Appendix D

Transport options review

Transport Options Review

Gunlake Extension Project

Prepared for Gunlake Quarries Pty Ltd | 2 February 2016

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Transport Options Review

Final

Report J14119RP1 | Prepared for Gunlake Quarries Pty Ltd | 2 February 2016

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1 Introduction

1.1 Background

The Gunlake Quarry, owned and operated by Gunlake Quarries Pty Limited (Gunlake), primarily services customers in the Sydney region including a number of concrete plants that are operated by Gunlake Concrete. Gunlake also has a smaller number of locally-based customers in the Southern Highlands and adjoining regions.

As part of the Gunlake Quarry Extension Project (SSD 15_7090), quarry production is proposed to increase from 750,000 tonnes per annum (tpa) to 2,000,000 tpa. Currently all products are transported by truck. If trucks are used for the increased production, there would be on average 276 additional daily truck movements at full production.

During 2012 to 2014, Gunlake funded the construction of the Bypass Road connection between Brayton Road and Red Hills Road, at a total cost of approximately $3 million, including the associated upgrades and reconstruction of adjoining existing sections of Brayton Road and Red Hills Road. The Bypass Road route has enabled significant volumes of truck traffic from both Gunlake Quarry and Johnniefelds Quarry to bypass the Marulan area which has provided a significant public benefit to the Marulan area.

For the proposed Gunlake quarry extension, the additional trucks would all travel to the Hume Highway via Bypass Road and Red Hills Road which is the primary haul route. The truck movements on the primary haul route would gradually increase and the full increase would not occur until after the Johnniefelds Quarry is closed, which will take up to 100 existing truck movements per day off the haulage route. There would be no increase in truck traffic through Marulan.

1.2 Cost and feasibility factors for road and rail transport

In 2009, an Australian Government Review (BITRE 2009) summarised the respective cost, travel time and other feasibility characteristics of using road or rail transport for bulk, non-bulk and urban freight transport, throughout Australia including near the major urban centres. The review found the following respect to the feasibility of road and rail transport for urban, medium and longer distance freight transport operations:

> *Up until the early 1960s, railways dominated all but the shortest land based freight tasks. Since then, vast improvements in road vehicle productivity and road infrastructure quality, the gradual removal of regulations restricting road freight carriage and the exponential growth in interstate trade has broadened the range of freight tasks for which road is better suited than rail.*

and:

> *Rail's high share of the bulk freight task – and consequently the freight task as a whole – is due mainly to large volumes of coal and iron ore. For these commodities, rail transport is essentially integrated with the mining operations. With streamlined loading/unloading systems and high volumes, commodity returns are sufficient to fund and sustain dedicated railway operation. Transporting many of these commodities by road would be vastly more expensive and there is effectively no competition from road transport.*

and:

> *In urban areas, the combination of often dispersed origins and destinations, comparatively short distances and small shipment volumes means freight is most effectively carried by road.*

and:

> *Rail generally has lower line-haul costs than road, especially for large volumes and over longer distances, but pick-up and delivery and rail terminal costs add significantly to the average door to door cost of rail, particularly for short haul freight. Consequently, average rail costs decline with increasing freight volumes and distances, such that rail is lower cost for door to door freight hauls above 1,000 kilometres.*

1.3 Transport alternatives

The feasibility of alternative transport options for the proportion of the Gunlake Quarry products which are to be transported to customers in the Sydney region has been reviewed in response to Council and community concerns regarding potential increased truck movements on the primary haul route.

A range of potential future road and rail transport options for the Sydney market component of the Gunlake Quarry transport task have been defined and analysed in this review, (see Figure 1.1):

- Road transport only options:
  - Option 1– Continue to use Brayton Road as the primary haulage route, west of the Bypass Road.
  - Option 2 – Construct an alternative dedicated haulage route for approximately 4 km on the east side of Brayton Road, to the Bypass Road.
  - Option 3 – Upgrade the Canyonleigh Road route to the Hume Highway (approximately 30 km) to B Double access standard as an alternative to the Brayton Road and Bypass Road haulage route.
  - Option 4 – Construct a new southern haulage route with access to the Hume Highway at South Marulan Road. Part of the route would be on Holcim (Australia) owned land, south of the Lynwood Quarry.

- Rail/road (Sydney) transport option:
  - Option 5 – Construct a new rail spur to the quarry approximately 5.5 km long, for direct rail loading of Gunlake quarry products for Sydney region customers at the quarry, combined with construction of a rail quarry products receival and distribution centre for Sydney.
- Rail/Road (local and Sydney) transport options:
  - Option 6 – Construct a new southern haulage route to link with the Lynwood Quarry rail siding and expand the capacity of the rail siding (ie with an additional track and loading facilities) for combined used by the Holcim (Australia) and Gunlake Quarries.
  - Option 7 – Construct a new southern haulage route to link with a new 1 km long Gunlake rail siding, which could be located on the north side of the Main Southern Railway line, approximately 2.5 km west of the Lynwood Quarry rail siding.

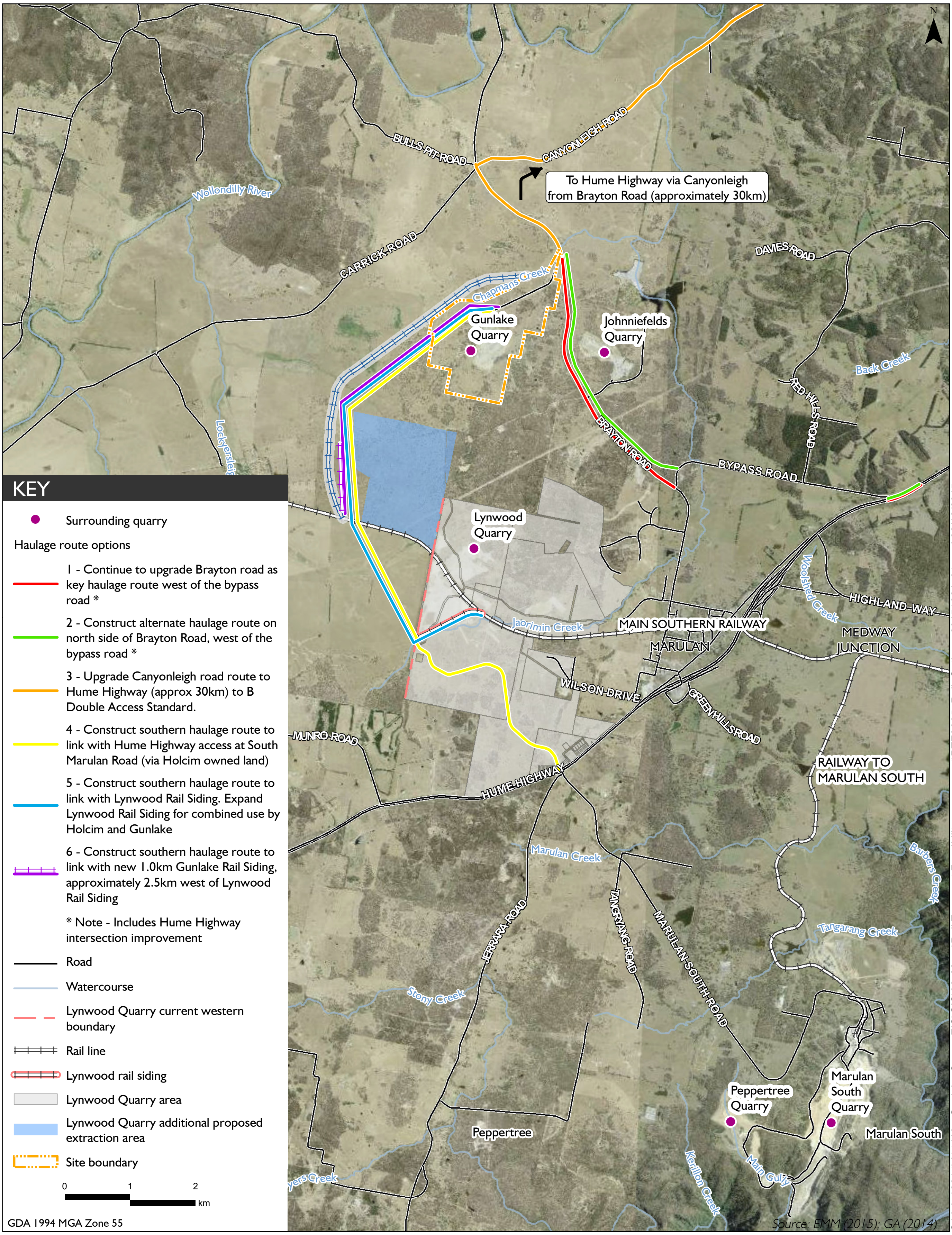
All the future rail-based transport options for Gunlake Quarry will have some component of road transport operations within the local Marulan area or at the Sydney end of the route, or at both ends, in the case of Option 6 and Option 7, so there is no dedicated rail transport only option.

The likely capital costs and resulting transport, economic and environmental benefits of the identified Gunlake Quarry road and rail transport options are discussed in the following sections and Chapters of this report.

1.4 Transport constraints

Gunlake has no access to the rail network in either Marulan or Sydney so there will be a high capital cost for establishing rail access infrastructure for the project.

This high capital cost would take many years to achieve full cost recovery (if at all) from subsequent rail versus road transport cost savings. Although the major proportion of the future quarry products would be transported to Gunlake Concrete and other customers in the Sydney region, the dispersed nature of the actual product destinations within Sydney would require a significant Sydney-road based product transfer and distribution system which would in practice limit the potential future transport cost savings which could otherwise be achieved by using a 'line haul' rail based transport operation for the bulk of the quarry product transport route.



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Road and rail transport options

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Figure 1.1

The following specific project rail transport opportunities and constraints would affect the future operational cost and efficiency of potential project rail transport operations:

- the high typical daily variation in the range of quarry products produced and their destinations in the Sydney region;
- the 'order of magnitude' cost and environmental and other feasibility implications for constructing rail access from the quarry to the Main Southern Railway, south-west of Marulan, including the potential feasibility of using the recently constructed Lynwood Quarry rail siding for Gunlake quarry product transport to Sydney and whether Holcim (Australia) would be likely to agree to this use;
- the necessary additional construction and operating costs for a dedicated Gunlake quarry product 'intermodal' storage and distribution facility adjacent to a rail line within the Sydney region, which would be required for the further distribution of quarry products to actual customer destinations within the Sydney region; and
- the future capacity of the NSW urban and regional rail network, in particular for the section of the interstate railway corridor between Marulan and Moss Vale, and the opportunity to create additional rail paths for locally based freight transport movements.

In addition to future 'line haul' rail transport options for the Gunlake Quarry, the potential additional local economic costs and potential benefits from additional project road transport and flow-on road improvements within the local Marulan area, should also be considered in an overall socio-economic evaluation of options.

The Gunlake quarry truck drivers primarily live within the local area and contribute to the local economy. Currently between 27 and 38 truck drivers (full time equivalent positions) work at Gunlake. A further 27 additional truck drivers within the local Marulan area would also be employed using road transport for the expanded quarry operations.

The additional local economic benefit from the corresponding increased local employment would be a significant mitigating factor against increased the local road transport usage with the proposal, which would primarily only affect the haulage route within the North Marulan area (eg via the Bypass Road and Brayton Road, west of the Bypass Road).

There would be significantly higher local economic benefits from the project with road transport compared to rail transport as the increased economic income of truck drivers based in the local area would create flow on employment, while the local economic benefits from rail transport would be lower as fewer train drivers would be required and they would be less likely to be locally based.

2 Product transport requirements

The quarry's primary customer is Gunlake Concrete. Gunlake Concrete has three existing concrete batching plants (CBPs) at Smeaton Grange, Glendenning and Silverwater. An additional two CBPs are proposed at Banksmeadow and Prestons. Gunlake Concrete's operations in Sydney are approximately 160 km from the quarry. The locations of the five (existing and proposed) Gunlake CBPs are shown in Figure 2.1.

Each Gunlake CBP can produce up to 150,000 cubic metres per annum of concrete which primarily comprises crushed rock aggregate (between 80 to 90% by weight) and other raw materials sourced from the Gunlake Quarry. The total annual tonnage of aggregate and sand which is supplied currently by the quarry to the three Gunlake CBPs and other Sydney customers is between 500,000 to 550,000 tonnes per annum, which represents approximately 70% of the total quarry production.

As noted in Chapter 1, rail transport is generally more financially and economically viable for homogenous bulk commodities, which are transported from a single point of origin to a single destination and do not require any separation from other parts of a bulk cargo during either their transit, loading or unloading procedures.

As the materials produced at the Gunlake quarry are not generally homogenous (the coarse and fine aggregates, sand and crusher dust are produced in a range of different diameters - either 20 mm, 10 mm, 7 mm or sand and dust gradings) each product must be kept separate to meet precise customer grading specifications.

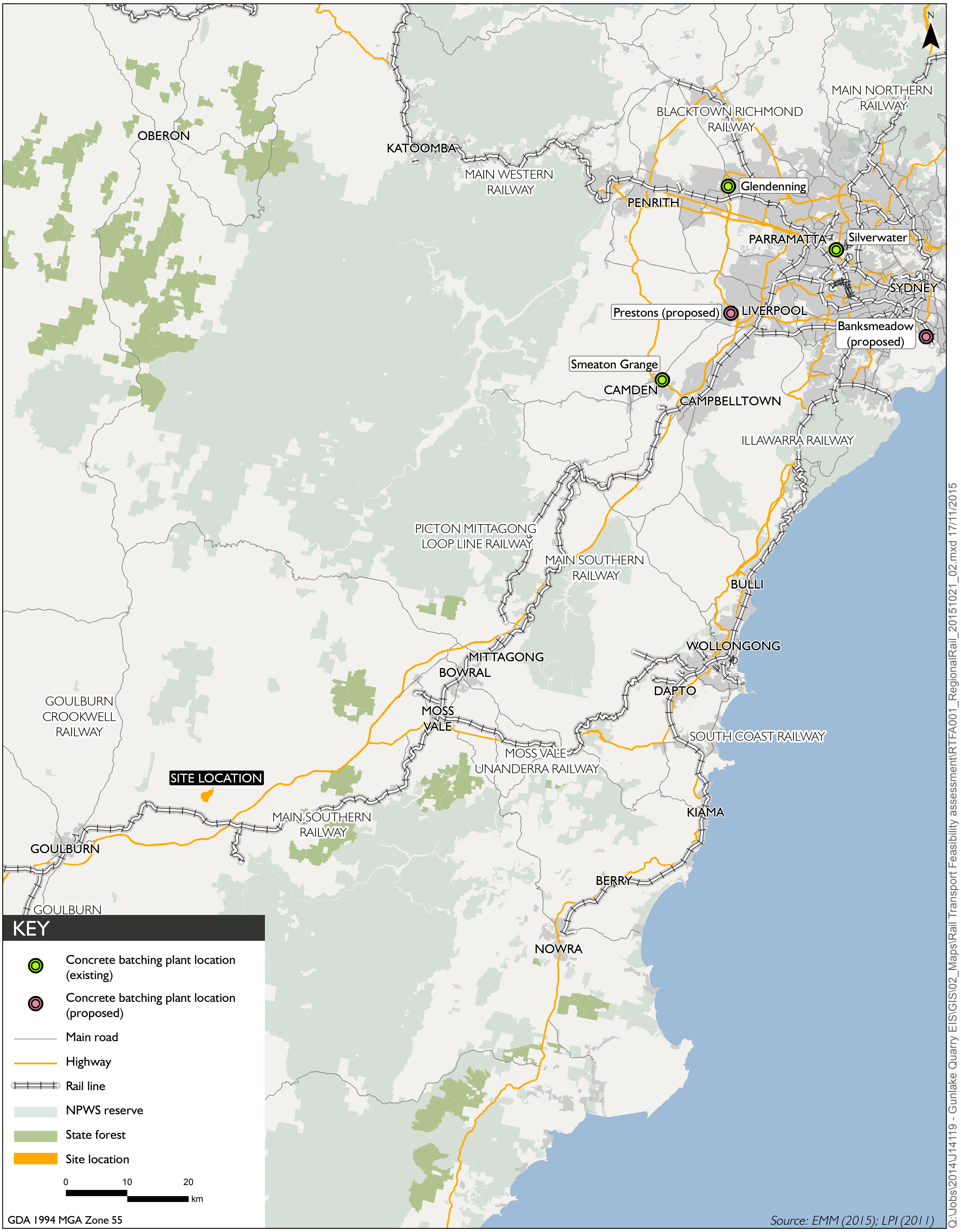
For a typical day at the quarry (4 September 2015) the following quantities of products listed in Table 2.1 were transported to Gunlake customers, mainly in the Sydney Region.

Table 2.1 Daily quarry product transport summary (4 September 2015)

Product	Number of truck loads	Percentage of truck loads
20 mm aggregate	24	28%
10 mm aggregate	16	20%
7 mm drainage aggregate	16	20%
20 mm roadbase	8	9%
10 mm drainage aggregate	8	9%
Manufactured sand	8	9%
Crusher dust	3	4%
20 mm DGB basecourse material	1	1%
All Categories	**84**	**100%**

The Gunlake quarry also supplies a range of local customers in the Southern Highlands and adjoining regions. These customers account for approximately 30% of the quarry production currently.

The local customer market for the quarry in the Southern Highlands is also expected to grow in the future along with the establishment of additional Gunlake CBP sites at Banksmeadow and Prestons in Sydney. Therefore the proportion of the future Gunlake quarry products which are transported to Gunlake CBP sites and other customers in Sydney is anticipated to remain at approximately 70%.



Regional rail network

Gunlake Quarry
Transport Options Review

Figure 2.1

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3 Comparison of road and rail transport options

3.1 Road transport options

The estimated capital costs road for potential road transport improvement options are described in Chapter 4. A summary of the key design features and other operational and environmental attributes is provided below.

3.1.1 Continuing to use Brayton Road as the key haulage route (Option 1)

i Design considerations

This option proposes the continuing use of Brayton Road, west of the Bypass Road as the primary haulage route for Gunlake Quarry, with a northbound acceleration lane at the Red Hills Road and Hume Highway access intersection.

The Brayton Road route requires some further shoulder widening works on sections west of the Bypass Road intersection, where the recently upgraded road has been constructed on an embankment, to provide safe road shoulders for a vehicle to stop at any location along the route. With this improvement, the route would meet the general future public traffic safety requirements for the North Marulan area for the future daily volumes of quarry products which are proposed to be transported via Brayton Road.

ii Environmental constraints

This option would continue to have amenity and traffic noise impacts along the sections of Brayton Road, Bypass Road and Red Hills Road used by haul trucks. These impacts and their respective mitigation measures are considered in detail in the extension project environmental impact statement.

3.1.2 Eastern dedicated road haulage route (Option 2)

i Design considerations

This option would construct an alternative dedicated haulage route for approximately 4 km on the north side of Brayton Road, between the Bypass Road and the Gunlake quarry access, along the route which is shown generally on Figure 1.1.

This option would require significant additional property acquisitions from all the properties which are located along the northern side of Brayton Road, between the Gunlake Quarry access and the Bypass Road, with associated local socio-economic impacts.

ii Environmental constraints

This option would continue to cause traffic-related noise and amenity impacts along the private haul road sections and the sections of the Bypass Road and Red Hills Road used by haul trucks.

In addition, there would be significant vegetation clearance impacts (probably more than at the quarry site) resulting from the need 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 cause significant soil disturbance and erosion.

This option also has the potential to generate noise and dust impacts during the construction of the new haul route.

3.1.3 Canyonleigh Road upgrade (Option 3)

i Design considerations

This option would upgrade the Canyonleigh Road route to the Hume Highway, from Brayton Road approximately 1.5 km west of Gunlake Quarry to the intersection with the Hume Highway at Sutton Forest (over a route length of approximately 30 km) to provide a B Double access standard alternative route to the existing Brayton Road and Bypass Road haulage route.

ii Environmental constraints

This option would generate potential traffic safety, amenity and traffic noise impacts along the sections of Canyonleigh Road that would be used by haul trucks. There are more houses along this 30 km long section of road than along either the Brayton Road/Bypass Road/Red Hills Road route.

Also, the necessary road widening would cause significant road-side vegetation loss along the route, resulting in a loss of biodiversity. Vegetation clearing would also generate potential Aboriginal heritage impacts and cause soil disturbance and erosion.

3.1.4 Southern dedicated road haulage route (Option 4)

i Design considerations

This option would construct a new southern haulage route around areas of the Lynwood Quarry to utilise access to the Hume Highway at South Marulan Road, as well as a new bridge over the Main Southern Railway.

Part of the route would need to travel through Holcim (Australia) owned land, south of the Lynwood Quarry.

ii Environmental constraints

This option would potentially cause new traffic noise and amenity impacts for the areas to the west of the quarry from the operation of quarry trucks using the new haulage route.

Substantial land clearing would also be required to establish a new road corridor to construct the dedicated haul road route, resulting in potential biodiversity impacts and impacts to Aboriginal heritage sites along the new 7 km haulage route. Land clearing also has the potential to cause soil disturbance and erosion.

3.2 Train loading options

The three identified options for loading trains in the Marulan area are described below. Each option would require significant new transport infrastructure. The detailed land acquisition requirements have not been identified for each option. However, a summary of the key environmental considerations is included in the description of each option below.

3.2.1 Gunlake quarry rail siding for direct rail loading at the quarry (Option 5)

i Design considerations

This option would construct a new rail spur line (approximately 5.5 km long) to allow direct loading of trains at the Gunlake Quarry. The general location of the required rail easement is shown in Figure 3.1. The rail spur line would need a short dual track section, 600 m long, near the quarry for a locomotive (or locomotives) to 'run around' the train when each empty train arrived to be loaded at the quarry.

The potential rail line easement is affected by the Holcim (Australia) proposal to extend the Lynwood Quarry further to the north and the west. If the Lynwood Quarry extension is approved, a Gunlake Quarry rail line would need to be located to the west of the Lynwood Quarry extension area.

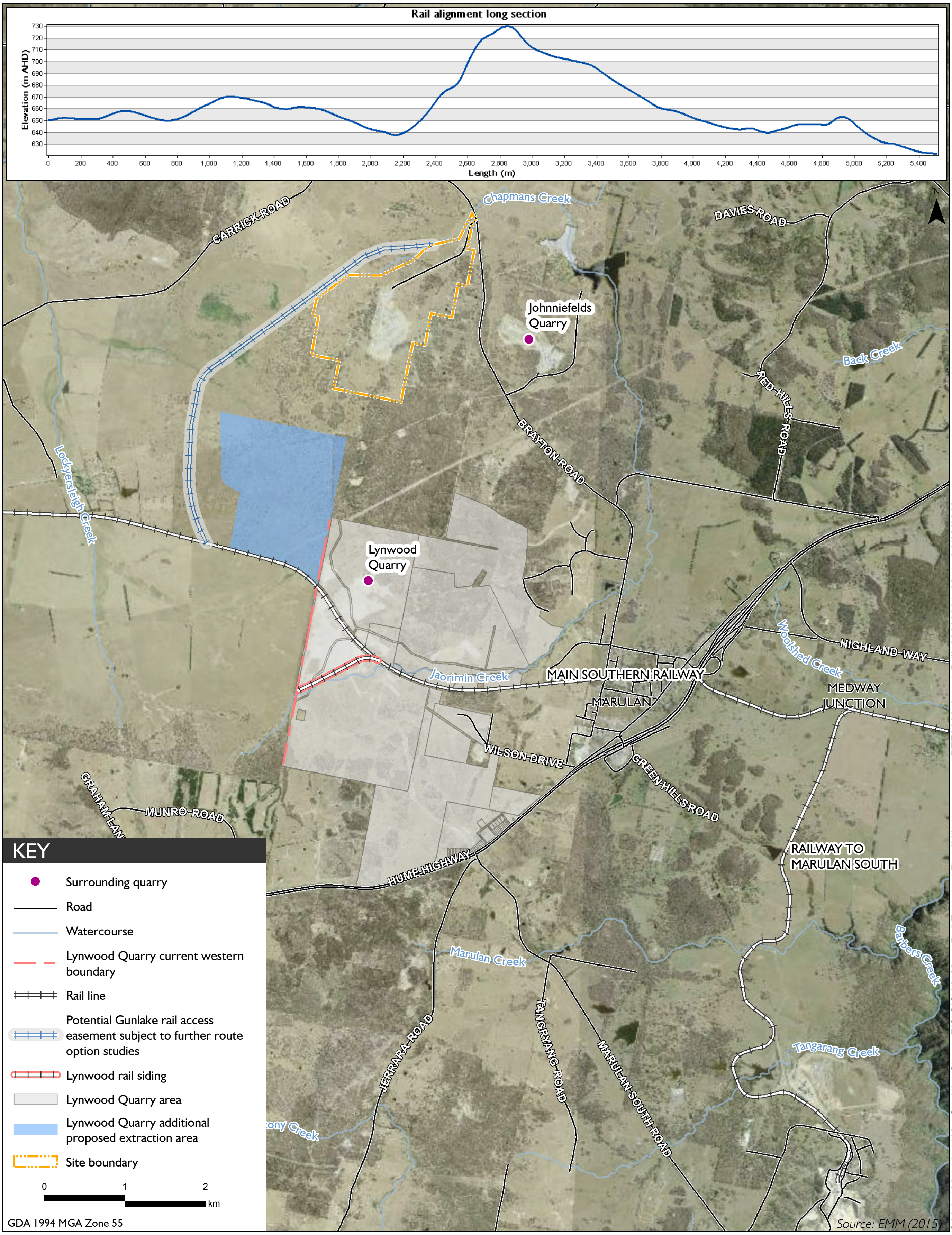
The new rail line would follow the longitudinal cross-section shown in Figure 3.1. The route is generally level at each end, but near the mid-way point of the route, the line would need to rise steeply to cross an approximate 50 m high ridge line. If this ridge line could be crossed without a tunnel, there would be difficult terrain to be crossed on the ridge line approaches, with a combination of embankments and/or bridges required and a deep cutting at the high point of the ridge line.

ii Environmental constraints

This option would be likely to generate rail noise and amenity impacts to residential properties in areas to the west of the quarry.

There could also be potentially significant biodiversity impacts and impacts to Aboriginal heritage sites along the 5.5-km long route of the new line including the additional areas which would need to be cleared to facilitate the construction of the new rail line. Land clearing also has the potential to cause widespread soil disturbance and erosion.

In addition to the potential impacts of the construction and operation of a new rail line and train loading facility within the Marulan area, there would also be potentially significant traffic, noise and dust impacts in the area within Sydney surrounding the intermodal terminal facility which would be required for all the identified rail transport options for the additional transport and distribution of the quarry products there.



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Rail network at Marulan

Gunlake Quarry
Transport Options Review

Figure 3.1

3.2.2 Use of Lynwood Quarry rail siding (Option 6)

i Design considerations

Conceivably, Gunlake Quarry products could be loaded onto trains at the Lynwood Quarry rail siding (Option 6) which is located along the southern edge of the Lynwood Quarry area on the southern side of the Main Southern Railway line, approximately 4.5 km west of Marulan (see Figure 3.2).

Figure 3.2 View of the Lynwood Rail Siding at Marulan looking north

The Lynwood Quarry rail siding is currently 1 km long and has a central 600 m long dual track section.

The maximum length of the trains which can be loaded at the siding is approximately 480 m. The Lynwood Quarry rail siding has a vertical loading chute, located near the northern end of the dual-track section, from which trains are loaded, wagon by wagon, as the train moves along the siding.

For this existing rail siding to be used by another operator such as Gunlake, at least one additional parallel siding and a second loading chute (with associated stockpiling areas) would also need to be established.

As the rail siding is owned by Holcim (Australia), there is no reason to assume that the Lynwood Quarry would consent to any modifications or to allow its use by another operator. Under NSW law there is no means by which a private rail infrastructure operator can be compelled to allow the use of their facilities by another rail operator.

ii Environmental constraints

The future transport of Gunlake Quarry products to the Lynwood Quarry rail siding would result in haul road traffic noise, amenity and dust impacts in the areas to the west of the quarry. Also, there would be potential biodiversity impacts and potential impacts to Aboriginal heritage sites along the 7 km route of the new haul road and potential visual impacts from a new road bridge over the Main Southern railway line.

Similar to the other identified rail transport options for the Gunlake quarry products, there would be potential additional traffic, noise and dust and other locality impacts in the areas surrounding the Sydney intermodal facility.

3.2.3 Gunlake rail siding adjacent to the Main Southern Railway line (Option 7)

i Design considerations

The third potential rail loading option in the Marulan area (Option 7) is for the Gunlake Quarry products to be loaded onto trains at new a purpose-built rail siding approximately 7 km west of Marulan and 2.5 km west of the Lynwood Quarry rail siding (Figure 3.1).

The new rail siding would need to be on the north side of the Main Southern Railway rail line so that a road over rail bridge was not required. A main siding would be about 1 km long, with an additional dual track at least 600 m long to permit a locomotive (or locomotives) to run around the train while it was being loaded at the facility.

This option would require the construction of a new 5 km long southern haulage road to link the quarry with the new rail siding. There would be potential additional road and rail noise impacts in the areas to the west of the quarry from the operation of the haul road and the loading of train at the siding.

ii Environmental constraints

There would be potential biodiversity and Aboriginal heritage impacts caused by clearing during the construction of the new 5 km long haul road and the rail siding facility. Clearing also has the potential to cause soil erosion impacts. There would also be potential construction and operations stage noise and dust impacts in the areas surrounding these facilities.

Similar to the other identified rail transport options for the Gunlake quarry products, there would be potential additional traffic, noise and dust and other locality impacts in the areas surrounding the Sydney intermodal facility.

3.3 Train unloading (Sydney)

As well as the rail infrastructure required for loading products in the Marulan area, rail unloading infrastructure would be required at a suitable site within the Sydney region to service the onward road-based supply of the quarry products to their ultimate destinations.

The five (existing and proposed) Gunlake CBP sites within the Sydney region are up to 50 km apart (as shown in Figure 3.3). An ‘intermodal’ rail transfer facility would need to be established with rail unloading and product storage facilities for the Gunlake Quarry products to reach these sites.

The Liverpool, Fairfield or Bankstown local government areas of south-western Sydney (Figure 3.3), would be the most suitable areas for a Gunlake intermodal terminal as they are adjacent to the existing freight-based sections of the Sydney rail network, which are between Liverpool and Chullora, and would be approximately equidistant from the five Gunlake Sydney CBP sites.

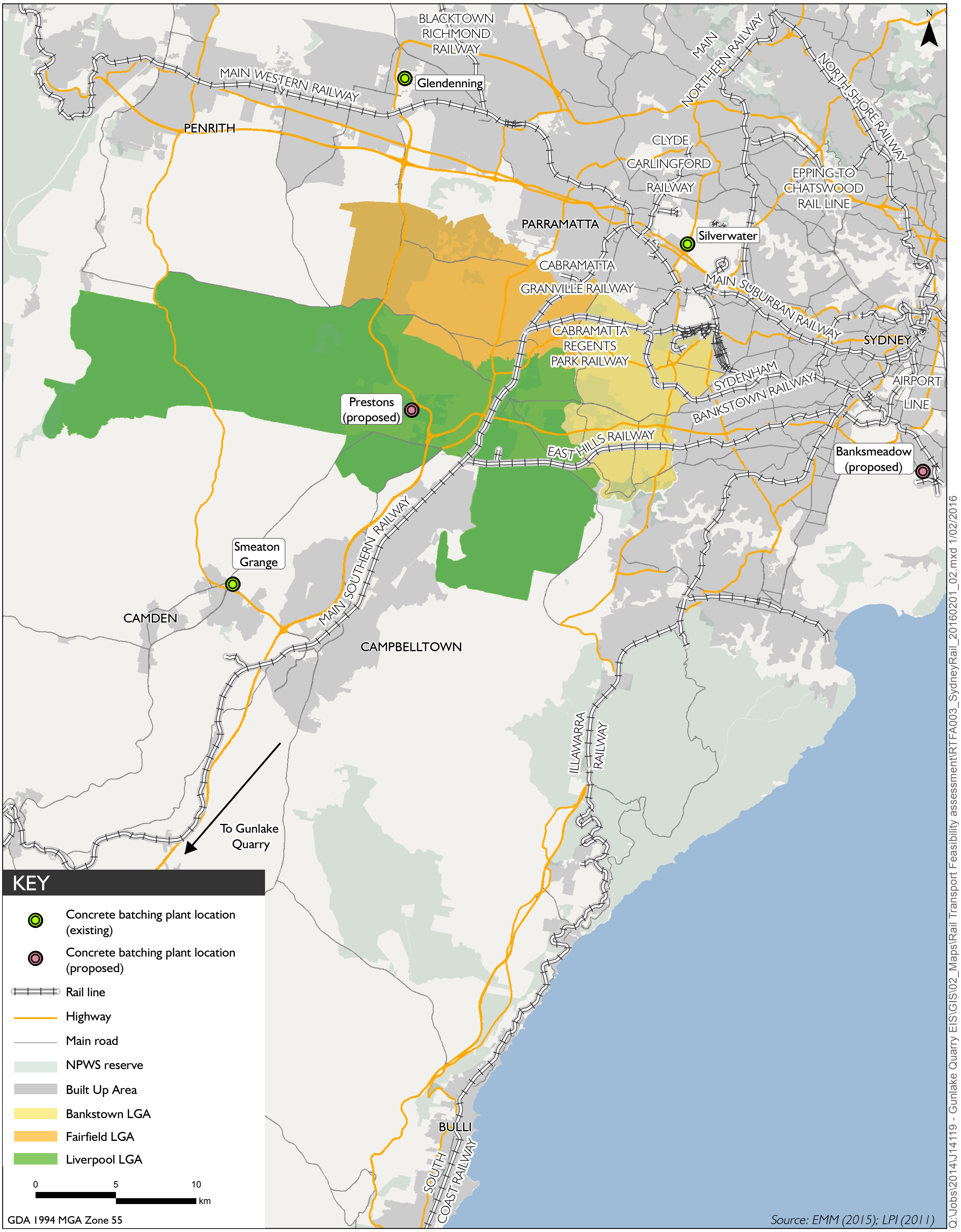
The specific design requirements for the intermodal rail terminal and transfer facility would be similar to the comparable facility which has recently been constructed by Holcim (Australia) at Rooty Hill in Sydney (Figure 3.4). The site would require, a dual track rail siding, product stockpile areas, a conveyor to link the rail unloading and product stockpiling areas and a truck loading and queuing area.

Figure 3.3 Recently constructed Holcim (Australia) rail transfer facility at Rooty Hill

Assuming a suitable Gunlake intermodal site could be found and developed in Sydney, this would also require twin 1 km long rail tracks for the train unloading and associated infrastructure, with associated land acquisition for the remainder of the site, and potentially significant additional costs for track modifications and re-signalling work to the adjacent main railway lines.

Additional costs for local road access improvements may also be required if local roads did not provide suitable capacity for truck access to the nearest major road intersection.

The recently approved new intermodal terminal under construction at Moorebank in south-western Sydney has highlighted the potentially significant local community concerns and objections which can arise where there is increased future truck traffic in densely populated urban areas near intermodal facilities.



Sydney rail network

Gunlake Quarry
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Figure 3.4

4 Capital cost of road and rail access options

4.1 Road construction capital costs

The likely capital cost of each of the four road based transport options has been estimated from recent typical examples of road construction costs in comparable rural areas of NSW, for other mining and extractive industry projects. As no concept design information is available for each option other than the route length and a preliminary understanding of the route terrain, a range of strategic level project cost estimating rates have been used to undertake an initial cost comparison of the options as follows:

- Further widening of an existing two lane sealed road, where the road has been constructed on an embankment, to provided increased shoulder width: $0.25 to $0.5 million per km.
- Construction of a two lane unsealed road for use as a private haul road: $0.5 to $1 million per km.
- Construction of a two lane sealed road to B Double access standard: $1 to $2 million per km.
- Indicative land acquisition for new route options: $1 to $2 million per km, assuming the property purchase cost would be for the entire property not only the future road easement.
- Construction of a major two lane road bridge crossing a railway line: $10 million.
- Construction of a rural freeway standard acceleration lane, including land costs: $2 to $4 million.

4.2 Road options comparison

The likely high and low range and mid-range capital cost estimates for each road transport options are summarised in Table 4.1. Option 1 which has a likely mid range capital cost estimate of $4.5 million would be the lowest capital cost future transport option for the quarry.

The other road transport options (Options 2 to 4) would have significantly higher capital costs of at least $15 million and would require significant additional annual road transport cost savings to be achieved over the project life to justify their higher initial cost.

Although the Canyonleigh Road upgrade option (Option 3 in Table 4.1) would potentially provide a shorter and more direct route for the future quarry trucks travelling to and from Sydney (in particular for the southbound direction where the existing detour for trucks via the South Marulan Road interchange would be avoided) the route would have generally steeper gradients than the existing Hume Highway route, so the potential transport cost savings from using the Canyonleigh Road route would be reduced.

As other road options (Options 2 to 4) would redistribute the future project related road haulage transport impacts away from the Brayton Road corridor (where these impacts are being effectively managed currently), these options would potentially adversely affect the environment and amenity of areas which are not affected at all by the project traffic currently.

4.3 Rail construction capital costs

The estimated indicative capital construction costs, including land acquisition costs and the additional haul road construction costs, including potentially a new haul road bridge crossing the Main Southern Railway line, have been estimated in Table 4.1 for the three potential rail loading access options for the Gunlake Quarry, which are described in Chapter 1 and section 3.2.

Table 4.1 Capital cost comparison of options

Option	Type	Option description	Likely capital cost range ($ million)	Mid-range capital cost estimate ($ million)
1	Road only	Continuing to use Brayton Road as the key haulage route, west of the Bypass Road, and a northbound acceleration lane at the Red Hills Road (Bypass Road) Hume Highway access intersection.	$3 to $6	$4.5
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
3	Road only	Upgrading the Canyonleigh Road route from Brayton Road to the Hume Highway (approx 30 km) to B Double access standard as an alternative haulage route to Brayton Road and the Bypass Road.	$30 to $60	$45
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. An appropriate payment to Holcim (Australia) for the use of their South Marulan access road to the Hume Highway would also need to be negotiated.	$13.5 to $17	$15
5	Rail with Sydney road distribution network	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
6	Rail with local road haulage and Sydney road distribution network	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
7	Rail with local road haulage and Sydney road distribution network	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

The likely capital cost for the rail infrastructure component for each option has been estimated per track km, with reference to a recent review of rail infrastructure project construction costs in NSW which was conducted by the NSW Legislative Council in March 2012 (*General Purpose Standing Committee No 3, Report 26*).

The NSW Legislative Council review concluded that the typical range of overall project costs per track km for eight examples of new rail projects, at both urban and rural locations throughout Australia, varied between $8 million and $74 million per track km. From this range, the likely 'order of magnitude' total project costs for a basic rural standard single track railway line to the Gunlake Quarry, or other comparable rail siding options, with associated train loading and locomotive turnaround facilities, would be within the range $10–20 million per track km. Using this costing range.

- a new 1 km dual track rail siding, adjacent to the Main Southern Railway line, incorporating a 600 m long train locomotive turnaround section and rail loading facilities. would cost between $20–$40 million

- An equivalent 1 km single track expansion of the Lynwood Quarry rail sidings to accommodate Gunlake product loading there would cost between $10–20 million.

- The longer 5.5 km full length Gunlake Quarry rail spur option (with a short dual track section to facilitate locomotive turnaround at the quarry end) would cost between $60–$120 million.

Using similar 'order of magnitude' costings of $10 to 20 million per track km, the additional new rail receival and transfer facility which would also be required for the ongoing transfer and distribution of the Gunlake products within Sydney, which would require approximately 2 km of new rail track and associated intermodal transfer 'train unloading' facilities, would add a further additional capital cost of between $20–$40 million to the project rail transport options.

4.4 Rail options comparison

The likely construction costs have been estimated for the four road based transport improvement options, the two local road and rail access options and the single local rail access only option for the quarry, as summarised in Table 4.1.

From the summary of the estimated capital cost of the project road and rail transport options in Table 4.1, the least expensive option for Gunlake Quarry rail access is likely to be Option 6. This option requires the construction of a new 7 km off-road haulage route from the quarry (including a bridge crossing over the Main Southern Railway line) to link with the Lynwood Quarry rail siding. With the inclusion of the associated intermodal terminal infrastructure within Sydney, this option would have a potential total capital cost of $43.5 to $77 million.

The estimated likely mid-range capital cost for this option is $60 million, which includes the necessary additional track and other modifications to the Lynwood Rail Siding. However, Gunlake would need to negotiate a shared use arrangement for the Lynwood Quarry Rail siding for this rail access option to be considered.

The next lowest capital cost rail access option for Gunlake would be the new 1 km long dual track Gunlake rail siding option (Option 7) which would have new rail sidings adjacent to the Main Southern Railway line, 2.5 km west of the Lynwood Quarry siding. It would require a new 5 km long dedicated haulage road from the quarry, generally following the potential rail easement route (Figure 1.1 and Figure 4.1).

This rail access option would have a potential total capital cost of between $42.5 to $85 million, including the necessary rail track and loading facility installations for the new rail siding and the associated intermodal terminal infrastructure in Sydney. The estimated likely mid-range capital cost for this option is $64 million.

The highest estimated capital cost for the three rail options is for a rail spur to the quarry (Option 5). It is estimated that this would have an capital cost of $80 to $160 million (including the associated intermodal terminal infrastructure in Sydney). The estimated mid-range capital cost for this option is $120 million.

A further detailed economic comparison of the three rail transport options is presented in Chapter 5, including calculation of the likely future transport cost savings for the project from using rail transport and whether these would be sufficient to pay back the initial capital cost of the proposed rail loading and unloading facilities, at Marulan and at Sydney.

In the economic comparison of the rail transport options, the residual economic value of the capital cost works for each option is assumed to be zero, which represents 100% depreciation of the initial asset value of the rail infrastructure works over the 30 year economic analysis period.

4.5 Local employment

The Gunlake quarry truck drivers primarily live within the local area and contribute to the local economy. Currently between 27 and 38 truck drivers (full time equivalent positions) work at Gunlake. A further 27 additional truck drivers within the local Marulan area would also be employed using road transport for the expanded quarry operations. The increased economic income of additional truck drivers based in the local area would create flow on employment, while the local economic benefits from rail transport would be lower as fewer train drivers would be required and they would be less likely to be locally based.

5 Potential cost savings from the use of rail transport

5.1 Comparisons of road and rail transport costs

5.1.1 Transport operational costs estimation

The current road based transport costs for the Gunlake quarry products are approximately $20 per tonne. For a 160 km loaded product trip, this rate represents a haulage cost rate of 12.5 c/tonne/km.

Further cost comparisons of the alternative use of road and rail transport for medium to long distance product transport in Australia is documented in an extensive report prepared by Consultants CRA International for Pacific National, *Two Case Studies on Road vs Rail Freight Costs* (CRA 2006).

The CRA study analysed in detail, the comparable road and rail transport costs for line haul bulk transport operations from Sydney (NSW) to Brisbane (Queensland) which is approximately 1,000 km and from Penola to Portland (Victoria) which is approximately 160 km.

These costs indicate there is a generally an approximate 47% saving in the typical line haul transport costs for rail transport compared to road transport for a long distance corridor general freight-transport operation. For any specific rail freight transport operation, the actual freight rates are negotiated between freight consignors and consignees and there is no published formula for calculating these rates.

Also, where multi-modal transfer operations are required, the additional terminal handling costs for the additional product transfer operation will tend to outweigh the initial potential cost advantages of rail transport for most short to medium distance line haul transport operations.

These additional terminal handling costs are generally significant higher for rail transport than road transport. The comparative study (CRA 2006) identified that for rail transport, the total terminal handling costs at both ends of the journey were typically about 40% of the overall corridor rail transport costs (20% at each end while for road transport, the total terminal handling costs were typically about 6% of the total corridor transport costs (3% at each end).

5.1.2 Gunlake Quarry transport operating costs

The operating costs for road transport only; rail with road transport within Sydney; and rail with road transport at both Marulan and Sydney, with associated additional transhipment costs, have been calculated as follows:

- For 160 km road transport (Options 1 to 4):
  - 160 km road transport @ 12.5 c/tonne km = $20/tonne.
- For 160 km rail transport with an additional 25 km road delivery in Sydney (Option 5):
  - 160 km rail transport @ 6.6 c/tonne km = $10.50/tonne;
  - 25 km road transport @ 12.5 c/tonne km = $3/tonne;
  - additional rail-road transhipment costs in Sydney = $2/tonne; and
  - total route transport cost = $15.50/tonne.

- For 160 km line haul rail transport with local transhipment and an additional 30 km road delivery in Sydney (Option 6 and Option 7)

  - road-rail transhipment costs at Marulan = $2/tonne;

  - 160 km rail transport @ 6.6 c/tonne km = $10.50/tonne;

  - rail-road transhipment costs in Sydney = $2/tonne;

  - 25 km road transport @ 12.5 c/tonne km = $3/tonne; and

  - total route transport cost = $17.50/tonne.

The estimated operating cost saving for the direct quarry access rail-road transport operation (Option 5) compared to the road-only transport (Option 1 to 4) is the difference between $20/tonne and $15.50/tonne, which is approximately $4.50 per tonne.

However, if the operating cost of road-rail transfer at Marulan is also included (as for Options 6 and 7), the equivalent cost saving for road-rail-road transport reduces to approximately $2.50 per tonne compared to road-only transport.

The projected future annual Marulan to Sydney product transport volumes are:

- approximately 525,000 tonnes per annum (70% of 750,000 tonnes) in 2015, increasing to potentially 1,400,000 tonnes per annum (70% of 2,000,000 tonnes) by 2025.

For these tonnages, the potential annual transport cost saving from the combined rail-road and road-rail-road transport would be for:

- rail-road transport (Option 5): a cost saving of $4.50/tonne, would save approximately $2.36 million in 2015, increasing to approximately $6.3 million in 2025; and

- road-rail-road transport (Option 6 and 7): a cost saving of $2.50/tonne, would save approximately $1.31 million in 2015, increasing to approximately $3.5 million in 2025.

5.1.3 Project benefit to cost ratio

Both NSW Treasury (NSW Treasury 2007) and Transport for NSW (Transport for NSW 2013) recommend the use of a 7% per annum future discount rate when undertaking either economic or financial feasibility analysis of transport infrastructure projects.

By applying a discount rates of 7% per annum to the predicted project cost savings for rail transport over 30 years, the total discounted total net project benefits which can be compared to the project capital costs. The estimated capital cost ($4.5 million) of the cheapest road transport option (Option 1) should also be included in the analysis as a 'do-minimum' cost to determine the baseline transport 'net capital cost' for rail transport against which future predicted rail transport cost savings should be compared.

The economic analysis results and the predicted economic benefit to cost ratio for each option, for the high, medium and low project capital cost estimates, are summarised in Table 5.1.

Table 5.1 Preliminary economic feasibility analysis of rail transport options

Project 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

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

A project benefit to cost ratio greater than 1:1 indicates that based on the assumptions incorporated in the analysis assuming that all other matters being equal, the option is economically efficient.

None of the rail options considered is economically efficient, even at the lowest range potential capital cost estimates considered.

Generally at the medium-range project capital cost estimates considered, the relatively high initial capital cost investment which would be required for all the project rail transport options would not result in any viable future project 'payback' period within the 30 year time period which is normally considered in an economic analysis for a transport infrastructure project.

All of the three rail transport options considered would effectively recover between 51% to 59% of their respective initial capital cost investments over this period.

In addition to this economic and financial feasibility constraint, there are extensive unresolved technical and design issues relating to the potential route alignment for the potential full length rail spur 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. 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.

In summary, all the rail access options considered would generally fail to achieve the necessary economic feasibility under all likely project capital cost scenarios, to justify proceeding with either of these options as the estimated project benefit to cost ratio is significantly less than 1:1 at the medium range project capital cost estimate, for all the options considered.

5.1.4 Other quarries in the area

The other quarry and limestone mine operators in the Marulan area, at Lynwood and Marulan South, use a combination of road and rail transport. The capital cost for the Lynwood Quarry rail loading facilities was significantly lower than the equivalent Gunlake rail loading facilities due to the proximity of Lynwood Quarry to the Main Southern Railway. In Marulan South's case, the investment in rail infrastructure was made when the cost of rail transport from Marulan to Sydney was cheaper than road transport and there were fewer constraints on developing intermodal terminal sites for Sydney.

5.1.5 Mix of products and destinations

Gunlake Quarry product demand from the quarry to the five CBP sites in Sydney and to other Gunlake customers generally, will typically be composed of up to five different graded quarry products each day giving over 25 different quarry product/customer transport combinations each day. These types of combinations of loads and destinations are difficult to service effectively using bulk rail transport. Hence, rail transport is now primarily used in NSW for 'line haul' bulk commodity transport, where fixed sets of wagons can be used to transport a single homogenous product in bulk loads, from a single point of origin to a single customer destination (eg coal or grain haulage for export) without any potential for cross contamination between different products being transported on different days in the same rail wagons.

5.1.6 Road and rail transport operational flexibility

Rail transport generally requires regular timetabled loads of materials to be transported each day according to fixed 'train paths' between specific rail network origin and destination points.

The Gunlake quarry product transport task would not generally meet this requirement as the volumes of material transported and the customers locations can vary widely from day to day. The inherent flexibility of road transport is much more suited to this type of distribution of quarry products.

The future availability of rail network capacity generally within the locality of Marulan and between Marulan and Sydney is also considered in Chapter 6.

6 Capacity of the NSW and interstate freight rail networks

The potential future use of rail transport for Gunlake Quarry products between Marulan and Sydney needs to be considered in the context of capacity issues for the entire NSW freight rail network, which is shown on Figure 6.1. The network includes several major interstate and long distance freight transport routes which operate south of Sydney. These are:

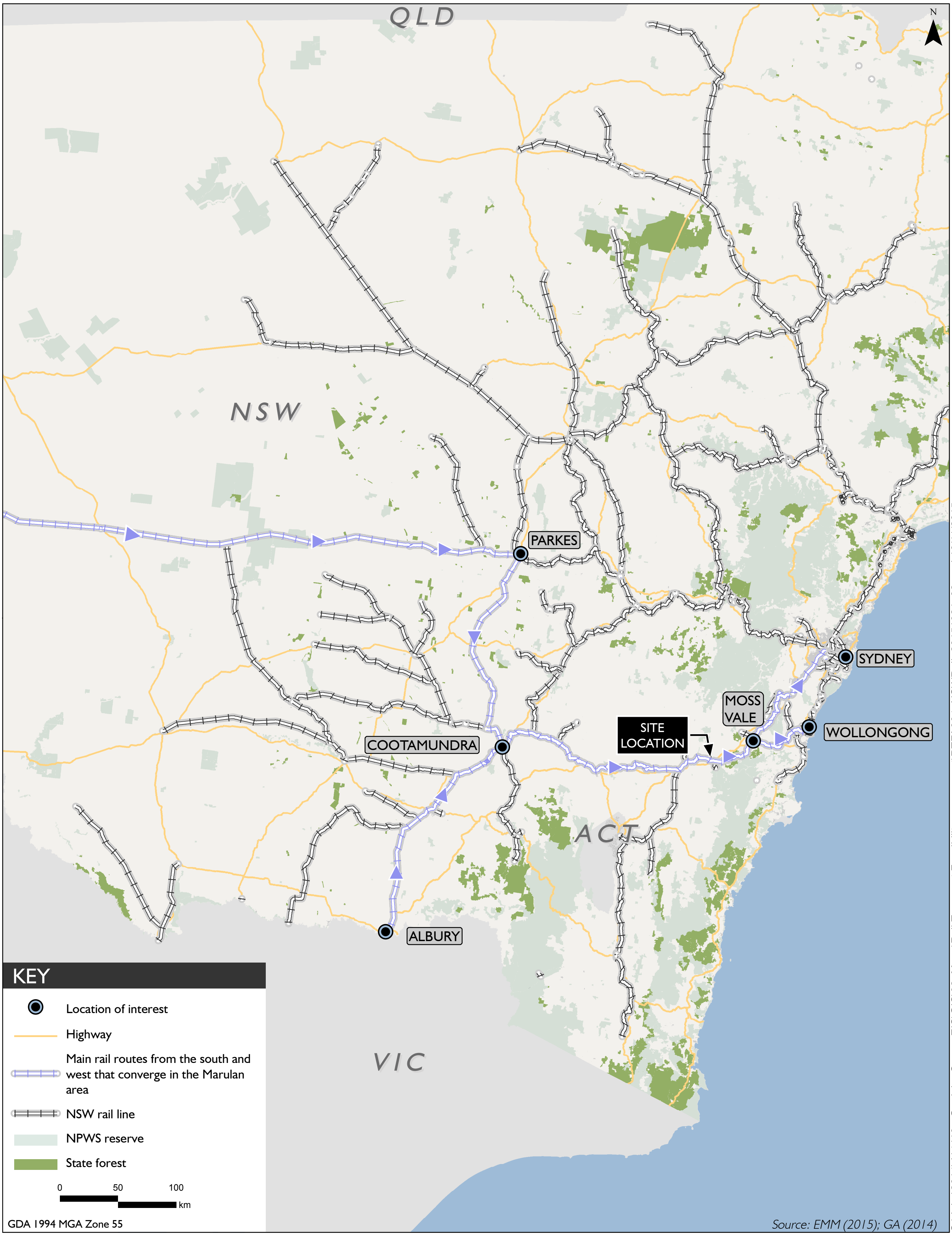
- the main southern interstate rail route to and from Melbourne, which passes through Junee, Wagga Wagga and Albury;
- the southern NSW to Illawarra (Port Kembla) rail transport route, which diverges from the Main Southern Railway line north of Moss Vale; and
- the Parkes to Cootamundra rail line which is increasingly used by freight trains travelling to and from the west of Sydney, to western NSW and interstate destinations, to bypass the steep and congested sections of railway line through the Blue Mountains, immediately west of Sydney.

These three significant long distance and interstate rail transport routes converge on the Marulan to Moss Vale section of the Main Southern Railway line, making this section one of the most heavily-used sections of all the north-south and east-west interstate rail transport routes in Australia.

The current utilisation of the main interstate rail routes in Australia is described in Bureau of Infrastructure, Transport and Regional Economics (BITRE), *Trainline 2 Statistical Report*, (BITRE 2014). The annual train loading tonnages for the key sections of the two main interstate rail corridors in Australia, east of Kalgoorlie are shown in Figures 6.2 and 6.3. The Main Southern Railway line at Moss Vale carries approximately 120 rail transport movements (60 each way) on a typical weekday, which represent a combination of approximately 60 passenger, and 60 freight train movements each day. The range of freight commodities carried includes:

- containers;
- cement;
- grain;
- coal;
- aggregates;
- steel;
- limestone; and
- other general freight movements.

Figures 6.2 and 6.3 illustrate how the Moss Vale to Marulan section of the north-south interstate rail transport route currently carries a greater tonnage of freight than any other section of the Australian interstate rail transport routes east of Kalgoorlie. For this reason, additional locally-based rail freight transport on the Moss Vale to Marulan section of the interstate rail transport route may ultimately reduce the overall national interstate rail network capacity for this highly constrained section of the Australian interstate rail transport network.



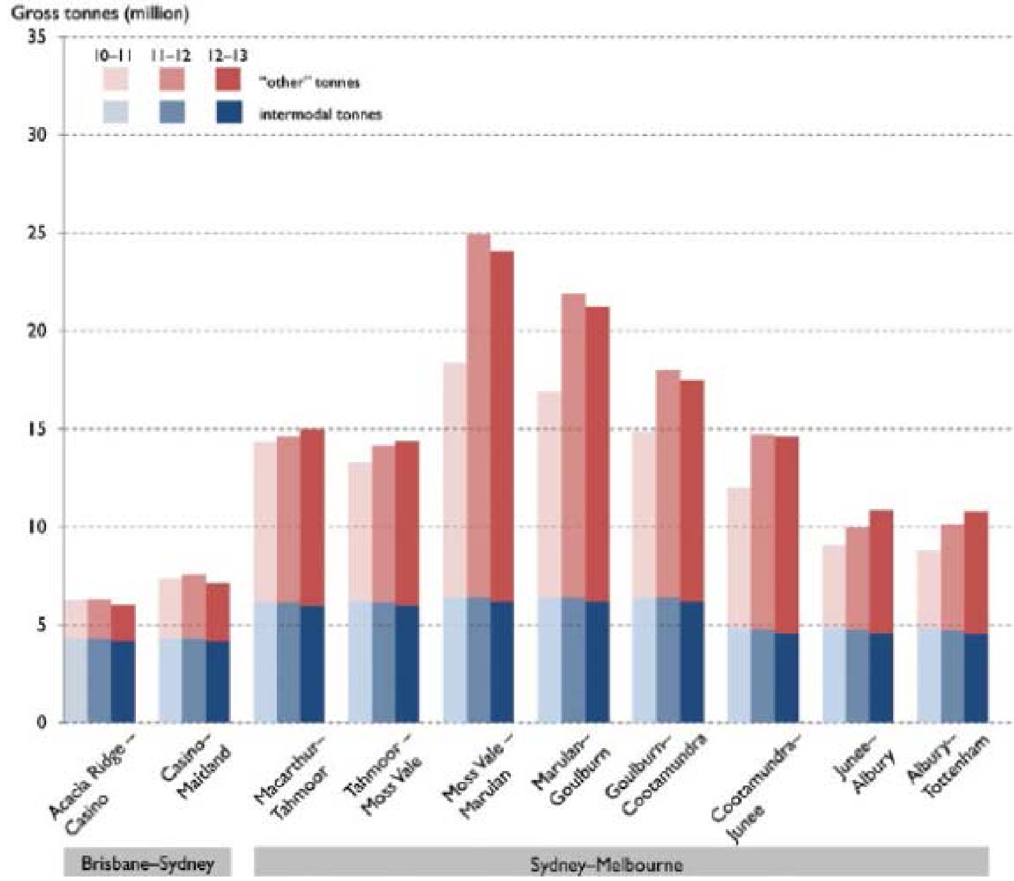
EMM

NSW rail network

Gunlake Quarry
Transport Options Review

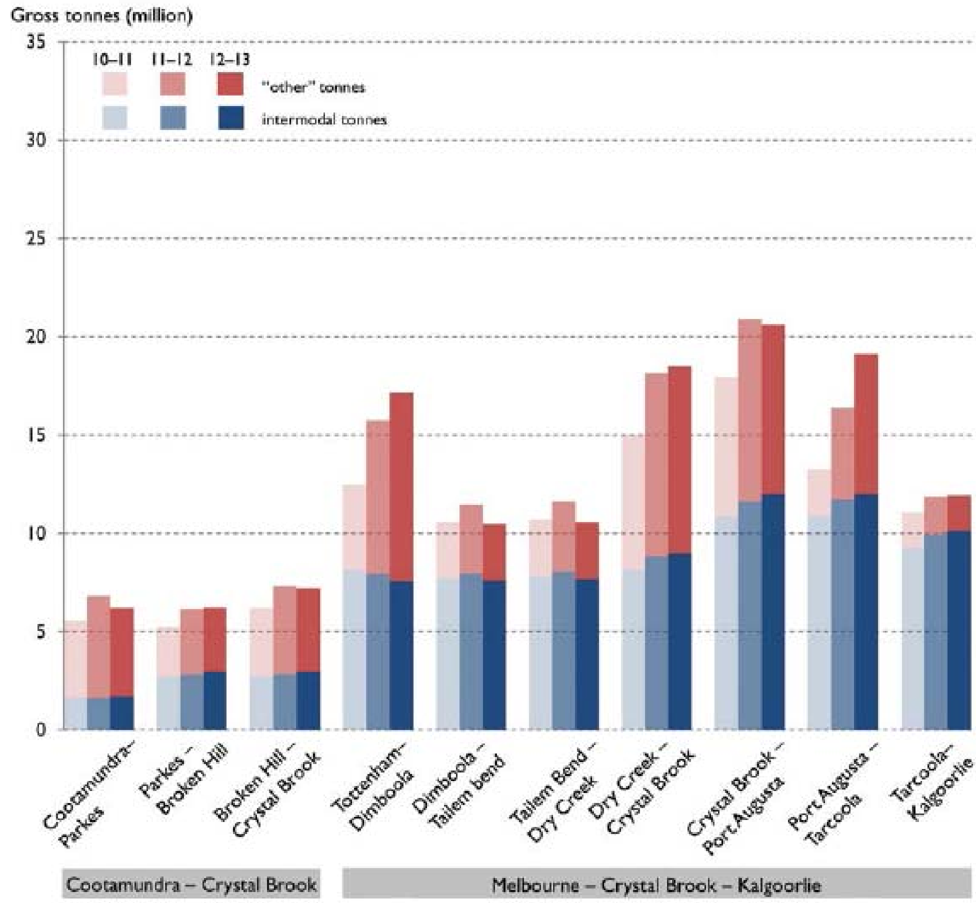
Figure 6.1

Q:\Jobs\2014\J14119 - Gunlake Quarry EIS\GIS\02_Maps\Rail Transport Feasibility assessment\RTFA004_NSWRail_20151021_02.mxd 10/11/2015



Source: Data provided by ARTC.

Figure 6.2 Gross tonnages on the north south corridor by line segment, 2010/11 to 2012/13



Source: Data provided by ARTC.

Figure 6.3 Gross tonnages on the east west corridor by line segment, 2010/11 to 2012/13

The Sydney region now has an increasingly congested passenger rail network, where the overall rail commuter travel demand is expected to increase significantly between 2011 and 2021. By 2031 it is projected that all the key Sydney rail corridors will struggle to meet their projected passenger travel demand including a number of shared passenger and freight rail routes. As commuter trains will continue to have precedence over freight trains during the peak travel periods on these routes, this will potentially restrict the longer term future flexibility for rail transport and adversely affect the reliability and delivery times for future rail freight transport to Sydney customer destinations.

The role of heavy road transport vehicles in moving longer distance freight across NSW is now substantial and is by far the most important method of transport for freight travelling to and from most newly developed areas of western Sydney. Areas such as Smeaton Grange (where a key Gunlake concrete plant is located) are relatively remote from the existing Sydney rail network and therefore rely almost exclusively on road transport for product and transport access.

In summary, there are 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. Furthermore, where there is road transport capacity available on the Hume Highway south of Sydney and there is no overriding NSW transport policy that dictates the use of rail transport instead road transport, the continuation of road transport for Gunlake quarry products to customers in Sydney is justifiable under both transport network efficiency and economic criteria.

7 Conclusions

7.1 Transport options

Gunlake transports product between Gunlake Quarry near Marulan and the main customers at dispersed locations throughout the Sydney region. Currently approximately 70% of the Gunlake quarry products are transported to Gunlake CBP sites and other customers in Sydney. In the future this proportion is anticipated to remain approximately the same.

A range of aggregate and other product sizes need to be supplied daily to each Gunlake CBP site in Sydney, together with other customers in Sydney and the Southern Highlands region. Typically, at least 25 different product/customer transport combinations need to be served by the quarry each day.

This transport options review examines the potential range of road and rail transport options for the transport of Gunlake Quarry products:

- Road transport only options:
  - Option 1– Continue to use Brayton Road as the primary haulage route, west of the Bypass Road.
  - Option 2 – Construct an alternative dedicated haulage route on the east side of Brayton Road, to the Bypass Road.
  - Option 3 – Upgrade the Canyonleigh Road route to the Hume Highway (approx 30 km) to B Double access standard as an alternative to the Brayton Road and Bypass Road haulage route.
  - Option 4 – Construct a new southern haulage route with access to the Hume Highway at South Marulan Road. Part of the route would be on Holcim (Australia) owned land, south of the Lynwood Quarry.
- Rail/road (Sydney) transport option:
  - Option 5 – Construct a new rail spur to the quarry, approximately 5.5 km long, for direct rail loading of Gunlake quarry products for Sydney region customers at the actual quarry, combined with construction of a rail quarry products receival and distribution centre for Sydney.
- Rail/Road (local and Sydney) transport options:
  - Option 6 – Construct a new southern haulage route to link with the Lynwood Quarry rail siding and expand the capacity of the rail siding (ie with an additional track and loading facilities) for combined used by the Holcim (Australia) and Gunlake quarries.
  - Option 7 – Construct a new southern haulage route to link with a new 1 km long Gunlake rail siding, which could be located on the north side of the Main Southern Railway line, approximately 2.5 km west of the Lynwood Quarry rail siding.

As products need to be transported to destinations in Sydney that are not close to any rail lines, there are no 'rail-only' options.

7.1.1 Road only options

Option 1 is the 'do-minimum' option which proposes the continuing use of Brayton Road, north of the Bypass Road as the primary haulage route for Gunlake Quarry, with a northbound acceleration lane at the Red Hills Road and Hume Highway access intersection. It has a likely mid range capital cost estimate of $4.5 million which would be the lowest capital cost future transport option for the quarry.

The other road transport options investigated (Options 2 to 4) would each have significantly higher capital costs of at least $15 million which would significant future annual road transport cost savings to be achieved over the project life to economically justify their required higher initial cost.

These other road options (Options 2 to 4) would potentially redistribute the future project road haulage transport related impacts away from the Brayton Road corridor (where these impacts are being effectively managed currently) and would therefore potentially adversely affect the environment and amenity of other areas which are not currently affected by any project traffic.

7.1.2 Road-rail options

A Gunlake Quarry rail spur line could be constructed from the northern side of the Main Southern Railway from a location approximately 2.5 km west of the Lynwood Quarry rail siding. A full length rail spur line to Gunlake Quarry would require a route following potentially steep and difficult terrain, approximately 5.5 km long (Option 5) or a 1 km long rail siding could be constructed with an approximately 5 km long haul road connecting the quarry to the siding (Option 7).

The road-rail options include consideration of the potential dual use (with capacity improvements) of the existing Lynwood Quarry rail loading siding which is on the south side of the Main Southern Railway line (Option 6). However, it is unlikely that Lynwood Quarry would allow their loading facilities to be used by a direct competitor for commercially reasonable terms. There is no means by which a private rail infrastructure operator can be compelled to allow the use of their facilities by another potential rail operator.

It should also be noted that no potentially suitable site for an intermodal facility for the recieval of products transported by rail to Sydney has been identified, so the costings and potential locations for this facility in the economic analysis are provisional only.

The likely range of high, medium and low project capital cost estimates for the three rail transport options have been estimated and used to calculate a preliminary project benefit to cost ratio based on the estimated future annual transport cost savings from the future use of rail transport instead of road transport, for the future proportion (70%) of the quarry products transported to customers in Sydney.

The potential future rail based product transport cost savings are as follows:

- rail-road transport (Option 5): a transport cost saving of $4.50/tonne, would save approximately $2.36 million in 2015, increasing to approximately $6.3 million in 2025; and
- road-rail-road transport (Option 6 and 7): a transport cost saving of $2.50/tonne, would save approximately $1.31 million in 2015, increasing to approximately $3.5 million in 2025.

At the medium-range project capital cost estimates considered, applying a discount rate of 7% per annum to the predicted project cost savings for rail transport over 30 years, all of the three project rail transport options considered would effectively recover between 51% to 59% of their respective initial capital cost investments over this period.

Even at the lowest range potential capital cost estimates considered, none of the rail options considered is economically efficient, as the three project rail transport options considered would effectively recover between 78% to 86% of their respective initial capital cost investments over a 30 year period.

The relatively high initial capital cost investment which would be required for all the project rail transport options would not result in any economically viable future project rail transport within the 30 year time frame that is normally considered in an economic analysis for a transport infrastructure project in NSW.

Each rail option would result in environmental impacts during its construction and operation at locations that are not currently impacted by Gunlake Quarry's operations.

7.1.3 Summary of preliminary economic analysis findings

Rail freight transport in NSW is now primarily focussed towards 'line haul' bulk commodity transport of homogenous products from a single point of origin to a single customer destination, where uniform trainloads of products are despatched each day according to a fixed rail timetable. Future product transport for Gunlake Quarry would be difficult and expensive to serve effectively using rail transport.

For the product transport by road, the continuing use of Brayton Road, Bypass Road and Redhill Roads to access the Hume Highway (Option 1) has an estimated mid-range capital cost of $4.5 million. Option 1 uses existing transport infrastructure with the addition of a northbound acceleration lane on the Hume Highway), where the intersection of Red Hills Road (on the Bypass Road route) meets the Hume Highway. The traffic safety and amenity impacts of Options 1 are considered in the environmental impact assessment and can be managed to ensure that they are acceptable. In comparison, product transport options 2 to 7 have estimated mid-range capital costs of between $15 million and $120 million. The potential environmental impacts of the additional transport infrastructure which would be required for these options have not been specifically assessed. However, all of these options will result in some impacts in areas where there are currently no environmental impacts from the quarry.

The increased economic income of additional truck drivers based in the local area would create flow on employment, while the local economic benefits from rail transport would be lower as fewer train drivers would be required and they would be less likely to be locally based.

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Appendix A

Calculation of discounted project benefits for rail transport options

Discounted Revenue Stream
Future Discount Rate 7%

After Year	Initial Value	1	Cumulative Value	
1		0.9300		
2		0.8649		
3		0.8044		
4		0.7481		
5		0.6957		
6		0.6470		
7		0.6017		
8		0.5596		
9		0.5204		
10		0.4840	6.8557	10 Years
11		0.4501		
12		0.4186		
13		0.3893		
14		0.3620		
15		0.3367		
16		0.3131		
17		0.2912		
18		0.2708		
19		0.2519		
20		0.2342	10.1737	20 Years
21		0.2178		
22		0.2026		
23		0.1884		
24		0.1752		
25		0.1630		
26		0.1516		
27		0.1409		
28		0.1311		
29		0.1219		
30		0.1134	11.7795	30 Years

Discounted Revenue Stream for Option 5

Future Discount Rate 7%

After Year	Initial Value	1	$ Million	Discounted	Cumulative Value $ Million	
	1	0.9300	2.36	2.19		
	2	0.8649	2.80	2.42		
	3	0.8044	3.24	2.60		
	4	0.7481	3.67	2.75		
	5	0.6957	4.11	2.86		
	6	0.6470	4.55	2.94		
	7	0.6017	4.99	3.00		
	8	0.5596	5.42	3.04		
	9	0.5204	5.86	3.05		
	10	0.4840	6.30	3.05	27.90	After 10 years
	11	0.4501	6.30	2.84		
	12	0.4186	6.30	2.64		
	13	0.3893	6.30	2.45		
	14	0.3620	6.30	2.28		
	15	0.3367	6.30	2.12		
	16	0.3131	6.30	1.97		
	17	0.2912	6.30	1.83		
	18	0.2708	6.30	1.71		
	19	0.2519	6.30	1.59		
	20	0.2342	6.30	1.48	48.81	After 20 years
	21	0.2178	6.30	1.37		
	22	0.2026	6.30	1.28		
	23	0.1884	6.30	1.19		
	24	0.1752	6.30	1.10		
	25	0.1630	6.30	1.03		
	26	0.1516	6.30	0.95		
	27	0.1409	6.30	0.89		
	28	0.1311	6.30	0.83		
	29	0.1219	6.30	0.77		
	30	0.1134	6.30	0.71	58.92	After 30 years

Discounted Revenue Stream for Options 6 and 7

Future Discount Rate 7%

After Year	Initial Value	1	$ Million	Discounted	Cumulative Value $ Million	
	1	0.9300	1.31	1.22		
	2	0.8649	1.55	1.34		
	3	0.8044	1.80	1.45		
	4	0.7481	2.04	1.53		
	5	0.6957	2.28	1.59		
	6	0.6470	2.53	1.63		
	7	0.6017	2.77	1.67		
	8	0.5596	3.01	1.69		
	9	0.5204	3.26	1.69		
	10	0.4840	3.50	1.69	15.50	After 10 years
	11	0.4501	3.50	1.58		
	12	0.4186	3.50	1.47		
	13	0.3893	3.50	1.36		
	14	0.3620	3.50	1.27		
	15	0.3367	3.50	1.18		
	16	0.3131	3.50	1.10		
	17	0.2912	3.50	1.02		
	18	0.2708	3.50	0.95		
	19	0.2519	3.50	0.88		
	20	0.2342	3.50	0.82	27.11	After 20 years
	21	0.2178	3.50	0.76		
	22	0.2026	3.50	0.71		
	23	0.1884	3.50	0.66		
	24	0.1752	3.50	0.61		
	25	0.1630	3.50	0.57		
	26	0.1516	3.50	0.53		
	27	0.1409	3.50	0.49		
	28	0.1311	3.50	0.46		
	29	0.1219	3.50	0.43		
	30	0.1134	3.50	0.40	32.73	After 30 years

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