting activities can result in the release of air pollutants including nitrous oxides. Blasting at the quarry is undertaken by an external contractor and proposed design considerations are outlined in Section 12.4. Accordingly, emissions and impacts from post-blast fume events were not considered quantitatively in the air quality assessment.

ii Results

Receptor locations 1, 2, 3 and 6 are the most impacted by emissions from Gunlake Quarry and Scenario 4 (2 Mtpa) has the highest impacts. The Gunlake Quarry-only incremental particulate concentrations and deposition rates are predicted to be below the applicable impact assessment criteria for all receptor location for all emissions scenarios.

The predicted cumulative particulate concentrations and deposition rates from Gunlake Quarry and neighbouring quarries are also below the applicable impact assessment criteria for all receptor location for all emission scenarios. When compared with the incremental concentrations, the increase in maximum 24-hour average PM_{10} and $PM_{2.5}$ concentrations is predicted to be negligible at the closest receptor locations. This is attributable to the prevailing east–west aligned wind regime. As a result, daily particulate concentrations from the Lynwood and Johnniefelds quarry operations generally do not affect the same receptors on the same days as Gunlake Quarry.

The cumulative frequency analysis showed that the likelihood of an additional day exceedance of the 24-hour average PM_{10} and $PM_{2.5}$ criteria is negligible (0.3% and 1.2–1.3%, respectively). Cumulative annual average particulate concentrations and deposition levels are also below the applicable impact assessment criteria at all receptor locations and for all emission scenarios.

12.3.2 Greenhouse gas impacts

The estimation of greenhouse gas (GHG) emissions for the Gunlake Quarry was based on the National Greenhouse Accounts Factors (NGAF) workbook (DoE 2014). For accounting and reporting purposes, GHG emissions are defined as 'direct' and 'indirect' emissions. Direct emissions (also referred to as Scope 1 emissions) occur within the boundary of an organisation and as a result of that organisation's activities. Indirect emissions are generated as a consequence of an organisation's activities but are physically produced by the activities of another organisation (DoE 2014). Indirect emissions are further defined as Scope 2 and Scope 3 emissions. Scope 2 emissions occur from the generation of the electricity purchased and consumed by an organisation. Scope 3 emissions occur from all other upstream and downstream activities, for example the downstream extraction and production of raw materials or the upstream use of products and services.

The estimated annual GHG emissions are presented in Table 12.2. The extension project will result in an increase (approximately threefold) in annual GHG emissions from the current operations, due primarily to the related increase in diesel fuel consumption and electricity demand for processing.

Table 12.2 Summary of estimated annual GHG emissions (tonnes CO_2-e/annum)

Scenario	Scope 1 emissions	Scope 2 emissions	Scope 3 emissions				
	On-site diesel	Electricity	On-site diesel	Electricity	Product transport (diesel)	Employee travel	Total
1	2,549	109	194	17	12,387	553	13,152
2	4,292	118	327	18	16,516	664	17,526
3	6,036	127	460	19	24,775	885	26,140
4	7,780	137	593	21	33,033	1,151	34,798

Note: GHG emissions are reported in tonnes of carbon dioxide equivalents (t CO_2-e). Non-CO_2 gases are converted to CO_2-e by multiplying the quantity of the gas by its Global Warming Potential (GWP) – see Table 26 of the NGAF workbook.

The annual Scope 1 and Scope 3 emissions at full production represent approximately 0.03% of total GHG emissions for NSW and 0.008% of total GHG emissions for Australia, based on the National Greenhouse Gas Inventory for 2013.

12.4 Management and mitigation

Mitigation measures and practices are currently in place to manage particulate matter emissions from Gunlake Quarry. These are detailed in Appendix L and include the following management practises to minimise emissions from the combustion of diesel:

- upgrade of the majority of mobile plant to USA-EPA Tier 3 and Tier 4 emission standard compliance;
- use of electronic fuel monitored engines, with servicing conducted every 250 days to ensure engine operation and emissions performance; and
- switching off any equipment that has been idling longer than three minutes.

The current and proposed measures were incorporated into the dispersion modelling which determined that the risk of adverse air quality impacts is low and all air quality impact assessment criteria were met. Notwithstanding, the following additional management measures will be implemented to enable Gunlake to continue to manage potential air quality impacts effectively:

- compliance with the USA-EPA Tier 3 or Tier 4 emissions standards, where practicable, for any new plant acquired by Gunlake; and
- consideration of the following factors during blast design:
    - delaying blasting to avoid unfavourable weather conditions that are likely to cause or spread a blast fume;
    - selecting an explosive product that is correct for the conditions;
    - monitoring the amount of hydrocarbon (diesel) in the product;
    - preventing water ingress into blast holes;
    - dewatering holes before loading;
    - keeping sleep time (the amount of time between charging and firing of a blast) to a minimum, well within manufacturer recommended times;
    - providing effective stemming; and
    - loading the product using the appropriate techniques.

The existing air quality monitoring network will continue under the extension project. Monitoring results will be reviewed on an annual basis against the EPL and approval conditions to determine if additional monitoring is required due to production increases.

12.5 Conclusions

Dispersion model predictions for the extension project predict that the proposed changes to operations will not result in any exceedances of the impact assessment criteria for key pollutants, including PM_{10}, $PM_{2.5}$, TSP, RSC and dust deposition. Current and proposed mitigation measures were incorporated into the modelling. Additional management measures for diesel emissions and blasting fumes will be implemented to enable Gunlake to continue to manage potential air quality impacts effectively.

The extension project will result in an increase in annual GHG emissions from the current operations due to increased diesel consumption and electricity demand for processing. At full production, the annual Scope 1 and Scope 3 emissions represent approximately 0.03% and 0.008% of total GHG emissions for NSW and Australia, respectively.

13 Aboriginal heritage

13.1 Introduction

This chapter provides a summary of the Aboriginal cultural heritage assessment (ACHA) prepared by EMM, which is presented in full in Appendix M.

The chapter describes the potential impacts of the extension project on Aboriginal cultural heritage values in the project area and, where impacts are unavoidable, the measures proposed to mitigate impacts.

The ACHA was completed with reference to the *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (DECCW 2010a). The assessment focuses on the extension area as the majority of the approved footprint has been previously assessed and subsequently disturbed as part of quarrying activities.

13.2 Existing environment

13.2.1 Registered Aboriginal parties

Invitations to register as a registered Aboriginal party (RAP) for the extension project were issued in April 2015. Twenty nine RAPs registered their interest in the project. The RAPs were sent information on the project, the proposed survey assessment method, and the method for test excavation. Comments received were incorporated into the ACHA where appropriate. The draft ACHA was also issued to the RAPs for their comment prior to finalisation. Details of the consultation undertaken, responses received and the outcomes are provided in Appendix M.

13.2.2 Landscape context

i Topography and drainage

The extension area is characterised by undulating hills with level to moderately inclined slopes. Most of the extension area comprises broad hill spur crests sloping north towards the quarry which are dissected by three creek lines tending north. These are a part of a series of nine water features (springs) within 1.5 km of the extension area in the headwaters of Chapmans Creek (see Section 8.2.4).

The extension area's level to gently inclined crests, gently inclined hill slopes and gently inclined foot slopes adjacent to streams indicate archaeological sensitivity. These landforms have been shown to predominantly contain open artefact sites as the remnants of past Aboriginal activity.

Drainage of the extension area in its current condition indicates that water availability was ephemeral. However, its present condition is the result of erosion and sediment accumulation. The natural springs may have contributed to greater water reliability of the area in the past.

ii Geology and soils

As described in Section 8.2.3, the quarry is within a folded and deformed basement Bindook Porphyry Complex sequence of Devonian age volcanic rock, volcanoclastics and intrusive lithologies (Cook 2008).

Bindook Porphyr generally consists of quartz, feldspar, porphyry, dacide, felstik and tuff. Granite and porphyry are typically unsuitable for stone tool manufacture, although finer grades of porphyry have manufacturable qualities and there are instances of this material being used in the Hunter Valley (Umwelt 2008). Quartz is the most local resource likely to have been used for stone tool manufacture. It is a resource widely utilised in the broader region and can occur in pockets and veins of geology such as granite and sandstone conglomerate. The quality of quartz can vary greatly from homogenous varieties with good flaking properties to material with numerous flaws and incipient fracture planes. Therefore, any stone artefacts in the project area that are not quartz are likely to have been imported from other areas.

Most of the extension area is part of the Bindook Road Soil Landscape, with a small portion (approximately 1.5 ha) of the Wyangala Soil Landscape (Hird 1991) occurring in the south-western corner where elevation increases. There is potential for the sandy loam soils to retain subsurface archaeological evidence on gentle gradients where erosion is minimal or where aggrading soils have accumulated archaeological material from up-slope.

The moderately inclined slopes and crests featuring rocky porphyry outcrops are less likely to contain Aboriginal objects because they would have been undesirable activity areas due to their gradient and the deterrent of rocky ground for camping. The soils in these areas are likely to be skeletal from sheet erosion and heavily mixed with large rock inclusions which make the potential for the accumulation of subsurface archaeological deposits to be low.

iii Climate

Overall, the extension area has mild to hot summer and mild to cold winters. The climate of the extension area for the past 1,000 years would probably have been much the same as present day conditions, providing a habitable environment.

iv Vegetation and historic land use

Prior to clearing for agriculture, native vegetation in the extension area would have been predominantly dry sclerophyll forest with red stringybark predominant. The extension area has largely been cleared of native vegetation but small scattered pockets of remnant vegetation occur in drainage depressions and on slopes of lower agricultural utility. Most of the extension area is now grassland having been cleared for agriculture, predominantly sheep grazing.

Vegetation clearance close to streams can change their morphology, increase bank erosion and cause sediment aggradation. Vegetation clearance also results in sheet erosion on crests and hill slopes which transports soils down-slope. These processes are likely to have occurred in the extension area. The streams have been dammed at a number of locations to retain water in drier months. There is also evidence of drainage diversion bunds built into hill slopes. These activities may have displaced any Aboriginal objects vertically and horizontally within the soil matrix without fully diminishing their archaeological and cultural value. The extent of displacement depends on the type of ground disturbance, gradient of slope and the type of erosion, such as sheet wash on hill slopes and gullying and scouring adjacent to streams.

Given that the woodland areas have been cleared over the past century, mature trees which might carry carving or scarring (also known as modified trees) were predicted to be rare in the extension area prior to the site survey. No modified trees were found during inspection of mature trees during the survey.

13.2.3 Archaeological context

The extension area is located near the boundary of two Aboriginal groups (based on Tindale 1974):

- the Ngunawal whose territory extended to the south and south-west from Queanbeyan to Yass and east to beyond Goulburn; and
- the Gandangara whose territory extended to the north and north-west at Goulburn and Berrima, down the Hawkesbury River to Camden and whose name incorporates terms meaning west and east.

There are also two groups whose boundaries occur nearby to the east and north-east:

- the Wodiwodi whose territory extends to the north-east north of the Shoalhaven Rover to Wollongong; and
- the Wandandian whose territory extends to the south-east from Ulladulla to the Shoalhaven River and Nowra.

Much information on the practices of Aboriginal people has been lost due to settlement and interactions with European settlers but certain generalisations can be made from early colonial records and subsequent research. Aboriginal people moved in small family groups (Smith 1992), which belonged to clans, all of which were united by language and cultural affinities with ties to specific territories. Historical records have noted large gatherings of people took place in Goulburn in the early 1800s (Smith 1992).

Aboriginal people subsisting on plant foods, aquatic life from the surrounding waterways and ate a variety of fauna. Aboriginal groups had a wide range of tools and equipment made of wood and stone, including reed spears and axes. The bark of stringybark trees were used for making shelters and rope.

Burial in the region was characterised by the interment of individuals in graves to be covered by a layer of stone, rocks and cobbles. There is evidence of the construction of gunyahs, a shelter made of bark or bushes laid against supporting trees or poles (Govett 1836, p. 19).

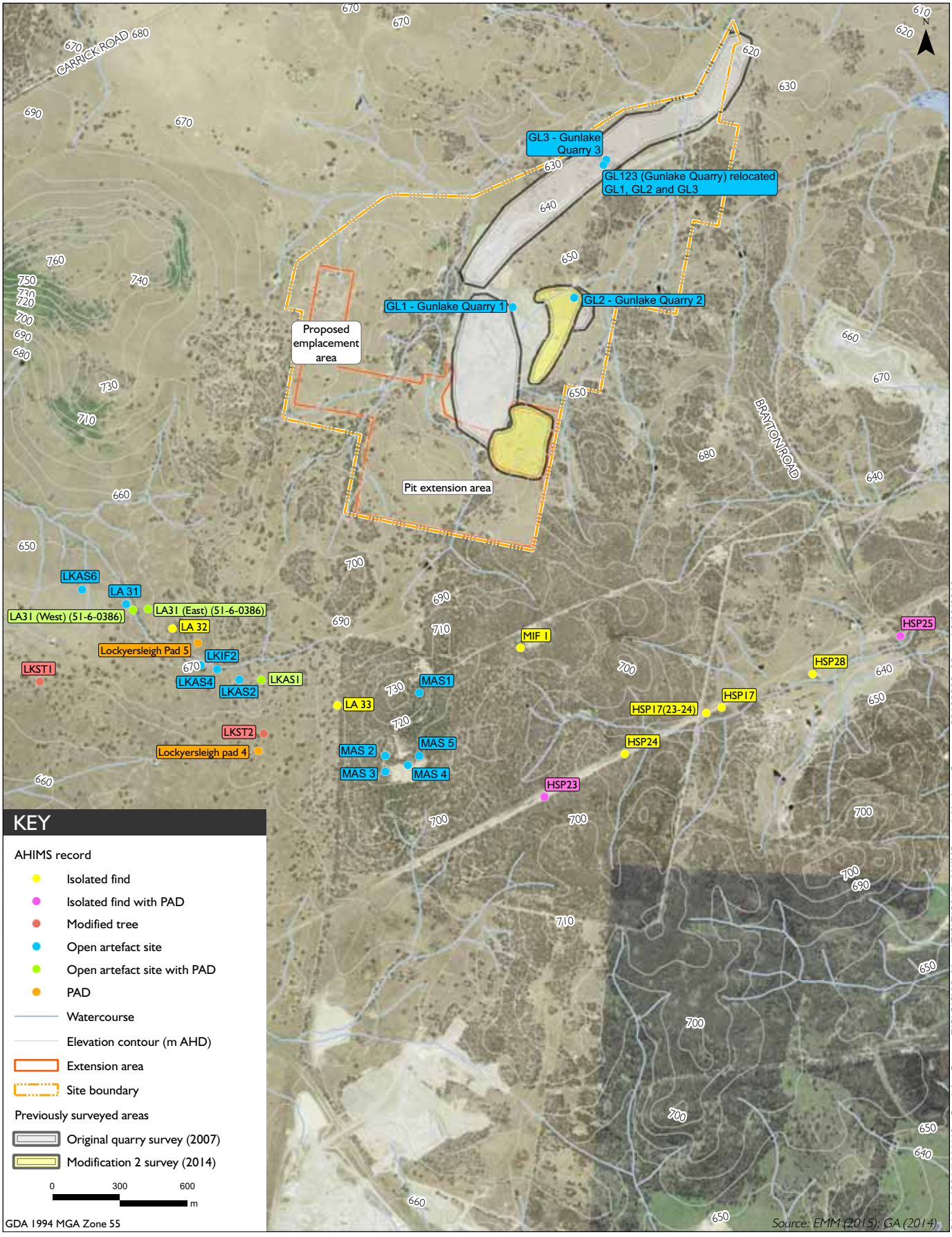
European explorers first visited the Southern Tablelands as early as 1798 when John Wilson was sent to the area by Governor Hunter (Chisholm 2006). Stock and cattle stations were established in the 1820s throughout the Goulburn Plains and the wool industry dominated the area during the 1800s (Firth 1983). Marulan, the closest town to the extension area (5 km south-east), was established first in 1834 and then moved approximately 2 km to the north-west in 1868 when the Great South Railway Line was constructed. Other towns established in the area included Bungonia (1836), Tallong (1869) and Wingello (1871).

13.2.4 Aboriginal sites

i Recorded sites

The most recent search of the Aboriginal Heritage Management System (AHIMS) register for the extension area was completed on 2 February 2016. The search identified previously recorded Aboriginal sites in the local area in order to assist in characterising the local archaeological record.

The search covered 4 km by 4 km centred on the extension area. It identified 20 Aboriginal sites. Figure 13.1 shows the AHIMS sites recorded near the project and their frequency is summarised in Table 13.1.



AHIMS results and previous surveys near the extension area

Gunlake Quarry
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Figure 13.1

Open artefact sites are the most common registered site type and are commonly found in close proximity to streams. Isolated finds are more sporadically distributed but also are associated with streams. Potential archaeological deposits (PADs) have been identified with open artefact sites (10%) and isolated finds (7%) but also where no Aboriginal objects have been identified (7%) and are recorded on inference only.

Two modified trees have also been recorded to the south of the extension area and are associated with the Lynwood Quarry Modification 4 Project (Umwelt 2015).

The only sites that occur within the project site boundary are three low density artefacts scatters recorded in 2007 and their relocated coordinates after salvage collection (AASC 2007, refer Section 4.3.3). No Aboriginal sites have been recorded in the project site boundary since the AASC report (2007).

Aboriginal sites recorded south of the extension area invariably comprise stone artefacts in low numbers. The closest site is over 700 m south of the project boundary (this site appears closer on the map has an incorrect AHIMS coordinates and does not actually occur near the project).

Table 13.1 AHIMS registered sites in the search area

Site type	Frequency	Percentage
Isolated find	7	23%
Isolated find with PAD	2	7%
Modified tree	2	7%
Open artefact site	14	47%
Open artefact site with PAD	3	10%
PAD	2	7%
Total	**30**	**100%**

ii Field survey

An EMM archaeologist, accompanied by five Aboriginal site officers, surveyed the extension area over two days on 27 and 28 July 2015, shown in Figure 13.2. The survey team walked 15 survey transects divided by the landform elements in the extension area, inspecting the ground surface at 10 m intervals along a corridor approximately 50 m wide where possible. The survey team targeted ground exposures such as scalds, eroding stream banks and animal tracks, which provided good ground surface visibility for the detection of Aboriginal objects, primarily stone artefacts. All mature trees were inspected for scars of Aboriginal origin.

Aboriginal sites identified during the survey were defined by the presence of one or more Aboriginal objects on the ground surface. The boundaries of a site were limited to the extent of the observed Aboriginal objects. Site locations were recorded using a hand-held GPS unit with recorded data confirmed on GIS software. Transects were accurately mapped by downloading tracks recorded on GPS. Photographs identifying landscape context and representative samples of site artefact contents were taken for each site. AHIMS site cards were prepared for all the sites recorded during the survey.

The survey team identified 15 individual Aboriginal sites. All of the Aboriginal sites were comprised of stone artefacts, made up of 12 open stone artefact sites and 3 isolated finds. The Aboriginal site locations are summarised in Table 13.1 and shown on Figure 13.2.

Table 13.2 Site type frequency within each landform type

Landform type	Open stone artefact	Isolated find	Total	Percentage of sites
Hill spur crest	5	0	5	33%
Foot slope	3	1	4	27%
Stream bank	2	0	2	13%
Modified: dam wall at stream channel	1	1	2	13%
Drainage depression	0	1	1	7%
Hill slope	1	0	1	7%
Total	**12**	**3**	**15**	**100%**

iii Test excavation

EMM archaeologists, accompanied by Aboriginal site officers, conducted an archaeological test excavation in the extension area over five days from 6 to 10 October 2015. The test excavation targeted landforms with predicted high to moderate subsurface potential. The test excavation program involved placing eight linear test pit transects across the extension area in the target landforms with 42 individual 1 m x 1 m test pits excavated.

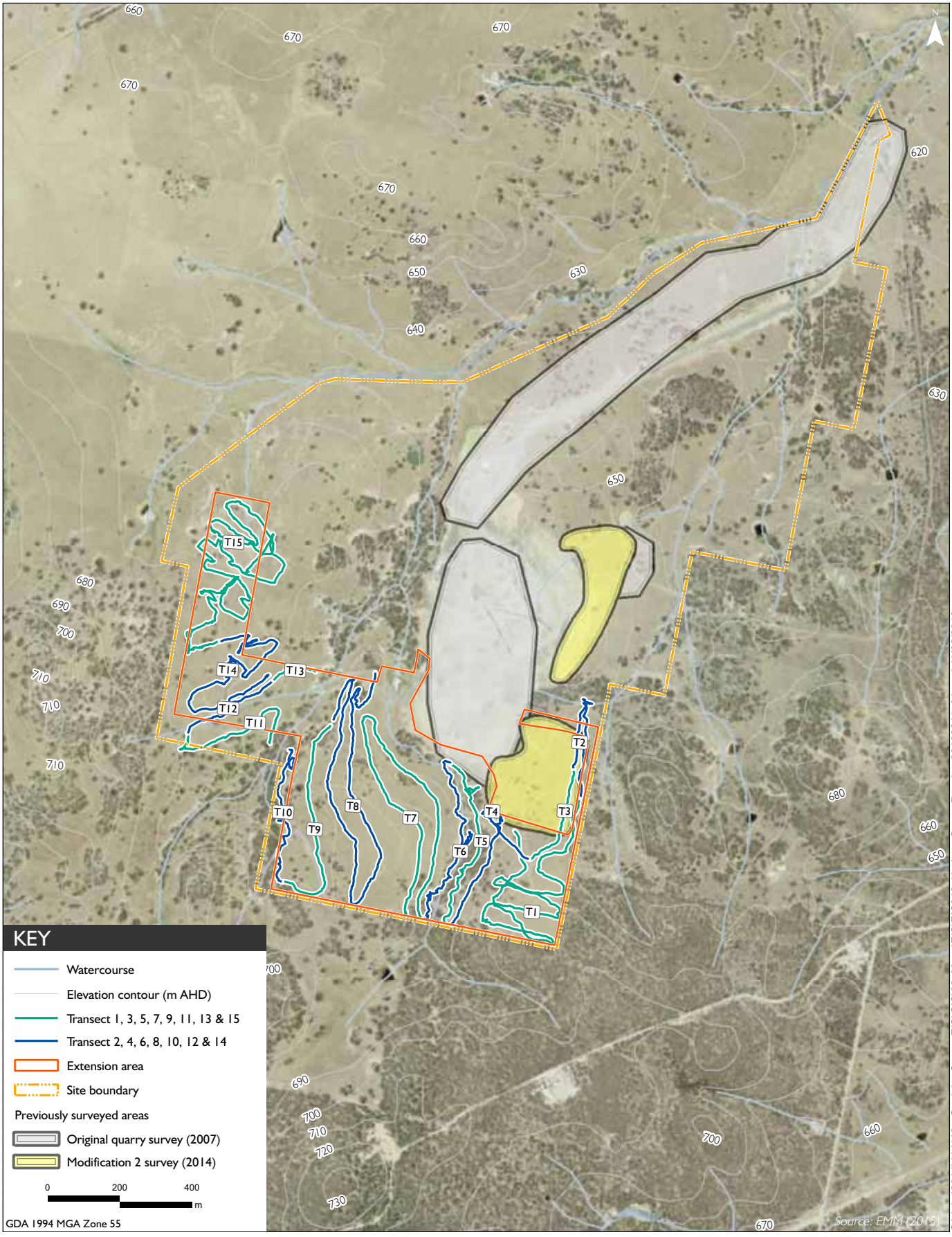
Artefact frequencies for each test pit are presented in Figures 13.3 and 13.4.

During the test excavation, 89 artefacts were recovered from the 42 test pits. One third (15) of the test pits contained artefacts. Artefact frequencies within the 42 individual 1 metre squares ranged from 0 to 20 artefacts/m^2. All but four of the artefacts (95%) were recovered from the upper 20 cm of soil, with artefacts invariably confined to the A1 soil horizon (approximately the upper 10 cm).

Approximately 80% of artefacts (72) were recovered from the hill spur crest in the proposed emplacement area. No artefacts were recovered from the hill spur crest in the proposed pit extension area and only five artefacts (6%) were identified in the proposed pit extension area as a whole.

iv Aboriginal occupation

All recorded Aboriginal sites were identified during the field survey (Figure 13.3), with no new Aboriginal sites recorded as the result of the test excavation (Figure 13.4 and Figure 13.5). Most of the archaeological material recovered (artefacts recovered from test pit transects 4, 5, 6, 7 and 8) can be considered as part of the larger GL14 site (comprised of GL14a, b, c and d). The subsurface material recovered from test pit Transect 3 is considered to be a part of GL5.



Field survey locations

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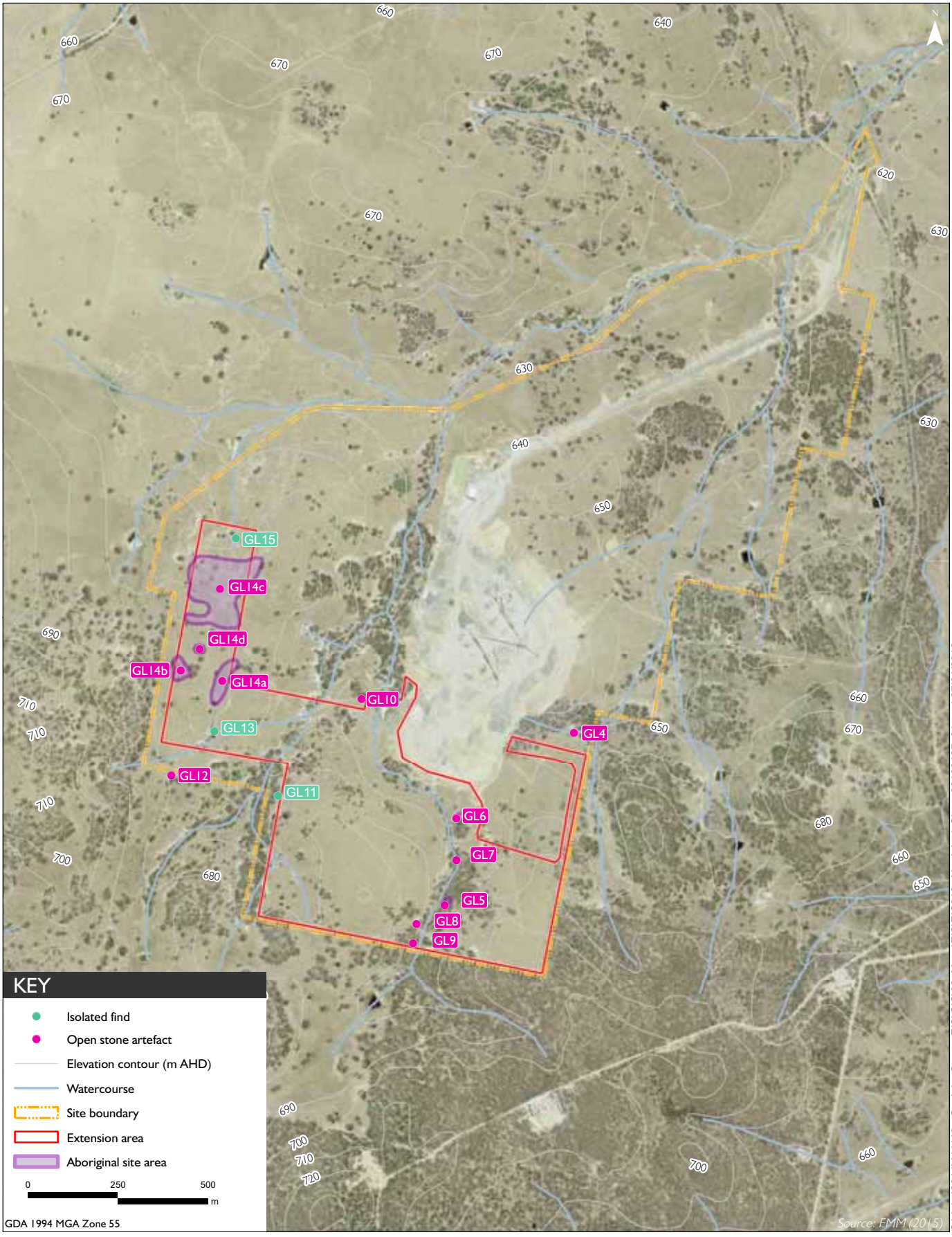
Figure 13.2



Aboriginal site results

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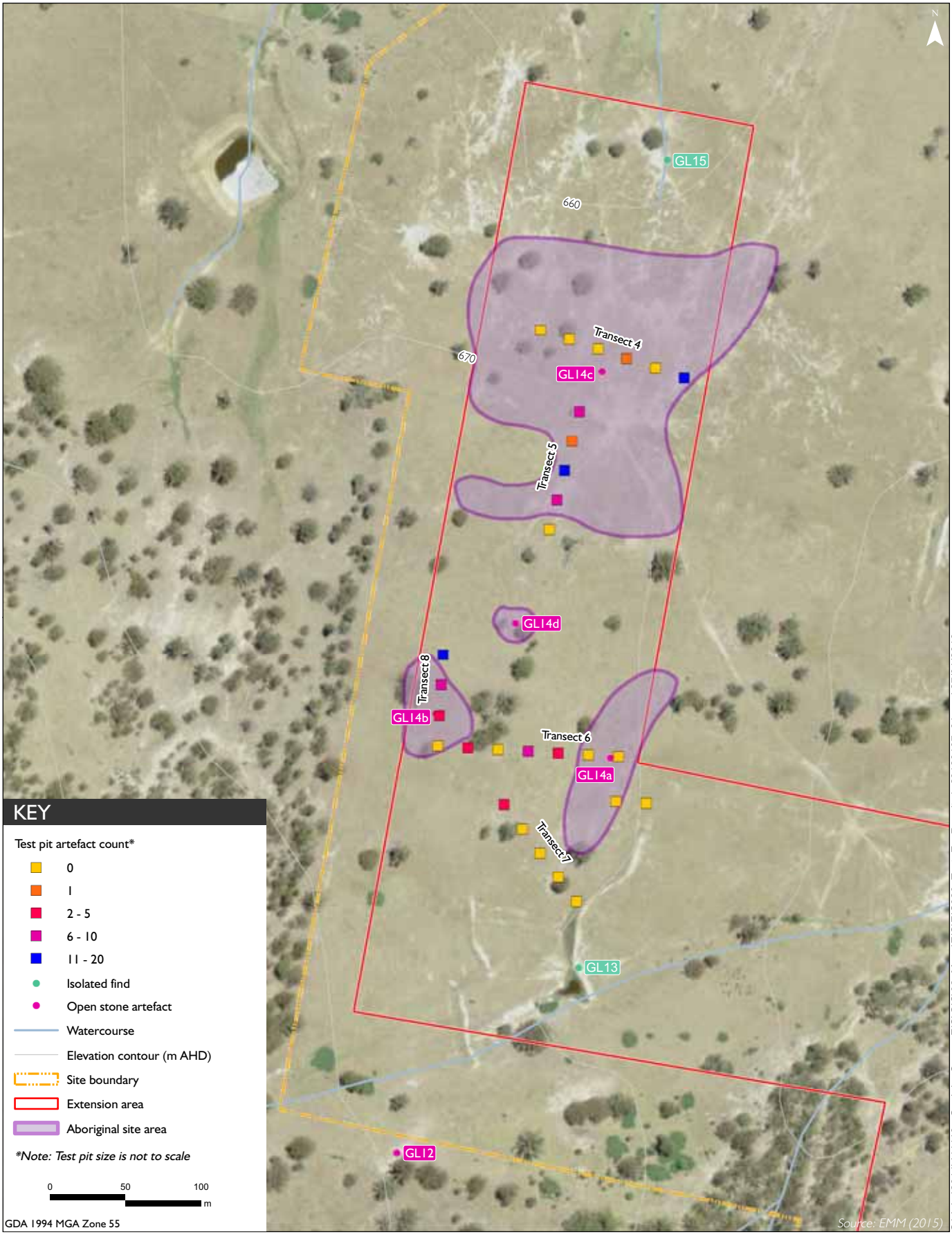
Figure 13.3



Test excavation results

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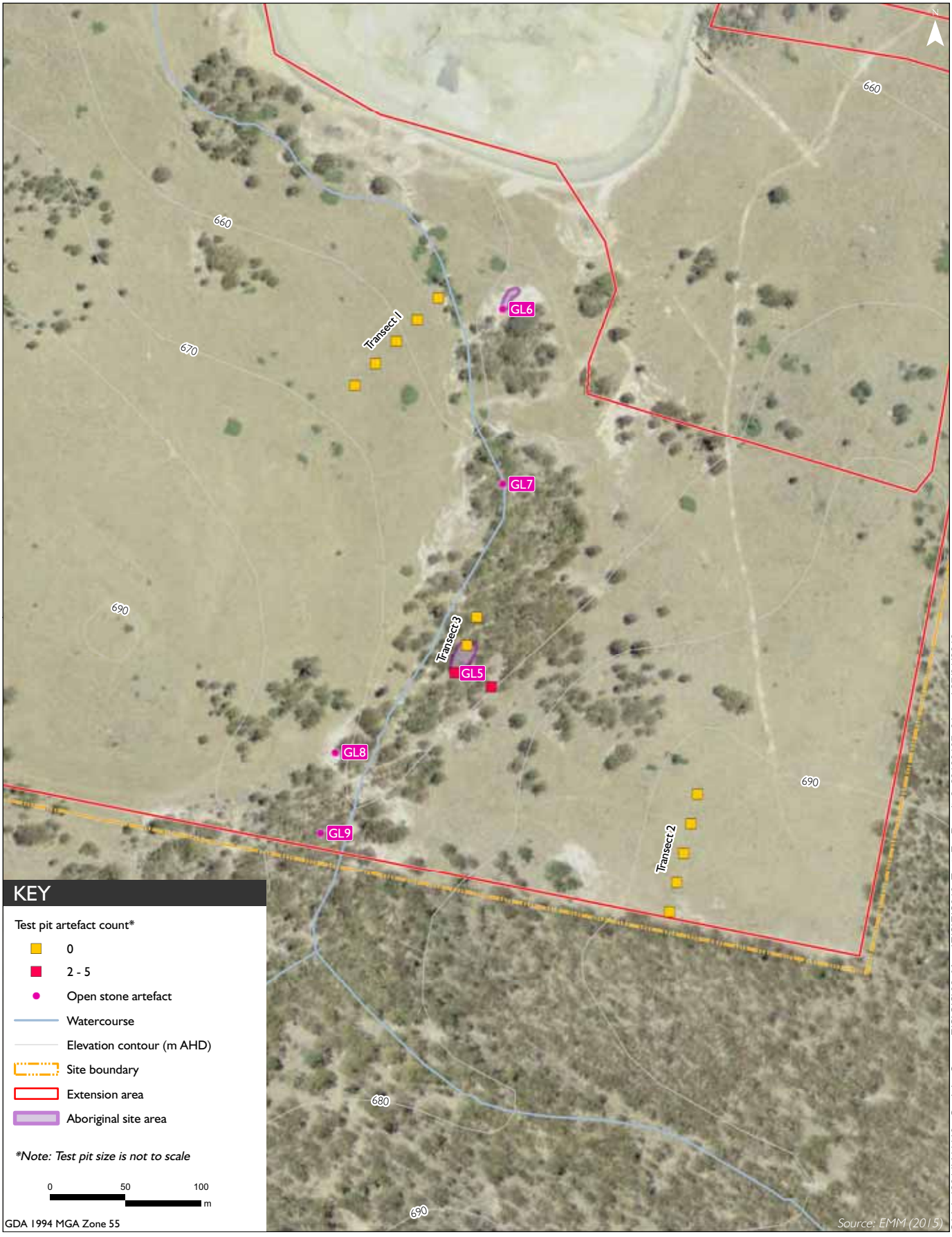
Figure 13.4



Test excavation results

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Figure 13.5

The survey and test excavation found hundreds of artefacts across the hill spur crest and its upper slopes (GL14) in the embankment area indicating concentrated occupation of this area. There was an average of 3.4 artefacts/m^2 (maximum frequency of 20 artefact/m^2). However, these frequencies are low compared to regional examples such as Peppertree Quarry which has an average of 171 artefacts/m^2.

Less intensive occupation is likely to have occurred on foot slopes and adjacent to creek banks across the extension area. The rocky hill spur crests and hill slopes in the proposed pit extension area did not have evidence of Aboriginal occupation.

The extent of erosion and paucity of subsurface archaeological deposit indicates that the extension area has low archaeological potential and that the surface evidence of Aboriginal occupation is characteristic of the local archaeological record.

13.3 Impact assessment

13.3.1 Cultural heritage values

The Australia ICOMOS Burra Charter 2013 defines cultural significance as follows:

> Cultural significance means aesthetic, historic, scientific, social or spiritual value for past, present or future generations. Cultural significance is embodied in the place itself, its fabric, setting, use, associations, meanings, records, related places and related objects. Places may have a range of values for different individuals or groups (ICOMOS 2013).

Places which have non-archaeological Aboriginal heritage values (or 'intangible' values) are places which have meaning in accordance with memory or tradition but are not associated with cultural objects. Research and consultation with the Aboriginal community was conducted to determine whether any socio-cultural heritage value relates specifically to the extension area regardless of archaeological evidence. No comments were received relating to cultural information specific to the extension area.

The scientific values (or 'tangible' values) of sites are identified as 'low', 'moderate' or 'high'. Scientific value is assessed according to the research potential of a site as well as rarity, integrity and representativeness. The assessment of scientific significance for sites within the extension area determined that there are a total of 11 sites of low scientific significance and one site of moderate scientific significance and no sites of high scientific significance. Sites GL14a, b, c and d were assessed as a single site because they were inferred to be fragmented concentrations of a broader distribution.

13.3.2 Impacts to sites

Out of the 15 Aboriginal sites identified during the archaeological investigations, 11 will be impacted to some degree (including sites GL11 and GL10 which are outside the mapped disturbance footprint). Seven Aboriginal sites will be subject to total loss. Sites GL14a, b, c, and d as a whole, including subsurface artefacts, will be subject to partial loss as site artefact distributions also occur outside the proposed embankment area. Four Aboriginal sites will be avoided, as they occur outside the project footprint.

13.3.3 Measures to minimise harm and alternatives

The potential impacts of the extension project have been avoided as far as possible as part of the quarry design process (see Section 3.10.1). The archaeological record in the proposed pit extension area is of low archaeological significance and it is not feasible to avoid the identified Aboriginal sites in this area without significantly altering the pit extension configuration.

The location of the proposed emplacement required consideration of the potential impacts to biodiversity (impacts to Box Gum Woodland EEC), Aboriginal heritage (impacts to GL14) and hydrology (impacting an ephemeral tributary of Chapmans Creek). The impacts these cannot be avoided entirely due the amount of reject and overburden material to be stored and the feasible height of the emplacement (ie the footprint could not be further reduced).

The feasibility of locating the emplacement south of its proposed position to minimise impacts to GL14 was considered. However, impacts to the archaeological resource can be mitigated through surface salvage collection. It would be harder to mitigate the impacts to biodiversity and hydrology for the southern option. This option was more likely to have been proposed if the test excavation program recovered extensive subsurface archaeological deposits warranting conservation.

13.3.4 Ecologically sustainable development considerations

Aboriginal heritage management is based on the principle of *intergenerational equity* which intends to ensure present generations consider future generations when making management decisions.

While it is acknowledged that the project is for quarrying activities that are common in the region (eg Peppertree Quarry, Lynwood Quarry and Marulan South Limestone Mine) and will result in additional impacts to Aboriginal heritage, the proposed management measures are anticipated to provide detailed information about the Aboriginal heritage of the extension area to ensure all information about the Aboriginal history of the area is not lost. This will help to achieve intergenerational equity by allowing retention of cultural materials for the enjoyment and education of future generations.

13.3.5 Cumulative impact within the region

Archaeological investigations for the project and at Lynwood Quarry (Umwelt 2015), has demonstrated that the archaeological resource of the region is relatively consistent and predictable, even in areas with limited water resources. It is reasonable to assume that many undiscovered Aboriginal sites comparable to those recorded in the extension area occur in the surrounding region, particularly in association with elevated landforms adjacent to streams. Existing conservation areas within the Lynwood Quarry project area will retain representative examples of the local and regional archaeological record.

While quarrying has resulted in impacts to Aboriginal sites, the management and mitigation of impacted sites through archaeological excavation, collection and consultation with the Aboriginal community has contributed to our understanding of the Aboriginal past in the region.

13.4 Management and mitigation

While Aboriginal sites cannot be replaced once lost, the salvage of Aboriginal objects that will be impacted by the project will provide a tangible link to these sites. Furthermore, with care in duration, those salvaged materials can be studied to help understand other Aboriginal sites present in the landscape and to add to the growing body of information about past Australian Aboriginal life.

The Gunlake Quarry Aboriginal Heritage Management Plan (AHMP) will be updated and provide details of:

- all Aboriginal sites identified for the project and those previously recorded in the broader project site boundary;
- management measures and their progress towards completion;
- continuing consultation and involvement of registered Aboriginal parties;

- protocols for newly identified sites;
- protocols for suspected human skeletal material; and
- provisions for review and updates of the AHMP.

Avoidance of Aboriginal sites is a preferred management option as it ensures Aboriginal sites and their landscape information will be preserved for future generations. Four Aboriginal sites, GL4, GL12, GL13 and GL15, will be avoided by the project as they occur outside the project disturbance boundaries.

All Aboriginal sites in the project disturbance footprint will be collected by a qualified archaeologist and RAPs. This will include the complete extent of the Aboriginal sites subject to total loss and partial loss. Collecting the entirety of the sites that will be only partially impacted will be undertaken primarily because of the highly eroded condition of the local soils. The sites will gradually degenerate further and moved by sheet wash, rill and gully erosion. It is proposed that collected artefacts are relocated to the same area as previously collected artefacts at site "GL123 (Gunlake Quarry) relocated GL1, GL2 and GL3" (AHIMS #51-6-0750).

If new Aboriginal sites are discovered outside of known site areas (which will be updated on completion of salvage collection), all work will halt and an archaeologist and members of the RAPs be contacted to determine the significance of the objects. Objects will be managed based on their sensitivity in a manner consistent with the management measures outlined above, including appropriate forms of salvage for the items.

In the event that known or suspected human skeletal remains are encountered during the activity, the procedures detailed in Appendix M will be followed.

13.5 Conclusions

The ACHA assessed the Aboriginal cultural heritage values within the extension area through field survey, test excavation and consultation with Aboriginal people.

Field survey identified 15 Aboriginal sites within the extension area, all comprised of stone artefacts. The highest artefact frequencies were identified on a hill spur crest in the proposed emplacement area.

The archaeological test excavation (eight test pit transects with 42 one metre square test pits) characterised the subsurface archaeological deposit of known surface sites and surrounding landforms in the extension area that had limited ground surface visibility.

All Aboriginal sites identified were assessed to have low archaeological significance, except one which was assessed as having moderate significance.

Eleven Aboriginal sites will be impacted to some degree by the extension project. All of the impacted sites will be salvaged by surface artefact collection and detailed recording. The remaining four sites will be avoided.

14 Social

14.1 Introduction

This chapter considers the potential social impacts associated with the extension project. It describes the current community profile of the local area including socio-economic characteristics, housing supply and current community issues. The social changes likely to occur as a result of the project are documented in order to identify positive and negative impacts of the project on the local community. Management and mitigation measures are provided to enhance social opportunities and mitigate negative impacts.

Extensive community consultation has been undertaken by Gunlake for the project (see Chapter 5). This forms an important component of this assessment by identifying perceived community issues associated with the project and enabling the development of appropriate mitigation measure to address these perceptions.

This assessment focuses on the Goulburn Mulwaree LGA in which the quarry is located.

14.2 Assessment area

The Goulburn Mulwaree LGA is located in the Southern Highlands region of NSW, approximately 200 km south-west of Sydney and 90 km north-east of Canberra. The LGA covers approximately 3,220 km^2 and is predominately rural. The Goulburn Mulwaree LGA is bound by Wingecarribee LGA to the north, Shoalhaven LGA to the east, Palerang LGA to the south and Upper Lachlan LGA to the west.

The main urban centres in the LGA are Goulburn with a population of 21,092 people, Marulan (1,382 people) and Tarago (351 people) (ABS 2011). Marulan is the nearest major urban centre to Gunlake Quarry, located approximately 7 km south-east of the existing quarry. Smaller rural villages in the LGA include Tallong, Bungonia and Lake Bathurst. The closest small settlements to the quarry are Brayton, Towrang, Greenwhich Park and Big Hill.

There has been moderate population growth in the Goulburn Mulwaree LGA over the last decade and forecasts suggest the area is likely to experience continued growth (Department of Planning 2008). This is due to the LGAs strategic location along the Hume Highway, the major transport route between Sydney, Canberra and Melbourne, and Goulburn's role as a regional service centre.

14.3 Community profile

14.3.1 Socio-economic profile

i Population size, growth and future change

The Goulburn Mulwaree LGA population increase by 10.6% over the last decade to an estimated 29,376 people in 2014 (ABS 2015b). This was less than the NSW population growth of 13% over the same time period.

It is forecast that there will be an 18.2% increase (5,200 people) in the total population in Goulburn Mulwaree LGA by 2031 (DPE 2014). While Goulburn Mulwaree LGA will grow, the rate will be slower than the rate for NSW over the same period, 27.8%.

ii Population structure and characteristics

In 2011, the largest age cohort in the LGA was 0–14 year olds (19% of the population), followed by 45–54 year olds (14%) and 35–44 year olds (13%) (see Figure 14.1). The 85 years and over age cohort experienced the greatest growth (60%) between 2001 and 2011 followed by the 75–84 year age cohort (32%) and 55–64 years (31%). There were declines in the proportion of the population aged 25–34 years (-14%), 15–24 years (-9%) and 0–14 years (-7%) (ABS 2011). This is indicative of an ageing population and migration of working age people to larger centres because of limited local employment opportunities.

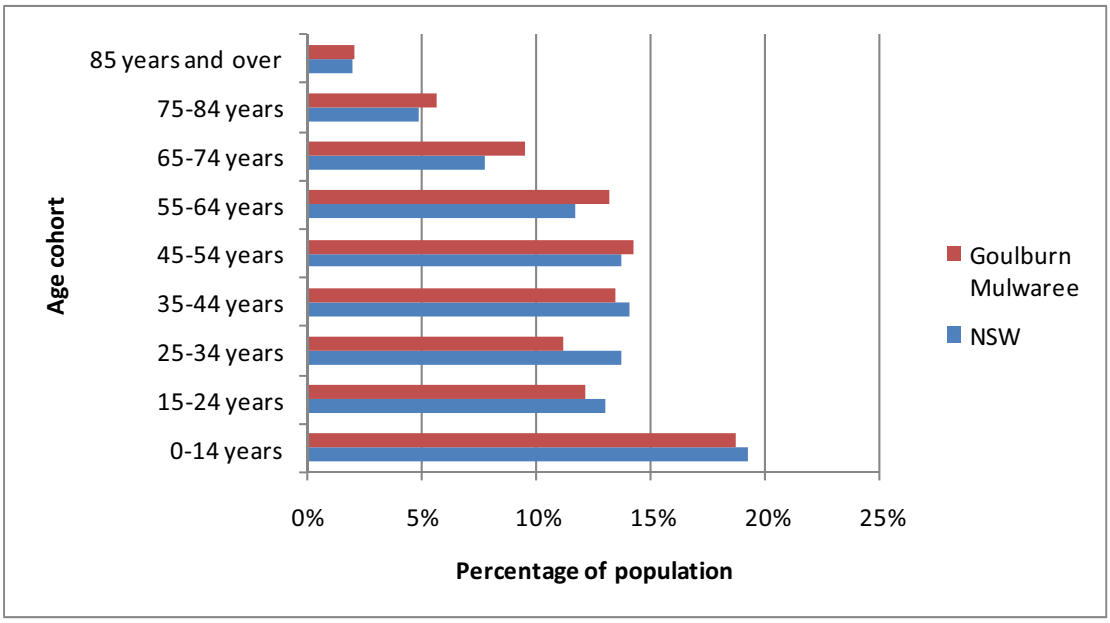

Figure 14.1 Population distribution of Goulburn Mulwaree LGA and NSW, 2011

The LGA's median age increased from 36 to 40 between 2001 and 2011 compared with 35 to 38 across NSW (ABS 2011).

Approximately 9% of the population in the LGA were born overseas compared with 27% across NSW. A total of 3% of the LGA population identified themselves as Aboriginal or Torres Strait Islander compared with 2% of the population of NSW in 2011 (ABS 2011).

iii Education and training

The LGA was ranked 43rd most disadvantaged of 153 LGAs in NSW in 2011 for education (ABS 2013). A significantly lower proportion of the population achieved year 12 or equivalent (31.8%) compared to NSW (49.2%) in 2011 (see Table 14.1). However, a greater proportion of the population in Goulburn Mulwaree LGA (33.9%) completed year 10 or equivalent compared to NSW (23.9%) (ABS 2011).

Table 14.1 Highest year of school completed by people aged 15 years and over in 2011

School year	Goulburn Mulwaree LGA (%)	NSW (%)
Year 12 or equivalent	31.8%	49.2%
Year 11 or equivalent	5.6%	5.0%
Year 10 or equivalent	33.9%	23.9%
Year 9 or equivalent	10.0%	6.6%
Year 8 or below	7.6%	5.6%
Did not go to school	0.5%	1.0%
Highest year of school not stated	10.6%	8.6%

Source: ABS (2011).

Within Goulburn Mulwaree LGA, 13.8% of adults had completed a bachelor degree in 2011 compared with 24.7% of adults across NSW. However, a much higher proportion of the population in Goulburn Mulwaree LGA held certificate level qualifications (41.8%) compared to the State (30.9%) (Table 14.2) (ABS 2011).

Table 14.2 Highest level of post-school education attainment by people aged 15 years and over

Level of educational attainment	Goulburn Mulwaree LGA (%)	NSW (%)
Postgraduate Degree Level	2.8%	7.5%
Graduate Diploma and Graduate Certificate Level	2.2%	2.6%
Bachelor Degree Level	13.8%	24.7%
Advanced Diploma and Diploma Level	13.4%	14.5%
Certificate Level	41.8%	30.9%
Level of education inadequately described	2.5%	3.1%
Level of education not stated	23.5%	16.8%

Source: ABS (2011).

iv Workforce and occupation structure

In June 2015, the unemployment rate in the LGA was 4.5%, or approximately 646 people. This was lower than the unemployment rate across NSW (5.9%) (Department of Employment 2015). The unemployment rate in the LGA has been decreasing since June 2013 while the NSW unemployment rate has remained relatively stable (Department of Employment 2015). Among those employed in 2011, 60% were full-time employees and 28% were part-time employees (ABS 2011).

The most common occupations in the LGA are community and personal service workers (15.6%), technicians and trade workers (14.2%) and professionals (14.2%). There was a large increase in community and personal service workers (40.4% increase), clerical and administrative workers (24.3%) and professionals (20.3%) in the LGA between 2001 and 2011 (ABS 2011).

v Business and economy

In 2013, there were 2,356 businesses in the LGA. Of these, the most common were in agriculture, forestry and fishing (27%), construction (13%), professional scientific and technical services (7%), rental, hiring and real estate services (7%) and retail trade (7%) (ABS 2015a).

In 2011, the main industries of employment in the LGA were health care and social assistance (14.5%), retail trade (12.8%) and public administration and safety (12.2%). Employment in electricity, gas, water and waste services increased by 71.9% between 2001 and 2011. There was also significant growth in employment in construction (57.6%), professional, scientific and technical services (42.6%) and financial and insurance services (39.7%). There were declines in employment in wholesale trade (-52.7%), agriculture, forestry and fishing (-41.7%) and information media and telecommunications (-20.0%) over the same period (ABS 2011).

14.3.2 Housing supply

In 2011, there were approximately 12,276 dwellings in the LGA. There are low levels of housing diversity in the LGA with 75% of the housing stock being detached dwellings and only 4% flats, units or apartments. In 2011, 15% of dwellings in Goulburn Mulwaree LGA were unoccupied compared with 10% of total dwellings in NSW (ABS 2011).

In the year to October 2015, the median sale price of houses in Goulburn Mulwaree LGA was $330,000. This was lower than the median sale price of houses across NSW ($430,000) for the same time period. It was also lower than the median sale price of houses in surrounding LGAs including Wingecarribee ($547,000), Shoalhaven ($379,000) and Palerang ($580,000). Therefore, housing in Goulburn Mulwaree LGA is relatively affordable (RP Data 2015).

Goulburn Mulwaree Council has designated considerable areas of land as urban release areas. These areas are largely located around Goulburn and Marulan and have sufficient capacity to accommodate future population growth and associated growth in dwellings.

14.3.3 Community issues

Stakeholder consultation has been undertaken by Gunlake to identify community concerns, values and issues associated with the extension project (see Chapter 5). Stakeholder consultation has informed interested parties about the project, its potential impacts and how they will be managed and mitigated.

The most common concerns identified by the community associated with the extension project were related to potential traffic impacts, including increased truck movements; reduced road surface conditions and safety; and truck driver conduct. Other matters raised included noise impacts associated with increased production and associated truck movements; air quality impacts including increased dust generation; and a general lack of information provided to local community members during community consultation and engagement.

14.4 Impact assessment

14.4.1 Workforce and employment

The extension project will require an additional 27 employees (including contracted truck drivers), comprising 7 on-site employees and 20 truck drivers. Therefore, the extension project will provide long-term employment for up to 90 on-site employees and truck drivers.

Given the skills required for the extension project, and the current skills mix of the population in the Goulburn Mulwaree LGA, it is likely that the on-site workers will be sourced locally or within commuting distance of the quarry. The additional truck drivers required for the extension project will comprise local and non-local workers who will return to their home at the completion of the day. Therefore, the extension project is not anticipated to generate any direct population growth within Goulburn Mulwaree LGA. As a result, the project will not create any additional pressure on local services, housing or infrastructure in the local area.

The extension project will also generate indirect or flow-on jobs in the local area through demand for goods and services by the quarry and its employees. This will provide modest economic stimulus to local business, particularly those in Marulan, including hotel trade, cafes, restaurants and quarry related services (see Chapter 15).

The Goulburn Mulwaree LGA has a highly polarised population age structure with a high proportion of 0–14 year olds and 35–54 year olds but a low proportion of 25–34 year olds (see Figure 14.1). This low proportion of people of working age is indicative of limited local job availability. Therefore, the extension project will provide important employment opportunities for the local community and will assist in maintaining the working age population of the LGA.

14.4.2 Amenity

Gunlake Quarry is located approximately 5–7 km north-west of Marulan, the nearest major town, in a region currently characterised by agriculture and quarrying. Due to the predominately rural setting of the area, there is potential for amenity impacts related to noise, dust and visual impacts.

The extension project's noise and air quality impacts are assessed in chapters 11and 12 respectively. It is predicted that all noise and air quality criteria will be met with the exception of noise levels at the closest private residence (see Section 11.3).

As described in Section 16.2.2, the quarry is generally visually shielded from the local road network and adjacent property residences by existing vegetation and the natural topography of the area. So visual impact so the proposed extension project will not significantly alter the visual impact of the quarry on surrounding land uses.

14.4.3 Truck movements

The extension project will generate an average 440 truck movements per day when in full production. Since rail transport is not feasible, all quarry product will be transported by road (see Section 3.10.2).

Traffic impacts associated with the project are described in Section 10.3 and traffic noise impacts are described in Section 11.3.7. In summary, while truck numbers will increase, there will be no significant traffic-related impacts.

Gunlake has already paid for a series of road improvements in the local area (see Section 3.4.3) and will continue to provide Section 96 contributions to the Council and will work with the Council on road maintenance and improvements to maintain safe road conditions along the product haul routes.

14.4.4 Community engagement

Open and transparent communication between Gunlake and affected landowners and groups is important in maintaining social amenity and cohesion in the local area. During consultation with the community, a lack of information about the extension project was identified as a key community concern. In particular, concern was raised about inadequate notice of community information sessions and the exclusion of particular areas surrounding the quarry at these sessions. These were addressed through the community information session held in Marulan on 30 July 2015, mailing out of approximately 700 fact sheets to a wide local area and two Community Consultative Committee meetings since June 2015 (see Section 0).

Gunlake recognises the importance of stakeholder consultation and has actively engaged with the local community regarding the extension project. It is noted that the local community is generally positive and supportive of the presence of quarrying in the region, including Gunlake Quarry, due to the economic benefits it provides. Therefore, key matters raised by the community in relation to the extension project are largely centred on specific operational aspects of the quarry rather than the presence of the quarry itself.

Gunlake will continue to consult and liaise with relevant stakeholders on these issues in an open and transparent manner in order to maintain social amenity in the local community (see Section 5.6).

14.5 Management and monitoring

14.5.1 Workforce and employment

Gunlake is committed to maximising the local benefits of the project. Therefore, Gunlake will continue to ensure that preference is given to local employees. Gunlake will use local or regional contractors and suppliers where this presents a cost effective and feasible option.

Gunlake is committed to providing ongoing training and certification opportunities for local community members to ensure they have the necessary skills to work in extractive industries.

14.5.2 Amenity

Visual, noise and air quality impacts have the potential to affect the amenity of the local area, particularly the rural nature of the area. Proposed management and mitigation measures for amenity impacts (noise, air quality and visual) are provided in the relevant chapters.

14.5.3 Truck movements

Appropriate controls will be implemented and maintained to minimise impacts on other road users of the truck movements associated with the quarry (see Section 10.4).

Gunlake will continue to meet its obligations under Section 94 development contributions to Goulburn Mulwaree Council for the life of the project so that the Council can maintain and improve the haul routes.

14.5.4 Community engagement

Therefore, Gunlake will continue to actively engage with the local community and affected individuals and groups. This will include the provision of regular project updates through newsletters, face-to-face meetings and the Community Consultative Committee.

In addition, Gunlake will continue to address any complaints and feedback on quarry operations.

14.6 Conclusions

The extension project has the potential to generate some negative social impacts, particularly through the perceived amenity and traffic impacts – although the actual impacts will generally not be significant. These perceptions will be addressed through the ongoing consultation program while the actual impacts will be minimised through the implementation of the controls described in this EIS and summarised in Chapter 18.1.

The extension project will generate a number of positive impacts. It will create an additional 27 jobs and will provide long-term employment for up to 90 people. This will provide an economic stimulus to the local area through the provision of wages and indirect or flow-on employment opportunities. It is anticipated that the additional employees will be sourced locally and as such the extension project will not generate any additional pressure on local housing supply and existing services and infrastructure. The project will also provide wider benefits through the supply of competitively priced products for the construction industry.

It is expected that these social benefits will outweigh the negative social impacts to generate net positive benefits for the local community and the wider economy.

15 Economics

15.1 Introduction

This chapter provides a summary of the economic assessment (EA) prepared by Gillespie Economics, which is presented in full in Appendix N.

This economic assessment provides the following:

- a cost benefit analysis (CBA) for the extension project — this is the primary way that economists evaluate the net benefits of a project, assess the economic justification for a project and consider whether it is in the public interest to proceed with the project;
- a local effects analysis (LEA) to assess the local impacts of the extension project, specifically:
  - effects relating to local employment;
  - effects relating to non-labour project expenditure; and
  - environmental and social impacts on the local community.
- a supplementary LEA using input-output (IO) analysis to assess the direct and indirect economic activity (economic output, value-added, income and employment).

15.2 Benefit cost analysis

15.2.1 Method

The BCA compared the present value of the aggregate benefits to society (global, national and NSW perspective) of the extension project to the present value of the aggregate costs of the project.

From an economic efficiency perspective, a project is considered to improve the economic welfare of society (ie to provide a net benefit) when the present value of the aggregate benefits to society exceeds the present value of aggregate costs.

The BCA of the extension project is based on financial, technical and environmental inputs provided by Gunlake, EMM and the technical reports provided in Appendices D to M. The BCA involved the following key steps:

- identification of the “base case” or “without the extension project” scenario;
- identification of the extension project and its implications;
- identification and valuation of the incremental benefits and costs;
- consolidation of value estimates using discounting to account for temporal differences;
- application of decision criteria;
- sensitivity testing; and

- consideration of non-quantified benefits and costs.

15.2.2 Identification of the base case

The base case is that Gunlake continues to operate under the current project approval until 2038 (ie as approved), extracting 750,000 tonnes per annum of saleable product, with associated rehabilitation and site decommissioning. The extension area would continue to be used as vacant buffer land with associated remnant vegetation which is dominated by woodland and derived native grassland.

The project case is that Gunlake expands quarrying to up to 2 Mtpa for the remainder of the currently approved quarry life (to 2038) and continues quarrying to 2046 assuming that the approved extension project life is 30 years, including rehabilitation and site decommissioning.

The base case and project case production profiles are shown in Figure 15.1.

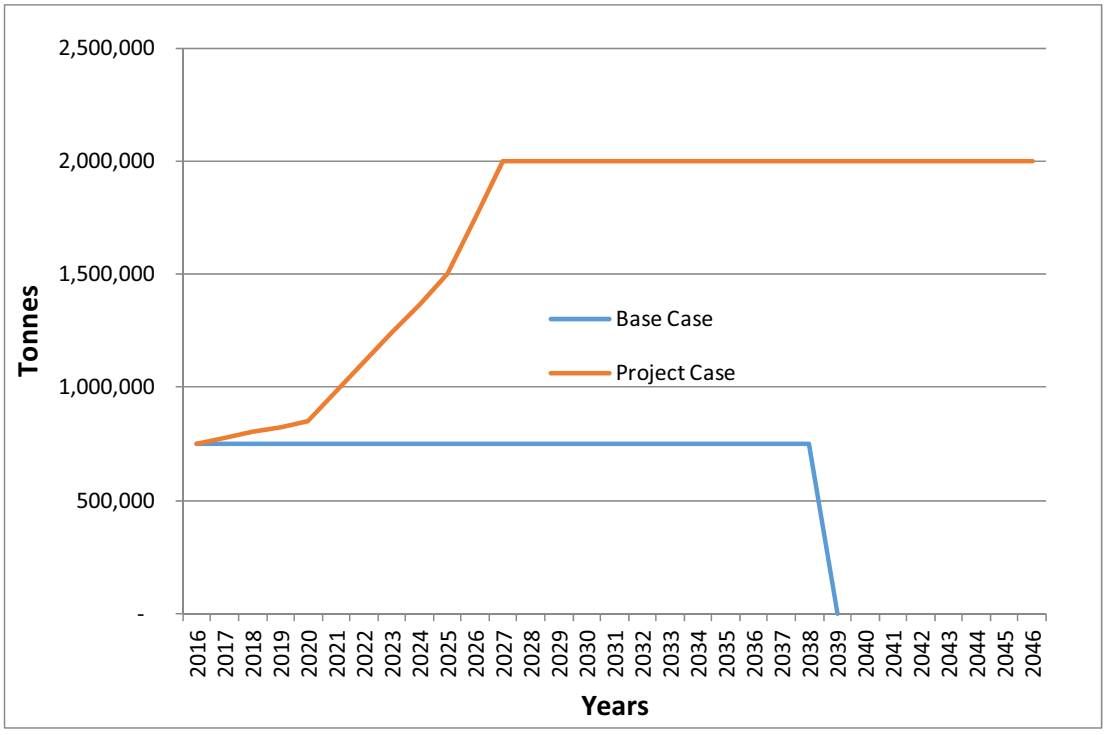

Figure 15.1 Indicative production schedules

15.2.3 Identification of benefits and costs

The incremental economic benefits of the Proposal (ie those additional to the base case) are outlined in Table 15.1.

Table 15.1 Incremental economic benefits and costs of the extension project

Category	Costs	Benefits
Net production benefits	Opportunity costs of capital equipment Opportunity cost of land Development costs including labour, capital equipment and acquisition costs for impacted properties and biodiversity offsets. Operating costs of mine including labour and mitigation, offsetting and compensation measures Decommissioning and rehabilitation costs in 2046	Avoided decommissioning and rehabilitation costs in 2039 Value of hardrock Residual value of capital and land
Potential environmental, social and cultural impacts of extraction, processing and transport to customers after mitigation, offsetting and compensation	Agricultural production Noise impacts Blasting impacts Air quality impacts Greenhouse gas impacts Surface water impacts Groundwater impacts Ecological impacts Road transport impacts Aboriginal heritage impacts Historic heritage impacts Visual impacts Net public infrastructure costs Loss of surplus to other industries	Wage benefits to employment Non-market benefits of employment Economic benefits to existing landholders Economic benefits to suppliers

15.2.4 Valuation of benefits and costs

The valuation of benefits and costs are summarised in Table 15.2 and described in detail in Section 4.4 of the economic assessment (Appendix N). The table identifies the projected production costs and benefits of the extension project, including capital and operating costs associated with the mitigation, offset and compensation of environmental, social and cultural impacts, along with the residual environmental, social and cultural impacts of the extension project after mitigation, offset and compensation. Specific mitigation, offset and compensation costs are commercial-in-confidence and are not separated out from the projected capital and operating costs of the extension project.

Table 15.2 Proposed extension BCA results

	Costs		Benefits	
	Description	**Value ($ million)**	**Description**	**Value ($ million)**
Production	Opportunity cost of land	$1	Avoided decommissioning and rehabilitation costs	$0
	Opportunity cost of capital	$0	Value of product	$195
	Development costs	$8	Residual value of capital	$0
	Operating costs	$166	Residual value of land	$0
	Decommissioning and rehabilitation costs	$0		
	Sub-total	**$175**	**Sub-total**	**$195**
	Net Production Benefits			**$21**
Environmental, social and cultural impacts	Greenhouse gas impacts	$5 ($0)	Wage benefits to employment	$1
	Agricultural impacts	Included in opportunity cost of land	Non-market benefits of employment	$10
	Noise impacts	Cost of mitigation works, acquisition and agreements included in capital costs	Economic benefits to existing landholders	$0
	Blasting	No properties impacted by exceedances	Economic benefits to suppliers	$0
	Air quality impacts	No properties impacted by exceedances		
	Surface water	No material impacts*		
	Groundwater	Cost of WALs included in capital costs ($0.03 million)		
	Ecology	Some loss of values but offset. Cost of biodiversity offset included in capital costs and operating costs		
	Road transport impacts	Cost of upgrades and road maintenance included in capital and operating costs		

Table 15.2 Proposed extension BCA results

Costs		Benefits	
Description	**Value ($ million)**	**Description**	**Value ($ million)**
Aboriginal heritage	11 sites impacted. Cost of AHMP included in capital and operating costs		
Historic heritage impacts	No material impacts*		
Visual impacts	No material impacts*		
Net public infrastructure costs	No material impacts*		
Loss of surplus to other industries	No material impacts*		
Non-market impacts sub-total	**$5 ($0)**		**$11**
Net social benefits – including employment benefits			**$26 ($32)**
Net social benefits – excluding employment benefits			**$15 ($21)**

Notes: *1. Monetary values are present values using a 7% discount rate.*

2. Totals may have minor discrepancies due to rounding.

3. When impacts accrue globally, the numbers in brackets relate to the level of impact estimated to accrue to Australia.

4. "No material impacts" does not mean that there will be no impacts but impacts are not likely to amount to more than 5% of the quantified net production benefits of the extension project.

The extension project is estimated to have total net production benefits of $21 million (excluding employment benefits). Gunlake is 100% Australian (NSW) owned, therefore, all of these net production benefits would accrue to Australia. The estimated net production benefits that accrue to Australia can be used as a threshold value or reference value against which the relative value of the residual environmental impacts of the extension project, after mitigation, compensation and offset, may be assessed. This threshold value is the opportunity cost to society of not proceeding with the extension project.

For the extension project to be undesirable from an Australian economic efficiency perspective, all incremental residual environmental impacts (to Australia) would need to be valued by the community at greater than the estimate of the Australian net production benefits, ie greater than the threshold value of $21 million.

Instead of leaving the analysis as a threshold value exercise, an attempt has been made to quantitatively consider the environmental, social and cultural impacts of the extension project. The potential impacts are internalised into the capital and operating costs of the proponent via mitigation, offset or compensation, and hence are incorporated into the estimate of net production benefits (Table 15.2). Other quantified impacts to Australia are estimated to be less than $1 million, considerably less than the estimated $21 million net production benefits of the extension project to Australia.

Overall, the extension project is estimated to have net social benefits to Australia of between $21 million (excluding employment benefits) and $32 million (including employment benefits), and hence is desirable and justified from an economic efficiency perspective.

i NSW costs and benefits

The *Guideline for the Economic Assessment of Mining and Coal Seam Gas Proposals* NSW Government (2015), provides the most up to date guidance on economic assessment of projects in NSW although the application of these guidelines is not mandatory for quarry projects. The guidelines have a particular focus on the costs and benefits of projects to NSW. Impacts that have a national or global dimension are apportioned to NSW, in particular:

- 32% of the estimated company tax generated from the extension project is attributed to NSW;
- all of the residual net producer surplus, ie net production benefits minus company tax, is attributable to NSW based on 100% NSW ownership of Gunlake Quarries;
- it is assumed that all contributions to the Council are required to mitigate impacts with a nexus to the extension project. However, the contributions exceed Councils forecast expenditures as a result of the extension project (see Section 3.4.3);
- 100% of potential wages benefits are attributable to NSW based on an assumption that all incremental employment will be filled by NSW residents;
- 100% of the potential non-market values of employment are attributable to NSW based on benefit transfer from a study that surveyed the NSW population;
- greenhouse gas impacts (which accrue globally) are attributed to NSW based on NSW's share of the global population; and
- all other potential environmental, social and cultural impacts would accrue to NSW households. However, these impacts will be largely mitigated, compensated or offset by Gunlkae in accordance with government policy and regulations.

Accordingly, the net social benefits of the extension project to NSW are estimated to be $16 million (excluding employment benefits) and $27 million (including employment benefits).

15.2.5 Sensitivity analysis

A sensitivity analysis was undertaken to determine the sensitivity the results to the uncertainties used in the CBA. The analysis indicated that the CBA results were not sensitive to changes in capital costs, opportunity costs of land, decommissioning costs, company tax rate or environmental costs that have not already been internalised into production costs, such as greenhouse gas costs and groundwater WAL costs. Since mitigation, offset and compensation costs will be a small component the capital and operating costs of the extension project, it is unlikely that large changes in these cost levels would have any significant impact on the CBA results.

A decline in the value of quarry products is also unlikely given the recent closure of major sources of supply, such as the Penrith Lakes Development Scheme, and the forecast strong growth in demand for quarry products to help address a backlog of public infrastructure projects (Productivity Commission 2014).

15.3 Local effect analysis

As noted in Section 15.1, LEA assesses the impacts of the extension project in the locality, in this case, the Goulburn Mulwarree LGA. In particular, LEA looks at the following:

- effects relating to local employment;
- effects relating to non-labour project expenditure; and
- environmental and social impacts on the local community.

A summary of the LEA for the proposed extension is provided in Table 15.3.

Table 15.3 Summary of local effects

	Project Direct	Project Direct: Local	Net Effect	Total Net Effect
Employment related				
Employment (FTE)	27	24	2	4.40
Income (per annum)	$1,175,931	$1,045,272	$86,753	$291,489
Other non-labour expenditure (per annum)	$7.3 million			
Second round and flow-on effects	Refer to Section 6 of Appendix N			
Contraction in other sectors	No material impact			
Displaced activities	Not applicable			
Wage impacts	No material impact			
Housing impacts	No material impact			
Externality impacts	**Incidence of Impacts**	**Magnitude of Impact**		
Greenhouse gas impacts	Local and NSW households	$0		
Agricultural impacts	Gunlake Quarries	Included in opportunity cost of land		
Noise impacts	Adjoining landholders	Landholders impacted above criteria compensated		
Blasting	Adjoining landholders	No properties impacted by exceedances		
Air quality impacts	Adjoining landholders	No properties impacted by exceedances		
Surface water	Local surface water users	No material impacts		
Groundwater	Local groundwater users	If WALs purchased off landholders then they are compensated. If from controlled allocation then no impact.		
Ecology	Local and NSW households	Some loss of values but offset by provision of biodiversity offsets		
Road transport impacts	Local residents	Impact mitigated by provision of road and intersection upgrades		
Aboriginal heritage	Aboriginal people and other local and NSW households	11 sites impacted		
Historic heritage impacts	Local and NSW households	No material impacts		
Visual impacts	Adjoining landholders	No material impacts		
Net public infrastructure costs	NSW Government and NSW households	No material impacts		
Loss of surplus to other industries	Local industries adversely impacted by the Project	No material impacts		

A supplementary LEA using input-output (IO) analysis was used to assess the direct and indirect economic activity project footprint in relation to output, value-added, income and employment in the local area.

The IO method is outlined in detail in Section 6 of the economic assessment (Appendix N).

The input-output analysis estimated that the extension project would make an annual incremental contribution to the economy for 22 years (ie in addition to the contribution from the approved operation until the end of the currently approved operations) of up to:

- $40 million in annual direct and indirect regional output or business turnover;
- $10 million in annual direct and indirect regional value added;
- $3 million in annual direct and indirect household income; and
- 60 direct and indirect jobs.

For the additional eight years of the project life the contribution to the economy would be up to:

- $68 million in annual direct and indirect regional output or business turnover;
- $22 million in annual direct and indirect regional value added;
- $6 million in annual direct and indirect household income; and
- 150 direct and indirect jobs.

15.4 Quarry cessation

As outlined in sections 15.2 and 15.3, the extension project will provide direct and indirect economic activity in the regional economy for 30 years. Conversely, the cessation of operations at the quarry will result in a contraction in regional economic activity. The magnitude of this contraction will depend on whether the workers and their families leave the area, whether alternative development opportunities arise, and the regional economy at the time. If it is assumed that some or all of the workers remain in the region, the economic impacts would not be as severe compared to a greater number leaving the region. The decision by workers to move or stay would be affected by a number of factors including the prospects of gaining employment in the regional economy compared to other regions, the likely loss or gain from homeowners selling, and the extent of “attachment” to the regional area (Economic and Planning Impact Consultants 1989).

Ultimately, the significance of the economic impacts once quarrying stops will depend on the regional economic structure and trends at the time. For example, if the quarry stops operating in a declining economy, the impacts might be significant. Alternatively, if the quarry stops operating in a growing diversified economy where there are other development opportunities, the end of quarrying may have little impact.

15.5 Conclusions

The extension project is estimated to have net social benefits to NSW of between $16 million and $27 million and hence is desirable and justified from an economic efficiency perspective. Environmental, social and cultural impacts of the extension project have been minimised through project design, and mitigation, offset and compensation measures. The value of residual impacts is considered to be negligible from an aggregated economic efficiency perspective.

The input-output analysis estimated that the extension project would make an annual incremental contribution to the economy for 22 years (ie in addition to the contribution from the approved operation until the end of the currently approved operations) of up to:

- $40 million in annual direct and indirect regional output or business turnover;
- $10 million in annual direct and indirect regional value added;
- $3 million in annual direct and indirect household income; and
- 60 direct and indirect jobs.

For the additional eight years of the project life the contribution to the economy would be up to:

- $68 million in annual direct and indirect regional output or business turnover;
- $22 million in annual direct and indirect regional value added;
- $6 million in annual direct and indirect household income; and
- 150 direct and indirect jobs.

The extension project would provide economic benefit to the Australian, NSW and regional economies. Accordingly, no economic mitigation measures are considered necessary.

16 Other matters

16.1 Hazards

This section provides an assessment of hazards from the extension project and determines if the project is a potentially hazardous or offensive development according to SEPP 33.

16.1.1 Potentially hazardous development

i *Applying SEPP 33* risk screening method

Potentially hazardous or offensive development is defined by SEPP 33 as development which poses a significant risk to, or which would have a significant adverse impact on, human health, life, property or the biophysical environment, if it were to operate without employing any control measures. This includes developments for the handling, storing or processing of hazardous materials. A development is classified as a hazardous or offensive development if the thresholds in *Applying SEPP 33* (DP&I 2011) — which compare the quantities of stored or used hazardous materials to the distance from publicly accessible areas — are exceeded. The hazardous materials classifications in *Australian Code for the Transport of Dangerous Goods by Road and Rail* (National Transport Commission 2007) (the Dangerous Goods Code) are used in DP&I (2011).

a. Hazardous materials stored, processed or handled

The storage conditions, quantities and hazardous properties of the materials that will be stored and used onsite are provided in Table 16.1. Explosives are transported to the quarry as needed for blasting, but are not stored onsite.

Table 16.1 Dangerous goods and other potentially hazardous materials to be stored onsite

Classification	Name	Storage conditions	Approximate quantity
Dangerous goods			
Class 2.1 Flammable Gas	Acetylene	3 bottles	5
Class 2.2 Non-flammable, non toxic gas*	Oxygen	6 bottles	6
	Carbon Dioxide (CO2)	4 fire extinguishers, stored at various locations and all machines	54
	Argo Shield Universal	4 bottles	4
Class 3 Flammable Liquid PG II	Unleaded Petrol	60 L	120 L
	All purpose thinner	20 L	20 L
Class 9 Miscellaneous dangerous substances PG III*	Diesel fuel**	55,000 L	55,000 L

Table 16.1 Dangerous goods and other potentially hazardous materials to be stored onsite

Classification	Name	Storage conditions	Approximate quantity
Other hazardous materials			
N/A	Oils (engine, hydraulic, and diesel)	Purpose built containers, in enclosed storage room in main compound	4,460 L
N/A	Window cleaner	Purpose built container, in enclosed storage room in main compound	40 L
N/A	Polo Citrus (Dust suppressant)	Purpose built container, in enclosed storage room in main compound	20 L
N/A	Dry Chemical ABE powder	33 fire extinguishers, stored at various locations	31
N/A	Dishwashing liquid	Purpose built container, in enclosed storage room in main compound	2 L
N/A	Antibacterial hand cleaner	Purpose built container, in enclosed storage room in main compound	20 L
N/A	Grease	Two purpose built containers, in enclosed storage room in main compound	500 kg
N/A	Coolant	Purpose built container, in enclosed storage room in main compound	200 L

Notes: **Exempt from "Applying SEPP" risk screening test.*

***The Dangerous Goods Code states that diesel is not subject to the code as it is has a flash point of more than 60°C. The Work Practice Data Sheet provided by Chemwatch identifies Diesel as a Dangerous Good Glass 9.*

A screening test for dangerous goods against the thresholds in SEPP 33 is provided in Table 16.2.

Table 16.2 *Applying SEPP 33* screening test

Dangerous goods classification	Total quantities	SEPP 33 screening threshold	Potentially hazardous?
Class 2.1 (liquefied excluding liquefied petroleum gas)	40m^3	Greater than 500 kg at specified distance	No
Class 3 PG II	140 kg	Greater than 5 t at specified distance	No

Based on the dangerous goods screening test, the development is not classified as potentially hazardous.

b. Transport of hazardous materials

Applying SEPP 33 also sets threshold limits for the transportation of hazardous materials to and from a site. The approximate quantities per load, and the number of weekly and annual deliveries are below the SEPP 33 transport screening thresholds (Table 16.3).

Table 16.3 *Applying SEPP 33* transportation screening test

Hazardous materials	Deliveries		Quantities per load (average)	Potentially hazardous?
	Weekly (peak)	Annual		
Class 1.1 Explosives	2	104	9,000 kg	No
Class 2.1 Flammable Gas	1	30	16 m^3	No
Class 3 PG II	1	36	20 L	No
Class 9	1	24	45,000 L	No

Based on the dangerous goods screening test, the development is not classified as potentially hazardous.

It is noted that, as part of the proposed extension project, the number of deliveries of Class 1.1 explosives will increase from one per fortnight to two per week. The transport and delivery of the explosives will continue to be undertaken by a licensed contractor, in accordance with all relevant standards and legislation.

ii Other risk factors

Applying SEPP 33 requires an assessment of other hazards/risk factors outside the scope of the risk screening method. An assessment of other types of hazards associated with the quarry is provided in Table 16.4.

Table 16.4 Other types of hazards

Type of hazard	Comments
Any incompatible materials (hazardous and non-hazardous materials).	No
Any wastes that could be hazardous.	No
The possible existence of dusts within confined areas.	No
Types of activities the dangerous goods and otherwise hazardous materials are associated with (storage, processing, reaction, etc.).	Use of explosives in blasting which is undertaken by licensed contractors, who hold a blasting explosives user licence with WorkCover NSW. No explosives will be stored onsite.
Incompatible, reactive or unstable materials and process conditions that could lead to uncontrolled reaction or decomposition.	No
Storage or processing operations involving high (or extremely low) temperatures and/or pressure.	No
Details of known past incidents (and near misses) involving hazardous materials and processes in similar industries.	No known incidents involving hazardous materials/processed at extractive industries.

iii Hazard management

A range of hazard control measures will be implemented during the extension project. Each of these will be appropriate for the hazard they are designed to control and will generally follow the *Hierarchy of Hazard Controls* (WorkCover NSW not dated). The storage and use of hazardous materials will be in accordance with the *Australian Standard 1940:2004 The Storage and Handling of Flammable and Combustible Liquids*.

As the quarry stores more than 10,000 L of diesel, WorkCover NSW is to be notified, and manifests and emergency plans developed.

iv Is the quarry a potentially hazardous industry?

An assessment of the storage and transport of hazardous materials against *Applying SEPP 33* determined that the quarry is not a potentially hazardous industry.

16.1.2 Potentially offensive industry

The air, noise, and water emissions from the extension project have been assessed to determine if the project is classified as a potentially offensive industry under SEPP 33.

i Air quality

Dispersion modelling for the extension project predicted that the proposed changes to operations will not result in any exceedances of the impact assessment criteria for key pollutants, including PM_{10}, $PM_{2.5}$, TSP, RSC and dust deposition (see Section 12.2). Current and proposed mitigation measures were incorporated into the modelling and no additional measures are required to manage air quality impacts.

ii Noise

Noise modelling for the extension project predicted significant impacts at two private residences. Gunlake has recently negotiated an agreement with the landowner of one of these residences and the other will be afforded voluntary land acquisition rights in accordance with the VLAM. Moderate impacts are predicted at a third residence which will be offered voluntary mitigation upon request in accordance with the VLAMP.

Sleep disturbance criteria, cumulative noise, road traffic noise, blast overpressure and ground vibration levels are all predicted to satisfy the relevant criteria.

iii Water

The extension project will require additional surface water controls to manage potential impacts and to provide a reliable supply of water for quarry operations. The proposed surface water management strategy will mitigate potential water quality and quantity impacts and the extension project will not impact on downstream water users. Water balance model results indicate that the quarry's process water requirements will be met under most climatic conditions and there are available contingencies if there are water shortfalls.

iv Is the quarry a potentially offensive industry?

Based on the findings of this EIS (as summarised above), the extension project will not result in unacceptable levels of pollution. Significant and moderate noise emissions are predicted at three residences which will be offered mitigation and/or acquisition rights in accordance with the VLAMP. Therefore, the quarry is not a potentially offensive industry.

16.1.3 Explosives and blasting

As noted in Section 16.1.1.i(a), explosives are transported to the quarry as needed for blasting, but are not stored onsite. Blasting at the quarry is conducted by a licensed contractor, and is monitored in accordance with the Noise and Blast Plan (NBP), which has been prepared with reference to AS 2187.2-2006 "*Explosives – Storage, Transport and Use*" and approved by DPE. The NPB describes procedures for the notification of surrounding landowner and occupiers prior to blast events, which include email/telephone notification of all residences within 2 km of the quarry pit.

Gunlake is committed the safety of the general public. Blasting at the quarry is 'routine' (ie no special blasting practises are required) and well established processes for blasting are followed. Given the location of the quarry pit on private land, the small number of surrounding residences, the distance to these residences and the existing safety and management procedures at quarry the risk to public safety from blasting is considered minimal.

16.1.4 Bushfire

The Goulburn-Mulwaree Council Bushfire Prone Land Map identifies land within the site boundary as Category 1 Vegetation, Category 2 Vegetation, and Buffer Zone. The extension project would not involve the construction of additional structures within bushfire prone land that would require bushfire risk management. Further, no habitable structures are currently within bushfire prone land with a distance of at least 80 m to the administration building and maintenance shed. The extension project would not alter the bushfire risk of the existing quarry.

16.2 Visual

The impact of the proposed extension project on visual amenity in the local area is considered below.

16.2.1 Existing environment

Gunlake Quarry is located in a rural setting and is surrounded by undulating terrain. The project area ranges from 636 m AHD at the northern end to approximately 700 m AHD at the southern end. A topographic ridge lies between the quarry and residences and traffic on Brayton Road.

The existing topography of the local area, together with areas of vegetation, generally screen quarry activities from public viewpoints, including the local road network. Brayton Road to the north and Carrick Road to the west have some views of the quarry. However, vehicles on these roads only have transient views of the site, largely obscured by vegetation, and distance and motion effects. The existing overburden emplacement, to the east of the quarry site, provides a visual screen for any potential views of the site from the east as the quarry operations and infrastructure area are largely behind the emplacement. The existing emplacement area has also been progressively rehabilitated (see photos 2.3 and 2.4) allowing it to better blend in with the surrounding visual landscape.

Gunlake Quarry is generally not visible from adjacent properties other than from the residence approximately 1.2 km north-west of the infrastructure area. Isolated parts of surrounding properties also have long distance views of the site. However, these views are generally from at least 5 km from the quarry.

Permanent lighting is currently installed at the infrastructure area to ensure safe operating conditions. This lighting is positioned to direct light downwards and away from sensitive receptors in order to minimise light emissions and nuisance impacts to surrounding landowners and road users. Lights are generally left off and only used as required.

16.2.2 Impact assessment

The extension project includes an increase in the disturbance area of the quarry to approximately 99 ha and the emplacement of overburden to the west of the quarry site. This will be in the southern-most and western-most portion of the quarry site that is furthest from public viewpoints and residences, largely shielding these aspects of the proposed extension from view.

The proposed overburden emplacement will be between 5 to 15 m above current ground level and has been designed to blend with existing topography of the area while remaining well below the ridgeline to the south of the site. As previously noted, the proposed emplacement will not generally be visible from public viewpoints given the surround topography and vegetation, and the intervening distance. There may be some incidental views of the proposed emplacement for road users on Brayton Road, travelling between Brayton and the quarry, however these will largely be obscured by distance and motion effects.

Due to the topography and existing vegetation in the local area, it is unlikely that the extension project will have significant visual impacts for surrounding landowners and road users. In addition, continued progressive rehabilitation of the quarry and the use of the existing overburden emplacement are to the east as a visual screen will further shield the quarry from public viewpoints.

The quarry is currently approved to operate 24-hours a day except between 6 pm Saturday to 2 am Monday and on public holidays (see Section 3.8). Operations currently occur in the infrastructure area during these hours. The proposed extension to operating hours (see Section 3.8) relate to the use of the tertiary crusher in the infrastructure area. No additional lighting will be required for operation of the tertiary crusher so there will be no addition impacts from lighting. No operations in the pit are proposed after 6 pm so lighting will not be required in the pit.

The proposed extension project will not significantly alter the visual impact of the quarry on surrounding land uses. Gunlake will continue to consult with surrounding landowners regarding the visual amenity of the quarry and will implement any reasonable additional controls to further reduce their visual impact if necessary.

16.3 Historic heritage

The impact of the proposed extension project on historic heritage is considered below.

16.3.1 Existing environment

No items of historic heritage have been identified in previous assessments of historic heritage significance at the quarry (AASC 2007 and Olsen 2014).

Notwithstanding, searches of the National, Commonwealth, and State heritage registers, the NSW Section 170 heritage registers and the Goulburn Mulwarree Local Environmental Plan were completed. No historic heritage sites were identified within the project area, or in the immediate vicinity of the proposed extension area.

The Aboriginal heritage site survey and test excavations (see Section 13.3) by EMM archaeologists with experience in Aboriginal and historic heritage site surveys did not identify any items of historic heritage significance in the proposed extension area. No historic structures or features of historic heritage significance were identified during the comprehensive survey which extended across the entire extension area and no indications of historic archaeological deposits were identified during the Aboriginal archaeological test excavation which sampled land across extension area. The only evidence of historic activity related to the construction of dams, drainage diversion bunds, vehicle tracks and livestock fences, none of which were considered to have historic heritage significance.

Previous survey locations are shown in Figure 13.1 and the Aboriginal heritage field survey locations for the proposed extension are shown in Figure 13.2. Given the extent of surveys at the site and the historic land use, comprising cleared agricultural land predominantly used for sheep grazing, there is low potential for currently unknown items of historic heritage significance to be present within the proposed extension area. A summary of the land use history of the project area can be found in Section 13.2.2.

16.3.2 Impact assessment

No historic heritage sites were identified within the project area and no impacts to historic heritage will result from the proposed extension project. The likelihood of unknown items of historic heritage significance being present in the proposed extension area is considered minor however, the following unexpected finds protocol will be implemented should an artefact/item/site of potential historic heritage be found:

- All works will cease within 10 m of the find and the area will be demarcated to protect the artefact/item/site. The relevant foreman or superintendent and the Environment Manager will be notified.
- The details of the site will be recorded including photos of the find.
- A suitably qualified heritage consultant will be contacted to assess the find.
- If the heritage consultant advises that the find is not an item of historic heritage significance, work will recommence.
- If the heritage consultant advises that the find is an item of historic heritage significance, the following steps will be taken:
    - The project archaeologist will assess and survey the artefact/item/site, to determine appropriate mitigation measures, including any further investigation or salvage works.
    - A representative of the Heritage Division will be notified of the location, significance of the find, likely impact and proposed mitigation measures.
    - The heritage consultant will then perform any required mitigation or management measures.

The unexpected finds protocol will form part of Gunlake's EMS.

17 Statement of commitments

17.1 Introduction

This chapter summarises the commitments made by Gunlake in this EIS to manage potential environmental impacts resulting from the proposed extension project. These commitments include management, mitigation, monitoring and/or compensation measures to be implemented for the life of the project.

17.2 Environmental management strategy

Gunlake implements a wide range of site-specific environmental management programs for its existing operations at the quarry. These are undertaken in accordance with an environmental management strategy (EMS) which was approved by the Department of Planning in November 2008 (see Section 2.13). The plans, procedures and monitoring programmes contained within the existing EMS will be reviewed and updated, in consultation with relevant agencies, to incorporate the extension project. The updated EMS will be consistent with the project approval and any other approvals for the project, should they be granted. The plans and any other measures contained within the EMS will be regularly reviewed and updated in accordance with project approval conditions.

17.3 Summary of commitments

A summary of the environmental management and mitigation measures described for specific aspects of the project are provided in Table 17.1.

Table 17.1 Commitments

Aspect	Commitment
Noise and vibration	*Voluntary land acquisition and mitigation* • Voluntarily mitigation rights would be offered to R7 in accordance with the VLAMP.
Air quality	*Air quality monitoring* • The existing air quality monitoring network will continue under the extension project. Monitoring results will be reviewed on an annual basis against the EPL and approval conditions to determine if additional monitoring is required due to production increases. *Air quality management* • The following additional management measures will be implemented to enable Gunlake to continue to manage potential air quality impacts effectively: - compliance with the USA-EPA Tier 3 or Tier 4 emissions standards, where practicable, for any new plant acquired by Gunlake; and - consideration of the following factors during blast design: ▪ delaying blasting to avoid unfavourable weather conditions that are likely to cause or spread a blast fume; ▪ selecting an explosive product that is correct for the conditions; ▪ monitoring the amount of hydrocarbon (diesel) in the product; ▪ preventing water ingress into blast holes; ▪ dewatering holes before loading; ▪ keeping sleep time (the amount of time between charging and firing of a blast) to a minimum, well within manufacturer recommended times;

Table 17.1 Commitments

Aspect	Commitment
	▪ providing effective stemming; and ▪ loading the product using the appropriate techniques.
Biodiversity	*Landscape Management Plan* • The landscape management plan (LMP) will be updated to include details on biodiversity management and rehabilitation for the extension project. The plan will be completed and implemented within 12 months of project approval. • The LMP will include procedures to be applied for the management of the offset properties, the arrangements for conservation in perpetuity and regeneration works to be undertaken. This will include the procedures for: - assisting the revegetation and regeneration in the offset areas, including establishment of canopy, understorey and groundcover in areas of native pasture where required; - controlling weeds and feral pests; - fencing and access arrangements; - erosion control; and - bushfire management. • An offset monitoring program will also be included within the LMP to monitor any changes to the condition of the offset areas. *Offsets* • An offset package of 155.6 ha incorporating the offset requirements of the original approval, as modified, and the extension project to compensate for the extension project impacts. • Offset areas will be secured where possible using a BioBanking agreement. Where this cannot be achieved, a suitable mechanism will be identified that follows the Policy's criteria. • The offset areas will be managed in accordance with the LMP.
Traffic and transport	*Road upgrades* • At the intersection of Hume Highway and Red Hills Road, an additional 500 m long (including taper) left turn northbound acceleration lane will be constructed before 2025 in accordance with the relevant Austroads (2013) intersection design requirements. *Traffic management plan* • The existing traffic management plan will be updated following project approval.
	Development contributions • Gunlake will continue to meet its obligations under Section 94 development contributions to Goulburn Mulwaree Council for the life of the project.

Table 17.1 Commitments

Aspect	Commitment
Groundwater	*Water management plan* The Gunlake water management plan will be updated to include: • triggers values to facilitate the identification of groundwater impacts outside of predictions; • the use of monitoring data to calibrate and update the model at significant project stages; • quarterly groundwater quality and level monitoring to facilitate the early identification of adverse impacts and test model predictions; • monitoring of spring flow in conjunction with the quarterly groundwater level and quality program; • monitoring mapped areas of Box Gum Woodland; • procedures for the re-use of site water; and • response protocols and contingency mitigation measures to be implemented in the event of an unpredicted adverse impact. *Groundwater licensing* • Gunlake Quarry will obtain a WAL(s) for the predicted groundwater take over the lifespan of extension project (up to 37 ML/year). • Groundwater monitoring bores will be registered under the Water Act.

Surface water	*Surface water licensing*
	• Gunlake will seek any required water licences should water need to be imported during extended dry periods.
	Surface water monitoring
	• The current surface water monitoring program will be modified to include monitoring at:
	  ○ two receiving water sites on Chapmans Creek, downstream of the quarry; and
	  ○ the Process Water Dam and Pit Dewatering Dam.
	• Should the monitoring program indicate that the quarry is potentially adversely affecting water quality in Chapmas Creek, Gunlake will undertake an investigation to establish the likely cause and will implement necessary mitigation measures.

Aboriginal heritage	*Aboriginal Heritage Management Plan*
	• The Gunlake Quarry Aboriginal Heritage Management Plan (AHMP) will be updated and provide details of:
	  ○ all Aboriginal sites identified for the project and those previously recorded in the broader project site boundary;
	  ○ management measures and their progress towards completion;
	  ○ continuing consultation and involvement of registered Aboriginal parties;
	  ○ protocols for newly identified sites;
	  ○ protocols for suspected human skeletal material; and
	  ○ provisions for review and updates of the AHMP.

Table 17.1 Commitments

Aspect	Commitment
	Aboriginal sites • All Aboriginal sites in the project disturbance footprint will be collected by a qualified archaeologist and members of the RAPs and relocated to the same area as previously collected artefacts at the site. • If new Aboriginal sites are discovered outside of known site areas, all work will halt and an archaeologist and members of the RAPs be contacted to determine the significance of the objects. Objects will be managed based on their sensitivity in a manner consistent with the management measures outlined above, including appropriate forms of salvage for the items. • In the event that known or suspected human skeletal remains are encountered during the activity, the procedures detailed in Appendix M will be followed.
Social	*Local employment, training and engagement* • Gunlake will ensure that preference is given to local employees. Gunlake will use local or regional contractors and suppliers where this presents a cost effective and feasible option. • Gunlake will provide ongoing training and certification opportunities for local community members to ensure they have the necessary skills to work in extractive industries. • Gunlake will continue to actively engage with the local community and affected individuals and groups and address any complaints and feedback on quarry operations.
Soils and rehabilitation	*Rehabilitation scheduling* • Rehabilitation will be progressively staged as soon as possible after final completion of works is determined. Staging of rehabilitation activities will require identification of timelines for decommissioning of pits, buildings and other supporting infrastructure. A more detailed schedule of works will be developed 12 to 24 months prior to the confirmed closure. *Erosion and sediment control* • ESC measures will be defined in an Erosion and Sediment Control Plan to be implemented throughout the life of the project. *Weeds* • Gunlake will take the necessary precautions to prevent excessive development of weeds within rehabilitated areas. *Rehabilitation monitoring* • Gunlake will undertake an ongoing monitoring program throughout and beyond the operation of the project. Areas being rehabilitated will regularly be inspected and assessed against the short and long-term rehabilitation objectives outlined in Section 6.4.1. • It is envisaged that rehabilitation monitoring will be undertaken for at least 2 years following the completion of all rehabilitation. The exact period would reflect seasonal conditions during that period. In any event, maintenance will continue until such time as the objectives have been achieved. The monitoring criteria will be reviewed and finalised with Goulburn Mulwaree Council at the time of submitting a final rehabilitation plan.
Visual	*Visual amenity* • Gunlake will continue to consult with surrounding landowners regarding the visual amenity of the quarry and will implement any reasonable additional controls to further reduce their visual impact, if necessary.
Historic heritage	*Unexpected finds* • Gunlake will include an unexpected finds protocol in relation to historic heritage as part of the EMS for the quarry.

18 Project justification and conclusions

This EIS has considered all potential impacts associated with the extension project, as well as the need for the project and alternative development options. This chapter provides a justification of the project on economic, social and environmental grounds and considers the proposal against the relevant objects of the EP&A Act. An EIS conclusion is then provided.

18.1 Project justification

The SEARs requires "the reasons why the development should be approved having regard to biophysical, economic and social considerations, including the principles of ecologically sustainable development." Each of these are considered below.

18.1.1 Economic justification

The economic impacts of the extension project are identified in the Economic Assessment (Appendix N). The economic benefits of the extension project include the provision of long-term jobs, the generation of 'flow-on' employment, increased expenditure in the local and regional economy and the provision of monetary contributions to local, State and Commonwealth governments through Section 94 Contributions and taxes.

i Local economic benefits

a. Employment

The quarry currently employs 50 to 63 people (full-time equivalent, FTE), the extension project will require about 27 additional employees so that quarry will employ the 77 to 90 people in total.

The extension project will generate direct and indirect employment for up to 60 people on top of the current direct and indirect employment from the existing operation.

This "trickle-down effect" on which the above estimate is based assumes that the new extension project employment positions are filled by people moving employment from other sectors and that the vacant positions created will be filled by others in the workforce. In the absence of this expected effect, the extension project will generate 4.4 additional direct and indirect jobs in the local economy based on local effects analysis (see Appendix N).

b. Local and regional contractors and suppliers

Gunlake will continue to use local or regional contractors and suppliers where this presents a cost effective and feasible option.

c. Local Section 94 Contributions

Gunlake Quarry and the Council have a road maintenance and capital improvement agreement to cover impacts associated with the movement of saleable product along the designated transport routes. To the end of the 2014/15 financial year, Gunlake spent $3.3 million on local roads.

Over the proposed life of the quarry, Gunlake's Section 94 Contribution obligation will be approximately $19 million. It is estimated that the Council's cost to repair, maintain and rebuild the haul route roads over this time will be about $12 million (based on Council calculations). Therefore there will be sufficient Council funds to maintain and repair the haul route roads and an excess contribution of about $7 million.

ii Broader economic benefits

a. Construction products

Demand for concrete will grow in the long-term due to the ongoing growth of Sydney. In *Population Household & Dwellings Projects: Sydney Metropolitan*, the Department of Planning and Environment predict that Sydney's population will grow from 4.29 million in 2011 to 5.06 million in 2021 and 5.86 million in 2031. This will require the construction of 664,300 homes and the supporting infrastructure required for this population growth between 2011 and 2031. This is reflected in the current Metropolitan Strategy that has increased the housing target by 17% and the minimum jobs target by 33% compared to the previous strategy.

The provision of housing and infrastructure to meet this growth will require an increase in the supply of heavy construction materials such as concrete and its constituents. Sydney currently uses almost 20 million tonnes of quarried aggregates every year. Historically, most of this aggregate has been extracted relatively close to Sydney. As these reserves are depleted, aggregate will have to be sourced further afield from quarries such as those at Marulan. Accordingly, the Department of Planning and Environment has determined that Marulan is a suitable area for the future supply of heavy construction materials for Sydney.

Gunlake is confident that demand for competitively priced quarry products will continue to grow to supply Sydney's ongoing growth. The expansion project will expand Gunlake's production capacity to meet increasing demand in the Sydney. This will assist to bring the economic benefits of growth:

- where construction materials are sourced, in this case Goulburn Mulwaree Council local government area; and
- where they are used locally and in Sydney.

b. Taxes

The payroll tax paid to the NSW Government by Gunlake will increase as a result of the additional employees required for the extension project. In addition, company and other taxes Gunlake pay to the Commonwealth Government will increase when quarry production increases.

c. Contribution to the economy

The cost benefit analysis (CBA) for the extension project (Appendix N) indicated that it will have net social benefits to NSW of between $16 million and $27 million.

Economic activity analysis, using input-output analysis, estimated that the extension project would make an annual incremental contribution to the economy for 22 years (ie in addition to the contribution from the approved operation until the end of the currently approved operations) of up to:

- $40 million in annual direct and indirect regional output or business turnover;
- $10 million in annual direct and indirect regional value added;
- $3 million in annual direct and indirect household income; and
- 60 direct and indirect jobs.

For the additional eight years of the project life the contribution to the economy would be up to:

- $68 million in annual direct and indirect regional output or business turnover;
- $22 million in annual direct and indirect regional value added;
- $6 million in annual direct and indirect household income; and
- 150 direct and indirect jobs.

d. Gunlake's businesses

Gunlake has been supplying hardrock for construction in both the Southern Highlands and the Sydney Metropolitan area. Gunlake is an independent NSW based quarry producer and provides aggregates to supply its three concrete plants in the Sydney region as well as other markets.

Gunlake is the only independent concrete and aggregate producer in Sydney and so assists to maintain a competitive market with lower concrete product prices for users such as construction firms. This in turn benefits the ultimate users of the built environment (eg businesses in offices, home purchasers and road users).

Gunlake's existing operations continue to contribute to the local, regional and NSW economy through:

- Gunlake Quarry which has a sufficient resource to supply local and Sydney markets for in excess of 100 years;
- Gunlake Concrete's three existing concrete batching plants (CBPs) at Smeaton Grange, Glendenning and Silverwater with two more CBPs proposed at Banksmeadow and Preston.
- the provision of over 120 full-time jobs throughout NSW; and
- expenditure of more than $1 million per month in local communities.

Gunlake Quarry provides Gunlake Concrete's concrete batching plants with secure, long-term supplies of aggregate and manufactured sand. The Gunlake Quarry is therefore part of a vertically integrated operation. From the perspective of Gunlake, this vertical integration has a number of advantages:

- it enables Gunlake to reduce its production and distribution costs by linking successive stages of production; and

- it ensures secure reliable supplies of inputs (of appropriate quality) in order to remain competitive.

This vertical integration of Gunlake's activities also has wider impact on the operation of market processes, ie it promotes greater economic efficiency in resource use and maximises welfare gains for society. Various efficiency gains accrue through vertical integration, including:

- technical efficiencies from combining together successive production process – cost minimisation;
- stockholding economies through the reduction in intermediate and contingency buffer stocks;
- elimination of some purchasing expenses in negotiating outside supply contracts by internalising these transactions within the firm;
- managerial economies by having a single administrative system to handle several production activities; and
- financial economies through more advantageous bulk buying discounts and by lowering the cost of raising capital.

The net result of such economies of vertical integration is a reduction in the average costs of production of concrete and hence the ability to compete in the market place with other firms, most of which are also vertically integrated. The result for the consumer is an increase in the output available in the market and lower market prices.

If competitors were the only source of hard rock for Gunlake Concrete, competitors would be in a position to operate a price squeeze. That is, squeeze the profit margins of Gunlake. This is done by the competitor raising Gunlake's costs through charging them a higher price for the raw material than the price charged for its own use, while setting a relatively low final product price. Other vertically integrated competitors would therefore be in a position to injure a non-integrated competitor.

18.1.2 Social justification

The adverse and beneficial social impacts of the extension project are described in Chapter 14. Gunlake is committed to maximising the local social benefits of the project.

As described above, the project will generate a range of economic benefits. These economic benefits will flow through to social benefits.

The Goulburn Mulwaree LGA has a highly polarised population age structure indicative of limited local job availability. The extension project will provide important employment opportunities for the local community and will assist in maintaining the working age population of the LGA. Gunlake will continue to ensure that preference is given to local employees. Gunlake is also committed to providing ongoing training and certification opportunities for local community members to ensure they have the necessary skills to work in extractive industries. The extension project will ensure that these benefits are sustainable by maximise the operating life of the existing quarry.

The extension project has the potential to generate some negative social impacts, particularly through the perceived amenity and traffic impacts – although the actual impacts will generally not be significant. These perceptions will be addressed through the ongoing consultation program while the actual impacts will be minimised through the implementation of the controls described in this EIS and summarised in Chapter 17.

Gunlake will continue to actively engage with the local community and affected individuals and groups. This will include the provision of regular project updates through newsletters, face to face meetings and the Community Consultative Committee.

The social benefits of the extension project will outweigh the negative social impacts to generate net positive benefits for the local community and the wider economy.

18.1.3 Biophysical justification

The extension project is within an existing quarry site, in a predominantly agricultural landscape containing some rural residences and two other quarries (Jonniefelds and Lynwood) close by.

The extension area has been largely cleared and has limited habitat due to the wide-spread removal of native vegetation for agriculture. There is some remnant vegetation in the extension area, particularly along Chapmans Creek and its tributaries. In these areas, the vegetation meets the description of Box Gum Woodland. The remnant vegetation provides habitat threatened fauna species. The extension project has been designed to avoid or minimise impacts but 12.2 ha of woodland and 41.9 ha of grassland vegetation will need to be removed. Biodiversity offsets have been proposed in accordance with the FBA and Commonwealth Environmental Offsets Policy which will result in a net biodiversity gain to compensate for the unavoidable biodiversity impacts.

The Aboriginal sites in the extension area have low archaeological significance, with the exception of one site with moderate significance. The impacted sites will be salvaged by surface artefact collection and detailed recording providing a greater understanding of these sites.

18.2 Objects of the EP&A Act

The project's consistency with the objects of the EP&A Act is considered below.

18.2.1 Proper management, development and conservation of natural and artificial resources

The object is "to encourage: (i) the proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment".

Gunlake quarry contains a substantial hard rock resource which is supported by existing human and physical infrastructure. This EIS has considered the environmental, economic and social impacts of the extension project and provided measures to manage, mitigate or avoid these impacts. The project will facilitate the proper development of the hard rock resource and overall will improve social and economic welfare in the local community.

18.2.2 Orderly development

The object is “to encourage: (ii) the promotion and co-ordination of the orderly and economic use and development of land”.

The proposal is for the extension of an existing quarry on land owned by Gunlake. Therefore, the extension project represents an orderly use of the land.

The extension project is expected to generate contribute up to $40 million in annual direct and indirect regional output or business turnover and up to $10 million in annual direct and indirect regional value added in addition to that from the currently approved operation. This incremental contribution will increase when the extension project operations extend beyond the life of the approved operations.

Extraction of the hard rock resource aligns with the NSW State Government’s objective to maximise rock resource utilisation in the Marulan area.

18.2.3 Communication and utility services

The object is “to encourage: (iii) the protection, provision and co-ordination of communication and utility services”.

The extension project will not impact on any communication or utility services and therefore, this object is not applicable.

18.2.4 Land for public purposes

The object is “to encourage: (iv) the provision of land for public purposes”.

Following the closure of the Crown roads, the extension project would be developed on privately owned land that is not available for public purposes. Therefore, this object is not applicable.

18.2.5 Community services and facilities

The object is “to encourage: (v) the provision and co-ordination of community services and facilities”.

The extension project will not generate any significant long-term increases in the local population. Therefore, it is unlikely to impact upon community services and facilities.

18.2.6 Protection of the environment

The object is “to encourage: (vi) the protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats”.

Gunlake undertook a preliminary review of potential environmental impacts of the extension project, including on biodiversity, to inform the project design. A range of design alternatives were considered (see Section 3.10) and the proposed extension project avoids or minimises impacts on biodiversity as far as possible. Where unavoidable impacts will occur, mitigation, management and compensatory measures have been identified. These measures will include progressive rehabilitation and the establishment of biodiversity offsets that will result in a net gain in biodiversity. The extension project has been designed to protect and conserve biodiversity.

18.2.7 Ecologically sustainable development

The object is "to encourage: (vii) ecologically sustainable development".

The principles of ESD are outlined in Section 6 of the POEO Act and Schedule 2 of the EP&A Regulation. The consistency of the extension project with each of these principles is provided below.

i Precautionary principle

The precautionary principle means that if there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

During the project planning phase and preparation of this EIS, experts in their respective fields identified and assessed the potential environmental impacts of the project in accordance with current government policies and guidelines. Where relevant, they also developed appropriate mitigation, management and monitoring measures for any identified impacts. Taking these measures into account, it is considered that there would be no threat of serious or irreversible damage to the environment. Therefore, the extension project is consistent with the precautionary principle.

ii Social equity including inter-generational equity

Inter-generational equity is the concept that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of current and future generations. A range of mitigation and compensatory measures are proposed that will minimise the impacts of the project during operation and a rehabilitation after closure will ensure that the parts of the quarry site are available for ongoing use while the quarry pit will be made stable and safe. The project is being developed to provide materials, such as concrete aggregate, that will be used in part to construct public infrastructure that will be used by current and future generations.

iii Conservation of biological diversity and maintenance of ecological integrity

The extension project has been designed to avoid or minimise impacts on biodiversity, however there will be unavoidable impacts on Box Gum Woodland EEC. To compensate, Gunlake will establish biodiversity offsets. This will increase the area and quality of land conserved for biodiversity protection and will improve connectivity between areas of remnant vegetation.

iv Improved valuation and pricing of environmental resources

A comparison of costs and benefits of the extension project demonstrates that benefits outweigh the costs. The proposal will enable the ongoing long-term employment of up to 90 people and will continue to provide economic benefits to the local community. The economics assessment undertaken for the project (Appendix N) provides monetary estimates of the intangible environmental, cultural and social impacts of the proposal. While these are estimates, they provide an indication of the economic value of environmental resources associated with the project.

The cost of most of the potential impacts of the project are internalised into the capital and operating via mitigation, offset or compensation measures. Other quantified impacts to Australia are estimated at less than $1 million.

Overall, the extension project is estimated to have net social benefits to Australia of between $21 million and $32 million (the latter incorporating the benefits of employment), and hence is desirable and justified from an economic efficiency perspective.

The extension project is consistent with the principles of ESD.

18.2.8 Affordable housing

The object is "to encourage: (viii) the provision and maintenance of affordable housing".

The extension project will not result in a significant long-term increase in population in the local area. Therefore, there would not be an increase in the demand for housing.

The project will supply competitively priced quarry products that are essential for all housing developments and will therefore play a role in the provision and maintenance of affordable housing.

18.2.9 Sharing of responsibility

The object is "to promote the sharing of the responsibility for environmental planning between the different levels of government in the State".

All relevant Commonwealth, NSW and local government agencies have been consulted during the preparation of this EIS (see Section 5.3). Further consultation will be undertaken following exhibition of the EIS. Therefore, all levels of government have been consulted about the project and will continue to be consulted through to the determination of the extension project.

18.2.10 Increased public involvement

The object is "to provide increased opportunity for public involvement and participation in environmental planning and assessment".

Extensive community consultation has been undertaken during the preparation of this EIS including both formal and informal consultation (see Section 5.5). Gunlake will continue to engage with the local and regional community.

18.3 Extractive Industries SEPP

The compatibility of the extension project with the Part 3 matters listed in the Extractive Industries SEPP is summarised in Table 18.1.

The consent authority must consider the compatibility of the proposed extractive industry with other land uses.

Table 18.1 Compatibility with the Extractive Industries SEPP

Matter	Compatibility
12 Compatibility of proposed mine, petroleum production or extractive industry with other land uses	
Before determining an application for consent for development for the purposes of mining, petroleum production or extractive industry, the consent authority must:	-

Table 18.1 Compatibility with the Extractive Industries SEPP

Matter		Compatibility
(a)	consider: (i) the existing uses and approved uses of land in the vicinity of the development, and (ii) whether or not the development is likely to have a significant impact on the uses that, in the opinion of the consent authority having regard to land use trends, are likely to be the preferred uses of land in the vicinity of the development, and (iii) any ways in which the development may be incompatible with any of those existing, approved or likely preferred uses, and	The existing and approved land uses are agriculture, residential and quarrying (see Section 1.3). Project development will not have a significant impacts on the existing surrounding land uses and there are no other preferred uses of land in the vicinity of the development. Therefore, it will not be incompatible with any existing, approved or likely preferred uses.
(b)	evaluate and compare the respective public benefits of the development and the land uses referred to in paragraph (a) (i) and (ii), and	The extension project will be developed on land owned by Gunlake. The value of foregone agricultural production on this land is included in the value of land and therefore internalised into the cost of the project.
(c)	evaluate any measures proposed by the applicant to avoid or minimise any incompatibility, as referred to in paragraph (a) (iii).	The measures to avoid or minimise impacts from the extension project are provided in Chapters 6 to 16 and are summarised in Chapter 17. With the implementation of these measures, the impacts of the project will not result in land use incompatibility.
13	**Compatibility of proposed development with mining, petroleum production or extractive industry**	
2) Before determining an application to which this clause applies, the consent authority must:		-
(a)	consider: (i) the existing uses and approved uses of land in the vicinity of the development, and (ii) whether or not the development is likely to have a significant impact on current or future extraction or recovery of minerals, petroleum or extractive materials (including by limiting access to, or impeding assessment of, those resources), and (iii) any ways in which the development may be incompatible with any of those existing or approved uses or that current or future extraction or recovery, and	The existing and approved land uses are agriculture, residential and quarrying (see Section 1.3). The extension project will increase the extraction of a known resource and will not preclude the ongoing extraction of this resource following the completion of the proposed quarry program. The extension project will not be incompatible with current or future quarry's in the area.
(b)	evaluate and compare the respective public benefits of the development and the uses, extraction and recovery referred to in paragraph (a) (i) and (ii), and	See Chapter 18.
(c)	evaluate any measures proposed by the applicant to avoid or minimise any incompatibility, as referred to in paragraph (a) (iii).	The measures to avoid or minimise cumulative impacts from the extension project and other quarries are provided in Chapters 6 to 16 and are summarised in Chapter 17. With the implementation of these measures, the impacts of the project will not result in incompatibility with other extractive industry.

18.4 Conclusions

The impacts of the extension project on the environment are summarised below followed by a summary of the project justification.

The extension project will require additional surface water controls to manage potential impacts and to provide a reliable supply of water for quarry operations. The proposed surface water management strategy will mitigate potential water quality and quantity impacts and the extension project will not impact on downstream water users. Water balance model results indicate that the quarry's process water requirements will be met under most climatic conditions and there are available contingencies if there are water shortfalls.

Groundwater impacts are predicted to be minor with a drawdown of 2 m predicted to be confined to within 1.5 km from the edge of the pit footprint by Year 30. No impacts to registered groundwater works are predicted and a neutral impact on water quality in the hydrological catchment is predicted.

Possible impacts to springs include a declined flow rate at two springs ceasing of flow at two springs. The springs do not support GDEs and are not considered to hold significant environmental value. The Box Gum Woodland within the zone of predicted drawdown does not rely on groundwater from within the hard rock strata and is not predicted to be impacted by groundwater drawdown.

Groundwater inflows to the pit of up to 37 ML/year are predicted and will require licensing from within the unallocated water in the GFRGS under the WM Act. There is sufficient water volume within the market or within the next controlled allocation order to allow the required WAL (or WALs) to be obtained. Groundwater inflows to the pit are not predicted to reduce baseflows to the ephemeral watercourses in the area (Chapmans Creek and Jaorimin Creek).

The biodiversity impacts of the project reflect its largely agricultural setting. Impacts to biodiversity have been avoided or minimised where possible through the design of the extended pit and placement of the additional overburden emplacement. A biodiversity offset package will compensate for unavoidable clearing of native vegetation.

Given the project's rural setting with few close private residences, air quality criteria will continue to be met at all residences. Noise criteria will be met at all but one private residence where noise levels will be defined as 'significant' based on the VLAMP. Therefore, the owner of this residence will be entitled to voluntary acquisition upon request in accordance with the VLAMP.

The Aboriginal sites in the extension area have low archaeological significance, with the exception of one site with moderate significance. The impacted sites will be salvaged by surface artefact collection and detailed recording providing a greater understanding of these sites.

A range of road and road/rail product transport options were reviewed. Continuing road transport of products on the currently approved haul routes is the only economical feasible transport option and will not introduce project impacts to areas where there are none currently. The impacts of this option on the road network; traffic noise levels and air quality at residences along the haul route will comply with applicable assessment criteria.

There is a sound and broadly-based justification for the extension project. It will expand the existing Gunlake Quarry to provide additional competitively priced construction products and will contribute to the economy directly and indirectly. Accordingly, the extension project will increase the economic and social benefits of the quarry in the local area and to NSW.

A range of commitments is provided in this EIS to meet environmental standards during construction and operations. The proposed measures will be further detailed in Gunlake Quarry EMS that will be updated should the project be approved.

The costs of most of the potential environmental and social impacts of the extension project are internalised and other quantified impacts are estimated to be less than $1 million. The project's net social benefits are between $21 million and $32 million (the latter incorporating the benefits of employment), and hence the extension project is desirable and justified based on the CBA that considers the environment, social and economic costs of the project.

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Abbreviations

Abbreviation	Meaning
ACHA	Aboriginal cultural heritage assessment
ACT	Australian Capital Territory
AHD	Australian Height Datum
AHIMS	Aboriginal Heritage Management System
AHIP	Aboriginal Heritage Impact Permit
AHMP	Aboriginal Heritage Management Plan
AIP	*NSW Aquifer Interference Policy*
ANZECC	Australian and New Zealand Environment and Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
AS	Australian Standards
BGL	Below ground level
BoM	Bureau of Meteorology
CBP	Concrete batching plant
CEEC	Critically endangered ecological community
CHMA	Cultural Heritage Management Australia
CMA	Catchment Management Authority
CO	Carbon monoxide
CORTN	UK Department of Transport Calculation of Road Traffic Noise
Council	Goulburn Mulwaree Council
dB	Noise is measured in units called decibels (dB). There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear.
DLWC	Department of Land and Water Conservation
DP	Deposited Plan
DPE	Department of Planning and Environment
DPI	Department of Primary Industries
DoE	Department of Environment
DoS	Degree of saturation
DRE	Division of Resources and Energy
DS Act	*Dams Safety Act 1978*
DSC	Dams Safety Committee
EC	Electrical conductivity
EEC	Endangered ecological community
EIS	Environmental Impact Statement
EMM	EMM Consulting Pty Limited Pty Limited
EPA	NSW Environmental Protection Austhority
EP&A Act	*NSW Environmental Planning and Assessment Act 1979*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EPL	Environment Protection Licence
EMS	Environmental management strategy
ESC	Erosion and sediment control
ESD	Ecologically sustainable development

Abbreviation	Meaning
FBA	Framework for biodiversity assessment
FEL	Front end loader
FM Act	*Fisheries Management Act 1994*
FTE	Full-time equivalent
GDE	Groundwater dependant ecosystem
GFRGS	Goulburn Fractured Rock Groundwater Source
GHG	Greenhouse gas
Groundwater WSP	Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011
GSG	Great Soil Group
Gunlake	Gunlake Quarries Pty Ltd
h	Hours
ha	Hectares
IBRA	Interim Biogeographic Regionalisation for Australia
ICOMOS	Internations Council on Monuments and Sites
INP	NSW Industrial Noise Policy
KFH	Key fish habitat
kHz	Kilohertz
KTPs	Key threatening processes
km	kilometres
kWh	Kilowatt hour
L	Litre
$L_{A1(1minute)}$	The 'A-weighted' noise level exceeded for 1% of the specified time period of 1 minute.
L_{A10}	The 'A-weighted' noise level which is exceeded 10% of the time. It is approximately equivalent to the average of maximum noise level.
L_{A90}	Commonly referred to as the background noise level. The 'A-weighted' noise level exceeded 90% of the time.
L_{Aeq}	The energy average noise from a source. This is the equivalent continuous 'A-weighted' sound pressure level over a given period. The $L_{Aeq(15\text{-}min)}$ descriptor refers to an L_{Aeq} noise level measured over a 15 minute period.
L_{Amin}	The minimum 'A-weighted' noise level received during a measuring interval.
L_{Amax}	The maximum root mean squared 'A-weighted' sound pressure level (or maximum noise level) received during a measuring interval.
LEP	Local Environment Plan
LGA	Local government area
LMP	Land Management Plan
LoS	Level of service
LSC	Land and soil capability
m	Metres
mg	Milligrams
MNES	Matters of national environmental significance
Mt	Million tonnes
Mtpa	Million tonnes per annum
NEPC	National Environment Protection Council
NGAF	National Greenhouse Accounts Factors
NO_2	Nitrogen dioxide
NPW Act	*National Parks and Wildlife Act 1974*
NSW	New South Wales

Abbreviation	Meaning
NV Act	*Native Vegetation Act 2003*
OEH	Office of Environment and Heritage
PAD	Potential archaeological deposits
PCT	Plant community type
PMST	Protected Matters Search Tool
POEO Act	*Protection of the Environment Operations Act 1997*
PSNLs	Project specific noise levels
$PM_{2.5}$	Fine particulate matter 2.5 microns in diameter or less
PM_{10}	Fine particulate matter 10 microns in diameter or less
RAP	registered Aboriginal party
RBL	Rating Background Level
RCS	Respirable crystalline silica
RL	Reduced level
RMS	Roads and Maritime Services
RNP	Road Noise Policy
Roads Act	*The NSW Roads Act 1993*
SEARs	Secretary's Environmental Assessment Requirements
SCCRS	Sydney to Canberra Corridor Regional Strategy
SCIVI	South Coast – Illawarra Vegetation Integration
SDWC	Sydney drinking water catchment
SEEC	Strategic Environmental and Engineering Consulting
SEPP	State Environmental Planning Policy
SPADE	Soil Profile Attribute Data Environment
SRD	State and Regional Development
SSD	State Significant Development
Surface Water WSP	Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources 2011
TECs	Threatened ecological communities
tpa	Tonnes per annum
TSC Act	*Threatened Species Conservation Act 1995*
TSP	Total suspended particulates
TSS	Total suspended solid
VEPA	Victorian Environment Protection Authority
VIS	Vegetation Information System
VLAMP	Voluntary Land Acquisition and Mitigation Policy
WALs	Water Access Licences
Water Act	*The Water Act 1912*
WM Act	*Water Management Act 2000*
WoNS	Weeds of National Significance
WSP	Water sharing plan
yr	Year