Section 4

Assessment and Management of Key Environmental Issues

PREAMBLE

This section describes the specific environmental features of the Application Area, focussing on the Stage 2 Site and its surrounds that would or may be affected during the life of the Proposal. The proposed design and/or operational safeguards and management measures are presented, followed by an assessment of the predicted level of impact(s) the proposed activities may have after implementation of these measures. Where appropriate, proposed monitoring programs are also described.

This page has intentionally been left blank

4.1 LOCAL SETTING

4.1.1 Introduction

The descriptions of various environmental aspects of the Proposal throughout this section are reliant upon a range of background information common to many of the key environmental issues. In this subsection, the local setting is described and background information is provided on the climate, land ownership and residences of the local setting. The local setting relevant to specific environmental features are described throughout the remainder of Section 4.

4.1.2 Meteorology

4.1.2.1 Introduction

Table 4.1 provides a brief statistical summary of climate data sourced from the following meteorological stations, chosen based on proximity to the Stage 2 Site and/or similar geographical context.

- Temperature: Lithgow Birdwood Street (Station # 063224) 1912 to 2006 (closure) and Lithgow (Cooerwul) (Station # 063226) 2006 to 2013.
- Rainfall: Lowther Park 1945 to 2014 (Station # 063049) (no other data is collected at this station).
- Evaporation: Bathurst Agricultural Station (Station # 063005) 1966 to 2013.

A meteorological station has been operated at the Site since 2003, however, temperature, humidity and rainfall data from the established meteorological stations has been used in preference due to the longer periods of monitoring. Wind data collected at the Austen Quarry meteorological station has been used in the generation of a wind data file for the local area which has been incorporated into dispersion (air) and noise modelling) for the Proposal.

4.1.2.2 Temperature and Humidity

January is the hottest month, having the highest mean temperature of 24.9°C, with November, December, February and March all with mean annual temperatures exceeding 20°C and maximum temperatures exceeding 30°C. The lowest temperatures were evident through June to August with the lowest mean temperature in July of 0.8°C.

4.1.2.3 Rainfall

Mean annual rainfall is 834.6mm, with mean rainfall highest from October to March. Statistically, the highest average rainfall occurs in January, however, be extremely variable, with infrequent, high intensity rainfall events occurring. This is exemplified by the cooler months of May to August which have the lowest mean rainfall, with no rainfall being recorded during these months in some years, but also several of the highest recorded monthly totals.

Table 4.1
Climate Data Summary

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Temperature (°C) Lithgow Birdwood Street (Station # 063224) 1912 to 2006 / Cooerwul (Station # 063226) 2006 to 2013													
Mean maximum temperature	24.9	24.0	21.8	18.0	14.1	11.0	10.3	11.8	15.1	18.3	21.1	23.9	17.8
Mean minimum temperature	11.6	11.8	9.8	6.6	3.8	1.9	0.8	1.3	3.3	5.9	8.0	10.2	6.3
Highest Daily Temperature	37.8	38.5	35.1	30.8	23.9	19.5	19.8	22.5	27.6	33.1	37.2	36.8	38.5
Lowest Daily Temperature	1.3	3.5	0	-4.0	-6.1	-7.0	-8.0	-7.7	-6.0	-2.3	-1.7	0.6	-8.0
Rainfall (mm) Lowther Park 1945 to 2014 (Station # 063049)													
Mean monthly rainfall	07.1	105.6	88.2	66.5	60.8	82.1	64.4	73.3	65.0	78.6	82.5	81.3	855.4
15th percentile month (2002)	72.2	226.6	81.2	52.2	60.4	35.0	38.0	16.2	29.4	9.2	28.2	45.6	694.2
90th percentile month (2010)	57.4	175.6	75.8	34.2	57.6	50.8	88.6	128.6	48.4	82.6	167.2	198.8	1 165.6
Highest daily rainfall	92.0	88.6	91.8	72.4	64.4	94.2	78.2	180.0	95.8	63.81	69.6	66.5	180.0
Evaporation (mm) Bathurst Agricultural Station (Station # 063005) 1966 to 2013													
Mean daily evaporation	6.8	5.7	4.5	2.9	1.7	1.1	1.2	1.8	2.8	4.0	5.2	6.5	3.7
Mean monthly evaporation	211	160	140	87	53	33	37	56	84	124	156	202	1 341
Source: Bureau of Meteorology 2014													

The 15th percentile (2002) and 90th percentile (2010) rainfall years have been presented as indicative of dry and wet years respectively. Notably, even in 'dry' years, there are likely to be periods of heavy rainfall which require consideration in the design of water and erosion and sediment control infrastructure.

4.1.2.4 Evaporation

Mean evaporation at the Bathurst Agricultural Station throughout the year is 3.7mm per day or 1 341mm per year. Monthly evaporation varies between 33mm in June and 211mm in January. Mean monthly evaporation is greater than mean monthly rainfall between September and April.

4.1.2.5 Wind

A site-representative meteorological data file was generated using The Air Pollution Model (TAPM) using data collected from the Austen Quarry Meteorological station for the year 2012. The TAPM file contained values for temperature, wind speed, wind direction, mixing height, stability class and the sigma theta parameters. **Figure 4.1** presents a summary of wind patterns generated by the TAPM meteorological data file. The wind roses indicate that on an annual basis, prevailing winds are from the northwest and west with significant winds also experienced from the south and southeast, especially during summer.

Calm conditions (<0.5m/s) are experienced approximately 6% of the time and the average wind speed is 2m/s.

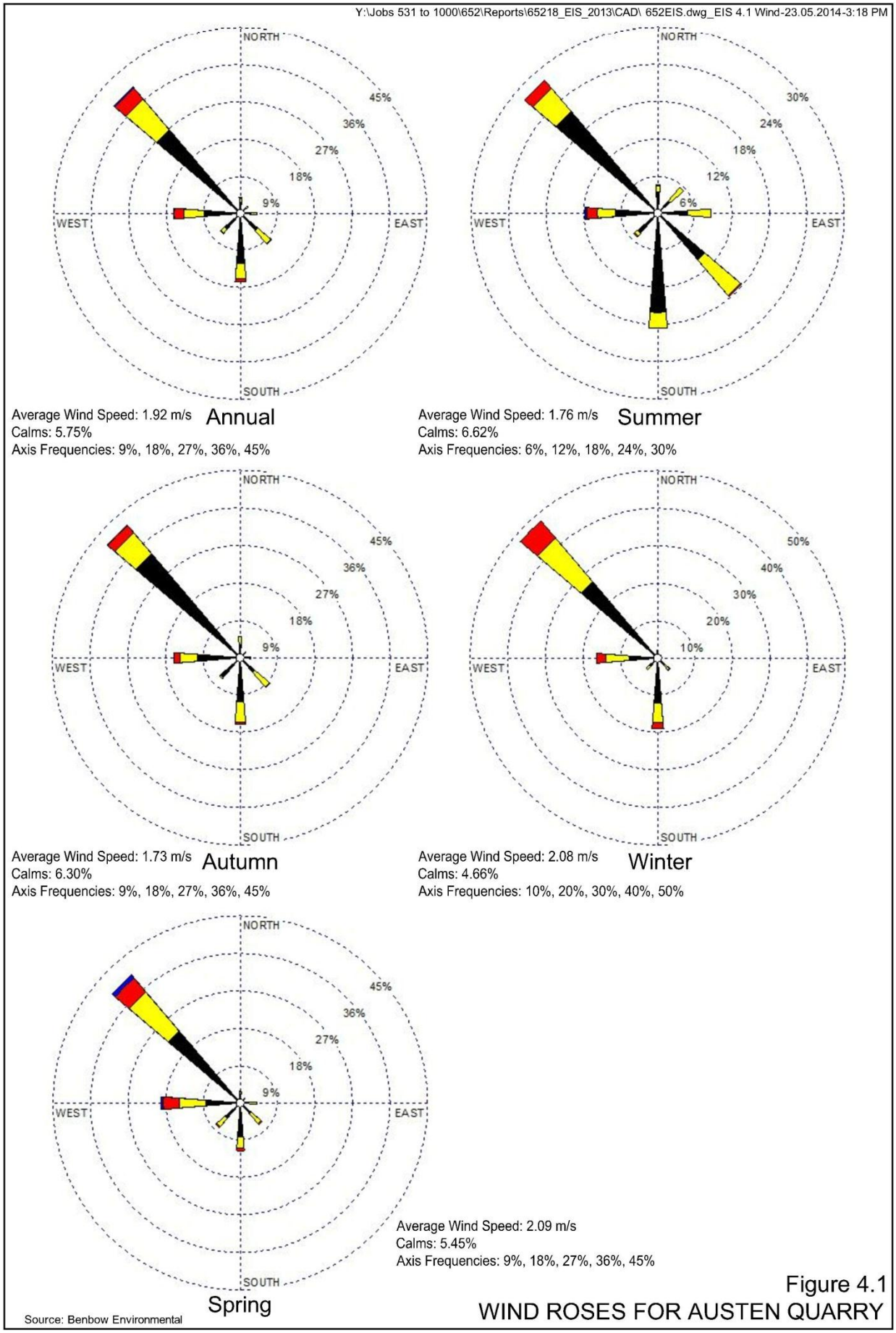


Figure 4.1
WIND ROSES FOR AUSTEN QUARRY

4.1.3 Land Ownership and Surrounding Residences

4.1.3.1 Surrounding Land Ownership

Figure 4.2 displays the land ownership of the Stage 2 Site and surrounds illustrating the large landholding of HPC which provides a significant buffer to neighbouring properties.

Within the approximate 4km radius of the Stage 2 Site displayed in **Figure 4.2**, several individual residences are present on larger properties, including but not limited to:

- "Good Forest" – 1km southwest of the Stage 2 Site boundary.
- "Glenroy" – 2.6km north of the Stage 2 Site boundary.
- "Ecclesbourne" – 3.1km west of the Stage 2 Site boundary.
- "Ant Hill" – 3.5km southwest of the Stage 2 Site boundary.
- "Glenleigh" – 3.8km southwest of the Stage 2 Site boundary.
- "Wuthering Heights" – 2.5km south of the Stage 2 Site boundary.
- "Duddawarra" – 2.7km south of the Stage 2 Site boundary.

In addition, there are several areas of smaller rural holdings with residences. These are concentrated as follows.

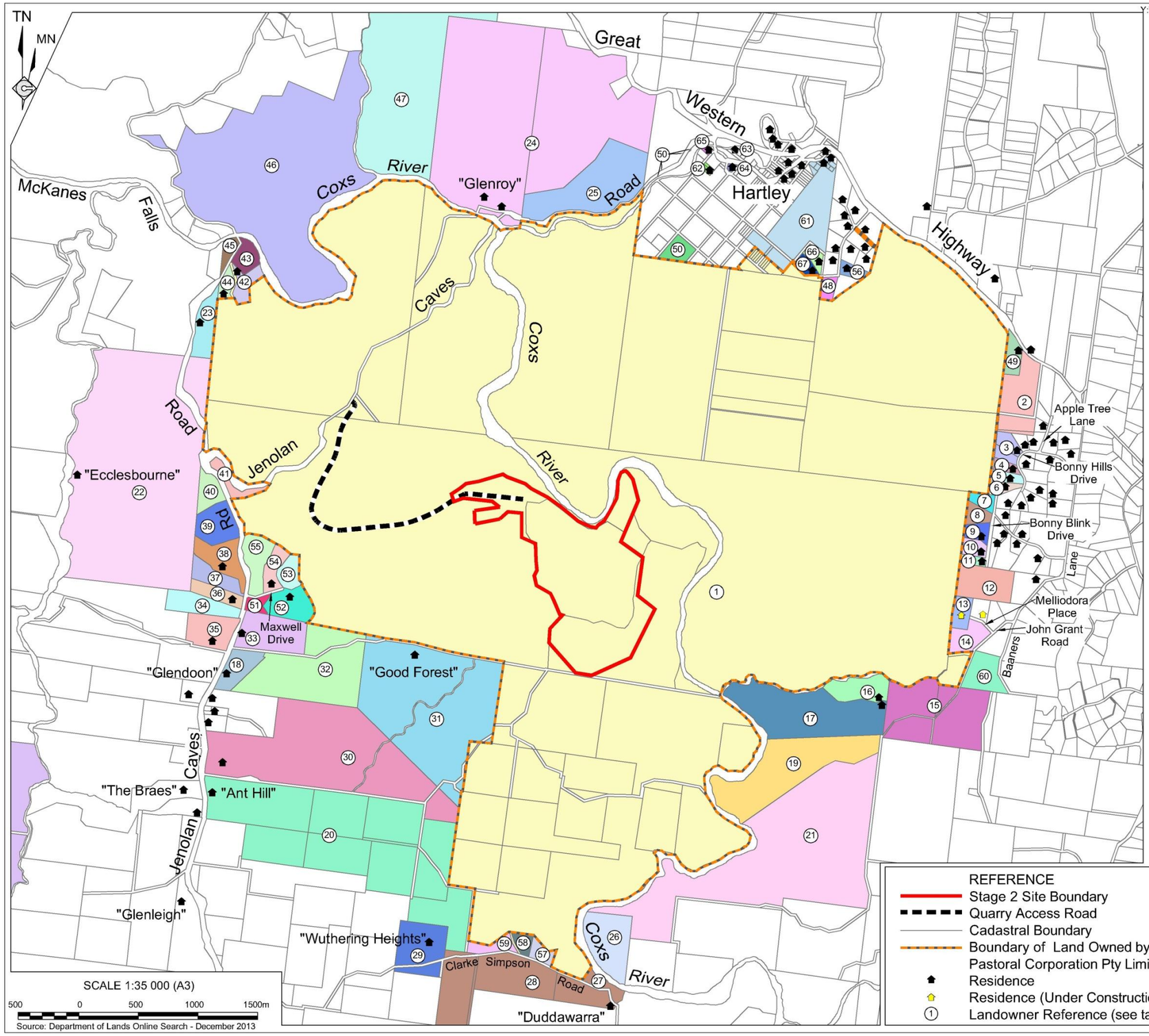
- Residences within the village of Hartley which occur between 2.5km and 3km to the north-northeast and northeast of the extraction area.
- Baaners Lane, Apple Tree Lane, Bonny Hills Drive, Bonny Blink Drive, Melliodora Place and John Grant Road with residences between 2.9km and 4.3km to the east and east-northeast of the Stage 2 Site boundary.
- Various residences on Jenolan Caves Road to the west of the Stage 2 Site boundary.
- A group of three residences on McKanes Falls Road to the northwest of the Stage 2 Site boundary.

4.1.3.2 Residences Adjacent to Transport Routes

The only residence located on the section of Jenolan Caves Road forming part of the primary transport route to Sydney is that on the Glenroy property adjacent to the bridge over the Coxs River. This residence is set back approximately 45m from the road. A second dwelling is located closer to the road (~12m), however, this is not inhabited.

Residences are also located on Jenolan Caves Road to the south of the quarry entrance, as well as on the Great Western Highway.

Y:\Jobs 531 to 1000\652\Reports\65218_EIS_2013\CAD\ 652EIS.dwg_EIS 4.2 Landowner 23.05.2014-3:18 PM



Ref	Landowner
1	Hartley Pastoral Co Pty Limited
2	T A & M Ashcroft
3	R L & D M Fairbairn
4	J W & D A Holmes
5	A E Raynor, J A Littlewood
6	B D & K N Berthon
7	D J & C Wessell
8	B R & K L Helmrich
9	M A Hilder
10	V J & J Turnbull
11	R J & S J Lawrence
12	S M Taylor, A R Thompson
13	R & W Knight
14	R D & D K Boland
15	Di Falco Brothers Pty Limited
16	J J & E E Turner
17	Lewis Brothers Pty Limited
18	R A Smith, R J Hall
19	R J Matthews
20	A V Joseph
21	P J & C A Meakin
22	B N & J K Houlison
23	J R & D A Young
24	B & R Barber
25	T Barber
26	J D & B L De Losa
27	J E Bell
28	J E & N A Bell
29	CH,CG,RA & JT Ward, ME Laidlow, MF King
30	R H & H E Berry
31	D W & L R Cullen
32	A M & B M Guinan
33	G Kitchener
34	J M & A D Luchetti
35	J A McDonald
36	C Hindle
37	D P Coates
38	L G & M L Swift
39	M Muntanion
40	K J & P F Reddacliff
41	T G Kelly, H C Kongdon
42	B L & C Fitzpatrick
43	R Bennett
44	P J & J L McPhail
45	The Minister for Public Works
46	G J & D M Corney
47	Nosbor Pty Limited
48	B J & D A Murphy
49	G M & E J Corbett
50	The State of New South Wales
51	N E Wilkinson
52	W H Samuels
53	N L Gastaldin
54	Kitchner Super Investments Pty Ltd
55	P A Deane
56	R S & J Gavin
57	T C & C H Watts
58	S K & P A Jones
59	A J & S D Jack
60	G & B M James
61	M J Dunstan
62	I Campbell
63	D Hirsch
64	J Farrag
65	J Cliffed
66	C & L B Grace
67	S J & K T Edwards

Figure 4.2
LAND OWNERSHIP AND RESIDENCES

This page has intentionally been left blank

This page has intentionally been left blank

4.2 LAND RESOURCES

4.2.1 Introduction

The DGRs issued for the Proposal identified "*Land Resources*" as a key issue for assessment requiring that the EIS provide a*" detailed assessment of the potential impacts on:*

- *soils and land capability;*
- *landforms and topography, including rock formations, steep slopes, land slippage;*
- *land use, including forestry use; and*
- *extractive material resources, including assessment of the size and quality of the resource and description of the methods used to assess the resource and its suitability for the intended applications.*

Based on the risk analysis undertaken for the Proposal (Section 3.3.1 and **Table 3.9**), the potential impacts relating to soil, land capability and agricultural suitability and their risk rankings (in parenthesis) after the adoption of pre-existing or standard mitigation measures are as follows.

- Loss of soil resources as a result of land preparation activities leading to rehabilitation outcomes not meeting objectives (Medium Risk).
- Degradation of soil resources during stockpiling resulting in reduced productivity of the final landform (Medium Risk).
- Erosion as a result of vegetation clearing, from stockpiles, or following soil replacement during rehabilitation resulting in:
  - rehabilitation outcomes not meeting objectives (Medium Risk); or
  - increased erosion on the final landform (Medium Risk).
- Reduced amenity of the final landform (Medium Risk).
- Final landform and land use incompatible with surrounding landscape (Medium Risk).

A review of the attributed risk levels, following the adoption of the recommended operational safeguards and controls, is provided in Section 6.2.1 and **Table 6.1**.

An assessment of soil and land capability for the Proposal was undertaken by Mr Mark Passfield of Strategic Environment and Engineering Consultants (SEEC). The resulting report is presented as Part 10 of the *Specialist Consultants Studies Compendium* and is referred to hereafter as "SEEC (2014)". Assessment of landforms, topography and land use have been completed by R.W. Corkery & Co. Pty Limited (RWC) with the assessment of extractive material resources also completed by RWC with the input of Groundwork Plus Pty Ltd, Don Reed & Associates Pty Ltd and the Applicant.

This subsection of the EIS provides a summary of the existing environment, potential impacts, safeguards and controls and impact assessment for each of these features of the environment, concentrating on those matters raised in the DGRs and submissions to the DGRs provided by various government agencies. A consolidated list of the identified requirements and where each is addressed is presented in **Appendix 3**.

4.2.2 Landforms and Topography

4.2.2.1 Existing Environment

The regional topography around the Stage 2 Site is shown on **Figure 4.3**. The Stage 2 Site is located on the western fringe of the Blue Mountains with steeply sloped valleys and ridges with elevations in excess of 1 050m AHD at the western extent of the Blue Mountains National Park and to the north at Mt York and Hassans Walls. Steeply incised ridges and valleys amongst gently undulating grazing land typify the topography of the region, with notable features including:

- Mt Blaxland which rises to 1 006m AHD to the west of the Stage 2 Site (and signifies the western most point of the 1813 crossing of the Blue Mountains by Blaxland, Lawson and Wentworth);
- "The Peak" Trigonometric Station, rising to 800m AHD within the Kanimbla locality to the south; and
- the very gently undulating plain of Hartley Vale and the River Lett valley.

Local topography is dominated by the Coxs River which drains to the east and adjoins the Stage 2 Site to the north (see **Figure 4.4**). The Coxs River flows further to the south of the Blue Mountains where it ultimately drains into Lake Burragorang, Sydney's main water supply source. Yorkeys Creek, another dominant topographic feature of the local setting, passes between the secondary processing area and Yorkeys Creek stockpile area where it drains into Coxs River at northwestern corner of the Stage 2 Site. The topography rises moderately to steeply from both the Coxs River and Yorkeys Creek with a series of ridges and incised gullies features of the local topography, especially to the south and east. Land directly to the south, east and west of the Stage 2 Site consists mainly of forested ridges and gullies developing to wider predominantly cleared valleys. Land to the north of Coxs River is mainly gently undulating grazing land.

The topography of the Stage 2 Site itself is illustrated on **Figure 4.5**. The secondary processing area is located on a flat area (elevation approximately 665m AHD) to the immediate south of the Coxs River and east of Yorkeys Creek. The landform rises steeply to the south to an elevation of approximately 835m AHD which forms part of a relatively significant east-west oriented ridge line of the local topography. Slopes on and immediately surrounding the Stage 2 Site typically range from less than 5° at the Coxs River bank up to 30°.

The topography of the Stage 2 Site includes a series of smaller individual ridges, incised by gullies, through the extraction area. These ridges are identified on **Figure 4.5** as the Northern Ridge, Central Ridge and Southern Ridge for the purposes of the visual impact assessment which follows (Section 4.4). The current extraction area has modified the topography of the Northern and Central Ridges although it is noted that the northern aspect of the Northern Ridge, which falls within the approved Stage 1 extraction area, has been excised from quarry extraction plans to date in order to provide a visual barrier to vantage points to the north. At its maximum elevation, this retained slope reaches 790m AHD, falling to the northeast to an elevation of approximately 780m AHD. The Stage 2 extraction area would modify the topography of the Southern Ridge (which has a maximum elevation of 810m AHD) and the Stage 2 overburden emplacement would extend into two small gullies incised in the main east-west oriented ridge line through the Stage 2 Site.

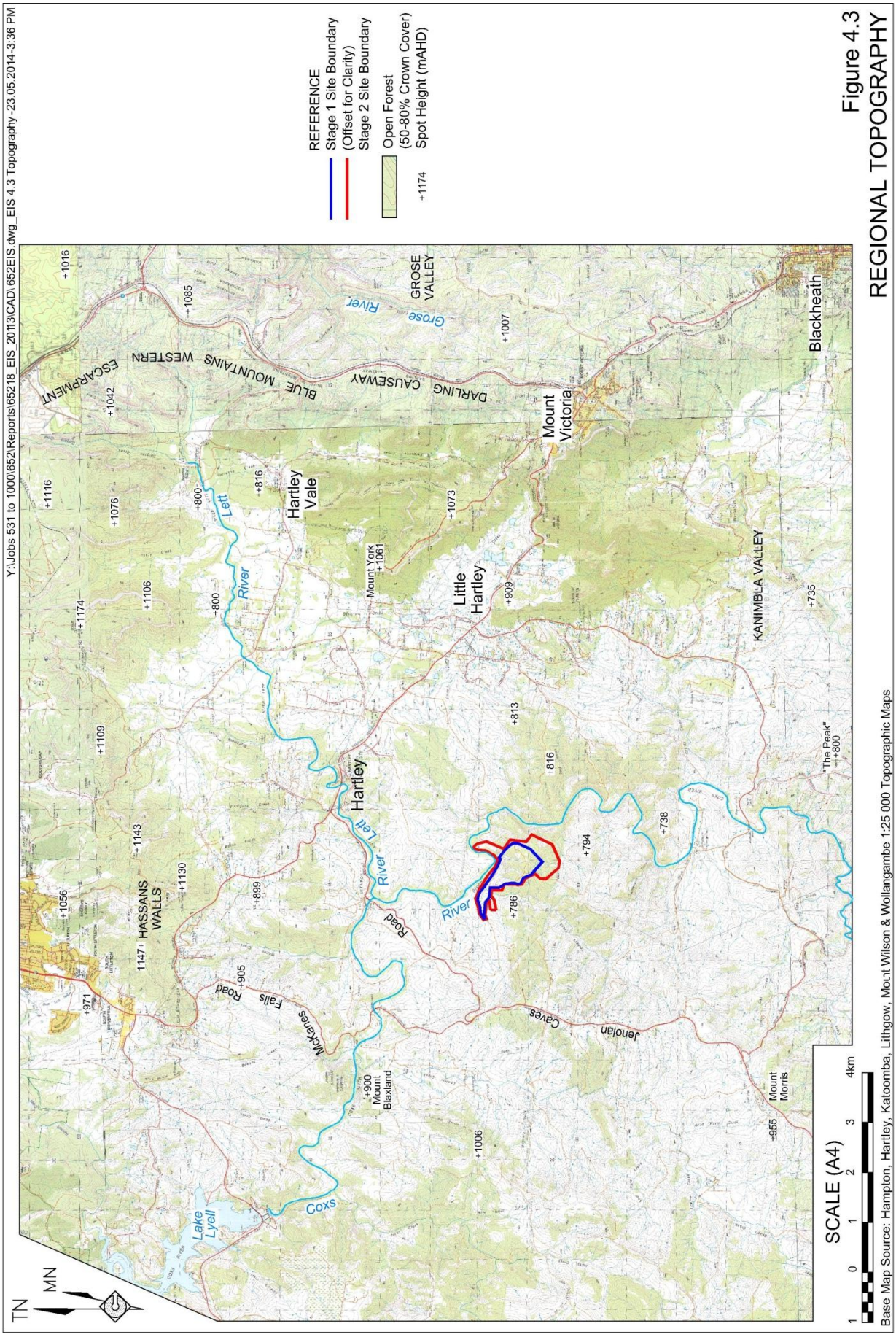


Figure 4.3
REGIONAL TOPOGRAPHY
REFERENCE
Stage 1 Site Boundary
(Offset for Clarity)
Stage 2 Site Boundary
Open Forest
(50-80% Crown Cover)
Spot Height (mAHD)
+1174
Y:\Jobs 531 to 1000\652\Reports\65218_EIS_2013\CAD\652EIS.dwg_EIS 4.3 Topography -23.05.2014-3:36 PM
GROSE VALLEY
Grose River
BLUE MOUNTAINS WESTERN ESCARPMENT
DARLING CAUSEWAY
Mount Victoria
Blackheath
Hartley Vale
Left River
Mount York
Little Hartley
KANIMBLA VALLEY
Hartley
HASSANS WALLS
Road
Falls
McKanes
Caves
Jenolan
"The Peak"
Mount Blaxland
Mount Morris
Lake Lyell
Coxs
TN
MN
SCALE (A4)
1 0 1 2 3 4km
Base Map Source: Hampton, Hartley, Katoomba, Lithgow, Mount Wilson & Wollangambe 1:25 000 Topographic Maps

Figure 4.4
LOCAL TOPOGRAPHY

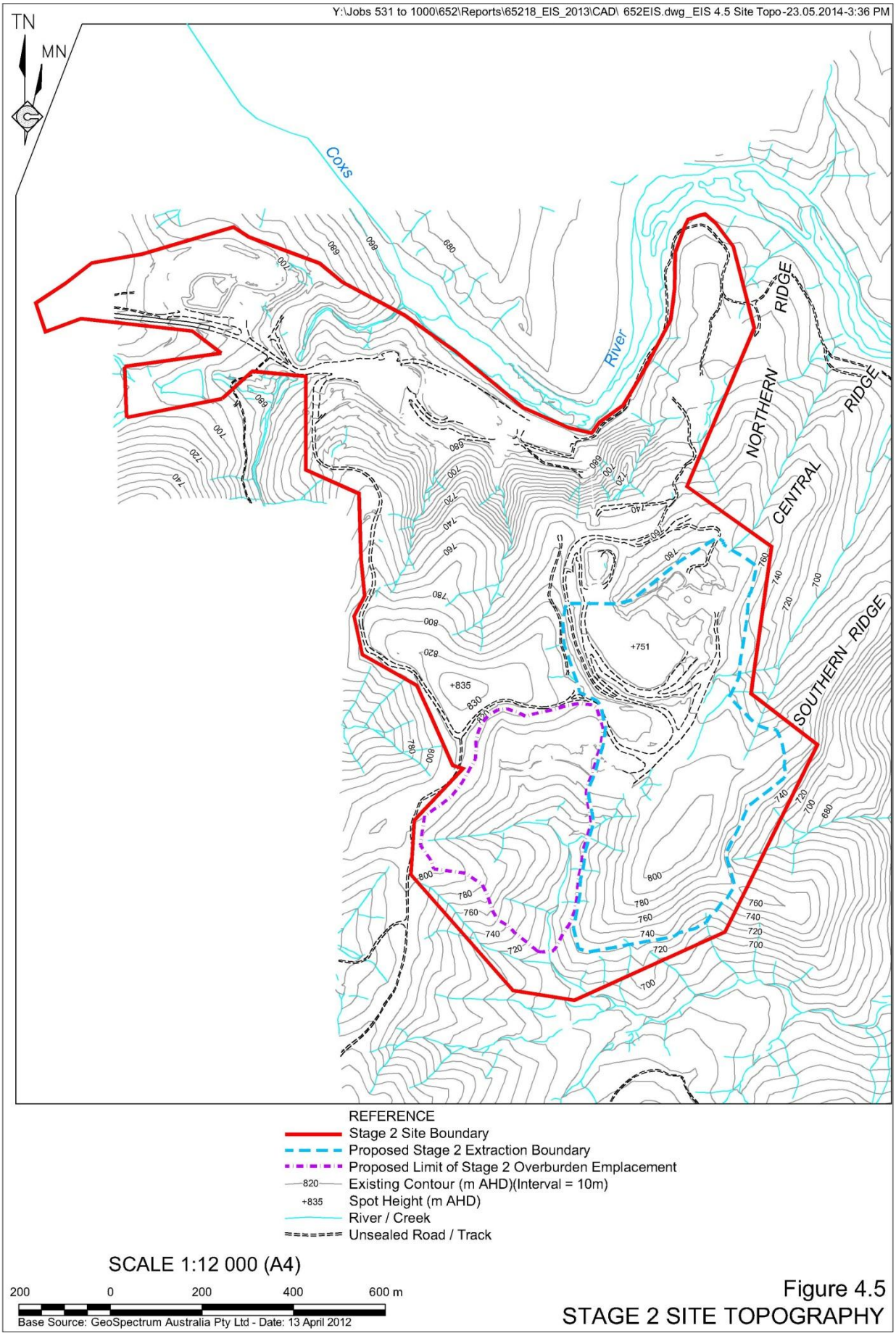


Figure 4.5
STAGE 2 SITE TOPOGRAPHY

The Yorkeys Creek stockpile area and Quarry Access Road are located on the cleared and undulating terrain to the west of the Coxs River and Yorkeys Creek.

4.2.2.2 Potential Impacts of the Proposal

The Proposal would modify the topography and landform by:

- removing sections of the Northern, Central and Southern Ridges to the northeast of the Stage 1 extraction area; and
- in-filling two small gullies to the south of the Stage 1 overburden emplacement.

Neither of these features represents a significant formation of natural, cultural or historic heritage. Given the competent nature of the local geology (igneous rock types of Lower to Middle Devonian in age interbedded with a range of metasediments of the Lambie Group), the potential for land slippage within the final extraction area is very low. Potential impacts as a consequence of the modified topography relate to:

- increased visibility of the modified landform (see Section 4.4.3); and
- drainage and sedimentation patterns (see Section 4.5.3).

Specific operational safeguards and management measures, followed by an assessment of impacts related to these parameters are considered in the sections noted above.

4.2.3 Land and Soil Capability

4.2.3.1 Soil Landscapes

The Stage 2 Site is located within the Mount Walker and Marrangaroo Soil Landscapes as mapped by the former Department of Land & Water Conservation incorporating the Soil Conservation Service of NSW (2002) (see **Figure 4.6**). Both the Stage 1 and 2 extraction areas and overburden emplacement are located on the Mount Walker Soil Landscape, which occurs on steep to very steep hills with narrow, rounded crests on the Lambie Group Metasediments. The secondary processing area and Yorkeys Creek stockpile area are located on the Marrangaroo Soil Landscape, which is mapped over rolling hills and narrow flat to rounded convex crests on Carboniferous granite. For the purpose of this assessment, there would be no additional disturbance to the soils within the Marrangaroo Soil Landscape.

SEEC (2014) provides further information on the common soil types of the two soil landscapes.

4.2.3.2 Soil Characteristics

4.2.3.2.1 Soils Testing and Analysis

Soil was sampled from two hand dug test pits within the proposed Stage 2 extraction area (at the site of previous exploration drill sites) (see **Figure 4.6**). As the landforms, vegetation and mapped soil landscape of the proposed Stage 2 overburden emplacement is consistent with that of the extraction area, SEEC (2014) determined it unnecessary to take separate samples, i.e. the soil observed within the extraction area would be representative of that within the overburden emplacement area.

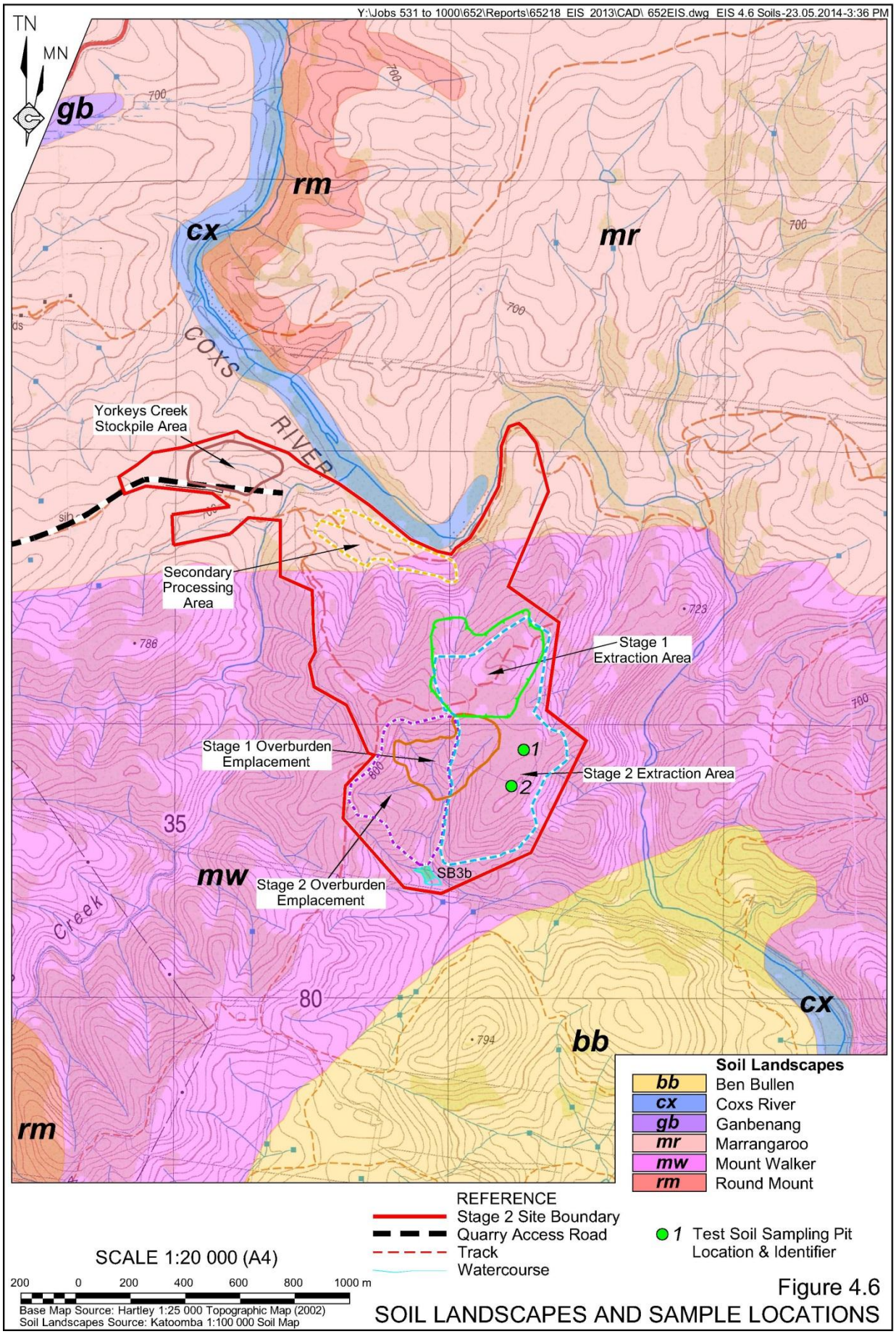


Figure 4.6
SOIL LANDSCAPES AND SAMPLE LOCATIONS

Samples of both topsoil and subsoil from each test pit were sent to the Scone Soil Laboratory of the NSW Department of Lands for analysis. The following provides a summary of the characteristics of the soil of the Stage 2 Site based on the inspection, in-field assessment and the laboratory results.

4.2.3.2.2 Physical Characteristics

Dimensions and Structure

A visual inspection confirmed the soils conform to the descriptions of the soil landscape mapping for the Mount Walker Soil Landscape with very gravelly, quartz-rich, shallow soils (Lithosol) encountered. The topsoil was found to be thin (<100mm), poorly defined and consisting of sandy loam with a small portion of coarse fragments derived from the parent rock. The subsoil layer is also relatively thin (600mm) above bedrock and consists of fine sandy loam to fine sandy clay loam with variable gravel content.

SEEC (2014) assessed the topsoils to be massive, i.e. without observable aggregation, while the subsoils were found to have a poor to moderate structure. The topsoil and subsoil were considered by SEEC (2014) to be sufficiently similar such that they could be stripped and managed as one unit, where soil stripping is practical.

Erosion Potential and Erosion Hazard

The results of K-Factor (sheet erosion) analyses of samples indicate moderate to high soil erodibility (0.025 to 0.034 for topsoils and 0.023 to 0.048 for subsoils).

The wind erodibility index for each sample also indicates moderate susceptibility to wind erosion.

Annual soil loss calculated using the Revised Universal Soil Loss Equation (RUSLE) (Landcom, 2004) suggests the soil loss class would be Class 5 (high) where the typical slope gradient approximates or exceeds 20% (SEEC, 2014). A Soil Loss Class of 5 dictates the need to implement specific erosion control practices between the months of December and February to reduce the erosion risk (see Section 4.2.3.5).

Soil Dispersibility

Emerson Aggregate Test testing and an analysis of the Exchangeable Sodium Percentage (ESP) were used to assess the dispersibility and sodicity of the soils. The results indicate the soils are not highly dispersible or sodic. However, based on the guidelines provided in Landcom (2004), soils in Test Pit 1 were dispersive enough to classify them as Type D and so this would be assumed for the design of sediment basins (refer to Section 4.5.4.2).

Soil Drainage and Water Holding Capacity

While the high gravel and sand content of the soils means they would have high permeability, the infiltration would be affected by the shallow bedrock. SEEC (2014) classified the soils as Hydrological Group D based on the guidelines provided in Landcom (2004).

Considering that up to two thirds of the soil mass can consist of rock fragments, the water-holding capacity of the soils is not high.

4.2.3.2.3 Chemical Characteristics

The results of the laboratory analysis are provided in SEEC (2014). In summary, the results indicate the following chemical characteristics.

- All soils samples were non-saline.
- All samples had a very low Cation Exchange Capacity (CEC).
- All samples had moderate base saturation.
- Topsoil samples were very strongly acidic while subsoils were moderate to strongly acidic.
- Topsoils were very high in organic matter and subsoils very low to moderate in organic matter.

SEEC (2014) provides a more comprehensive review of the test parameters and interpretation of the chemical results.

4.2.3.3 Land Capability

The land capability of those areas of the Stage 2 Site to be disturbed was assessed by SEEC (2014) against *The Land and Soil Capability Assessment Scheme (a general rural land evaluation system for New South Wales)* (OEH, 2012). SEEC (2014) assessed the Land and Soil Capability as Class 6 indicating severe limitations (including soil acidification and common rock outcropping) for a wide range of land uses with few management practices available to overcome them. Soil fertility is very low and, agriculturally, the land is suitable only for low productivity grazing (with limitations).

4.2.3.4 Potential Impacts of the Proposal

The soils of the Stage 2 Site are of poor quality and severely limited in potential use outside of limited grazing and nature conservation. Potential impacts from the Proposal include further reduction in soil quality as a result of poor management practices (associated with stripping, stockpiling and other handing procedures).

As the use of stockpiled soil in rehabilitation would be limited in the short to medium term, the soils would remain in stockpiles for several years. Degradation of the soils is also a possibility as a result of reduced aerobic function, modification to soil structure and erosion.

Finally, there is a potential for a reduction in soil quality upon reuse if there was inappropriate handling and placement of the soils or the use of inappropriate fertilisers.

4.2.3.5 Operational Safeguards and Controls

Vegetation clearing, soil stripping and stockpiling procedures have been discussed in Sections 2.5.3.1 and 2.5.3.2. A summary of these and other soil management procedures and safeguards which would be implemented are provided as follows.

Soil Stripping

- Available soil would be stripped to the depth where bedrock is encountered (600mm to 1 000mm) in all areas to be disturbed by extraction and overburden placement. No further mechanical blending of the soils would be undertaken as current practices indicate the removal process would be sufficient to blend the topsoil and subsoil layers.
- All soils would be handled as little as possible to minimise structural damage. This would be achieved by operator training and ensuring the areas for stripping and stockpiling are clearly identified.
- Unless unavoidable, soil stripping on land with slope gradients exceeding 20% would not be undertaken between December and February each year.
- If soil stripping is to be undertaken on land with slope gradients exceeding 20% between December and February, control practices would be nominated and implemented based on the particular conditions of the Stage 2 Site. These could include such measures as: immediately applying adequate ground cover; or reducing the slope length to half through the use of mulch berms.
- Soils would not be stripped or replaced during extremely wet or dry conditions.

Soil Stockpiling

- Machinery used for stripping operations would place their loads neatly and uniformly so the stockpile does not require further forming prior to establishment of vegetation cover.
- Driving of machinery on the soil stockpiles would be prohibited once the stockpiles are created to minimise compaction and further degradation of soil structure.
- Soil stockpiles would not exceed 2m in height.
- Stockpiles would be seeded and fertilised as soon as possible after emplacement, using a mix of sterile annual groundcover or native grasses.

Erosion and Sediment Control

- Upslope water diversion would direct overland surface water flow away from the soil stockpiles.
- Downslope sedimentation controls would be implemented as required, until such time as the surface of the soil stockpiles are appropriately stabilised using groundcover species or mulch.

Soil Inventory and Monitoring

- An inventory of available soil would be maintained to ensure a record of available soil materials is available for planned rehabilitation activities.
- Soil testing and chemical analysis would be completed prior to use in rehabilitation to confirm the quality of the stockpiled material and inform the use of any fertiliser to be applied to the rehabilitated areas.

4.2.3.6 Assessment of Impact

4.2.3.6.1 Soils

The management procedures set out in Section 4.2.3.5 for the soil resource have been designed to ensure the proper handling and management of soil stockpiles and to provide the maximum opportunity for successful rehabilitation of the Stage 2 Site. The practices have been developed based on the operating experience gained to date on the Stage 2 Site, which have been shown to be successful. Assuming the implementation of the proposed soil management measures, the impact associated with soil removal, storage and re-use is anticipated to be minimal.

4.2.3.6.2 Land Capability

Given the severe limitations on land use (Land Capability Class 6), the proposed soil management measures nominated in Section 4.2.3.5 and the rehabilitation procedures of Section 2.13.5, it is considered the final landform could be successfully rehabilitated to provide an equivalent land capability class.

4.2.4 Land Use

4.2.4.1 Existing Environment

The Stage 2 Site is situated on land zoned Rural (General) 1(a) under the Lithgow Local Environmental Plan (LEP), with the majority of land surrounding the Stage 2 Site also zoned for similar land use. In keeping with this zoning, the HPC-owned properties on which the Stage 2 Site is located and the larger properties to the south, west and north are operated as pastoral properties, are used primarily for cattle grazing, sheep grazing, cereal and fodder crops.

Land in the vicinity of the Stage 2 Site and the Quarry Access Road is currently used for minor grazing and short-term industrial machinery storage.

Other notable land uses of the local setting are as follows.

Conservation Areas

On Lot 31, DP1009967 and to the north of the Stage 2 Site is an area managed as part of a conservation agreement between HPC and OEH (National Parks & Wildlife Service) for the protection and conservation of habitat for the threatened *Eucalyptus pulverulenta*.

Also, and as a consequence of the steep terrain over significant portions of the HPC-owned properties, particularly to the south of the Coxs River, much of this land has severe limitations for agriculture (see also Section 4.2.2.3) and is managed primarily for passive biodiversity conservation (with occasional grazing for fuel management purposes).

Rural (Small Holdings)

Within and surrounding the villages of Hartley and Little Hartley to the north and northeast, along Coxs River Road to the east, and along Jenolan Caves Road to the west of the Stage 2 Site are smaller lots, many developed with residences under the Rural (Small Holdings) Zone 1(c) of the Lithgow LEP.

Recreation and Tourism

A camping ground used periodically by short-term campers (predominantly on weekends) is located adjacent to the Glenroy Bridge over the Coxs River. The camping ground is approximately 2.5km north of the Stage 2 Site. The Coxs River itself is used for various recreation activities such as fishing, hiking and camping, as well as for the amenity value it provides. It is important to note that access to the Coxs River is generally via private landholdings.

Bed & Breakfast style accommodation is also a feature of the local area, "The Peak at Mt Kanimbla" (26 Megalong Place, Kanimbla) approximately 6km (as the crow flies) from the Stage 2 Site being a notable example.

Jenolan Caves Road is also the primary route between Sydney (via the Great Western Highway) and the Jenolan Caves, a significant regional tourist feature.

Sydney Drinking Water Catchment

The Stage 2 Site is located within the Mid-Coxs River sub-catchment of the Warragamba Catchment, i.e. the upper reaches of the Sydney Drinking Water Catchment.

4.2.4.2 Potential Impacts of the Proposal

As the land to be disturbed as part of the Proposal is located on the lower class (Class 6) land of the HPC property, and the water required would be obtained under existing entitlements, the potential impact on agricultural land uses is negligible.

On the basis that the Proposal would not result in any significant change to the noise levels received or air quality at these locations (see Sections 4.7.6 and 4.8.7), the Proposal almost certainly would not impact on these land uses.

It is recognised that the Proposal requires the ongoing movement of heavy vehicles on Jenolan Caves Road. This could have a minor effect on the amenity of, or access to local and/or regional tourist / recreational features or facilities. As assessed in Section 4.3.6, however, when the level of traffic proposed and commitments made by the Applicant to effectively manage the transport fleet are considered objectively, this is unlikely to result in any great change to the current setting.

It is also noted that poor erosion and sediment control, or drainage management generally, on the Stage 2 Site could affect the water quality and aquatic environment of the Coxs River. This in turn could reduce the value of the Coxs River for recreational pursuits such as fishing, hiking and camping, or reduce the quality of water entering the Sydney drinking water supply. As assessed in Section 4.5.6, however, following the implementation of the proposed safeguards and controls, the likelihood of significant pollution to local waters which could impact on these land uses is very small.

Realistically, the only land use which could be significantly impacted by the Proposal would be the passive conservation undertaken on the HPC properties.

4.2.4.3 Operational Safeguards and Controls

Operational safeguards and controls focussed on reducing the impact of the Proposal on traffic, surface water, noise and air quality are described in Sections 4.3.5, 4.5.4, 4.7.4 and 4.8.5 respectively.

With respect to managing impacts on the passive biodiversity conservation which is a feature of the local setting, the Applicant has:

1. provided for the rehabilitation of the extraction area and overburden emplacement to a return to native vegetation (see Section 2.13.5); and
2. included a biodiversity offset strategy to compensate for the temporary loss in biodiversity attributable to the proposed quarry extension (see Section 2.14).

In order to ensure that those sections of the Stage 2 Site with a higher land capability are returned to agricultural use, the Applicant has provided for rehabilitation of the secondary processing area and Yorkeys Creek stockpile area back to agricultural land. As these areas form part of the existing Austen Quarry, there has been no classification of the pre-disturbance land capability. However, it is considered reasonable to achieve a land capability of Class 4 or better (i.e. land which provides for grazing, intermittent cultivation with specialised practices) reflecting the land use on other areas within of the HPC properties.

4.2.4.4 Assessment of Impact

On the basis that the Proposal would realistically only impact on the passive biodiversity conservation of the Stage 2 Site, and considering the proposed rehabilitation and biodiversity offset measures proposed to mitigate and compensate for this temporary impact, the impact of the Proposal on local land uses would be minimal.

An assessment of the impact of the Proposal on agricultural resources more generally is provided in Section 4.14.

4.2.5 Extractive Material Resources

Section 2.4 describes the geology of the Stage 1 and Stage 2 extraction areas and exploration methods and processes undertaken to determine the size and quality of the resource. Section 2.4 also describes the intended final products of the quarry. The resources defined within the Stage 2 extraction area have been assessed to be comparable to the resources within the Stage 1 extraction area. Hence, the Applicant proposes to continue to produce the same range of quality products.

4.3 TRAFFIC AND TRANSPORTATION

4.3.1 Introduction

The DGRs issued for the Proposal identified "*Traffic and Transport*" as a key issue, requiring that the "*EIS include:*

- *accurate predictions of the road and rail traffic generated by the construction and operation of the development;*
- *an assessment of potential traffic impacts on the safety and efficiency of the road network; and*
- *a detailed description of the measures that would be implemented to maintain and/or improve the capacity, efficiency and safety of the road and rail networks in the surrounding area over the life of the development.*

The DGRs also made reference to the need to take into account two RTA documents entitled "Guide to Traffic Generating Developments" (RTA, 2002) and the "Road Design Guide"[1].

Additional matters for consideration in preparing the EIS were also provided in the correspondence attached to the DGRs from the NSW Roads and Maritime Services (RMS) Division of Resources & Energy (DRE), Lithgow City Council (LCC) and Blue Mountains City Council (BMCC). The additional matters are outlined as follows.

RMS

- Consider the potential impacts to the safety and efficiency of the classified road network.
- The EIS should include a Traffic Impact Assessment (TIA) that takes into account the key issues relevant to the scale of this proposal as set out in *Table 2.1* of the Roads and Traffic Authority "Guide to Traffic Generating Developments".
- The impact of the proposed development on the surrounding road network.
- The number and type of vehicles required to service the quarry.
- Details of existing and proposed access conditions.
- Intersection sight distances.
- Impact on Transport (i.e. School Bus Routes).
- Road traffic noise and dust generation.
- Considerations for mining & extractive industries under Clause 16(1) of the State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007; and
- The TIA should consider the Austroads "Checklist for Traffic Impact Assessments" that is *Appendix A* of the Guide to Traffic Management Part 12: Traffic Impacts of Development 2009 (provided with the agency submission accompanying the DGRs).

[1] The Road Design Guide has been superseded by the Austroads "Guide to Road Design" series and RMS Supplements.

DRE
- Document route(s) used to transport quarry products to market.

LCC
- Consider the need for upgrades to the Glenroy Bridge based on the total number of trucks expected to use the bridge each day.

BMCC
- Consider the risks associated with heavy truck transport of materials as they cross the Blue Mountains.
- Consider rail transport as an alternative transportation method of materials.

Based upon the risk analysis undertaken for the Proposal (Section 3.3.1 and **Table 3.9**), the potential impacts relating to traffic and transport-related issues and their risk rankings (in parentheses) after the adoption of the existing mitigation measures are as follows.

- Ongoing truck traffic and possible congestion noticed by other motorists (medium).
- Deterioration of the road surface (low).
- Ongoing truck traffic influencing business owners and tourist facility operators throughout the Blue Mountains (low).
- Ongoing truck traffic (noise and vehicle emissions) noticed by residents living adjacent to or near the Great Western Highway (moderate).
- Periodic death or injury to native animals crossing the transport route (moderate).

A road transport assessment for the Proposal was undertaken by GTA Consultants (NSW) Pty Ltd. The assessment is presented as Part 1 of the *Specialist Consultants Studies Compendium* and is referred to hereafter as "GTA Consultants (2014)".

Both the road traffic assessment and the EIS have been prepared with reliance placed upon the Applicant's considerable experience with its existing transport operations. The Applicant is mindful that the transportation of quarry products to its concrete plants and customers is fundamental to the success of its entire business. As a consequence of this importance, the Applicant has placed and will continue to place emphasis upon the safe and efficient delivery of its quarry products with least impacts upon other motorists, road users and roadside residents and businesses.

It is noted that the Austen Quarry is fully constructed and operational and hence there will be no requirements for any construction or site establishment phase.

This section provides a summary of the report prepared by GTA Consultants (2014), concentrating on those matters raised in the DGRs and accompanying documentation raised by various government agencies and throughout the community consultation program. It is noted that the request by Blue Mountains City Council for the EIS to "consider rail transport as an alternative transportation method of materials" has been specifically addressed in Section 2.15.6 of the EIS. A consolidated list of the identified requirements relating to traffic and transportation, and where each is addressed, is presented in **Appendix 3**. GTA Consultants (2014) also incorporates tabulated requirements nominated by the RMS and where they are addressed in the Traffic Impact Assessment. The EIS incorporates the key requirements nominated by RMS. Matters relating to road traffic noise and dust generation are addressed in Sections 4.9 to 4.10 respectively.

4.3.2 Existing Road Transport Environment

4.3.2.1 Introduction

The components of the existing road transport environment currently used by heavy and light vehicles travelling to and from the Austen Quarry are described in this subsection. Also detailed is the existing contribution that the traffic to and from the Austen Quarry makes to the road transport environment.

4.3.2.2 Road Network

The road network used by heavy and light vehicles travelling to and from the Austen Quarry is displayed in **Figure 4.7**. For the purposes of this document, the road network is described as either "local" i.e. from Mount Victoria to Lithgow or "regional" i.e. from Emu Plains to Mount Victoria. These descriptors relate to the spread of the Applicant's customers and trucks on the road network, not the designation of the roads within any formal road hierarchy.

The key road servicing the Austen Quarry is the Great Western Highway, a State highway that provides access between Sydney (at Railway Square) and Bathurst. The highway coincides with many other named roads between Railway Square and Lapstone in the Lower Blue Mountains, however, is designated as the "Great Western Highway" or "A32" through the entire Blue Mountains Local Government Area. Vehicles travelling from Lapstone to Hartley traverse approximately 70km of the Great Western Highway.

Access from the Great Western Highway to the Quarry Access Road near Hartley is via Jenolan Caves Road, also designated a State road or "253". This road intersects with the Great Western Highway approximately 11km west-northwest of Mount Victoria and 12km southeast of Lithgow and provides access to both Jenolan Caves and Oberon. The intersection of Jenolan Caves Road with the Great Western Highway (and Blackmans Creek Road) is a four-way priority-controlled intersection with priority for highway traffic. A left-turn deceleration lane and a right-turn bay are provided on the Great Western Highway for vehicles turning into Jenolan Caves Road. Vehicles travelling from the Great Western Highway traverse approximately 4.3km of Jenolan Caves Road to the quarry entrance.

Access from Jenolan Caves Road to the product stockpile areas within the Austen Quarry is achieved via the 3.1km Quarry Access Road commencing at the quarry entrance. This is a private road constructed specifically to provide access from the quarry to the main road network. The intersection between the Quarry Access Road and Jenolan Caves Road has already been widened to provide an auxiliary right turn (AUR) treatment and auxiliary left turn (AUL) treatment which allow through traffic on Jenolan Caves Road to pass vehicles slowing to turn right or left into the quarry.

4.3.2.3 Road Conditions

Great Western Highway

The section of the Great Western Highway used by vehicles travelling between the Austen Quarry and the Sydney metropolitan area comprises mainly divided roads with two travel lanes in each direction between Lapstone and Katoomba. **Figure 4.8** displays the alignment of the Great Western Highway between Hartley and Emu Plains.

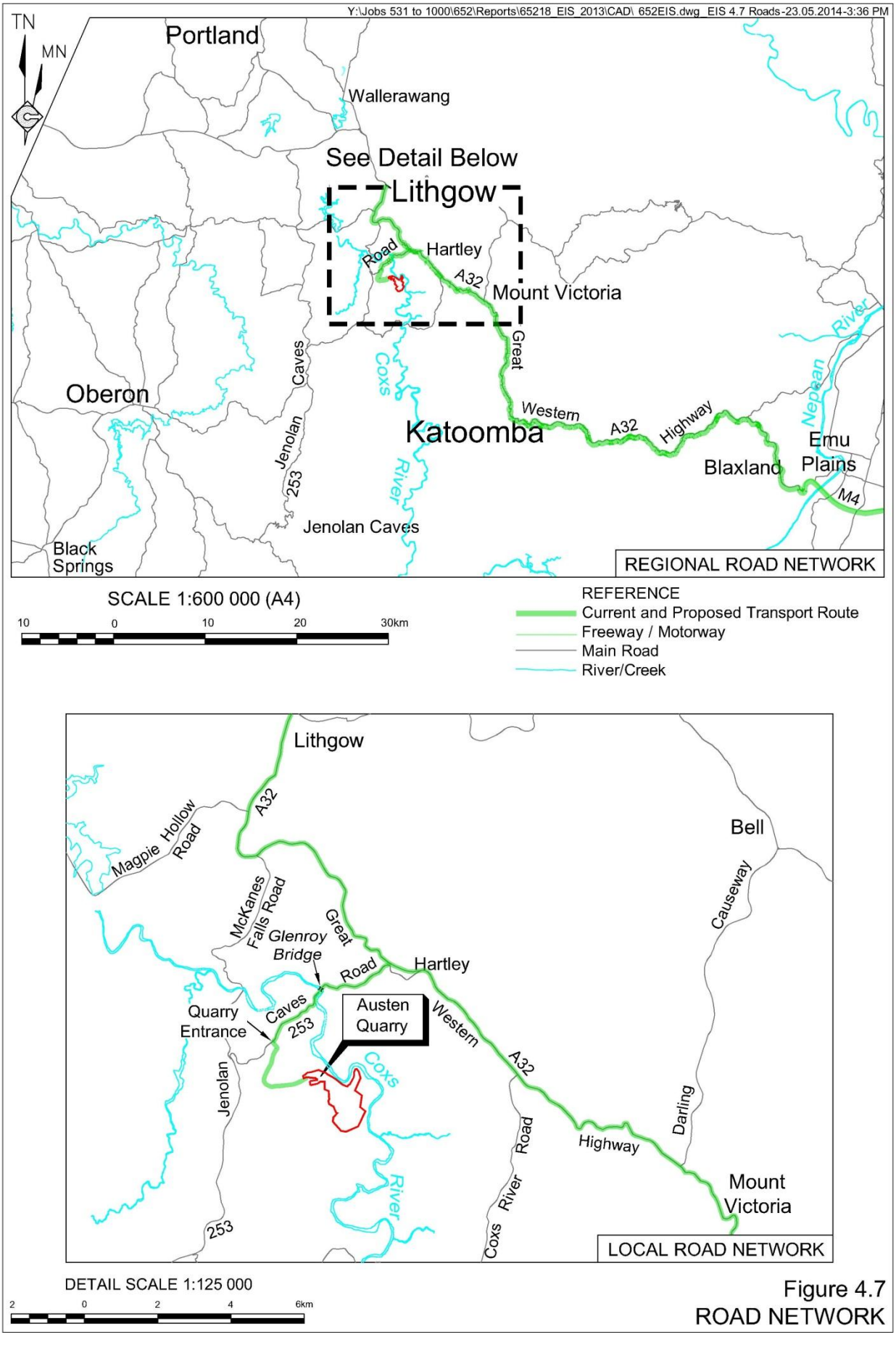


Figure 4.7
ROAD NETWORK

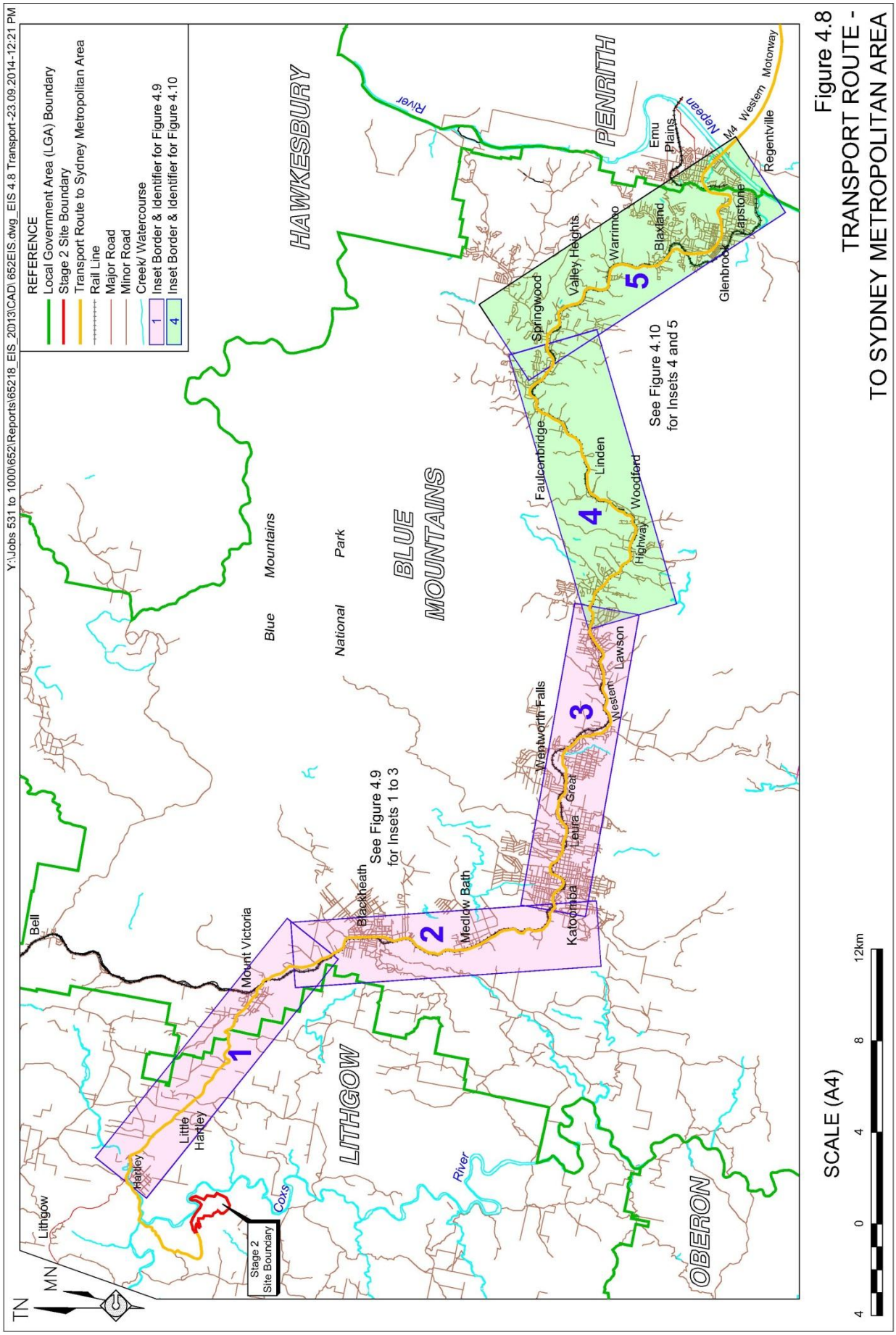


Figure 4.8
TRANSPORT ROUTE - TO SYDNEY METROPOLITAN AREA

The upgrading of the final 7.7km of the 43km of the highway between Lapstone and Katoomba is due to be completed by approximately 2016. The dual lane sections of the highway completed to date have been constructed to a high standard specifically to cater for the heavy vehicles that travel through the Blue Mountains. The proposed upgrades of the Great Western Highway between Katoomba and Lithgow are discussed further in Section 4.2.3.2.

The section of the Great Western Highway between Katoomba and Hartley is predominantly single lane in each direction with various slow vehicle passing lanes strategically placed in those areas with considerable topographic relief. The road pavement on this section of the highway is typically 9m wide, providing 3.5m wide travel lanes and 1m sealed shoulders. This section of the highway is marked with both centre lines and edge lines.

Figures 4.9 and **4.10** display the speed and related zones along the Great Western Highway through the Blue Mountains. Speed zones regularly change through the Blue Mountains with a total of 36 changes, including the eight defined school zones applicable from 8:00am to 9:30am and 2:30pm to 4:00pm on school days.

A summary of the speed zones is as follows.

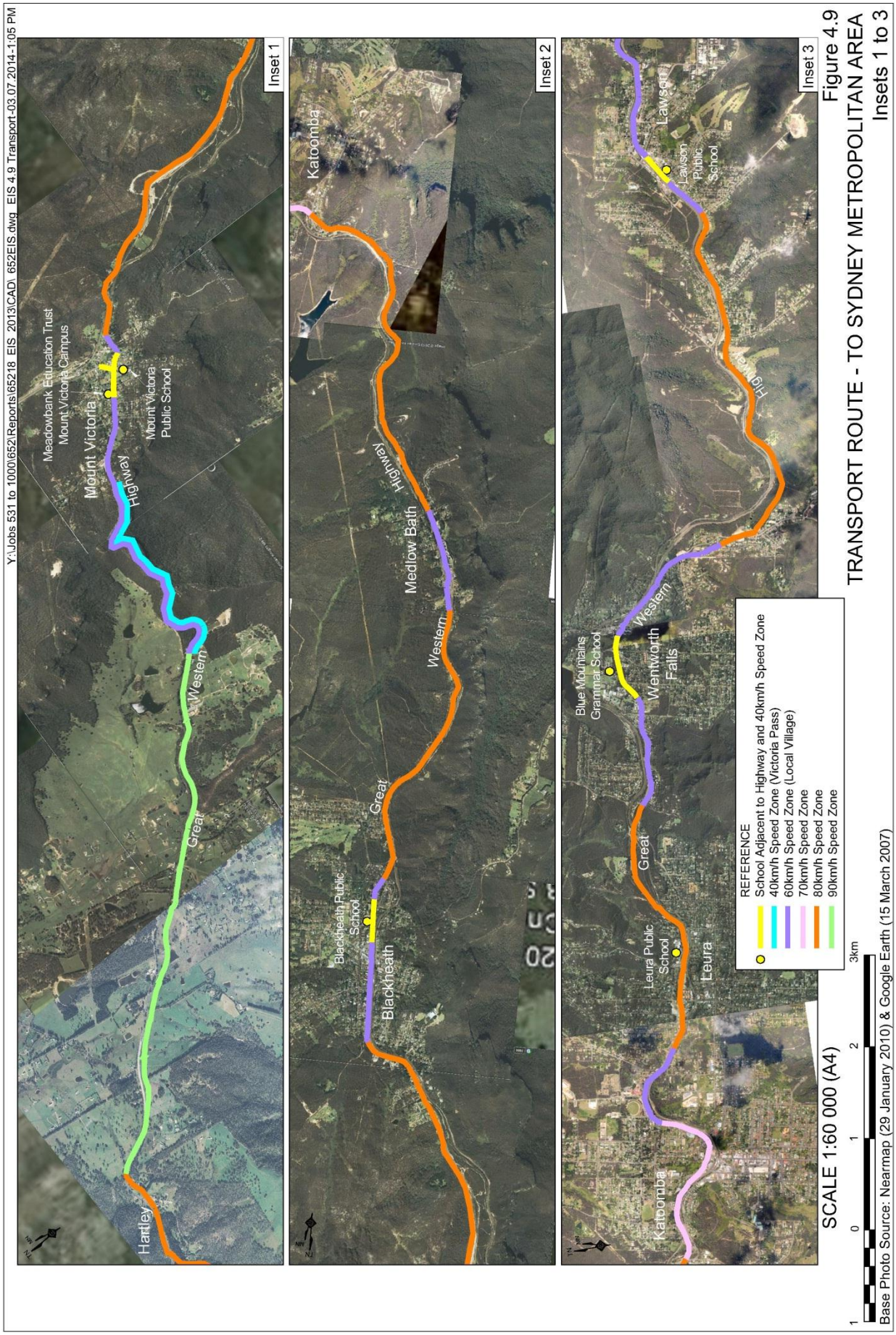
- 40km/h – 3.8km (8 School Zones).
- 40km/h – 7.7km (Current Road Works).
- 60km/h – 25.0km (Includes all school zones / all vehicles).
  19.8km (Includes all school zones / heavy vehicles).
- 70km/h – 8.9km (two sections).
- 80km/h – 30.8km (ten sections).

Two sections of the Great Western Highway have 60km/h speed restrictions for heavy vehicles when travelling eastwards through the Blue Mountains, namely at Linden/Faulconbridge (1.8km) and east of Glenbrook (3.4km).

The section of the Great Western Highway used by vehicles travelling to and from the Austen Quarry from Lithgow comprises mainly a single travel lane in each direction with various passing lanes both up and down River Lett Hill. Sections of the highway on River Lett Hill also have centre dividing concrete jersey kerbs. The pavement along this section of the highway is in excellent condition as most of it has recently been upgraded. The pavement is typically approximately 9m wide with 3.5m wide travel lanes and centre and edge line markings. The section of the highway from the top of River Lett Hill to east of Lithgow is referred to as the "Forty Bends".

Jenolan Caves Road

The 4.3km section of Jenolan Caves Road between the Great Western Highway and the Quarry Access Road comprises a single travel lane in each direction with a sealed width of approximately 6.5m, sealed shoulders of variable width and marked centre lines and edge lines. The condition of the road pavement along the section of Jenolan Caves Road between the Great Western Highway and the Quarry Access Road is very good. Jenolan Caves Road crosses the Coxs River approximately 2.2km south of the Great Western Highway over the Glenroy Bridge. The approaches to the northern and southern sides of the bridge were upgraded (funded by Hy-Tec) in late 2012 to remove general depressions between the bridge deck and its approaches that were contributing to impact noise as vehicles entered onto and departed from the bridge.


Y:\Jobs 531 to 1000\652\Reports\65218 EIS 2013\CAD\ 652EIS.dwg EIS 4.9 Transport-03.07.2014-1:05 PM
Inset 1
Inset 2
Inset 3
Meadowbank Education Trust Mount Victoria Campus
Mount Victoria
Mount Victoria Public School
Highway
Western
Great
Hartley
Katoomba
Medlow Bath
Blackheath Public School
Blackheath
Lawson
Lawson Public School
Blue Mountains Grammar School
Wentworth Falls
Leura Public School
Leura
REFERENCE
School Adjacent to Highway and 40km/h Speed Zone
40km/h Speed Zone (Victoria Pass)
60km/h Speed Zone (Local Village)
70km/h Speed Zone
80km/h Speed Zone
90km/h Speed Zone
SCALE 1:60 000 (A4)
3km
Base Photo Source: Nearmap (29 January 2010) & Google Earth (15 March 2007)
Figure 4.9
TRANSPORT ROUTE - TO SYDNEY METROPOLITAN AREA
Insets 1 to 3

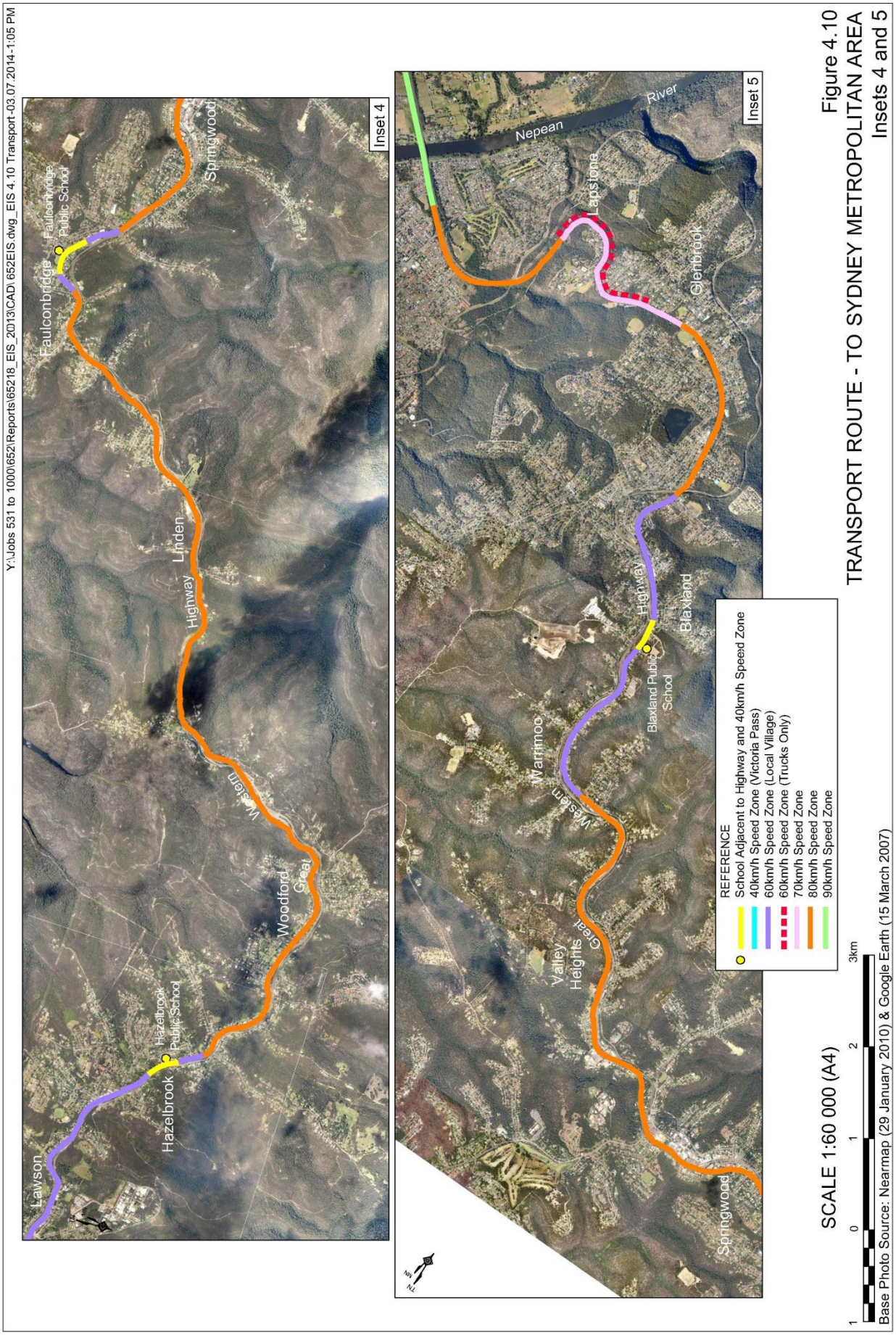


Figure 4.10
TRANSPORT ROUTE - TO SYDNEY METROPOLITAN AREA
Insets 4 and 5

There are no passing lanes along Jenolan Caves Road between the Great Western Highway and the quarry entrance as there are numerous bends and either hilly or vegetated land adjoining the road thereby limiting visibility for motorists. The sign-posted speed limit along the full length of Jenolan Caves Road between the Great Western Highway and the quarry entrance is 80km/h, with lower advisory speeds at selected locations.

Quarry Access Road

The 3.1km Quarry Access Road has a single travel lane in each direction with a sealed width of approximately 10m. The road is marked with both centre lines and edge lines. The road is in a good condition with only a couple of sections where the pavement requires periodic maintenance. The Quarry Access Road is fenced for most of its length to prevent stock from the adjoining pastures crossing the road. The signposted speed limit on the Quarry Access Road is 80km/h.

4.3.2.4 Traffic Volumes, Composition and Road Capacity

Great Western Highway

The Great Western Highway provides the major road freight, tourist and commercial link between Sydney and the central west and western New South Wales. Vehicles travelling through the Blue Mountains comprise light vehicles, motor bikes, vans, 4WDs, cars with caravans, buses, coaches and trucks of varying configurations including B-doubles. The Great Western Highway also serves local community trips, local freight and industry and tourist trips. These vehicles comprise light vehicles, 4WDs, vans, mini-buses, school buses, delivery or service vehicles and trucks of varying configurations.

RMS has published little recent data about traffic types and volumes travelling along the Great Western Highway through the Blue Mountains. GTA Consultants (2014) has reviewed a range of traffic counts on the Great Western Highway collected by RMS between Blackheath and Faulconbridge between 2009 and 2013. These counts together with traffic volumes assembled by Evans and Peck (2012) between Forty Bends and Mt Victoria has enabled GTA Consultants to assemble a profile of daily total and heavy vehicle traffic through the Blue Mountains for 2015, i.e. comparable to existing traffic levels. **Table 4.2** lists the estimated total traffic volumes and heavy vehicles travelling along the Great Western Highway between Little Hartley and Faulconbridge in 2015.

Table 4.2 also records the estimated proportion that trucks travelling to and from the Austen Quarry account for in terms of total traffic and heavy vehicles, i.e. based on the current average (which is assumed to include truck movements from the Austen Quarry) and maximum traffic movements (which would include additional truck movements from the Austen Quarry). It is noted that the Austen Quarry trucks typically account for less than 1% of total traffic travelling through the Blue Mountains and between 4.4% and 8.8% of the heavy vehicles.

Table 4.2
Estimated Daily Traffic Volumes on Great Western Highway in 2015

Location	Vehicles/Day	Heavy Vehicles/Day (Av = 12%)	Austen Quarry Trucks[x1]			
			Total Vehicles		Heavy Vehicles	
			% Average Day	% Maximum Day	% Average Day	% Maximum Day
Little Hartley	11 100	1 333	1.42	2.54	11.85	19.52
Victoria Pass	14 900	1 788	1.06	1.06	8.84	14.88
Blackheath	17 990	2 159	0.88	0.88	7.32	12.47
Medlow Bath	19 750	2 370	0.80	0.80	6.67	11.41
Leura	28 600	3 432	0.55	0.55	4.60	8.01
Wentworth Falls East	30 070	3 608	0.53	0.53	4.38	7.63
Bullaburra	26 520	3 182	0.60	0.60	4.97	8.61
Lawson	28 900	3 468	0.55	0.55	4.56	7.93
Woodford	28 510	3 421	0.55	0.55	4.62	8.03
Faulconbridge	28 690	3 443	0.55	0.55	4.59	7.98
x1 Average Daily Truck Trips = 166 / Maximum Daily Truck Trips = 288						
2015 Traffic Source: Modified after GTA Consultants (2014) – Tables 4.2 and 4.3						

Jenolan Caves Road

Data on traffic volumes on Jenolan Caves Road to the north and south of the Quarry Access Road was collected through tube traffic counts between Friday, 8 March 2013 and Thursday, 21 March 2013. **Table 4.3** lists the recorded daily traffic volumes at both locations. GTA Consultants (2014) note that data recorded on Saturday, 9 March 2013 and Sunday, 10 March 2013 was uncharacteristically high due to a local event, "the Six Foot Track Marathon" that finished at Jenolan Caves and hosted 800 entrants as well as spectators. As the results indicate a level of usage well in excess of the non-event weekend, the assessment of Saturday conditions on Jenolan Caves Road by GTA Consultants (2014) did not include the data collected on Jenolan Caves Road on 9 and 10 March 2013.

The data collected in March 2013 also established the average weekday daily traffic composition. **Table 4.4** lists the recorded traffic composition, i.e. distinguishing between:

- light vehicles (motor cycles, cars, vans, 4WDs or utilities (including those towing a trailer or caravan);
- single unit "rigid" trucks and buses (with two or four axles); and
- articulated vehicles such as semi-trailers, rigid trucks, B-doubles and road trains.

The data in **Table 4.4** indicates that the rigid and articulated heavy vehicles on Jenolan Caves Road account for approximately 21% of the total traffic travelling south of the quarry entrance and 30% north of the quarry entrance on an average weekday, i.e. the trucks arriving and departing from the quarry at that time increased the percentage of heavy vehicles in the total traffic by 9%. It is understood that the heavy vehicle traffic recorded south of the quarry entrance is attributable to a range of timber-related industries in Oberon and two quarries near Oberon, namely the Oberon Quarry (Oberon Quarries) and Oberon White Granite Quarry (Mudgee Stone Company). The recorded traffic data for the sites on Jenolan Caves Road indicate that trucks travel on this section of road 24hrs per day seven days per week.

Table 4.3
Surveyed Daily Two Way Traffic Levels on Jenolan Caves Road and the Quarry Access Road (vehicles/day)

Day and Date	Jenolan Caves Road North of Quarry Access Road	Jenolan Caves Road South of Quarry Access Road	Quarry Access Road
Friday 8 March	1 432	1 233	232
Saturday 9 March	1 964	1 866	108
Sunday 10 March	1 815	1 766	18
Monday 11 March	1 132	1 087	266
Tuesday 12 March	1 077	852	231
Wednesday 13 March	1 087	824	224
Thursday 14 March	1 052	895	240
Friday 15 March	1 301	1 096	258
Saturday 16 March	1 332	1 267	132
Sunday 17 March	1 389	1 456	11
Monday 18 March	1 169	862	285
Tuesday 19 March	1 201	814	303
Wednesday 20 March	1 165	849	272
Thursday 21 March	1 186	947	246
Average Weekday	**1 180**	**946**	**256**
Average Day	**1 307**	**1 130**	**202**

Source: GTA Consultants (2014) – Table 3.4

Table 4.4
Surveyed Average Weekday Daily Traffic Composition on Jenolan Caves Road and Quarry Access Road (March 2013)

	Jenolan Caves Road north of Austen Quarry		Jenolan Caves Road south of Austen Quarry		Quarry Access Road	
Vehicles per Weekday	**No.**	**%**	**No.**	**%**	**No.**	**%**
Light	823	69.8	748	79.1	85	33.5
Rigid	70	5.9	53	5.6	16	6.3
Articulated	286	24.3	145	15.3	153	60.2
Vehicles per Saturday						
Light	1 480	89.8	1 470	93.8	40	33.3
Rigid	76	4.6	70	4.5	0	0.0
Articulated	92	5.6	26	1.7	80	66.7

Source: Modified after GTA Consultants (2014) – Table 3.5.

Quarry Access Road

Table 4.4 recorded an average of 256 vehicles per day travelling on the Quarry Access Road on the weekdays during the recording period in March 2013. Approximately two-thirds of the vehicles on the Quarry Access Road were heavy vehicles. A separate review of weighbridge data from the quarry office suggests that truck movements recorded arriving and leaving the quarry have periodically approached 300 per day. On those days, heavy vehicles would account for 75% to 80% of total traffic on the Quarry Access Road.

GTA Consultants (2014) also collected data which shows that the busiest hours for heavy vehicle movements on the Quarry Access Road were between 5:00am and 6:00am and 5:00pm and 6:00pm. These busiest hours did not coincide with the busiest hours on Jenolan Caves Road which typically occurred late morning and between 4:00pm and 5:00pm.

Road Capacity

The capacity of a road is defined as the maximum hourly rate at which vehicles can reasonably be expected to traverse a point or uniform section of a lane or roadway during a given time period under the prevailing roadway, traffic and control conditions. The capacity of a single traffic lane will be affected by factors such as the pavement width and restricted lateral clearances, the presence of heavy vehicles and grades.

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

GTA Consultants (2014) established that the LOS for Jenolan Caves Road and the Quarry Access Road was "A" for both the AM and PM weekday peak periods. A Level of Service "B" was calculated for Jenolan Caves Road on a Saturday reflecting the higher volume of background traffic on weekends, which is unrelated to the Austen Quarry.

4.3.2.5 Intersection Operations and Performance

Two key intersections are relevant to the Proposal, i.e. those where turning movements are undertaken by quarry traffic, namely:

i) Quarry Access Road/Jenolan Caves Road; and

ii) Jenolan Caves Road /Great Western Highway/Blackmans Creek Road.

Beyond these intersections, vehicles travelling to and from the Austen Quarry are effectively on the Great Western Highway where no turning movements are required.

For vehicles entering Jenolan Caves Road from the Quarry Access Road, the available sight distance is approximately 200m to the north and south. For vehicles entering the Great Western Highway from Jenolan Caves Road, the available sight distance is approximately 200m to the west and 400m to the east.

GTA Consultants (2014) undertook intersection turning movement surveys for 2.5 hours on a morning and an afternoon at each of the two intersections on 29 May 2013 which identified the busiest hours (for all traffic) and the proportion of turning traffic and direction. Two-way traffic volumes on the intersection approaches are displayed in **Table 4.5**.

Table 4.5
Weekday Peak Hour Two Way Traffic at Intersection Approaches (vehicles/hour)

Intersection and Approach	AM Peak Hour	PM Peak Hour
Jenolan Caves Road and Great Western Highway	7:30-8:30am	4:00-5:00pm
Blackmans Creek Road (North)	9	6
Great Western Highway (East)	527	618
Jenolan Caves Road (South)	58	79
Great Western Highway (West)	482	553
Jenolan Caves Road and Quarry Access Road	8:45-9:45am	4:15-5:15pm
Jenolan Caves Road (North)	77	73
Quarry Access Road (South)	19	18
Jenolan Caves Road (South)	60	61
Source: GTA Consultants (2014) – Table 3.8		

During the entire 2.5 hour morning survey periods, the quarry generated a total of 20 inbound and 15 outbound trips. During the entire 2.5 hour evening survey period, the quarry generated a total of 15 inbound and 26 outbound trips. A small number of these trips may have been generated by the lessee of the adjacent land, whose vehicles also use the Quarry Access Road.

Throughout the survey period, all heavy vehicle movements in and out of the Quarry Access Road were to and from the north. Approximately 82% of light vehicles generated by the Austen Quarry travelled to and from the north, and 18% of light vehicles travelled to and from the south.

GTA Consultants (2014) undertook an analysis of the operating performance of both intersections using *SIDRA Intersection* (SIDRA), a computer-based modelling package which calculates intersection performance characteristics including the degree of saturation, average delays and levels of service.

Both intersections operate at a satisfactory level of service with the highest average delays being approximately 35 seconds per vehicle and 29 seconds per vehicle for vehicles turning right from Jenolan Caves Road onto the Great Western Highway during the morning and evening peak hours respectively. A significant portion of the delay is that associated with physically negotiating the turn rather than the delay waiting for a gap in the traffic.

Further details of the results of the SIDRA analysis are provided in GTA Consultants (2014).

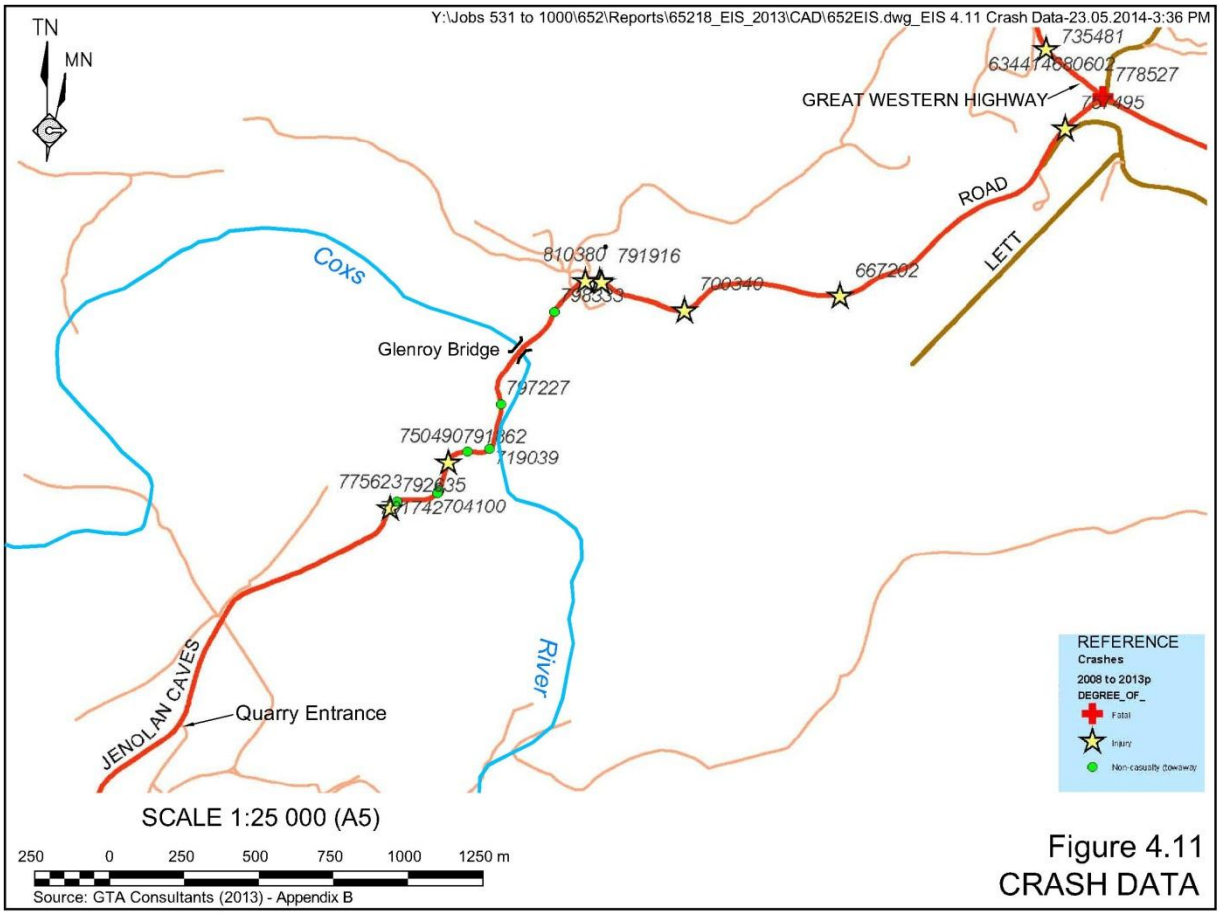
4.3.2.6 Road Safety

Jenolan Caves Road

An appreciation of the safety record of Jenolan Caves Road between the quarry entrance and the Great Western Highway has been established through reference to validated crash data reported to Police and recorded by the RMS.

Figure 4.11 displays the locations of 19 crashes that occurred along Jenolan Caves Road during the period 2008 to 2013 between the quarry entrance and the Great Western Highway.

The majority of crashes involved a single vehicle leaving the road and typically striking an object such as an embankment or fence. Speed was a contributing factor in all of these crash types, and all occurred on bends on Jenolan Caves Road. Half of the reported crashes of this type occurred on a wet road surface.



The two crashes between vehicles travelling in opposing directions were each head-on crashes which involved a car (or similar) and semitrailer, one of which was fatal and occurred at the intersection with the Great Western Highway. In each of these cases, the records suggest that the car (rather than the semitrailer) was travelling on the incorrect side of the road.

Great Western Highway

Validated crash data reported to Police and recorded by the RMS for the 5 year period from 1 July 2008 to 30 June 2013 recorded a total of 1327 crashes on the Great Wester Highway between Lapstone and Lithgow. Of these crashes, approximately 70% were either:

- single vehicles which lost control and left the roadway (39%); or
- intersection-type crashes (32%).

Approximately 12% of all crashes on the Great Western Highway involved a rigid or articulated truck. GTA Consultants (2014) provide further commentary on the crash statistics through the Blue Mountains.

Austen Quarry Traffic

The Applicant has maintained records of accidents/incidents involving heavy vehicles travelling to and from the Austen Quarry since 2005. These records show that over that period, only one accident has occurred involving a truck travelling from the quarry. As noted above, the accident was a result of the car involved travelling on the wrong side of the road.

4.3.2.7 School Bus Services

School bus routes for both primary and secondary school students are located along the Great Western Highway to transport children between Lithgow, Hartley and the Blue Mountains. A single bus route uses Jenolan Caves Road in the vicinity of the Quarry however this bus does not stop between the quarry entrance and the Great Western Highway. Bus services are operated by the Blue Mountains Bus Company and Lithgow Bus Lines. Operations managers of both companies were contacted to determine general routes, peak travel times and other relevant information.

The majority of school bus services in the Blue Mountains are operated by the Blue Mountains Bus Company that provides buses between Mount Victoria and schools in Orchard Hills and Kingswood. Buses use the Great Western Highway for pick-up and drop-off for the length of the journey except for the west-bound journey between Lawson and Linden where buses leave the highway. Lithgow Bus Lines operates most of the school bus routes in Lithgow and surrounding areas such as Hartley and Hampton. The Great Western Highway is used for routes between Lithgow and Hartley as well as routes to the Blue Mountains. A summary of peak times and bus numbers is provided in **Table 4.6**.

Both operators utilise designated stops along all routes, though many of these consist of household driveways. Neither operator has received complaints from parents or reports from bus drivers regarding child safety in relation to existing heavy truck traffic. Both operators indicated that the continuing road improvements would be of benefit to their operations once completed but highlighted their frustration at the removal of key bus stops. The Blue Mountains Bus Company also highlighted the effectiveness of speed limiting heavy vehicles in the Blue Mountains in maintaining safety. Both companies indicated that heavy truck transport was not limiting their operations and not creating safety concerns for students.

Table 4.6
Bus Services and Peak Hours in Blue Mountains and Lithgow

Bus Operator	Number of Buses	AM Peak Period	PM Peak Period
Blue Mountains Bus Company	AM Peak - 61 PM Peak - 64	7:00-8:30am	2:45-5:30pm
Lithgow Bus Lines	6	7:00-9:00am	3:00-5:00pm
Source: Blue Mountains Bus Company and Lithgow Bus Lines			

4.3.3 Future Road Transport Environment

4.3.3.1 Introduction

Throughout the life of the Proposal, the road network used by vehicles travelling to and from the Austen Quarry will continue to be upgraded and traffic levels from all other sources will continue to increase. This section reviews the documented proposed improvements to the road network and projected traffic movements unrelated to the Proposal. It is noteworthy that a number of the proposed road improvements between Mount Victoria and Lithgow will themselves be destinations for quarry products from the Austen Quarry.

4.3.3.2 Road Network

The road network currently used for vehicles to travel to and from the Austen Quarry would continue to be used for the life of the Proposal, i.e. until at least 2050. During the coming years, the RMS has two sets of planned road works along the Great Western Highway between Mount Victoria and Lithgow.

A range of upgrade works are planned to enable the design speed of the highway to be increased to 90kph and to improve safety at nine intersections with the highway, including the Jenolan Caves Road intersection. The proposed upgrade work at this intersection outlined in RMS (2013) would comprise the following works.

- Retain existing turning lanes.
- Westbound traffic limited to one lane at the intersection.
- Increase the length of the right turn bay into Jenolan Caves Road.
- Tie into vertical levels of highway.
- Adjust the vertical level of Jenolan Caves Road to match the level of the highway.
- Widen shoulders northwest of intersection.

A range of other upgrades are proposed along the highway to improve safety for all vehicles.

In the longer term, the RMS proposes to upgrade the Great Western Highway from Mount Victoria to Lithgow to a standard similar to the current standard of the highway east of Katoomba (Mount Victoria to Lithgow Alliance, 2013) with two travel lanes in each direction and a separating median. **Figure 4.12** displays the concept design for this section of road, as at April 2013. As part of the upgrade, RMS proposes to construct a bypass at River Lett Hill (to the south of the existing alignment) including safer access to Jenolan Caves Road and Blackmans Creek Road via an interchange.

It remains RMS's long term objective to also upgrade the Great Western Highway from Katoomba to Mount Victoria in the same manner thereby improving safety for all motorists using the highway.

4.3.3.3 Traffic Volumes and Composition

It is envisaged that the composition of traffic travelling on both Jenolan Caves Road and the Great Western Highway will remain comparable to the existing composition. However, RMS forecasts the traffic levels will increase typically at an average of 2% per year.

Great Western Highway

Table 4.7 displays the forecast traffic volumes on the Great Western Highway between Mount Victoria and Lithgow for a range of years up to 2035.

Table 4.8 displays the forecast traffic levels on the Great Western Highway between Blackheath and Faulconbridge at 5-yearly intervals up to 2035.

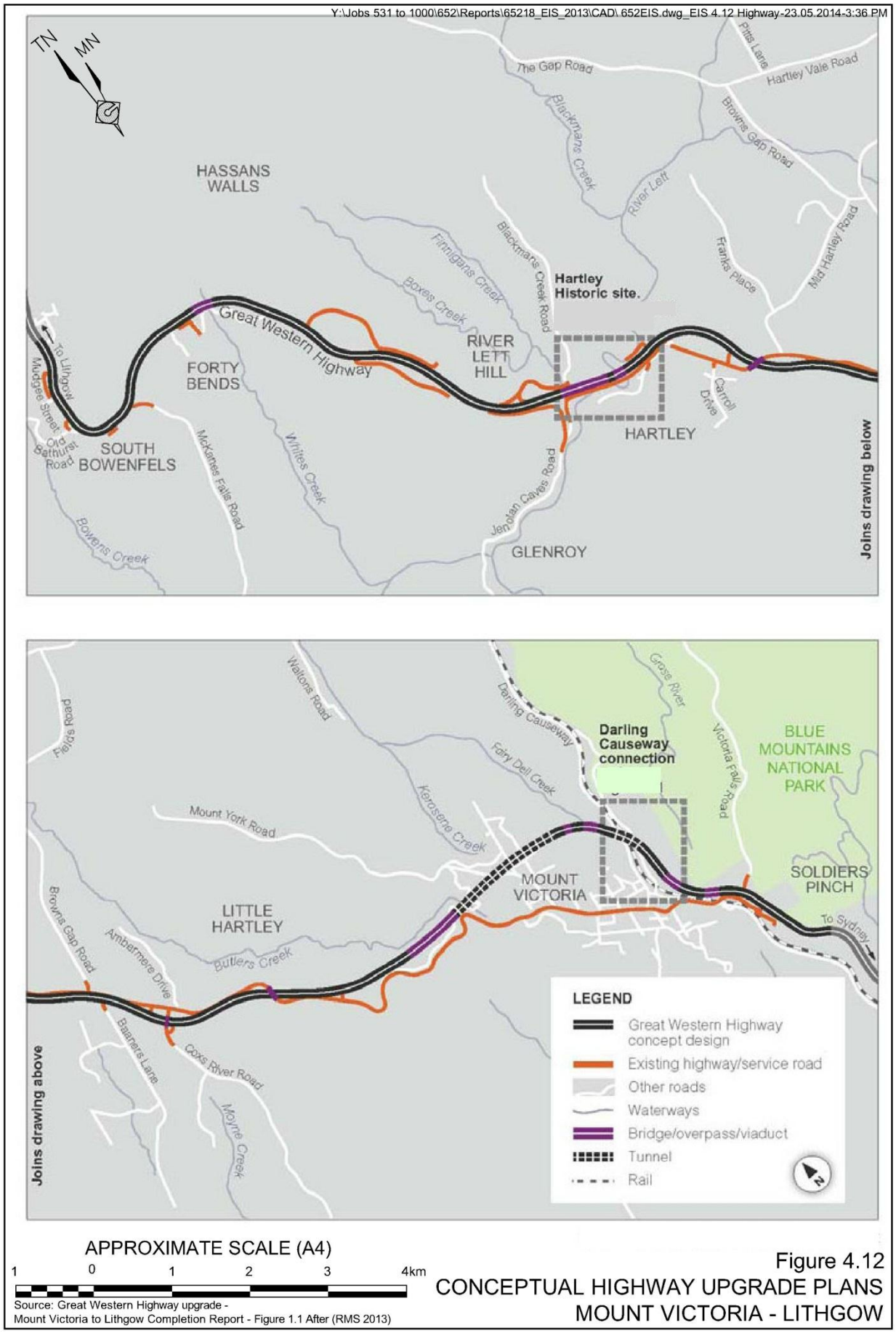


Figure 4.12
CONCEPTUAL HIGHWAY UPGRADE PLANS
MOUNT VICTORIA - LITHGOW

Table 4.7
Forecast Traffic Volumes on the Great Western Highway – Mount Victoria to Lithgow

Location	2011[AB]	2013	2015[A]	2020	2025[A]	2035[A]
Daily (vehicles/day)						
Forty Bends	7 900	8 150	8 400	9 150	9 900	11 800
Hartley	8 800	9 100	9 400	10 250	11 100	13 200
Little Hartley	10 400	10 750	11 100	12 100	12 100	15 600
Victoria Pass	14 000	14 450	14 900	16 250	17 600	21 000
AM Peak (vehicles/hour)						
Forty Bends	480	490	500	550	590	710
Hartley	530	550	560	610	660	790
Little Hartley	630	650	660	720	780	940
Victoria Pass	850	870	890	970	1 050	1 260
PM Peak (vehicles/hour)						
Forty Bends	650	680	700	770	830	980
Hartley	720	750	780	860	930	1 100
Little Hartley	860	900	930	1 020	1 100	1 300
Victoria Pass	1 150	1 200	1 240	1 360	1 480	1 740
A RMS daily forecasts B RMS peak hourly forecasts						
Source: GTS Consultants (2014) – Table 4.2						

Table 4.8
General Traffic Forecasts on Great Western Highway Through the Blue Mountains

Location	2015	2020	2025	2030	2035
Daily (vehicles/day)					
Blackheath* (99.231)	17 990	19 590	21 200	22 810	24 410
Medlow Bath* (99.913)	19 750	21 580	23 410	25 240	27 070
Leura* (99.042)	28 600	31 150	33 700	36 260	38 810
Wentworth Falls East	30 070	32 850	35 630	38 410	41 190
Bullaburra* (99.043)	23 460	25 670	27 880	30 090	32 310
Bullaburra	26 520	29 000	31 480	33 960	36 450
Lawson	28 900	31 340	33 810	36 280	38 750
Woodford-Hazelbrook	28 510	31 020	33 530	36 040	38 550
Faulconbridge* (99.914)	28 690	31 440	34 200	36 960	39 720
Peak Hourly (vehicles/hour)					
Blackheath* (99.231)	1 800	1 960	2 120	2 280	2 440
Medlow Bath* (99.913)	1 980	2 160	2 340	2 520	2 710
Leura* (99.042)	2 860	3 120	3 370	3 630	3 880
Wentworth Falls East	2 400	2 620	2 860	3 080	3 300
Bullaburra* (99.043)	2 350	2 570	2 790	3 010	3 230
Bullaburra	2 650	2 900	3 150	3 400	3 650
Lawson	2 280	2 480	2 680	2 860	3 060
Woodford-Hazelbrook	2 280	2 480	2 680	2 880	3 080
Faulconbridge* (99.914)	2 870	3 140	3 420	3 700	3 970
* 2% per annum growth on previously recorded levels					
Source: Modified after GTA Consultants (2014) – Table 4.3					

GTA Consultants (2014) notes that it is assumed the projected levels in both **Tables 4.7** and **4.8** reflect the current average level of production at the Austen Quarry and not the currently approved and proposed ongoing maximum production level at the quarry.

The increase in light vehicle trips related to the movement of the on-site workforce are assumed to be included in the background forecasts presented by RMS in **Table 4.8**.

4.3.4 Austen Quarry Traffic Generation

Products are despatched between 5.00am and 10.00pm Monday to Friday, and between 5:00am and 3:00pm on Saturdays, public holidays excluded. At its current production rate of 750 000tpa of quarry products, Austen Quarry generates an average of approximately 83 truck loads or 166 truck trips per weekday, up to a maximum of approximately 150 truck loads or 300 truck trips per weekday (a trip is a one way movement, so an unladen truck arriving at the quarry and departing laden from the quarry generates two trips).

As discussed in Section 2.8.3, the ongoing despatch of the current upper approved level of 1.1 million tpa would involve one of two scenarios on weekdays.

Scenario 1: **Predominantly Sydney Customers** (95% to Sydney / 5% local).
Average: 125 loads / 250 trips per weekday.
Maximum: 180 loads / 360 trips per weekday.

Scenario 2: **Sydney Customers and Local Road Works** (70% to Sydney / 30% local).
Average: 150 loads / 300 trips per weekday.
Maximum: 250 loads / 500 trips per weekday.

The corresponding number of loads and trips or movements for these scenarios are as follows.

Trips through the Blue Mountains

Scenario 1: 119 loads / 238 trips or movements on an average week day.
171 loads / 342 trips or movements on a peak week day.

Scenario 2: 105 loads / 210 trips or movements on an average week day.
170 loads / 340 trips or movements on a peak week day.

Trips for Local Deliveries

Scenario 1: 6 loads / 12 trips or movements on an average week day or Saturday.
9 loads / 18 trips or movements on a peak week day or Saturday.

Scenario 2: 45 loads / 90 trips or movements on an average week day.
80 loads / 160 trips or movements on a peak week day.

The level of truck traffic on a Saturday travelling through the Blue Mountains would typically be approximately 60% of the weekday traffic levels, i.e. 74 loads on an average Saturday and 105 loads on a busy Saturday. It is noteworthy that local deliveries to road construction projects would be minimal of a Saturday.

Light Vehicle Trips to and from the Austen Quarry

- 64 trips on a week day.
- 50 trips on a Saturday.

It is most likely that Scenario 1 would be the most common occurrence, except for those days when local projects are supplied, e.g. to supply RMS road works between Lithgow and Mount Victoria. In reality, there may only be two or three periods until 2050 when this level of local traffic would occur. On the days when local RMS road works are being supplied, it is highly unlikely that maximum traffic levels through the Blue Mountains would be achieved.

During the short-term campaigns to supply local RMS road works, when smaller capacity rigid trucks of (average) 15t capacity dominate trips to and from the quarry, a maximum of 25 truck loads or 50 trips or movements per hour could occur. For deliveries to the Sydney metropolitan area, when the dominant vehicle types entering and exiting the quarry are truck and dog trailer combinations or 19m B-Doubles, a maximum of 20 truck loads or 40 trips or movements per hour could occur.

The proposed average product transport distribution is indicated on **Figure 2.7**, i.e. approximately 95% of despatched products would be transported along the Great Western Highway to the east of Jenolan Caves Road, and 5% transported along the Great Western Highway to the west of Jenolan Caves Road. This distribution would vary when RMS road works or other local projects are being undertaken to the west of Jenolan Caves Road. It is anticipated that during these periods the proportion of product trucks from the quarry may reach approximately 30% to the west and 70% to the east. When RMS local road works are being undertaken between Hartley and Mount Victoria, the higher levels of product truck movements may also occur over that section of the Great Western Highway. As noted above, deliveries to supply to RMS road works projects would use smaller capacity rigid trucks. The majority of these deliveries would generally be completed by 11:00am.

It is Hy-Tec's intention to increase production and despatch of quarry products during the period to March 2020 to the level currently approved, i.e. 1.1 Mtpa. Beyond March 2020 to March 2050, the Applicant intends to maintain production between the current level of 750 000tpa and 1.1Mtpa. The actual level of product despatch would reflect the prevailing buoyancy in the building and construction industries together with substantial State and local government infrastructure projects. The traffic assessment assumes despatch of the maximum 1.1Mtpa beyond March 2020.

4.3.5 Management and Mitigation Measures

The Applicant proposes to continue to manage the transportation of the quarry products to its concrete batching plants and customers in a manner that causes least impact to other motorists and road-side residents and businesses.

Central to the Applicant's management of product transportation is the Company's "Chain of Responsibility: Driver – Vehicle Checks". The Applicant has developed the standard which applies at all of its quarries and involves all relevant personnel from managers through to drivers. Any person who is involved in consigning, packing, loading, despatching and/or driving any of the quarry products is required to undertake their tasks in accordance with the

standard. It similarly applies to a business which controls the use of a commercial vehicle and receiving goods or freight. An important component of the Standard is a Driver Fatigue Manual.

Each truck driver (and their representative contracting company) is required to sign the documentation acknowledging the Applicant's expectation of them and the intention to undertake random checks of both the driver's and vehicle's records.

The Applicant's expectation of drivers (and contractors) transporting its products from the Austen Quarry cover a whole range of issues relating to:

- the driver's compliance with all road laws, on-site requirements, alertness, driving behaviour, response to other motorists and the use of all relevant equipment e.g. truck covers; and
- the truck's compliance with all relevant laws and guidelines with respect to safety checks, noise levels and emissions.

Given the trucks delivering quarry products for the Austen Quarry enter directly onto a State road (Jenolan Caves Road) and then join the Great Western Highway, also a State road, the maintenance of both roads is funded by the State Government which draws funds from truck registrations and fuel levies.

There is no requirement for the Applicant to fund any road maintenance activities on public roads. The Applicant's discussions with Lithgow City Council regarding the need for further upgrade works on the Glenroy Bridge over the Coxs River established that no further works are required. The Council's enquiry followed the Applicant's agreement to fund the removal of raised sections at the northern and southern approaches to the Glenroy Bridge caused by the misalignment of the bridge deck and its approaches. This work was completed in late 2012 and has noticeably reduced impact noise when trucks leave the bridge when travelling both southwards and northwards.

GTA Consultants (2014) recommends that the delays for vehicles turning right onto the Great Western Highway be re-assessed at two-yearly intervals beyond 2020 to establish whether there is a need to restrict the number of departing trucks during the morning and afternoon peak periods on the surrounding road network. The Applicant is committed to this monitoring recognising that both RMS's short-term and long-term plans for upgrading the intersection may maintain an acceptable Level of Service at that time.

The Applicant recognises that from time to time, incidents may occur involving a truck travelling to or from the Austen Quarry that attract a complaint. The Applicant encourages any motorist/resident to record the registration number of the offending truck and report it to the Applicant via its complaint/Head Office line 02 9647 2866. Each complainant can be assured that each complaint will be thoroughly investigated and assessed in accordance to its Chain of Responsibility Standard.

4.3.6 Assessment of Road Traffic Impacts

4.3.6.1 Introduction

The assessment of road traffic impacts relating to the Proposal relies considerably upon the experience gained to date and the current performance of the product transportation system. The assessment focuses upon the impacts of the vehicles travelling to and from the Austen Quarry beyond 2020 and the performance of the intersection between Jenolan Caves Road and the Great Western Highway.

The quarry-related data relied upon for the assessment of impacts is as set out in Section 4.3.4, noting that the nominated traffic volumes relate to the despatch of 1.1Mtpa of products and therefore is the most conservative as the quantity of products despatched in a number of years would be less than 1.1Mtpa.

4.3.6.2 Traffic Volumes

Jenolan Caves Road

Daily traffic volumes to the north of the quarry entrance are projected to be approximately 1 800 and 2 000 vehicles per day on weekdays and Saturdays respectively in 2035.

Table 4.9 summarises the predicted hourly traffic levels on Jenolan Caves Road on a peak day in 2035 incorporating both predicted background growth in non-Austen Quarry-related traffic and Austen Quarry-related traffic. This information identifies that the total weekday and Saturday peak hourly traffic volumes would respectively remain below 150 and 220 vehicles per hour on Jenolan Caves Road north of the quarry entrance in 2035.

It is noted that the number of product trucks travelling along Jenolan Caves Road on most days of the year would be below those nominated in **Table 4.9** with average levels typically between approximately 60% and 70% of the maximum levels.

The time required for truck loading and processing via the weighbridge provides for a natural staggering of exiting vehicles. This would minimise the potential for convoying of truck movements between the Austen Quarry and the Great Western Highway.

Great Western Highway

The product trucks travelling to and from the Austen Quarry through the Blue Mountains would remain comparable in number to those already approved to use the highway. This fact together with predicted background growth in other traffic would result in the proportion of quarry-related traffic decreasing over time. For example, **Table 4.10** displays the reduction in the total vehicles and heavy vehicles on an average day for the Years 2015, 2025 and 2035. As an example, the Austen Quarry product trucks would account for 0.47% of the overall traffic at Leura in 2025 and 0.41% in 2035.

Table 4.9
Peak Day Hourly Traffic 2035 – Jenolan Caves Road (vehicles/hour)

	Jenolan Caves Road North of Quarry Access Road						Jenolan Caves Road South of Quarry Access Road					
	Light		Heavy		Total		Light		Heavy		Total	
	Quarry	Total	Quarry	Total	Quarry	Total	Quarry	Total	Quarry	Total	Quarry	Total
Weekday												
5:00 to 6:00	6	23	31	43	37	66	1	20	0	10	1	30
10:00 to 11:00	1	79	38	62	39	140	0	83	0	32	0	115
11:00 to 12:00	2	83	27	55	29	138	0	76	0	25	0	102
16:00 to 17:00	3	107	24	38	27	144	1	103	0	17	1	120
17:00 to 18:00	8	90	20	25	28	116	2	82	0	9	2	90
Weekday Total*	52	1 165	370	639	422	1 804	12	1 072	0	286	12	1 357
Saturday												
5:00 to 6:00	8	17	33	39	41	57	2	11	0	9	2	20
11:00 to 12:00	6	152	35	59	41	211	1	171	0	12	1	183
12:00 to 13:00	4	133	17	22	21	155	1	138	0	9	1	147
14:00 to 15:00	1	154	1	9	2	163	0	148	0	7	0	156
Saturday Total*	41	1 697	210	309	251	2 007	9	1 701	0	122	9	1 823

Austen Quarry operating at 1.1Mtpa, peak expected to occur approximately 5 times per year.

Note *: vehicles / day

Source: GTA Consultants (2014) – Modified after Tables 4.8 & 5.1.

Table 4.10
Proportion of Austen Quarry Trucks travelling on the Great Western Highway through the Blue Mountains

Location	2015		2025		2035	
	Total Vehicles %	Heavy Vehicles %	Total Vehicles %	Heavy Vehicles %	Total Vehicles %	Heavy Vehicles %
Blackheath	0.88	7.32	0.75	6.21	0.65	5.39
Medlow Bath	0.80	6.67	0.67	5.62	0.58	4.86
Leura	0.55	4.60	0.47	3.91	0.41	3.39
Wentworth Falls East	0.53	4.38	0.44	3.70	0.38	3.20
Bullaburra	0.60	4.97	0.50	4.18	0.43	3.61
Lawson	0.55	4.56	0.47	3.89	0.41	3.40
Woodford-Hazelbrook	0.55	4.62	0.47	3.93	0.41	3.42
Faulconbridge	0.55	4.59	0.46	3.85	0.40	3.31

Source: **Table 4.2** and based on forecast traffic levels in **Table 4.8** with 12% heavy vehicles.

The potential for convoyed entry onto the Great Western Highway would be minimised by the natural staggering of exiting trucks from the Austen Quarry. Once on the Great Western Highway, the pre-existing flow of traffic would dictate the separation distance between trucks. It is worthy of note that, even at maximum production, trucks from the Austen Quarry would represents less than 0.9% of all vehicle movements across the Blue Mountains (see **Table 4.10**). This combined with the numerous dual lane sections of the Great Western Highway would provide for the natural management of truck spacing.

4.3.6.3 Intersection Performance

The key intersection assessed for the Proposal is the Great Western Highway/Jenolan Caves Road intersection. GTA Consultants (2014) re-assessed the performance of the intersection using SIDRA assuming the continued peak day operation at the Austen Quarry and the projected overall 2035 traffic volumes.

The average delay for vehicles turning right onto the Great Western Highway during the morning peak hour would be approximately 76 seconds per vehicle, a level considered to be unacceptable. The average delay during the afternoon peak period would be 53 seconds per vehicle. This assessment relates to the current morning and afternoon peak hour delays/vehicle of 35 seconds and 29 seconds respectively.

It is recognised that this assessment has assumed no upgrade to the intersection, a feature that is highly unlikely given the plans of RMS outlined in Section 4.3.3.2.

4.3.6.4 Road Capacity

Jenolan Caves Road

GTA Consultants (2014) assessed that the level of service experienced on Jenolan Caves Road in 2035 would not change from the current level as a result of the background growth in traffic levels and the maximum quarry-related traffic. This would apply for the scenarios when products are destined largely to Sydney or during periods of local upgrades on the Great Western Highway.

Great Western Highway

Based on the Austroads (2013) guide and the forecast peak hourly volumes, indicative Levels of Service along the Great Western Highway are presented in **Table 4.11**.

Table 4.11
Indicative Future Peak Day Levels of Service on the Great Western Highway 2035

Location	Total Vehicles per Hour	Number of Lanes	Speed Limit	Level of Service
Forty Bends	980	3	80	A
Hartley	1 110	3	90	A
Little Hartley	1 310	3	90	A
Victoria Pass	1 750	3	60	B
Leura	3 890	4	80	C
Wentworth Falls East	3 310	4	70	B
Bullaburra	3 660	4	80	B
Lawson	3 070	4	80	B
Woodford-Hazelbrook	3 090	4	80	B
Faulconbridge	3 980	4	70	C
Austen Quarry operating at 1.1Mtpa, peak day expected to occur approximately 5 times per year. Levels of Service from Table 4.4 of Austroads (2013)				
Source: GTA Consultants (2014) – Table 5.7				

The results demonstrate that with continued operation at the Austen Quarry, peak day activity at the quarry would result in Levels of Service C on the Great Western Highway in 2035. Level of Service C reflects an acceptable level of comfort and convenience within the zone of stable traffic flow, with drivers restricted to some extent in their freedom to select their desired speed and manoeuvre within the traffic stream.

4.3.6.5 Pedestrians, Cyclists and School Buses

The Proposal is not expected to generate any additional demand for pedestrian or cyclist activity. The number of pedestrians walking along or across Jenolan Caves Road in the vicinity of the quarry would remain negligible. Furthermore, the number of product trucks travelling to and from the Austen Quarry would remain comparable in number to those currently approved to use the transport route. Importantly, no increase in the exposure of cyclists to heavy vehicle traffic along the transportation route would occur as a result of the Proposal. While not directly related to the Proposal, it is noted that pedestrians and cyclists are likely to benefit from the completed and planned upgrade work along the Great Western Highway that includes elements such as over or underpass crossings, off-road shared paths and widened road shoulders. On the basis of the preceding, no additional specific facilities are warranted.

The number of truck trips generated by the Austen Quarry on a peak day, once spread over the operating hours of the quarry and taking into account The Applicant's management of despatch times to avoid peak traffic periods on the Great Western Highway, would have a negligible effect on the delays experienced by pedestrians crossing the Great Western Highway through the villages within the Blue Mountains. Most of the highway pedestrian crossing locations occur at key intersections or at existing traffic lights.

The Applicant's management of despatch times and avoidance of peak traffic periods would also minimise the potential interaction between quarry traffic and school buses.

4.3.6.6 Road Safety

The Proposal would result in the ongoing use of the Great Western Highway, primarily through the Blue Mountains to and from the east of the Jenolan Caves Road intersection. This is the most appropriate route for such vehicles, being the major arterial route used carrying freight between Sydney and western NSW. The ongoing upgrading program for the Great Western Highway is progressively improving the route to meet the current and future road transport demands along it, with the various upgrades aiming to improve traffic flow and reduce the risk of crashes. The design of all road works take into consideration the specific needs of heavy vehicles, such as their slower acceleration and braking capabilities.

The Applicant's Road Truck Traffic Management Plan aims to maximise the safety of road users both inside the Quarry and on public roads, and continued compliance with that Plan will reduce the risk of incidents associated with the quarry trucks.

4.3.6.7 Conclusion

The comprehensive traffic assessment undertaken for the Proposal has established that the product trucks travelling to and from the Austen Quarry can be accommodated on both Jenolan Caves Road and the Great Western Highway. The volume of Austen Quarry trucks compared

with overall traffic levels would diminish throughout the life of the quarry. Importantly, the adoption of the Applicant's Chain of Responsibility for product transportation would continue to minimise the adverse impacts on other motorists and roadside residents and businesses.

4.4 VISIBILITY

4.4.1 Introduction

The DGRs issued for the Proposal identified "*Visual*" as a key issue requiring that the "*EIS include a detailed assessment of the:*

- *changing landforms on the site during the various stages of the development;*
- *potential visual impacts of the development on private landowners in the surrounding area as well as key vantage points in the public domain, including Hassans Wall Lookout.*
- *a detailed description of the measures that would be implemented to minimise the visual impacts of the development.*

Additional matters for consideration in preparing the EIS were also provided in the correspondence attached to the DGRs from the DTIRIS - Resources and Energy Department and Blue Mountains City Council requesting that visual impacts and proposed mitigation measures be assessed particularly for vantage points on the Blue Mountains Escarpment.

Based on the risk analysis undertaken for the Proposal (Section 3.3.1 and **Table 3.9**), the potential impacts relating to visual amenity and their risk rankings (in parenthesis) after the adoption of pre-existing or standard mitigation measures are as follows.

- Increased visibility of the quarry from local residences resulting in decreased visual amenity of local setting (medium risk).
- Increased visibility of the quarry from local roads resulting in decreased visual amenity of the LGA as a whole (medium risk).
- Increased visibility of the quarry from local lookouts within Lithgow City LGA (Hassans Walls, Second Lookout and others off Hassans Walls Road) resulting in:
  - reduced aesthetic value of lookouts (high risk); or
  - reduced patronage of local lookouts and reduction in local tourism (high risk).
- Increased visibility of the quarry from local lookouts within Blue Mountains City LGA (Mt York, Bardens Lookout and others) resulting in:
  - reduced aesthetic value of lookouts (high risk); or
  - reduced patronage of local lookouts and reduction in local tourism (high risk).

A review of the attributed risk levels, following the adoption of the recommended operational safeguards and controls, is provided in Section 6.2.1 and **Table 6.1**.

The visual impact assessment for the Proposal was undertaken by Mr Alex Irwin of R.W. Corkery and Co with assistance from Messrs Lee Attard and Darryl Thiedeke of Hy-Tec Industries, and Messrs Rod Huntley and Luke Twigg of Groundwork Plus. This subsection of the EIS provides a summary of the visual impact assessment, concentrating on those matters raised in the DGRs and submissions to the DGRs provided by various government agencies. A consolidated list of the identified requirements and where each is addressed is presented in **Appendix 3**.

4.4.2 The Existing Visual Landscape

4.4.2.1 Local Setting

The Stage 2 Site is dominated by the forested ridges aligned in a generally northeast-southwest axis between the Coxs River in the east and Jenolan Caves Road in the west. These ridges are visible from the Blue Mountains Escarpment to the east (notably from Mt York and Mt York Road) and north (notably the Hassans Walls and other lookouts on Hassans Walls Road), as well as the Great Western Highway (Between Mt Victoria Pass and River Lett Hill) and other local roads.

4.4.2.2 Identification of Vantage Points

Based on an initial desktop review of the 1:25 000 topographic map sequence below, potential vantage points with direct line of sight views of the current and/or proposed quarry disturbance were identified.

MEADOW FLAT 8831-II-S	**LITHGOW** **8931-III-S**	WOLLANGAMBE 8931-II-S
TARANA 8830-I-N	**HARTLEY** **8930-IV-N**	**MOUNT WILSON** **8930-I-N**
OBERON 8830-I-S	**HAMPTON** **8930-IV-S**	**KATOOMBA** **8930-I-S**

Line of sight was determined by generating a series of virtual line between the potential vantage points and the quarry and excluding points where intervening topography exceeds or comes to within 10m of this virtual line. Potential vantage points were considered to be roads, areas of residential development, lookouts or potential walking tracks. Inaccessible escarpment areas were excluded. To confirm the visibility of the quarry from the vantage points identified by desktop review, a field inspection was completed on Friday, 20 September 2013. **Figure 4.13** identifies the locations inspected and highlights those which currently have, or are considered likely to have in the future, views of the Stage 2 Site.

4.4.2.3 Visibility Zones

4.4.2.3.1 Identification of Zones

The following provides a summary of the visibility of the Stage 2 Site from the accessible vantage points identified as discussed in Section 4.4.2.2. The various locations have been grouped into visibility zones based on orientation from the Stage 2 Site, proximity to the Stage 2 Site and/or general setting (see **Figure 4.13**).

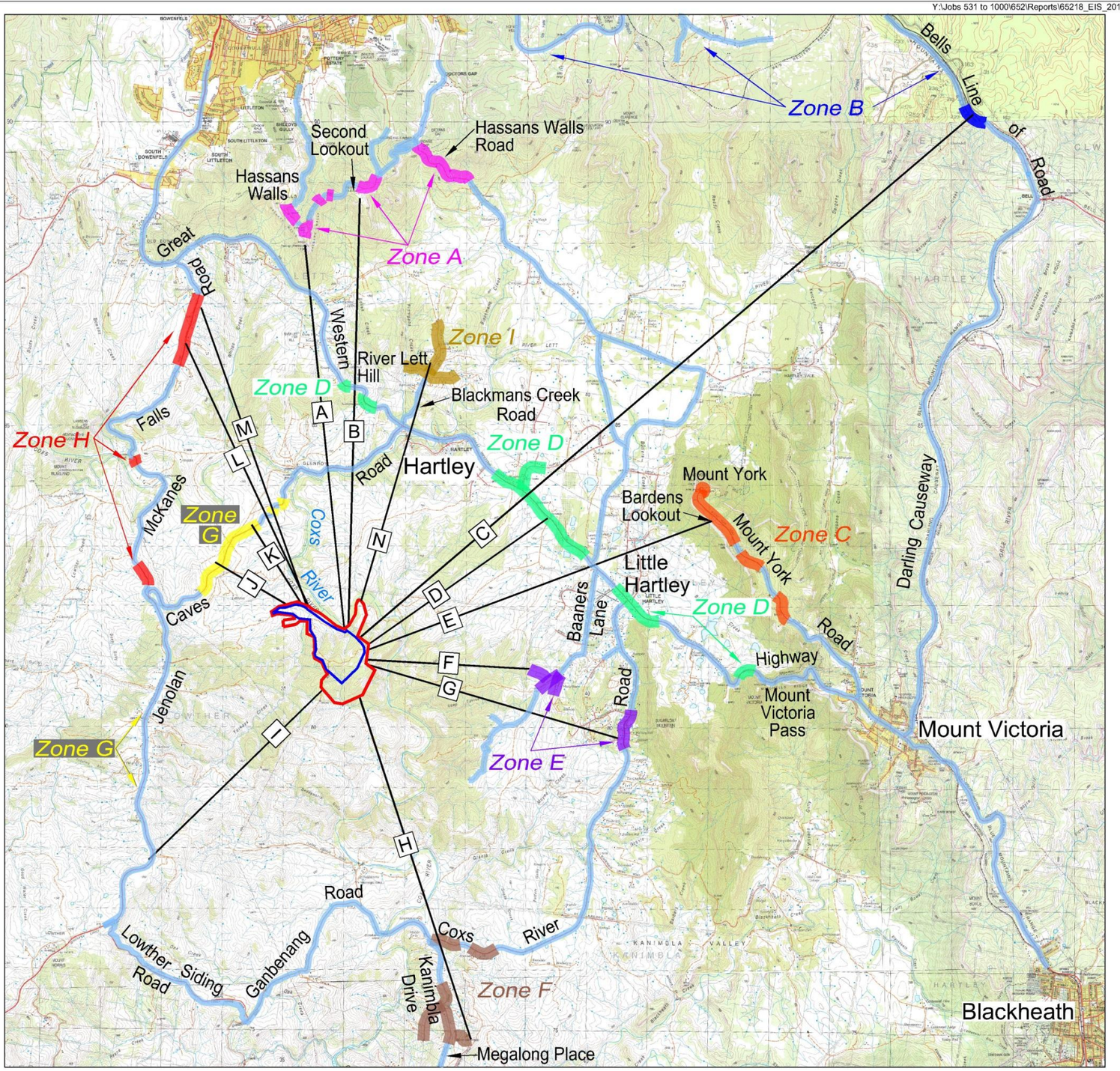
TN
MN

REFERENCE
- Stage 1 Site Boundary
- Stage 2 Site Boundary
- Open Forest (50-80% crown cover)
- Inspection Circuit
- B — Cross Sectional View (See Figures 4.14 - 4.24)

Zones of Visual Impact (Vantage Points with View of the Stage 2 Site)

- A — Hassans Walls, Second Lookout & Hassans Walls Road
- B — Bells Line of Road
- C — Mount York & Mount York Road
- D — Great Western Highway
- E — Little Hartley (Roads and Residences)
- F — Kanimbla (Coxs River Road/ Kanimbla Drive/Megalong Place)
- G — Jenolan Caves Road
- H — McKanes Falls Road
- I — Blackmans Creek Road

Notes 1: View of the Stage 2 Site may be of undisturbed area or obscured by intervening vegetation
2: Section lines through Stage 2 Site Boundary are not shown on this figure for clarity



SCALE 1:75 000 (A3)
1 0 1 2 3 4km

Base Map Source: Hampton, Hartley, Katoomba, Lithgow, Mount Wilson & Wollangambe 1:25 000 Topographic Maps

Figure 4.13
VISUAL IMPACT ZONES SURROUNDING THE AUSTEN QUARRY

This page has intentionally been left blank

This page has intentionally been left blank

Figures 4.14 to **4.23** provide photos taken from selected points surrounding the Stage 2 Site, as well as a cross-sectional representation of the topography between the photo point at the Stage 2 Site and the approximate field of view. The photos included on **Figures 4.14** to **4.16**, **4.18** and **4.23** were taken on 20 September 2014 prior to a series of showers passing through the region which impacted on visibility and photo quality. The photo included on **Figure 4.17** was taken on 10 October 2013 and the photos included on **Figures 4.19** (Melliodora Place), **4.21** and **4.23** taken on 7 April 2014. The photos used on **Figures 4.19** and **4.20** (Pippin Place) were obtained from Google Earth Street View.

4.4.2.3.2 Zone A: Hassans Walls, Second Lookout and Hassans Walls Road

Views of the quarry from Hassans Walls have long been known and discussed, with the current quarry extraction plan reflecting the retention of visual screening of the extraction area (see **Figure 4.14**). Similar and perhaps clearer views of the quarry are available from 'Second Lookout' to the east of Hassans Walls (see **Figure 4.15**). Between Hassans Walls and Second Lookout are walking trails from which the quarry is clearly visible. Views of the quarry are also available on the descent of Hassans Walls Road although vegetation provides a relatively effective screen and the circuitous nature of the road precludes observation for drivers.

Although at least 6.5km from the Stage 2 Site, the secondary processing area, Yorkeys Creek stockpile area, extraction area Access Road and western face of the current extraction area are visible. Notably, the retention of a ridge to the north of the Stage 1 extraction area (the "Northern Ridge") identified on **Figures 4.14** and **4.15** provides a visual screen to the extraction area to the south of this. The ridge beyond the extraction area forms part of the Stage 2 extension of the extraction area.

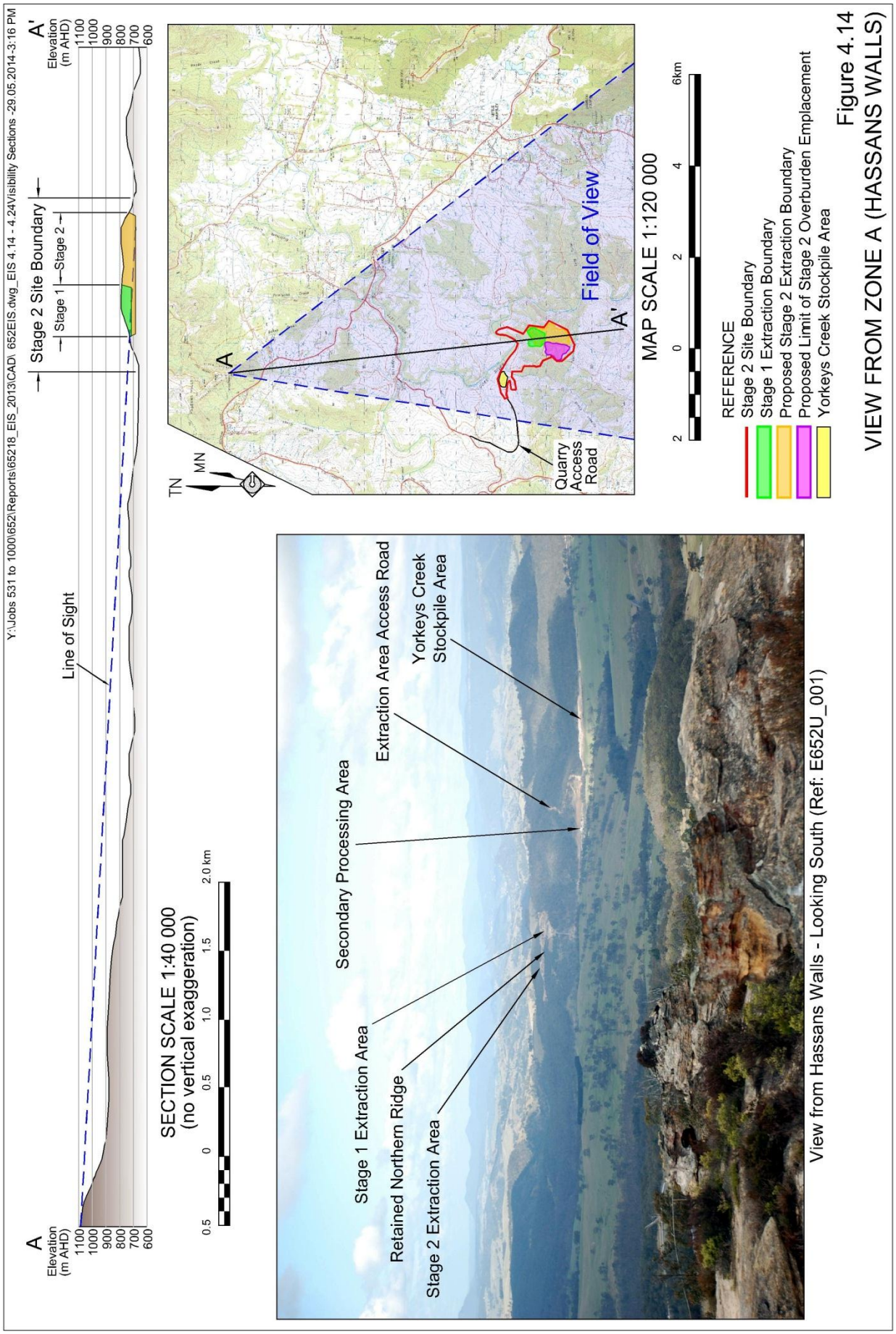
4.4.2.3.3 Zone B: Bells Line of Road

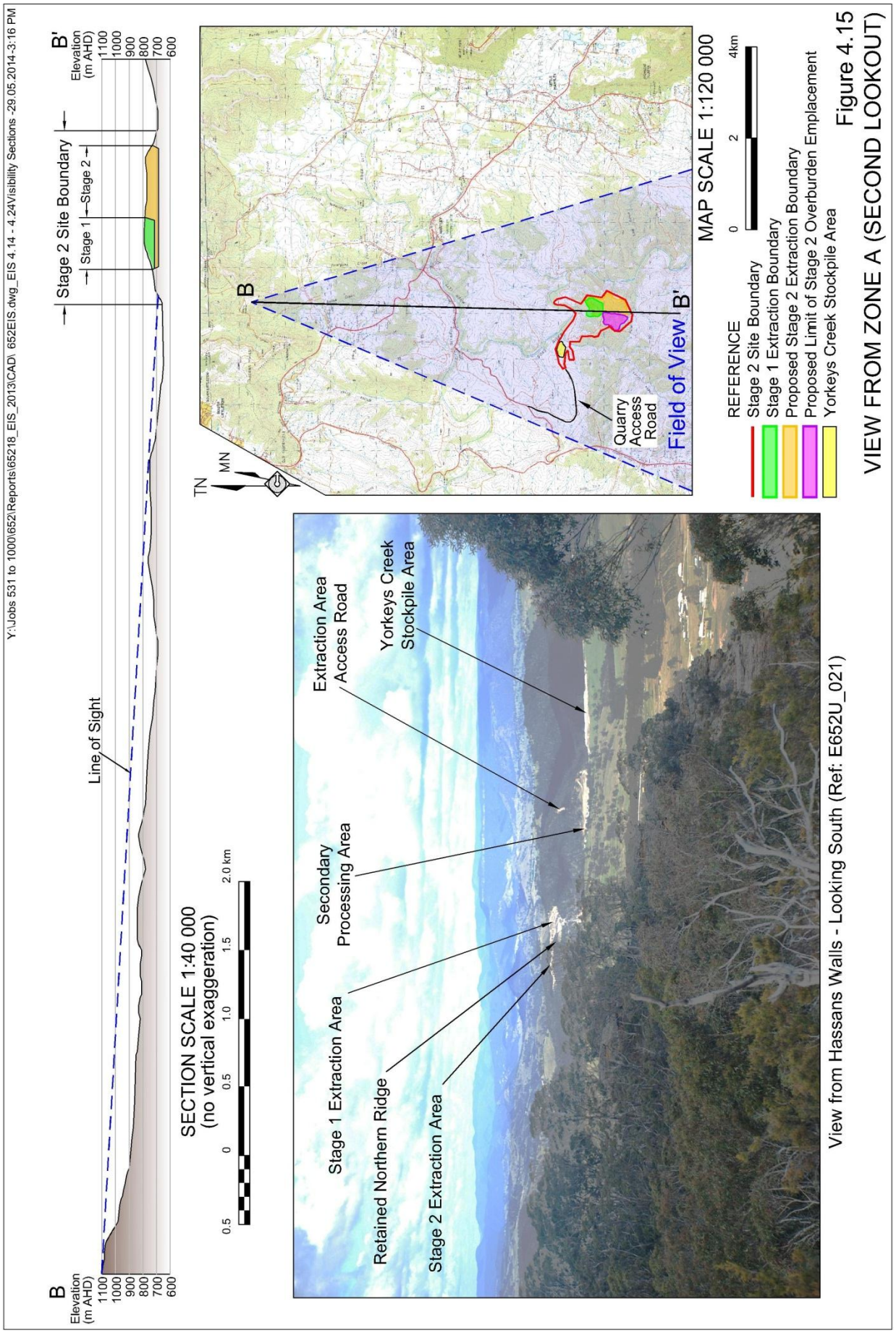
Views of the Stage 2 Site are obscured from most potential vantage points to the north and northeast along Bells Line of Road and various residential communities located along this road, e.g. Clarence, Dargan. One notable exception is provided at the Monkey Creek Café, located approximately 1km southeast of Dargan on Bells Line of Road, where distant views (14km) of the extraction area are available (see **Figure 4.16**). The ridge beyond the extraction area forms part of the Stage 2 extension of the extraction area.

The Stage 2 Site would also be visible from the edge of the escarpment to the south of Bells Line of Road, however, as this area is largely inaccessible it has not been considered.

4.4.2.3.4 Zone C: Mount York and Mount York Road

This historic site has clear and unimpeded views of the quarry from the main lookout, Bardens Lookout (see **Figure 4.17**) and walking trails along the southern side of Mount York Road.


Y:\Jobs 531 to 1000\652\Reports\65218_EIS_2013\CAD\ 652EIS.dwg_EIS 4.14 - 4.24Visibility Sections -29.05.2014-3:16 PM
A
A'
Elevation (m AHD)
1100
1000
900
800
700
600
Stage 2 Site Boundary
Stage 1
Stage 2
Line of Sight
SECTION SCALE 1:40 000
(no vertical exaggeration)
0.5
0
0.5
1.0
1.5
2.0 km
TN
MN
Field of View
Quarry Access Road
MAP SCALE 1:120 000
2
0
2
4
6km
REFERENCE
Stage 2 Site Boundary
Stage 1 Extraction Boundary
Proposed Stage 2 Extraction Boundary
Proposed Limit of Stage 2 Overburden Emplacement
Yorkeys Creek Stockpile Area
Secondary Processing Area
Extraction Area Access Road
Yorkeys Creek Stockpile Area
Stage 1 Extraction Area
Retained Northern Ridge
Stage 2 Extraction Area
View from Hassans Walls - Looking South (Ref: E652U_001)
Figure 4.14
VIEW FROM ZONE A (HASSANS WALLS)


Y:\Jobs 531 to 1000\652\Reports\65218_EIS_2013\CAD\ 652EIS.dwg_EIS 4.14 - 4.24Visibility Sections -29.05.2014-3:16 PM
B
Elevation (m AHD)
1100
1000
900
800
700
600
Line of Sight
B'
Stage 2 Site Boundary
Stage 1
Stage 2
SECTION SCALE 1:40 000
(no vertical exaggeration)
0.5
0
0.5
1.0
1.5
2.0 km
TN
MN
B
B'
Field of View
Quarry Access Road
MAP SCALE 1:120 000
0
2
4km
REFERENCE
Stage 2 Site Boundary
Stage 1 Extraction Boundary
Proposed Stage 2 Extraction Boundary
Proposed Limit of Stage 2 Overburden Emplacement
Yorkeys Creek Stockpile Area
Extraction Area Access Road
Yorkeys Creek Stockpile Area
Secondary Processing Area
Stage 1 Extraction Area
Retained Northern Ridge
Stage 2 Extraction Area
View from Hassans Walls - Looking South (Ref: E652U_021)
Figure 4.15
VIEW FROM ZONE A (SECOND LOOKOUT)

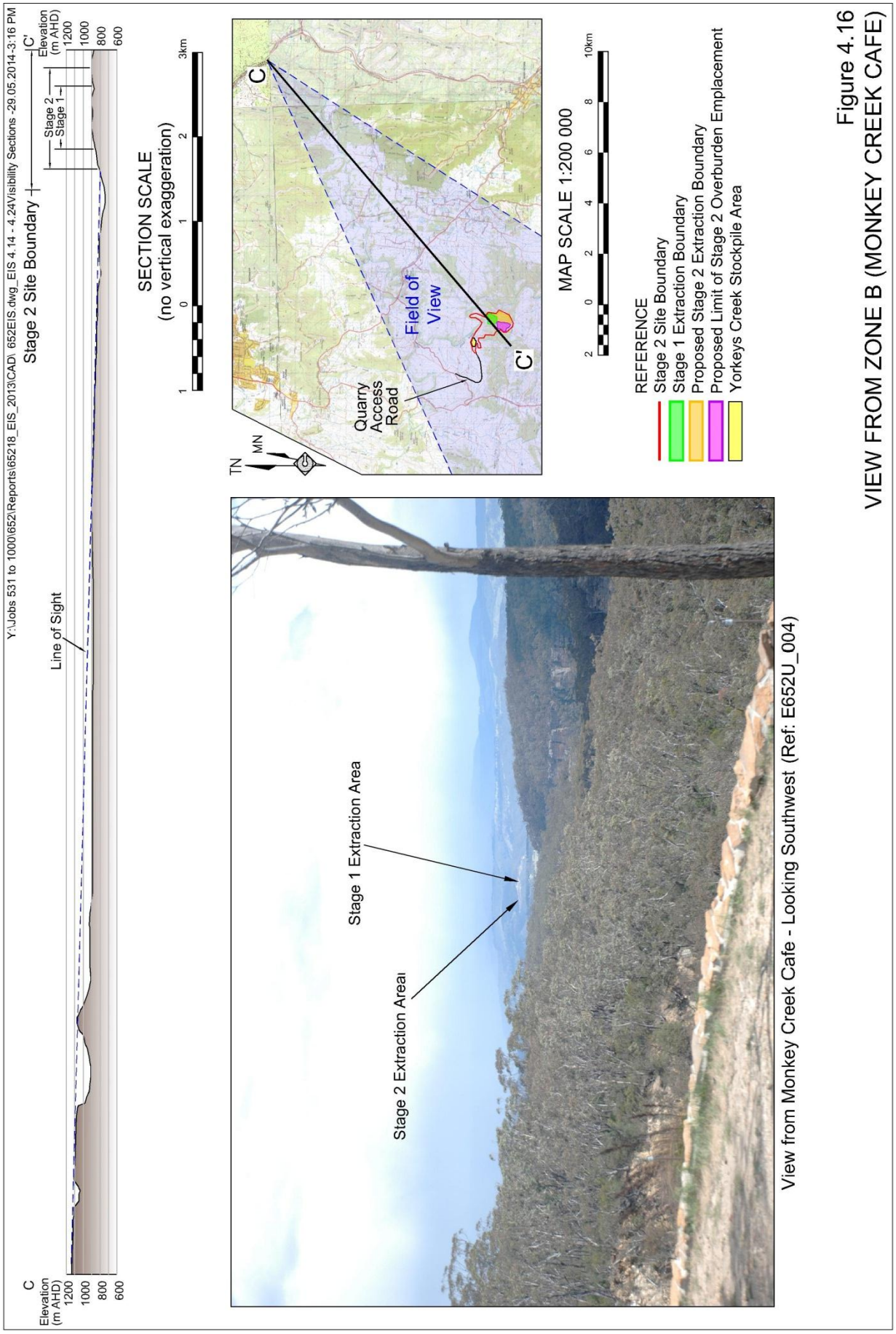


Figure 4.16
VIEW FROM ZONE B (MONKEY CREEK CAFE)

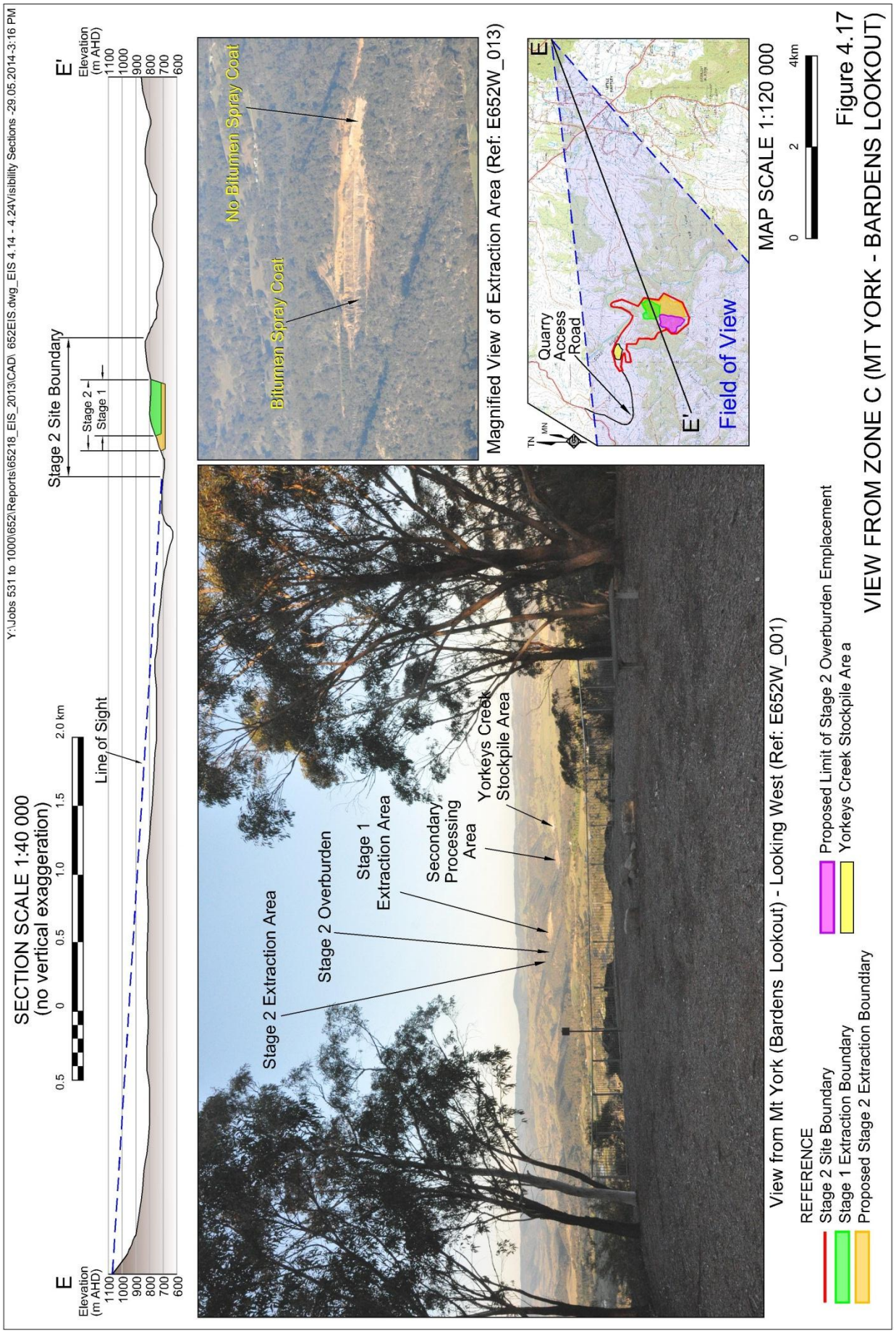
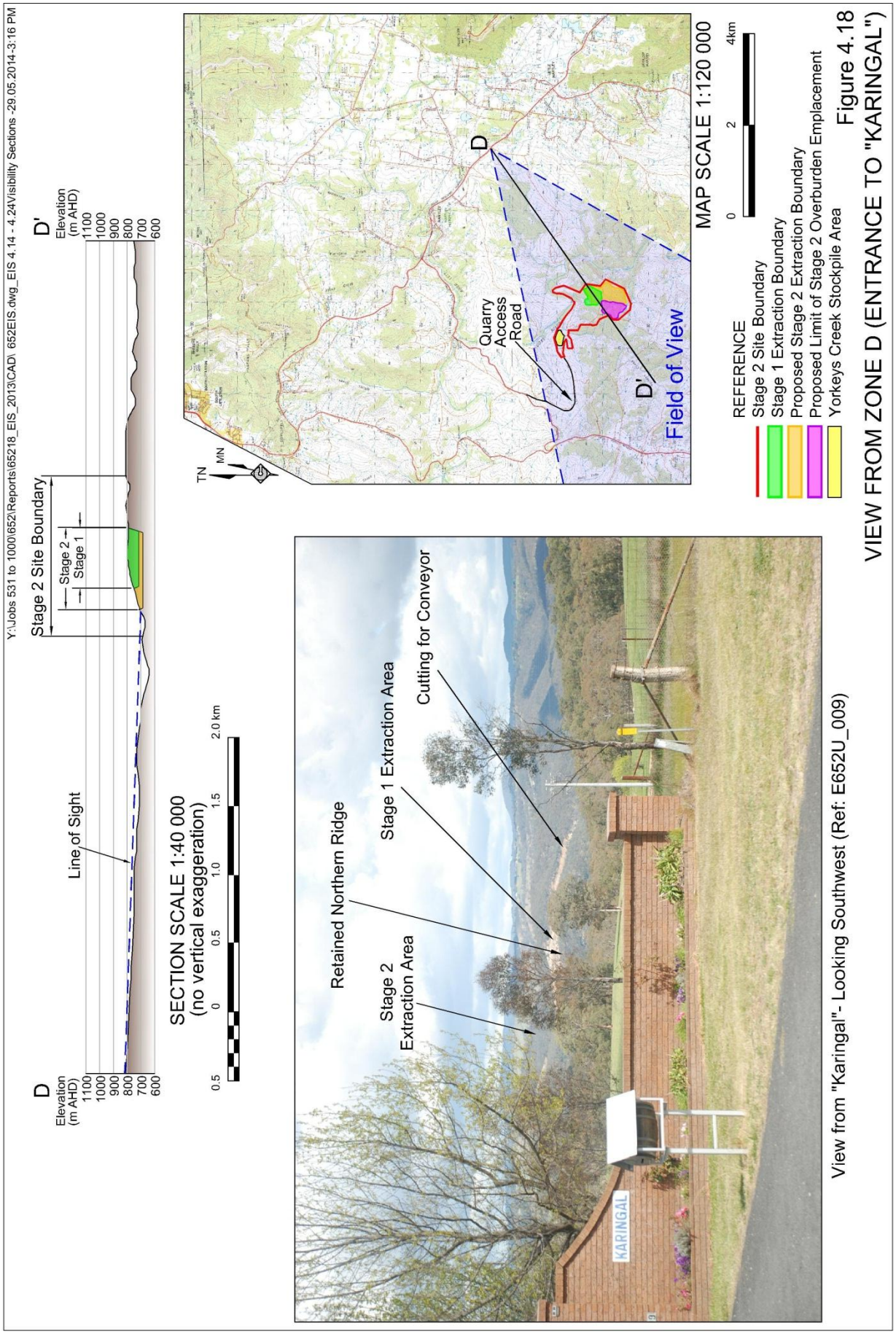


Figure 4.17
VIEW FROM ZONE C (MT YORK - BARDENS LOOKOUT)


Y:\Jobs 531 to 1000\652\Reports\65218_EIS_2013\CAD\ 652EIS.dwg_EIS 4.14 - 4.24Visibility Sections -29.05.2014-3:16 PM
D
D'
Elevation (m AHD)
1100
1000
900
800
700
600
Stage 2 Site Boundary
Stage 2
Stage 1
Line of Sight
SECTION SCALE 1:40 000
(no vertical exaggeration)
0.5
0
0.5
1.0
1.5
2.0 km
TN
MN
Quarry Access Road
Field of View
MAP SCALE 1:120 000
0
2
4km
REFERENCE
Stage 2 Site Boundary
Stage 1 Extraction Boundary
Proposed Stage 2 Extraction Boundary
Proposed Limit of Stage 2 Overburden Emplacement
Yorkeys Creek Stockpile Area
Retained Northern Ridge
Stage 1 Extraction Area
Cutting for Conveyor
Stage 2 Extraction Area
KARINGAL
View from "Karingal"- Looking Southwest (Ref: E652U_009)
Figure 4.18
VIEW FROM ZONE D (ENTRANCE TO "KARINGAL")

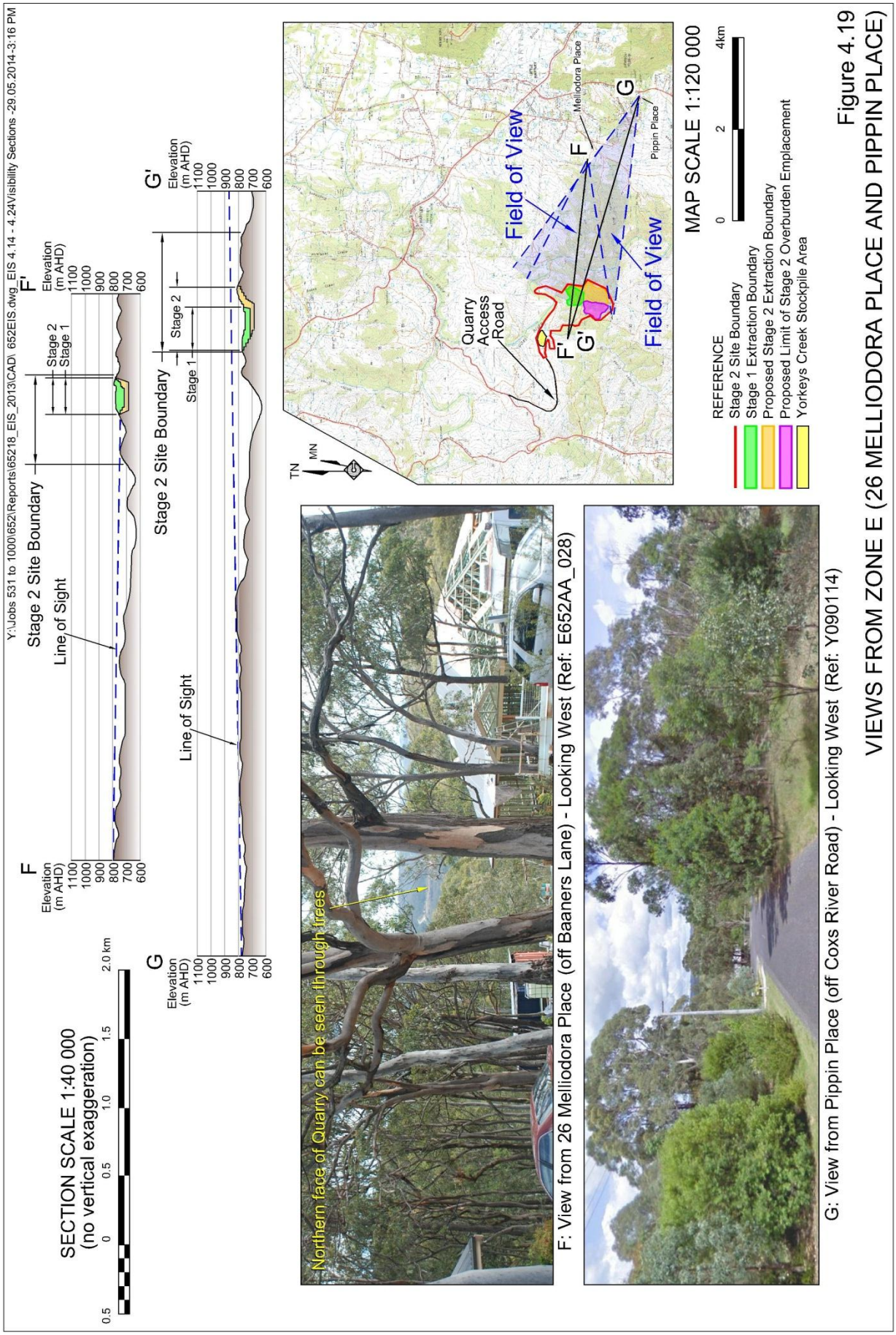


Figure 4.19
VIEWS FROM ZONE E (26 MELLIODORA PLACE AND PIPPIN PLACE)

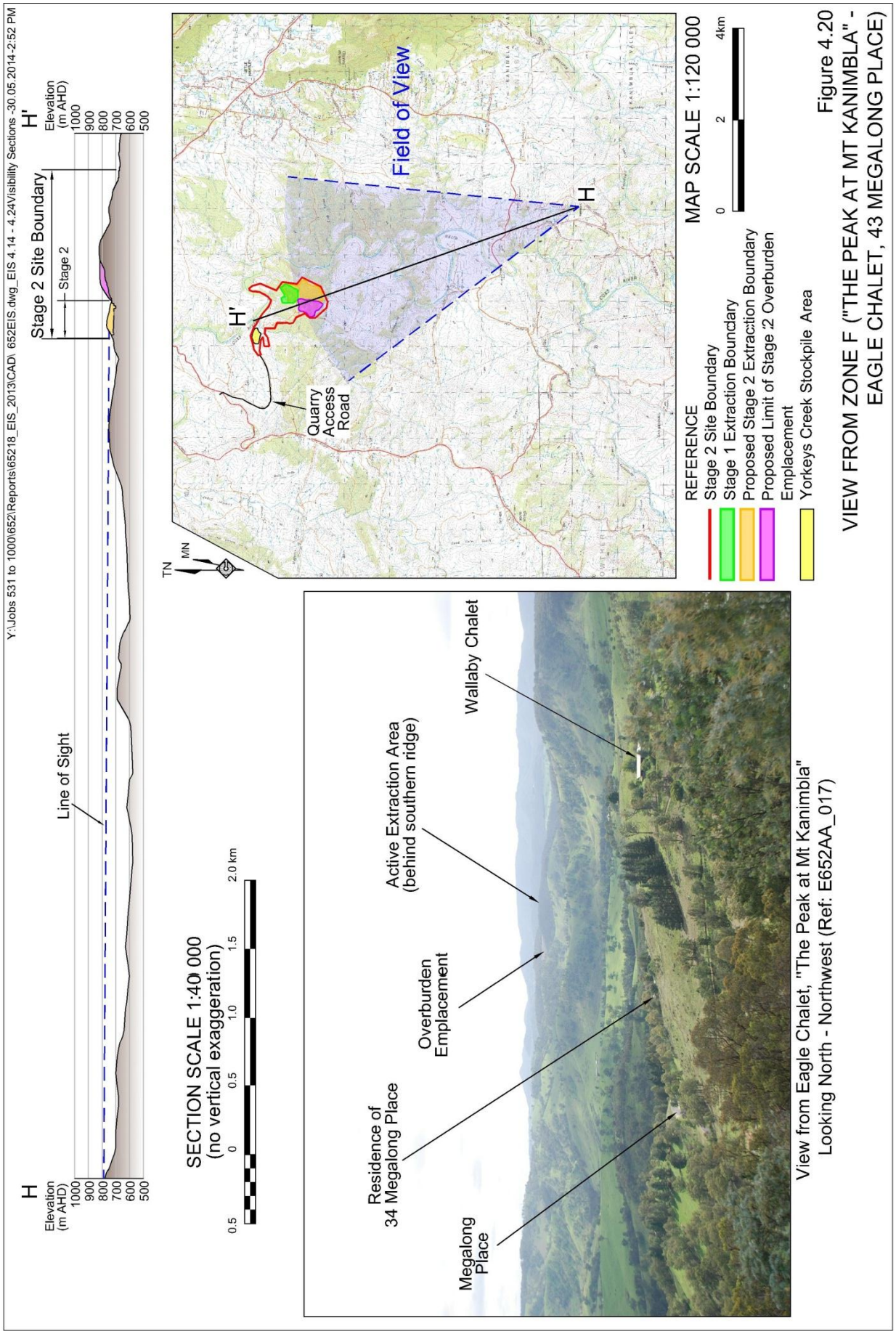


Figure 4.20
VIEW FROM ZONE F ("THE PEAK AT MT KANIMBLA" - EAGLE CHALET, 43 MEGALONG PLACE)

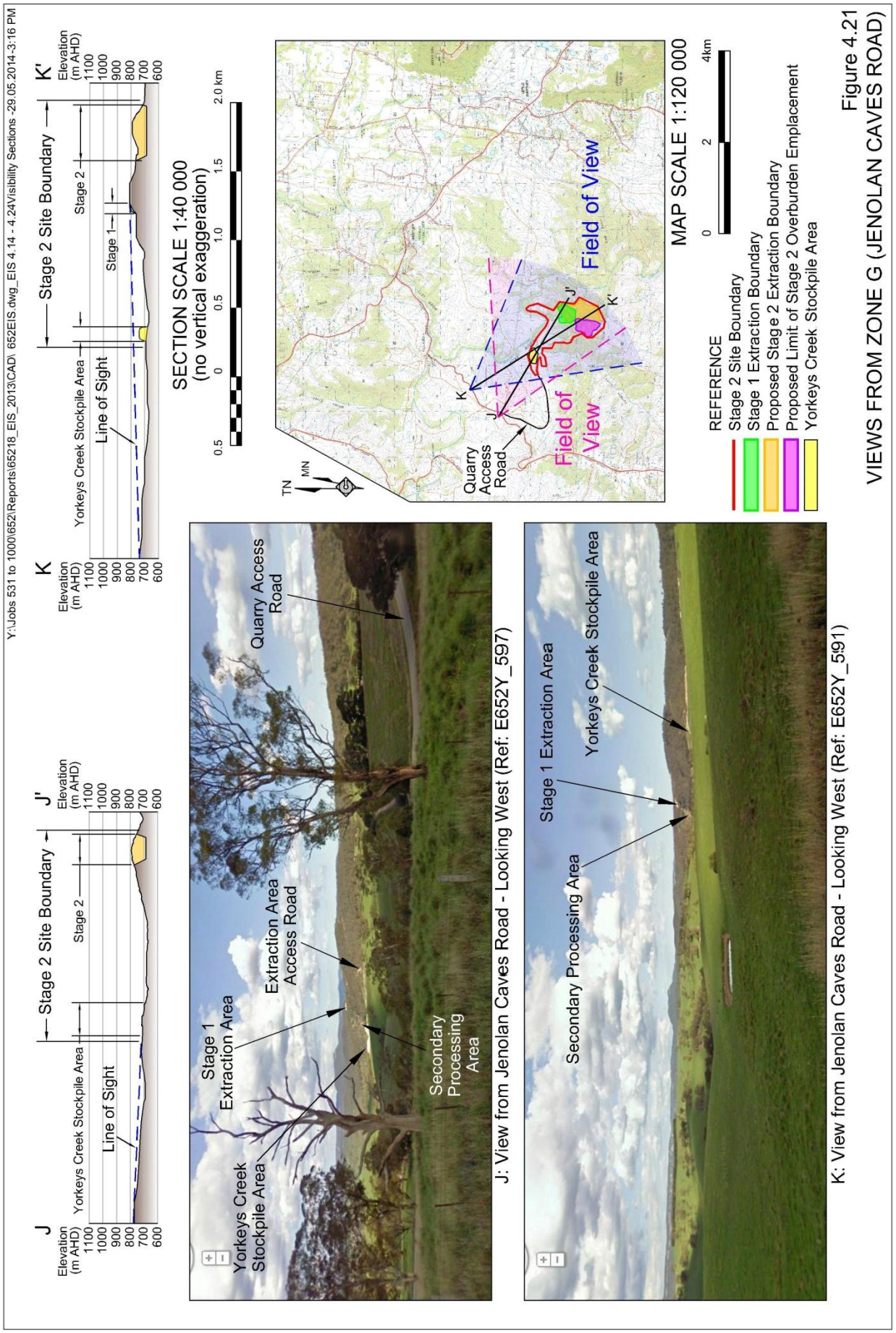


Figure 4.21
VIEWS FROM ZONE G (JENOLAN CAVES ROAD)

Y:\Jobs 531 to 1000\652\Reports\652218_EIS_2013\CAD\652EIS.dwg_EIS 4.14 - 4.24Visibility Sections -29.05.2014-3:16 PM
I
I'
Elevation (m AHD)
1100
1000
900
800
700
600
Stage 2 Site Boundary
Stage 2
Stage 1
Line of Sight
SECTION SCALE 1:40 000
(no vertical exaggeration)
0.5
0
0.5
1.0
1.5
2.0 km
TN
M/N
Quarry Access Road
Field of View
MAP SCALE 1:120 000
0
2
4km
REFERENCE
Stage 2 Site Boundary
Stage 1 Extraction Boundary
Proposed Stage 2 Extraction Boundary
Proposed Limit of Stage 2 Overburden Emplacement
Yorkeys Creek Stockpile Area
Site behind Ridge
View from "Anthill" - Looking Southeast (Ref: E652U_044)
Figure 4.22
VIEW FROM ZONE G ("ANTHILL")

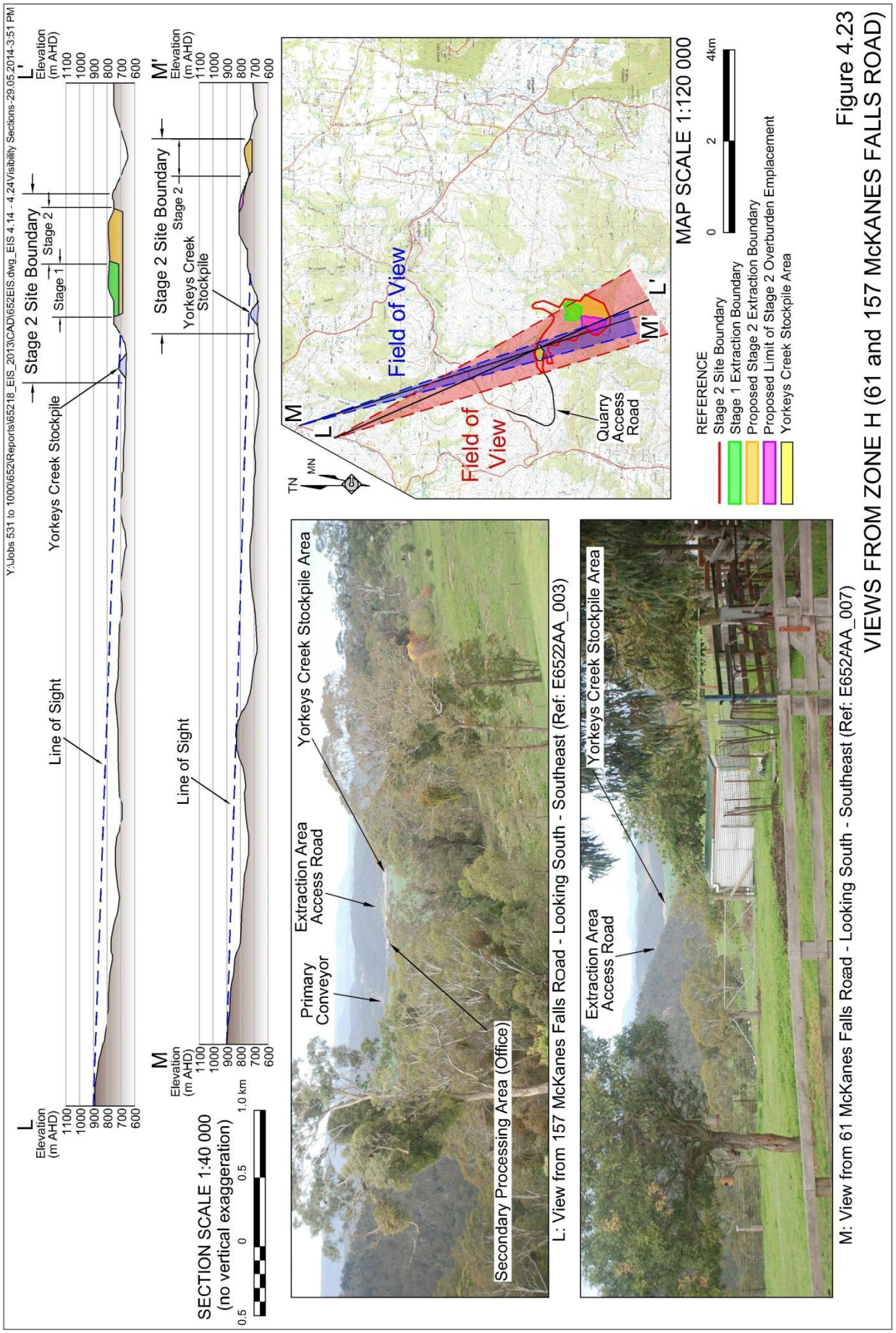


Figure 4.23
VIEWS FROM ZONE H (61 and 157 McKANES FALLS ROAD)

The secondary processing area, Yorkeys Creek stockpile area, and western face of the current extraction area are all visible (at a distance of approximately 6.5km to 7.0km). Notably, the application of a bituminous film to the western face of the extraction area reduces the contrast and therefore visual impact of this feature (see magnified photo inset of **Figure 4.17**). Retention of the Northern Ridge identified on **Figures 4.14** and **4.15** also provides a visual screen to the primary crushing station. The north-south oriented ridges to the south of the extraction area (left side in the photo) form part of the Stage 2 extension of the extraction area. These are referred to throughout this and future sections as the Central and Southern Ridges and play an important part in the reduction and mitigation of impacts.

4.4.2.3.5 Zone D: Great Western Highway

Between (approximately) Browns Gap Road and Mid Hartley Road, the Stage 2 Site can be viewed from the highway and roadside. Views from buildings (primarily) on the southern side of the highway are also available, however, road side vegetation provides an effective screen, in particular to buildings on the northern side of the highway. **Figure 4.18** provides the visual outlook towards the Stage 2 Site from the driveway of the "Karingal" property which covers the majority of the land adjoining the Great Western Highway from which the Stage 2 Site is visible. Notably, "Karingal" is owned by HPC (the company from which the Applicant leases the land on which the Stage 2 Site is located and therefore project- related).

On descent of Mt Victoria Pass, occasional views of the current extraction area are available, however, these are only fleeting as vehicles wind down the slope. Similarly, occasional views are available from vehicles descending River Lett Hill, with views also available from the properties on the southern side of the highway on River Lett Hill.

4.4.2.3.6 Zone E: Little Hartley (Roads and Residences)

The main thoroughfares of Little Hartley, Coxs River Road and Baaners Lane, along with the many small access roads to the rural residential style development of this area (e.g. Bonnie Hill Drive, Bonnie Blink Drive, John Grant Road, Melliodora Place off Baaners Lane and Morris Place, Cranbrook Park Road, Pippin Place, Blackheath Creek Road off Coxs River Road) were inspected.

The Stage 2 Site cannot be viewed from the section of Coxs River Road which passes through Little Hartley or the local roads that diverge from it. **Figure 4.19** provides a Google Earth street view image of the view from Pippin Place, considered to be the location most likely to afford views of the Stage 2 Site off Coxs River Road, which illustrates this assessment. The Stage 2 Site is visible from a property at the end of Melliodora Place, with fleeting and obscured views also available for the Stage 2 Site from John Grant Road to the immediate south of the intersection with Melliodora Place. **Figure 4.19** provides the visual outlook towards the Stage 2 Site, obscured by mature trees, from the driveway entrance to 26 Melliodora Place. Notably, the owners of this property are constructing a residence at a slightly lower elevation where the intervening vegetation effectively screens the extraction area of the Stage 2 Site.

4.4.2.3.7 Zone F: Kanimbla (Coxs River Road / Kanimbla Drive / Megalong Place)

To the south of the Stage 2 Site, distant views of the overburden emplacement are occasionally available from the Kanimbla locality, either from Coxs River Road or several elevated vantages points on some properties of Kanimbla Drive and Megalong Place. **Figure 4.20** provides the visual outlook and cross-sectional interpretation (Section H) of the Stage 2 Site from the Eagle Chalet of "The Peak at Mt Kanimbla" luxury chalets (43 Megalong Place). Eagle Chalet is located at an elevation of approximately 790m AHD and is adjacent to The Peak Trigonometric station at 800m AHD. Visible from Eagle Chalet, at a distance of 6.2km, is the upper lifts of the overburden emplacement. A view obscured by vegetation is also available from the Wallaby Chalet, as well as the main residence of 43 Megalong Place.

Similar views of the Stage 2 Site would be available from several other elevated locations of Megalong Place.

4.4.2.3.8 Zone G: Jenolan Caves Road

Between the Coxs River and intersection with McKanes Falls Road, views of the quarry, primarily the Yorkeys Creek stockpile area and extraction area access road are available. **Figure 4.21** provides representative views on approach to the Stage 2 Site entrance from the east and west, taken from Google Earth street view. The extraction area is not currently visible and it is not expected that the Stage 2 extension of the extraction area would be visible.

Beyond the intersection of McKanes Falls Road, intervening topography screens both the Stage 1 and proposed Stage 2 activities. A view from the driveway of the "Anthill" property, one of the more elevated positions on Jenolan Caves Road illustrates this (see **Figure 4.22**).

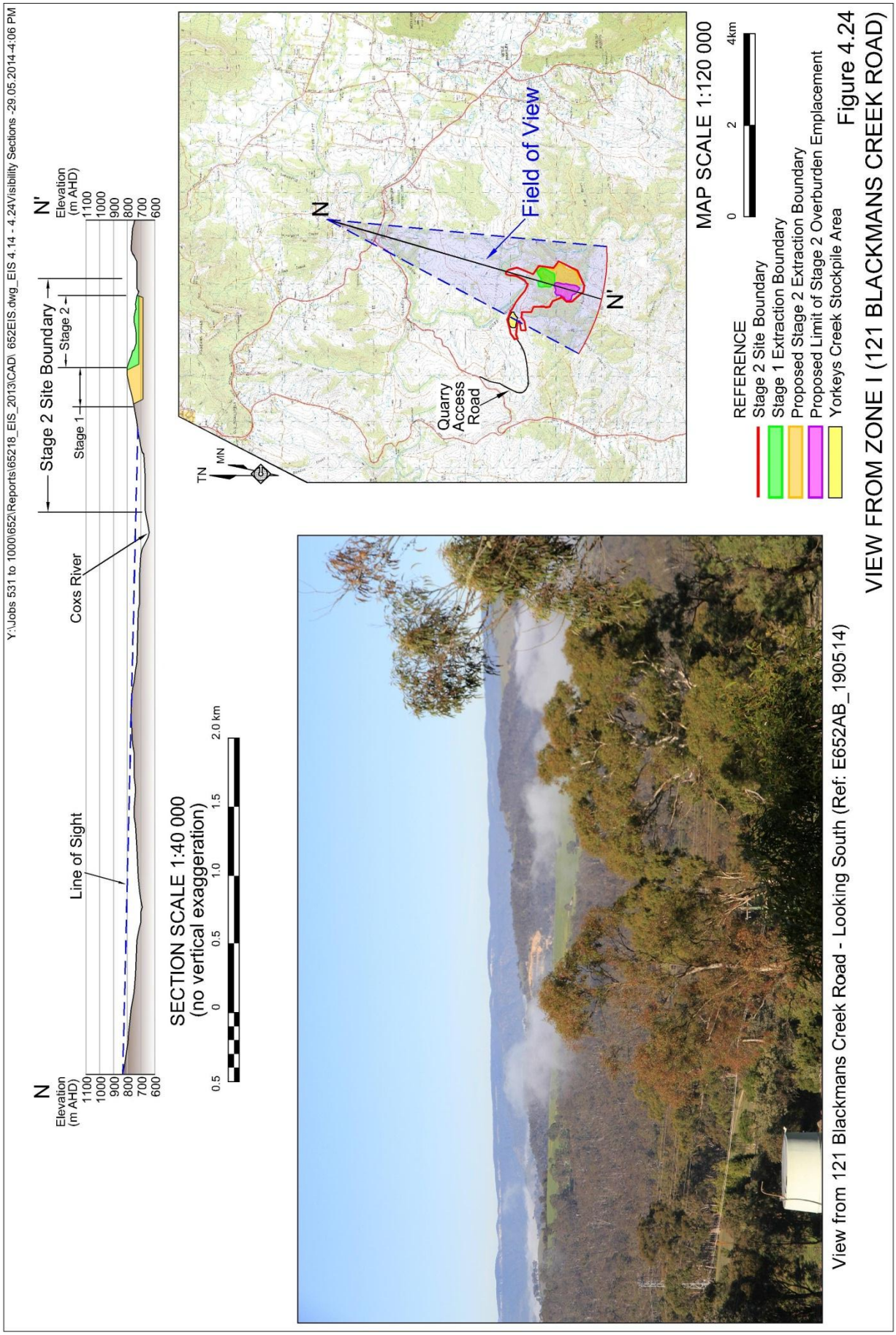
4.4.2.3.9 Zone H: McKanes Falls Road

Views of the extraction area and overburden emplacement are and will continue to be screened by intervening topography. However, the Yorkeys Creek stockpile area, some cleared areas of the secondary processing area, primary conveyor to the secondary processing area and extraction area Access Road are visible from a distance of between 4.5km and 5km from some residences of McKanes Falls Road. **Figure 4.23** provides the visual outlook and cross-sectional interpretation of the Stage 2 Site from 61 and 157 McKanes Falls Road.

4.4.2.3.10 Zone I: Blackmans Creek Road

Blackmans Creek Road intersects with the Great Western Highway opposite Jenolan Caves Road at the base of River Lett Hill. From elevated vantage points on properties along Blackmans Creek Road, the completed western face of the approved extraction area is visible. **Figure 4.24** provides the visual outlook and cross-sectional interpretation of the Stage 2 Site from 121 Blackmans Creek Road. There are two notable features of the view available from 121 Blackmans Creek Road.

1. The retained Northern Ridge screens all views of the current extraction area and primary crushing station.
2. The effectiveness of the bituminous film application over the completed quarry face is evident. The section of the completed face where the film has not been applied cannot be accessed by the equipment used in the application.


VIEW FROM ZONE I (121 BLACKMANS CREEK ROAD)
Figure 4.24
View from 121 Blackmans Creek Road - Looking South (Ref: E652AB_190514)
REFERENCE
Stage 2 Site Boundary
Stage 1 Extraction Boundary
Proposed Stage 2 Extraction Boundary
Proposed Limit of Stage 2 Overburden Emplacement
Yorkeys Creek Stockpile Area
MAP SCALE 1:120 000
0
2
4km
Field of View
Quarry Access Road
TN
MN
N
N'
SECTION SCALE 1:40 000
(no vertical exaggeration)
0.5 0 0.5 1.0 1.5 2.0 km
Line of Sight
Coxs River
Stage 2 Site Boundary
Stage 1
Stage 2
Elevation (m AHD)
1100
1000
900
800
700
600
Y:\Jobs 531 to 1000\652\Reports\65218_EIS_2013\CAD\ 652EIS.dwg_EIS 4.14 - 4.24Visibility Sections -29.05.2014-4:06 PM

4.4.3 Potential Changes to Visual Amenity

4.4.3.1 Introduction

As a consequence of the Proposal, it is considered as unlikely that the quarry would become visible from additional vantage points to those nominated in Section 4.12.2 and illustrated on **Figures 4.14** to **4.24**. However, the area of exposure that would be visible from these locations is likely to increase and the following reviews what are likely to be the main changes to the visibility of the Stage 2 Site and therefore visual amenity of the local setting.

4.4.3.2 Zone A: Hassans Walls, Second Lookout and Hassans Walls Road

As the extraction area extends through the ridges to the south of the Stage 1 extraction area (the "Central Ridge" and "Southern Ridge"), the exposed area of the quarry visible from the north, i.e. from Hassans Walls, Second Lookout and Hassans Walls Road would be increased (at least temporarily). The upper lifts and eastern edge of the overburden emplacement would also become visible.

Notably, the ridge to the north of the Stage 1 extraction area (the "Northern Ridge") which currently screens some views of the extraction area from Hassans Walls and other elevated vantage points to the north would continue to provide a visual screen of the northern extension area along the existing north-south oriented ridge. Other design features and controls to be implemented by the Applicant to reduce the exposure and impact on visual amenity of the Stage 2 Extension are discussed in Section 4.12.4.

4.4.3.3 Zone B: Bells Line of Road

There would be very minimal change to the views of the Stage 2 Site currently available (at significant distance) from the isolated points on Bells Line of Road.

4.4.3.4 Zone C: Mount York and Mount York Road

Clear unimpeded views of the southern wall of the Stage 1 extraction area are available from both major lookouts and walking trails on the southern side of Mount York Road. The Stage 2 Extension would potentially increase the area of the extraction area exposed to views from these lookouts. The upper lifts of the proposed overburden emplacement would also become visible. As is discussed further in detail in Section 4.4.4, the Applicant has gone to considerable effort to develop strategies to both reduce the area of exposed quarry operations from vantage points within Zone C (refer to Section 4.4.4.2), as well as reduce the impact of any residual views of the quarry operations (both in terms of overall exposure and longevity) (refer to Section 4.4.4.3).

4.4.3.5 Zone D: Great Western Highway

Viewed on a similar orientation as from Zone A (River Lett Hill) and Zone C (Hartley), the extension of the extraction area and overburden emplacement would increase the exposed areas visible from these vantage points. While closer to the Stage 2 Site than equivalently oriented views from Zones A and C, the likely change in visual amenity is not considered to be as great given the elevation of views from Zone D are lower allowing for greater screening by

intervening topography and vegetation. Furthermore, views from vehicles travelling on the Great Western Highway are likely to remain fleeting rather than constant due to the alignment of the road surface and presence of vegetation (both natural and planted following initial approval of the quarry).

4.4.3.6 Zone E: Little Hartley (Roads and Residences)

The extension of the extraction area and overburden emplacement would continue to be screened by topography and vegetation, i.e. operations would remain unseen from Coxs River Road, associated local roads and residences.

As the extraction area is extended to the east and south, the area exposed to views from 26 Melliodora Place would increase. The vegetation which surrounds the site of the residence under construction would, however, continue to provide a visual screen of Stage 2 Site operations. Furthermore, the owners of 26 Melliodora Place noted the effectiveness of the application of a bituminous film over the completed quarry faces in reducing the visibility of the Stage 2 Site further when consulted on 7 April 2014 (refer to Section 3.2.2.5.1).

4.4.3.7 Zone F: Kanimbla (Coxs River Road / Kanimbla Drive / Megalong Place)

As the extraction area is extended to the south, the Southern Ridge which currently screens the extraction area would be removed exposing the elevated locations of the Kanimbla locality to views of the extraction area. The increased elevation of the overburden emplacement and excavation of the Southern Ridge would also result in larger areas of this structure being visible from vantage points within this zone.

4.4.3.8 Zone G: Jenolan Caves Road

The increase in visibility of the quarry from vantage points on Jenolan Caves Road would be similar to those available from the Hassans Walls Lookout. Notably, intervening topography is likely to screen any view of the extended overburden emplacement and exposure of the extraction area extension is not likely to be as significant given the reduce elevation of the vantage points when compared to Hassans Walls.

4.4.3.9 Zone H: McKanes Falls Road

As it is the intention of the Applicant to reduce the volume of material stockpiled on the Yorkeys Creek stockpile area (the most visible aspect of the Stage 2 Site), the exposure of Stage 2 Site operations will reduce over time. Section 4.4.4.3 reviews proposed measures that would be implemented to reduce the visual impact of the Yorkeys Creek stockpile area and secondary processing area.

4.4.3.10 Zone I: Blackmans Creek Road

The quarry-related disturbance that is or may be visible from vantage points on Blackmans Creek Road is categorised as either:

- disturbance associated with the approved quarry operation; or
- disturbance associated with the proposed extension.

Current measures to minimise the visibility of the approved quarry operations, most notably the completed western face of the extraction area would be maintained. As illustrated on **Figure 4.24**, the application of a bituminous film over the completed extraction face is effective in reducing the visibility of the extraction area (a lack of access to the benches of the western extraction face has to date prevented the completion of the bituminous film application over a small section). Regardless of whether the proposed extension proceeds, this view of the Stage 2 Site would remain. The Applicant remains committed, however, to identifying a method of either applying the bituminous film to this section of the completed face or some other measure to reduce the visibility.

4.4.3.11 Lighting Impacts

The Proposal includes an increase in the operating hours to include the evening period of 6:00pm to 10:00pm, although it is noted there would be no increase in activities from that currently undertaken in the early morning period (5:00am to 7:00am). As a consequence, the Proposal could result in the lights used within the extraction area being visible from vantage points surrounding the Stage 2 Site. Notably, evening operations within the secondary processing area currently occur, although the level of lighting may increase to account for the continuation of processing operations until 10:00pm.

4.4.3.12 Conclusion

There are unlikely to be significant changes to the visibility of the Stage 2 Site viewed from Zones B, D, G and H. In fact, a reduction in the volume of material stored within the Yorkeys Creek stockpile area over time should actually reduce the visual exposure of operations on the Stage 2 Site from Zone H.

The area of exposure potentially visible from some vantage points within Zone E, e.g. Melliodora Place, would increase, however, given the screening provided by intervening vegetation, this increase should remain relatively unobtrusive.

The most significant changes to the visibility of the Stage 2 Site from vantage points surrounding the Stage 2 Site, would most likely be from Zones A, C and F. As a consequence, the identification and implementation of design features, operational controls and safeguards to reduce the impact of the Stage 2 Extension on local visual amenity has concentrated on those views available from these zones. Successful reduction in impact achieved for these locations would similarly reduce the impact at other vantage points.

4.4.4 Environmental Controls and Management

4.4.4.1 Visibility Management Objectives

The management of the impact of the Proposal on local visual amenity would be undertaken to achieve two objectives.

1. To reduce the area of the extraction area and overburden emplacement visible from the various vantage points surrounding the Stage 2 Site at any one time.
2. To mitigate the effect of any exposed areas of the Stage 2 Site from the various vantage points surrounding the Stage 2 Site at any one time.

The following provides a discussion of the various design features, controls and management that would be implemented by the Applicant to achieve these objectives.

4.4.4.2 Controls and Management to Reduce Areas of Exposure

Reducing the area of the Stage 2 Site exposed from vantage points surrounding the Stage 2 Site would be achieved primarily through the design and sequence of the extraction area and overburden emplacement. The following summarises the key features of Proposal design aimed at reducing the area of the quarry exposed.

Stage 2 Extension Design

- The primary crushing station would remain in the current location which is not visible from any of the visual zones (Zones A to I) surrounding the Stage 2 Site.
- No further extension of, or modification to the secondary processing area and Yorkeys Creek stockpile area is proposed. In fact, a gradual reduction in the volume of products contained within the Yorkeys Creek stockpile area is planned which would reduce the size of these stockpiles visible from Zones A, C, G and H.

  A program to crush and reprocess 40 000t of scalps contained within the Yorkeys Creek stockpile area has been commissioned and the Applicant is aiming to process at least 100 000t of stockpiled scalps annually. This should ensure that the volume of process by-product stockpiled is at least stabilised at current volumes (refer to Section 2.9.2 for information on annual by-product generation). Periodically larger campaigns to supply larger road or other infrastructure projects should lead to the reduction and ultimate removal of the stockpile.
- The Northern Ridge, currently excised from the Stage 1 extraction area to screen views from Zone A, would remain undisturbed should the Proposal be approved. This would continue to screen views of the lower benches of the extraction area from Zones A, G and H.
- The eastern perimeter of the extraction area has been restricted to ensure that elevated sections of the Central and Southern Ridges are retained to the northeast (between the extraction area and Zones C, D and E).
- The extension of the overburden emplacement would be primarily contained within two gullies to the south and west of the existing overburden emplacement. These gullies are screened to the north (Zones A, E, G and H) by natural topography. The lower elevations of these gullies area also screened to the northeast and east (Zones C, D and E) by the Central and Northern Ridges.

Stage 2 Extraction Area Extension Sequence (see also Figure 2.6)

- Initial extraction would occur in the southern portion of the extension area to the southwest of the most elevated point of the Southern Ridge. This would leave a visual barrier in place to the visual vantage points within Zones C and D.

- The area to the south of the most elevated point of the Southern Ridge would be excavated first, daylighting to the south before the active face is progressed to the north (see Stages A, B and C of **Figure 2.6**). This sequencing of the extraction area would ensure that a more elevated section of the Southern Ridge always remains between the extraction area and visual vantage points to the northeast (Zones C and D)
- A similar method of screening the extraction activities would be provided to the north through the retention, for as long as possible, of the most elevated section of the Central Ridge (see Stage C of **Figure 2.6**).
- Screening of extraction activities to the north would be further enhanced through the alignment of the active extraction face along an approximate northeast-southwest axis.
- The sequence has been designed to reach the terminal western face as quickly as possible such that the targeted impact minimisation measures described in Section 4.12.4.3 can be applied as soon as possible over the life of the Proposal.

Stage 2 Overburden Emplacement Extension Sequence (see also Figure 2.6)

- The initial extension of the Stage 2 overburden emplacement would increase the elevation of the overburden emplacement by approximately 30m, to an elevation equivalent to the extraction area access road. Once the maximum elevation of the overburden emplacement is obtained, overburden placement would revert to the lower benches of the overburden emplacement.
- The extension is sequenced in this way to allow for the most exposed section of the overburden emplacement (visible from Zones A, C, D and F) to be completed and rehabilitated prior to the Central and Southern Ridges being removed to their full extent. This would avoid the area of exposure being maximised later in the life of the Proposal.

The measures proposed to reduce the exposure of active or disturbed areas of the Stage 2 Site have focussed on the visual zones to the northwest, north, northeast and east, as these make up the majority of visual vantage points. It is noted that these measures would not mitigate views of the Site from the south. Section 4.4.4.3 reviews the various management measures and controls to be implemented to reduce the impact of those components or activities on the Stage 2 Site which cannot be screened or removed from view.

4.4.4.3 Controls and Management to Reduce Impacts of Exposure

Controls and management measures to reduce the impact of exposed disturbance would be more targeted and largely build upon measures currently in place at the quarry. The following considers each of the components that would be visible, the zones from which views of these would be available and the methods of mitigating the visual impacts.

Secondary Processing Area (and Primary Conveyor)

While generally screened from view from most vantage points due to its low elevation, the stockpiles, conveyors and other components of the secondary processing area would be visible from Zones C and H (see **Figures 4.17** and **4.23**). The following visual impact mitigation measures would be implemented.

- The profiled slopes between the administration centre and extraction area Access Road (see **Plate 4.1**) would be benched, covered with soil (or other appropriate growth medium) and vegetated with grass or other groundcover.
- The vegetation established on the completed northern face and fill slope between the extraction area and secondary processing area (see **Plates 4.2** and **4.3**), would be retained and maintained.

Yorkeys Creek Stockpile Area

The stockpile of fill and road pavement materials contained within this area is visible from Zones A, C, G and H (see **Figures 4.14**, **4.15**, **4.17**, **4.21** and **4.23**). The Applicant proposes to implement both a short-term and long-term strategy for mitigating this impact.

- Long-term Visual Impact Reduction Strategy

  Through reprocessing of the material contained within the stockpiles, and modifications to the scalps processing of raw throughput to the processing operations, the Applicant would improve the marketability of the products including:

  – specialty aggregates;
  – fill sand;
  – road base;
  – select fill; and
  – specialty sands and other products.

  As discussed in Section 2.11.1, an increase in the hours of operation available for processing (to 10:00pm) would provide greater scope for the processing of scalps in an efficient and cost-effective manner.

  As the Applicant increases sales, the volume of material contained within the stockpile would be reduced over the life of the Proposal. The Applicant notes that proposed road works projects on the Great Western Highway such as the Forty Bends upgrade are likely to require in excess of 250 000t of fill material. The logical source of these materials due to quality and proximity would be the Austen Quarry. This project alone could account for 30% to 40% of the currently material stockpiled.

Plate 4.1: Unvegetated slopes of the Secondary Processing Area
(Ref: E652W_009)

Plate 4.2: Established Vegetation of the Stage 1 Extraction Area
(Ref: E652W_021b)

Plate 4.3: Established grass coverage of Northern Extraction Face
(Ref: E652S_027)

Plate 4.4: Rehabilitation of the Overburden Emplacement
(Ref: E652P_026)

Short-term Visual Impact Reduction Strategy

- While markets for the various products are identified and developed, the Applicant proposes to maintain a cover of grassy vegetation on the outer slopes of the stockpiled material. The Applicant is currently investigating the use of seeded spray for use on the exposed walls and steep slopes.
- In addition, the Applicant has committed to planting multiple rows of trees on the ridgeline to the immediate north to provide additional screening of the stockpile area.
- Trials of various methods for establishing and maintaining grass cover on the stockpiles are planned for spring 2014, with confirmation of the proposed approach to be made prior to spring 2015.

Stage 1 Extraction Area (Completed Western Face)

Views of the completed western faces of the extraction area are, and would continue to be visible from Zones A to E and I (see **Figures 4.14** to **4.19** and **4.24**). However, as the western extraction area face is completed (or where it is to remain inactive for extended periods), a bituminous film would be applied to reduce the contrast between the pale rhyolite and darker background vegetation. The insets of **Figures 4.17** and **4.24** illustrate the effectiveness of the bitumen in reducing the contrast created by the exposed rock wall and therefore visibility.

The Applicant is also investigating the use of seeded spray for the exposed quarry walls.

Stage 2 Extraction Area Extension

As the extraction area is extended, temporary views of extraction of the central and southern ridge would be available from the visual zones to north (Zones A, D and I).

Longer term or permanent views of the extraction activities within the Stage 2 extraction area would be limited to Zones C, E and F. The primary method of reducing the visual impact of the extraction area from vantage points within these zones would be as follows.

- Application of bituminous film to terminal extraction faces, or faces unlikely to be worked for extended periods of time. The photo insets of **Figures 4.17** and **4.24** illustrate the effectiveness of this method in reducing the visual impact of the extraction area.
- Progressive rehabilitation of the completed benches of the extraction area. As the extraction area reaches the outer perimeter, a layer of overburden (for water retention) followed by soil would be placed on the final bench. The bench would then be seeded with native groundcover, shrub and tree species.
- Where the use of floodlights are required within the extraction area, these would be directed downwards and towards the west, wherever possible. Special attention would be paid to lighting of internal haul roads within the extraction area to ensure that lights are not directed towards the east or south.

Overburden Emplacement Extension

- The overburden emplacement area is currently visible from Zone F (see **Figure 4.24**) and would become visible from Zones C, D, E and I as the elevation increases from 780m to 810m AHD. In order to mitigate the impact resultant from the development of the overburden emplacement, the Applicant would sequence the development and rehabilitation of the overburden emplacement as follows. The initial component of the overburden emplacement to be completed would be the upper lifts. Immediately on completion, these lifts would be profiled, covered with soil and seeded with groundcover species to reduce the contrast between the overburden and surrounding vegetation.
- The initial revegetation would be followed by direct seeding or planting of tree and shrub species commensurate with those of the surrounding vegetation communities. **Plate 4.4** illustrates that the Applicant has been successful to date in establishing vegetation over rehabilitated land.
- On completion of the upper lifts, overburden placement would revert to the lower elevation benches, following the same program of bench completion, profiling, soil application, groundcover establishment then tree planting.
- Placement of overburden would be avoided after 6:00pm as far as practicable. If required, floodlights would be positioned to direct light downwards and towards the north or west.

General Visual Impact Mitigation Strategies

The following more general visual impact mitigation strategies would be implemented.

- The tree plantings along Jenolan Caves Road would continue to be maintained, with water or fertiliser provided under extreme conditions to ensure survival and growth.
- Emissions of dust would be minimised on the Stage 2 Site through the application of water to trafficked areas, stockpiles and conveyor transfer points (see also controls of Section 4.8.5).
- Maintenance of the Stage 2 Site in a tidy and orderly manner.
- Lighting plant (both permanent and temporary) would be selected and located such that the light:
  - is not directed towards Jenolan Caves Road;
  - is not directed to the south or east when placed within the extraction area or on the overburden emplacement; and
  - minimises the ‘lume’ created by the lights.

The Applicant would also continue to investigate additional or alternative impact mitigation measures to reduce the impact of the Proposal on visual amenity. The use of the bituminous film on the extraction faces is an excellent example of the Applicant's adoption of this 'adaptive management' approach. For several years, various options for reducing the visual contrast of the extraction area faces were investigated before the current approach was adopted and implemented.

4.4.5 Assessment of Residual Impacts

4.4.5.1 Area of Exposure

With respect to the first objective of visual amenity management nominated in Section 4.4.4.1, i.e. to reduce the area of the extraction area and overburden emplacement visible from the various vantage points surrounding the Stage 2 Site at any one time, the proposed design features, operational controls and management measures would be effective. Views of the Stage 2 Site from vantage points within Zones B, E, G, H and I would remain largely unchanged and in fact should be improved as a result of both the short-term and long-term visual impact management strategies proposed for the Yorkeys Creek stockpile area.

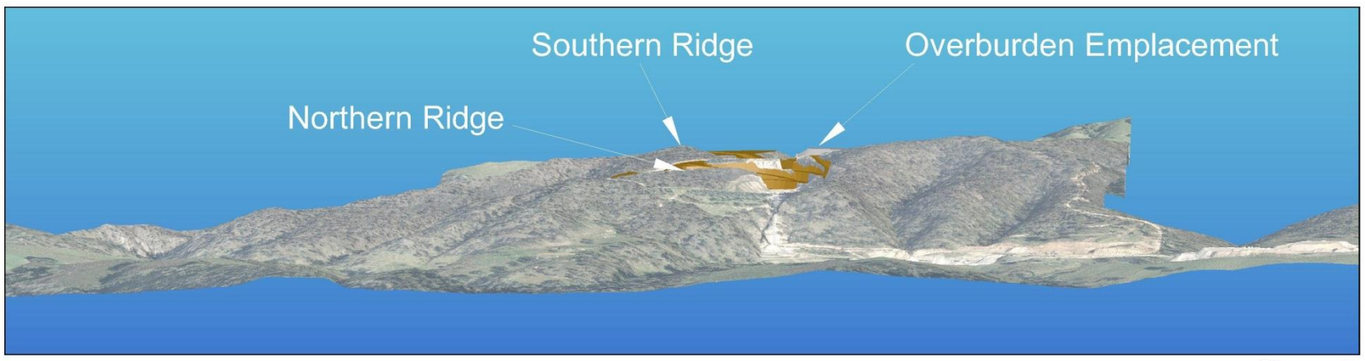
An increase in the visibility of the Stage 2 extension to the extraction area and overburden emplacement would be unavoidable from some vantage points, most notably those within Zones A, C, D and F.

Zones A, C and D

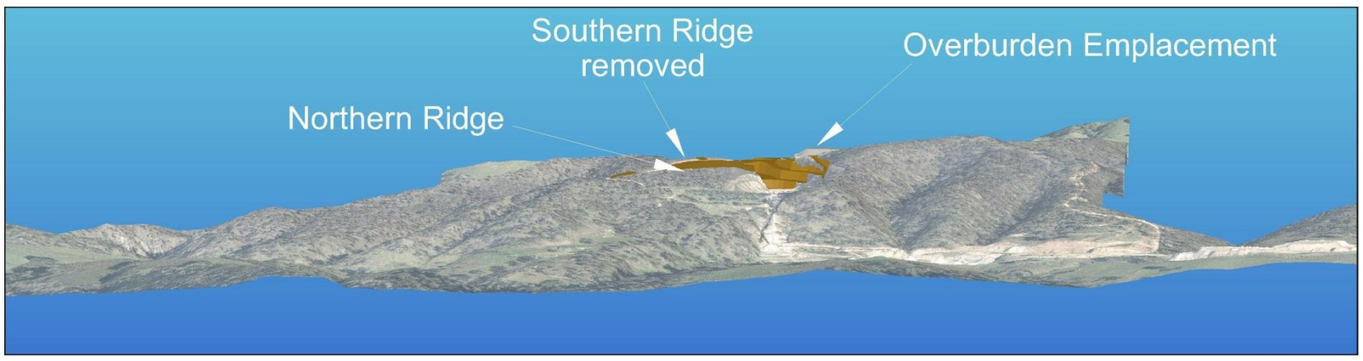
To illustrate the progressive exposure of the Stage 2 Site from Hassans Walls (Zone A) and Mt York (Zone C[2]), Groundwork Plus prepared a series of 3-Dimensional interpretations from these vantage points based on the existing and future topography (at each stage of the extraction sequence). **Appendix 5** provides the original images provided by Groundwork Plus and **Figures 4.25** and **4.26** combine these to match the extraction stages of **Figure 2.6**. **Figure 4.27** provides the final predicted view of the Stage 2 Site from Hassans Walls and Mt York.

Figures 4.25 to **4.27** demonstrate that while the Stage 2 extraction area and overburden emplacement would be visible from vantage points to the north and northeast, the sequencing of operations would minimise the area of exposed disturbance at any given time. This minimisation in the area exposed at each stage would be achieved by maximising the effective screening provided by natural topography, e.g. the Northern, Central and Southern Ridges. It is noted that the images presented in **Figures 4.25** to **4.27** do not attempt to illustrate how the management measures discussed in Section 4.4.4.3 would reduce the visual impact of proposed Stage 2 Extension, most notably progressive rehabilitation and application of the bituminous film to completed or inactive extraction faces,. These figures are presented solely to illustrate how extraction area design and sequencing minimises the area of exposed quarry.

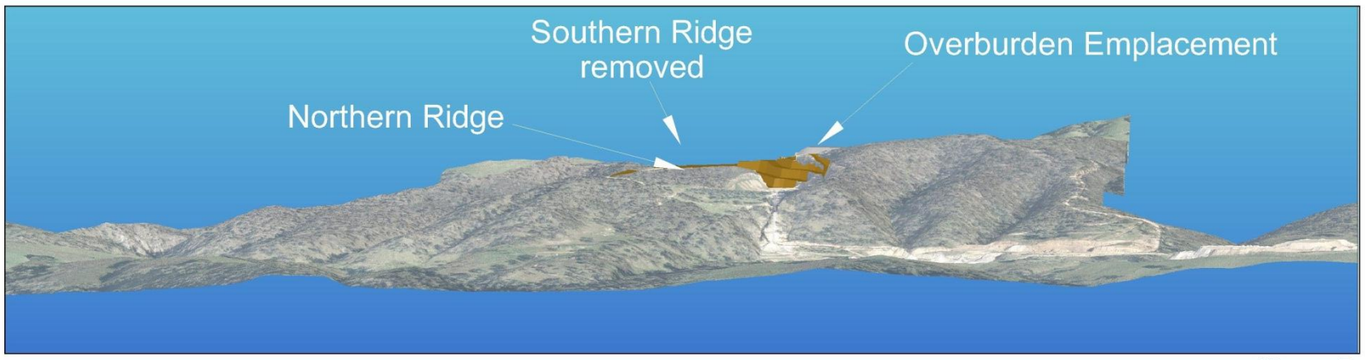
[2] The exposure of the Stage 2 extraction area and overburden emplacement from Zone C is indicative of the view which might be available from vantage points within Zone D (in the Little Hartley to Hartley section of the Great Western Highway), albeit more fleeting as viewed from a vehicle and obscured by roadside vegetation.



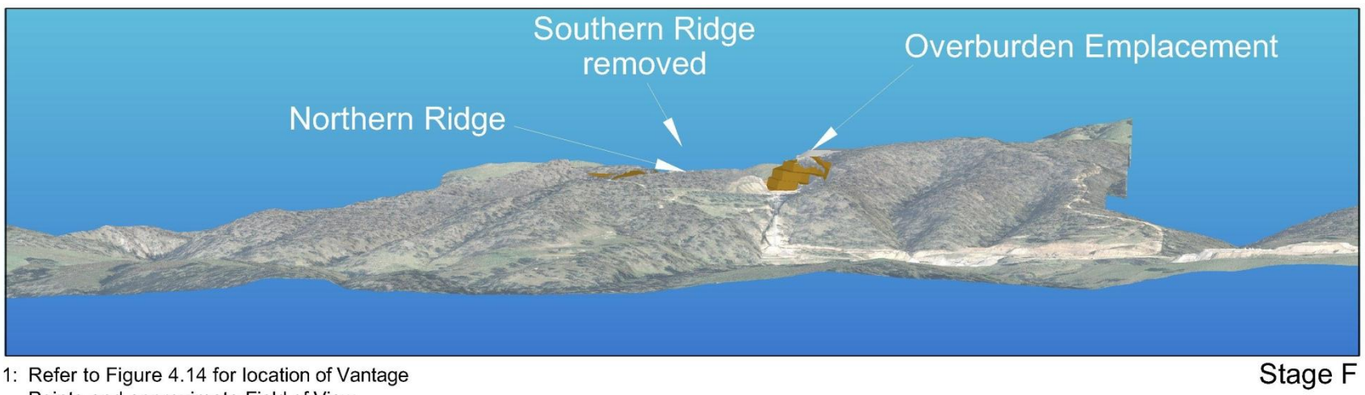
Stage A



Stage C



Stage D



Stage F

Notes 1: Refer to Figure 4.14 for location of Vantage Points and approximate Field of View
2: The horizon and foreground has been removed for clarity
3: Colouration of the extraction area and overburden emplacement has been chosen to emphasise these features in this figure. Management measures as discussed in Section 4.4.4.3 would reduce the visual impact significally

REFERENCE
- Extraction Area
- Overburden Emplacement
- Vegetation

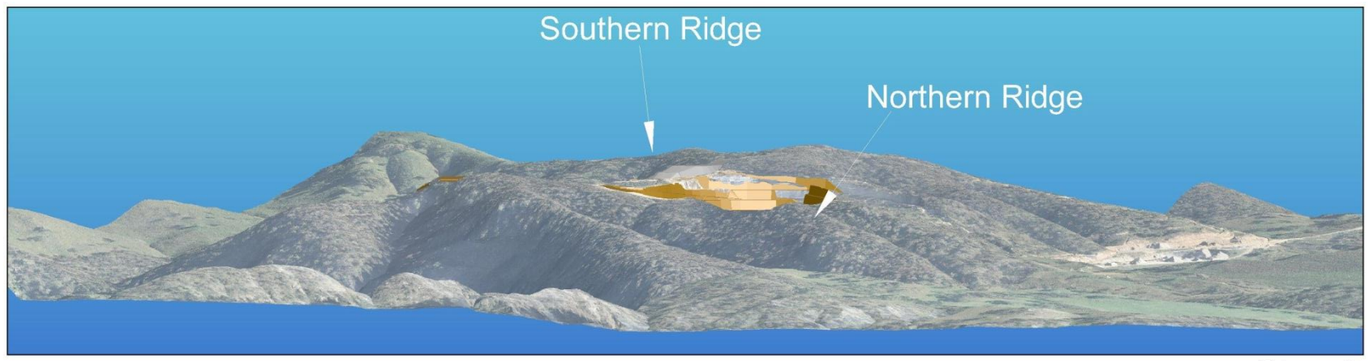
Source: Groundwork Plus (see Appendix 5)

Figure 4.25
PROGRESSIVE EXPOSURE OF THE
STAGE 2 EXTENSION FROM HASSANS WALLS

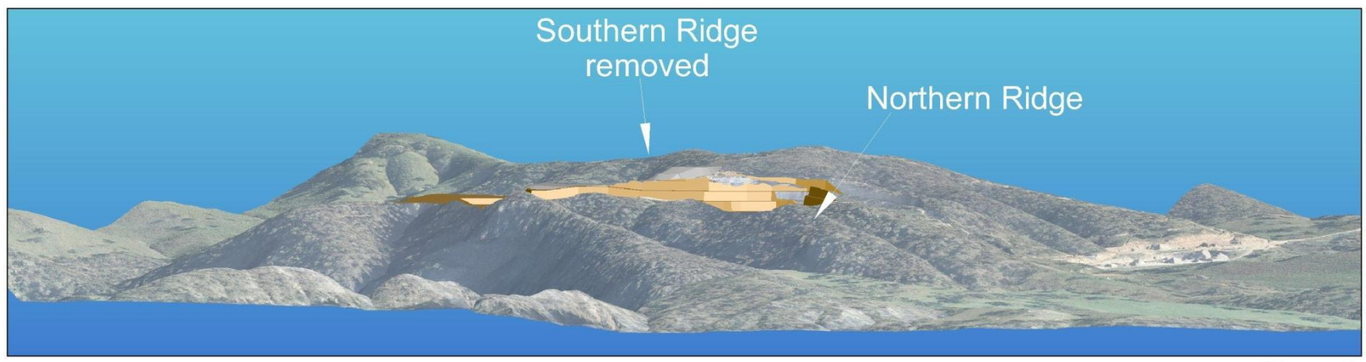
This page has intentionally been left blank

This page has intentionally been left blank

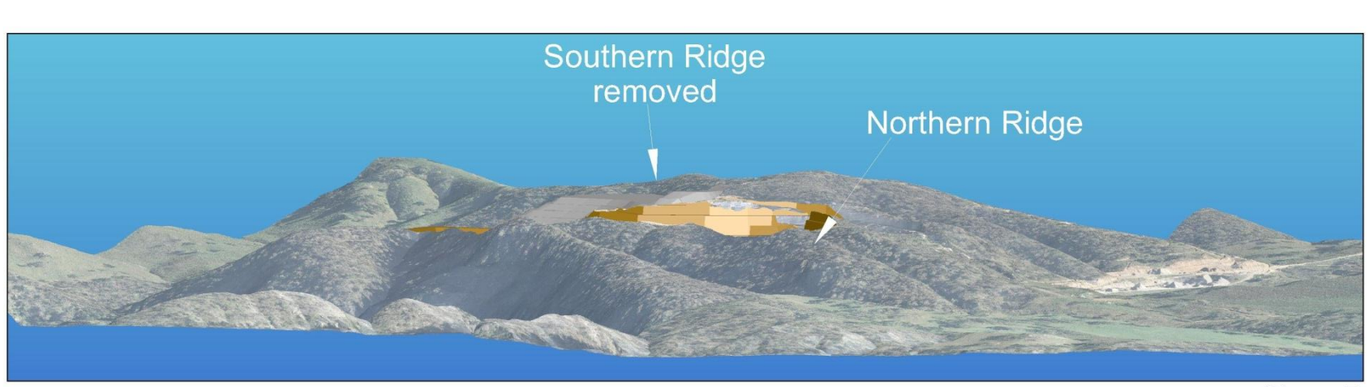
Y:\Jobs 531 to 1000\652\Reports\65218_EIS_2013\CAD\ 652EIS.dwg_EIS 4.26 Exposure -25.09.2014 -1:51 PM



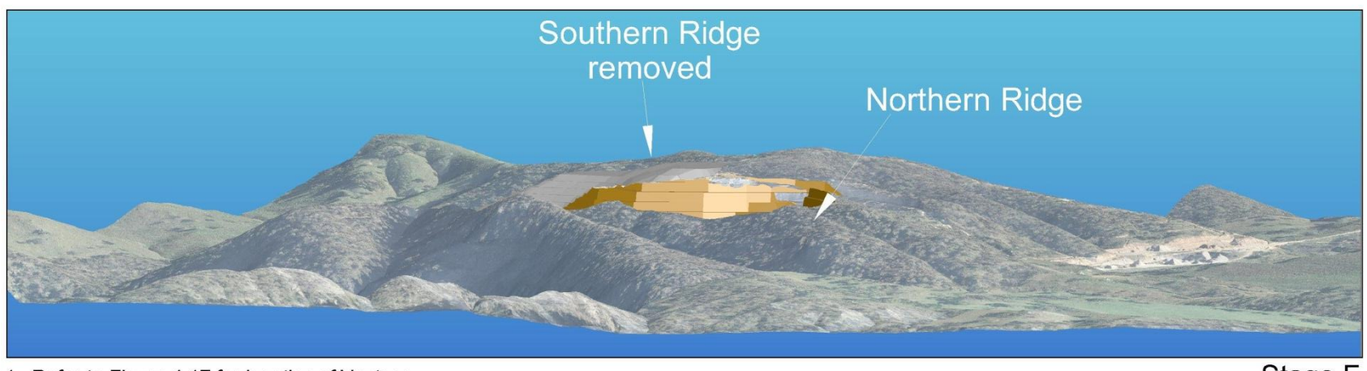
Stage A



Stage D



Stage E



Stage F

Notes 1: Refer to Figure 4.17 for location of Vantage Points and approximate Field of View
2: The horizon and foreground has been removed for clarity
3: Colouration of the extraction area and overburden emplacement has been chosen to emphasise these features in this figure. Management measures as discussed in Section 4.4.4.3 would reduce the visual impact significally

REFERENCE
- Extraction Area
- Overburden Emplacement
- Vegetation

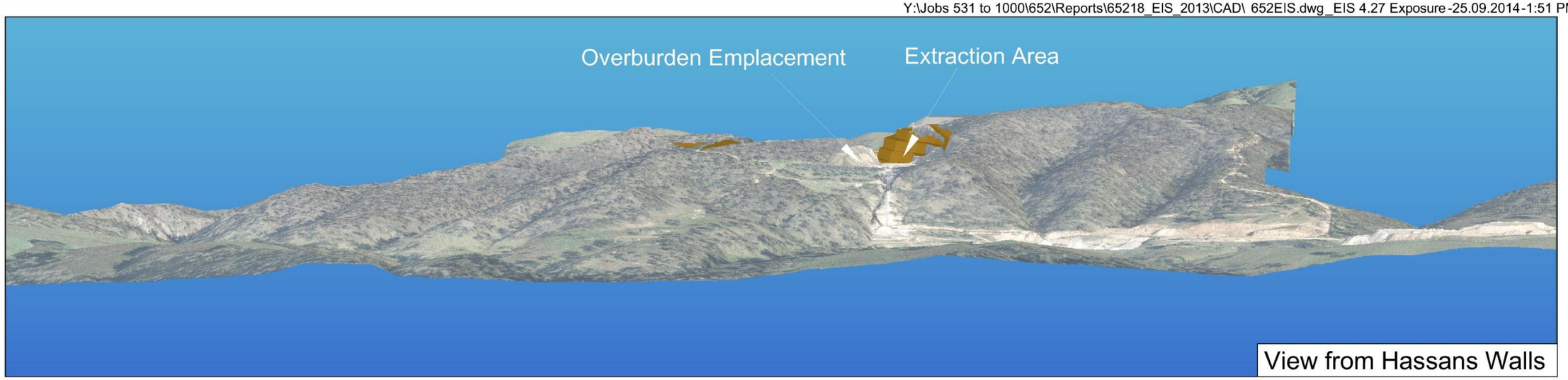
Source: Groundwork Plus (see Appendix 5)

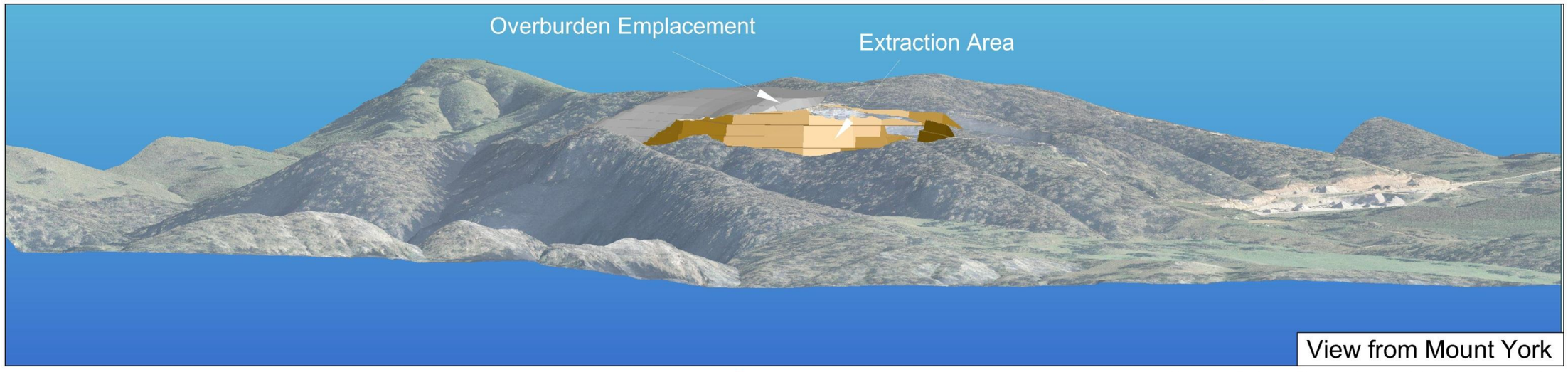
Figure 4.26
PROGRESSIVE EXPOSURE OF THE STAGE 2 EXTENSION FROM MOUNT YORK

This page has intentionally been left blank

This page has intentionally been left blank

Y:\Jobs 531 to 1000\652\Reports\65218_EIS_2013\CAD\ 652EIS.dwg_EIS 4.27 Exposure-25.09.2014-1:51 PM





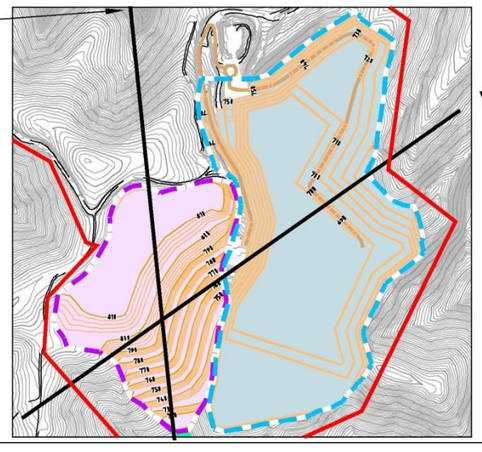
View from Hassans Walls

REFERENCE
Stage 2 Site Boundary
Proposed Stage 2 Extraction Boundary
Proposed Limit of Stage 2 Overburden Emplacement
Internal Haul Road

MAP SCALE 1:20 000

200 0 200 400 600 800 1000 m

Source: Groundwork Plus (see Appendix 5)



View from Mount York

REFERENCE
Extraction Area
Overburden Emplacement
Vegetation

Notes 1: Refer to Figures 4.14 and 4.17 for location of Vantage Points and approximate Field of View
2: The horizon and foreground has been removed for clarity
3: Colouration of the extraction area and overburden emplacement has been chosen to emphasise these features in this figure. Management measures as discussed in Section 4.4.4.3 would reduce the visual impact significally

Figure 4.27
PREDICTED FINAL VIEWS FROM HASSANS WALLS AND MOUNT YORK

This page has intentionally been left blank

This page has intentionally been left blank

As discussed in preceding sections, the vantage points of Hassans Walls and Mt York provide the greatest visual exposure of the Stage 2 Site from the north and northeast. The impact minimisation measures effective for these vantage points would be equally if not more effective from those vantage points with more distant or obscured views within Zones A to E, and G to I.

Zone F

Groundwork Plus also prepared a series of interpreted visual montages from "The Peak at Mt Kanimbla" (Eagle Chalet) (see **Appendix 5**). **Figure 4.28** presents the interpreted view of the Stage 2 Site from this location as the extraction area and overburden emplacement are progressively developed and rehabilitated.

Figure 4.28 illustrates that over the life of the Proposal, the area of the Stage 2 extraction area and overburden emplacement visible from vantage points within Zone F would increase. As is also illustrated by **Figure 4.28**, however, progressive rehabilitation and management of the extraction faces of the Stage 2 Site is likely to reduce the impact of this increase is exposed quarry operations.

At distances such as those to the vantage points of Zone F (~6km), visibility is most affected by contrast, e.g. between the paler coloured rock and darker vegetation which surrounds it and less by the actual activities undertaken. This is exemplified by the owners of 43 Megalong Place identifying the disturbance associated with the Stage 1 overburden emplacement but misidentifying this as a road or farm track. The reduced visibility of the Stage 1 extraction area from Hassans Walls and other vantage points after the application of a black bituminous film (see insets to **Figures 4.17** and **4.23**) is also illustrative of this.

4.4.5.2 Impact of Exposure

With respect to the first objective of visual amenity management nominated in Section 4.4.4.1, i.e. to reduce the area of the extraction area and overburden emplacement visible from the various vantage points surrounding the Stage 2 Site at any one time, the proposed design features, operational controls and management measures would be effective.

While it is concluded in Section 4.4.5.1 that the area of exposed disturbance on the Stage 2 Site would be reduced as far as possible, the area of exposed disturbance would be increased as a result of the Proposal. Assuming the implementation of the various mitigation measures nominated in Section 4.4.4.3, however, the impact of this increase in exposure would be reduced to the greatest extent considered feasible, thereby achieving the second objective noted in Section 4.4.4.1, i.e. to mitigate the effect of any exposed areas of the Stage 2 Site from the various vantage points surrounding the Stage 2 Site at any one time. Supporting this assessment, the following is noted.

- The visual amenity of the secondary processing area and Yorkeys Creek stockpile area would be progressively improved through a reduction in the area currently disturbed or lacking vegetation.
- The application of the bituminous film to terminal or inactive extraction area faces is effective in reducing the visual contrast and therefore impact of these features of the quarry.

- A focus on progressive rehabilitation would ensure that the visual impact of the overburden emplacement and (to a lesser extent) terminal faces of the extraction area would be reduced as quickly as possible.
  - **Plate 4.4** demonstrates the ability of the Applicant to successfully revegetate sections of the Stage 1 overburden emplacement.
  - **Figure 4.28** provides the interpreted views of the Stage 2 Site when viewed from Zone F, considering the planned progressive rehabilitation and bituminous film application.
- Impacts of night lighting would be managed through selection and placement of lights to minimise the overall 'lume' and ensure the direction of lighting is away from those visual zones with direct views of the extraction area and overburden emplacement.
- The Applicant would continue to implement an adaptive management approach to identifying and mitigating impacts on visual amenity.
- The Applicant would continue to manage dust and light emissions such that these do not impact on local visual (or general) amenity.
- The establishment of the proposed Biodiversity Offset Area (BOA), while not specifically mitigating the visual impact of the extraction area and overburden emplacement, would ensure that that the areas surrounding the Stage 2 Site are protected from future clearing or modification which would impact on local visual amenity.

4.4.6 Monitoring

The Applicant would undertake a series of annual photographs from vantage points within each of the Zones nominated and compare (in the case of Hassans Walls and Mt York) against the sequence of impact presented **Appendix 5** and **Figures 4.25** to **4.28**. These photos, along with a discussion as to compliance with the impact predicted, would be included in the annual reporting to be completed for the Proposal and submitted to DP&E and other agencies.

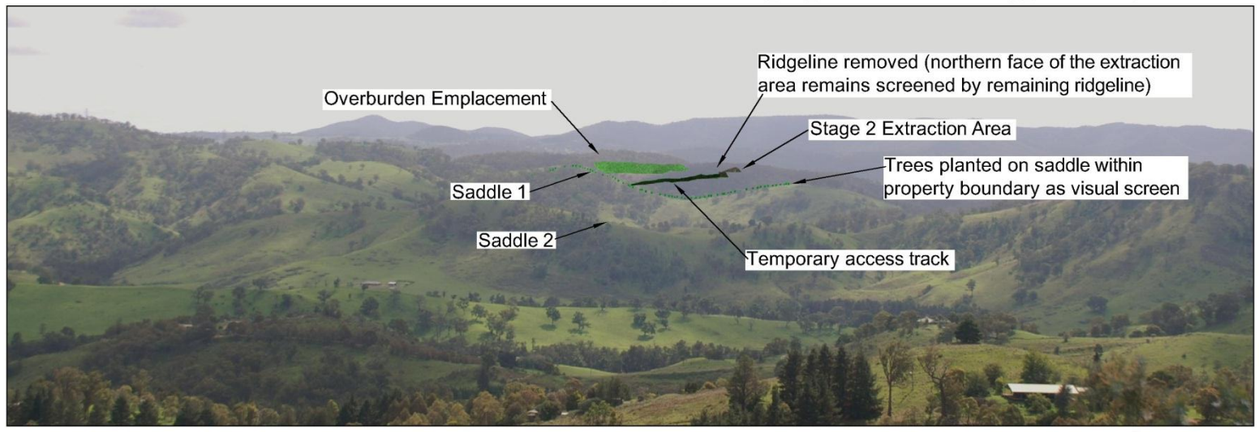
4.5 SURFACE WATER

4.5.1 Introduction

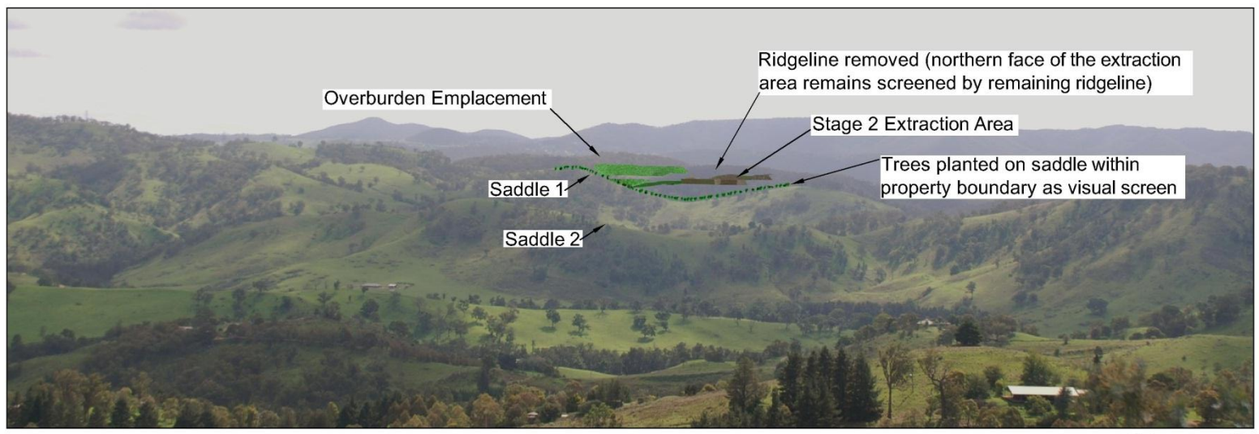
The DGRs issued for the Proposal identified "*Soil and Water*" as a key issue requiring that the "*EIS include:*

- *a detailed assessment of potential impacts on the quality and quantity of existing surface and ground water resources, including:*
  - *detailed modelling of potential groundwater impacts;*
  - *impacts on riparian, ecological, geomorphological and hydrological values of watercourses, including environmental flows, in particular Coxs River;*

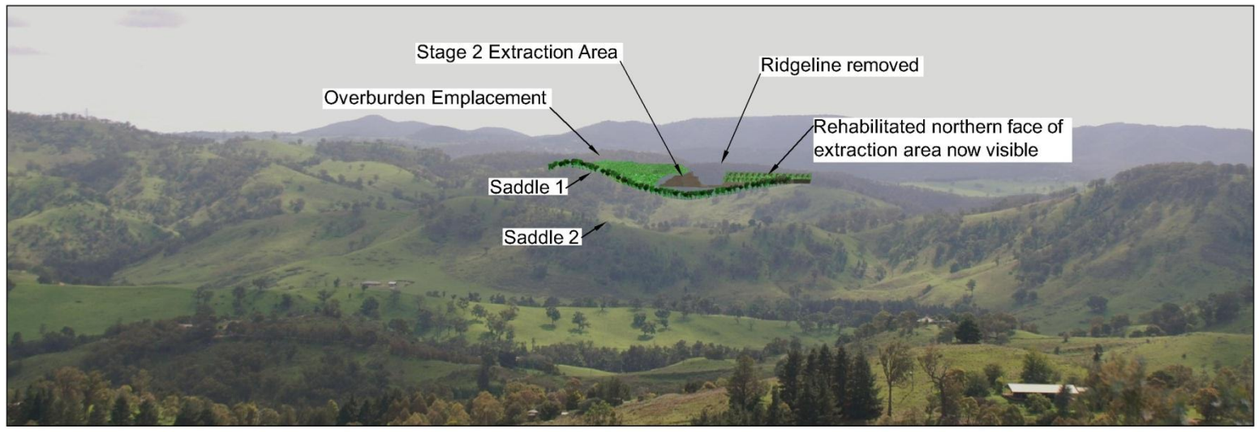
Y:\Jobs 531 to 1000\652\Reports\65218_EIS_2013\CAD\ 652EIS.dwg_EIS 4.28 Exposure -30.05.2014-3:34 PM



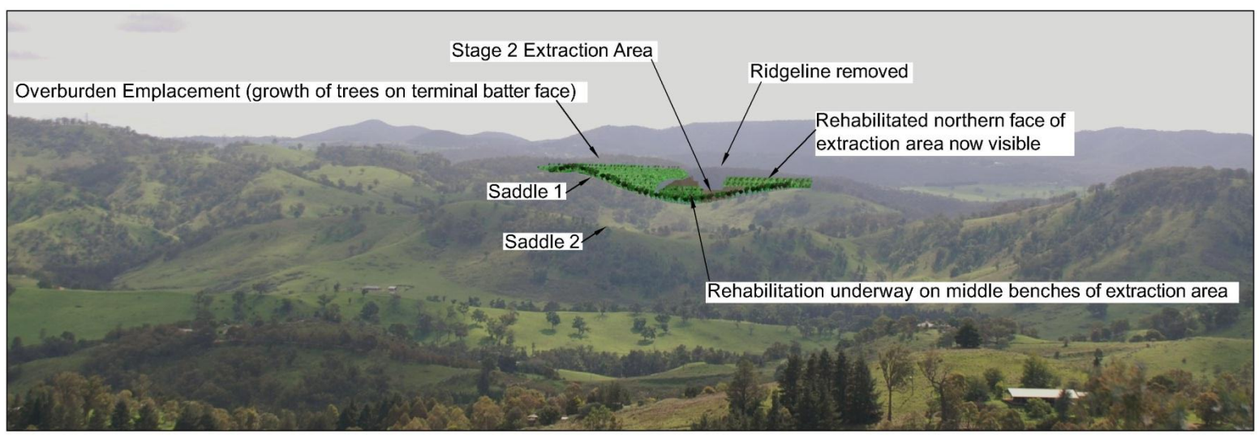
Stage A



Stage C



Stage E



Stage F

Notes 1: Refer to Figure 4.20 for location of Vantage Point and approximate Field of View
2: Colouration of active areas and rehabilitation is indicative only

Source: Groundwork Plus (see Appendix 5)

Figure 4.28
PROGRESSIVE EXPOSURE OF THE STAGE 2 EXTENSION FROM "THE PEAK AT MT KANIMBLA"

This page has intentionally been left blank

This page has intentionally been left blank

  - *whether the development can operate to achieve a neutral or beneficial effect on water quality in the drinking water catchment, consistent with the provisions of State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011;*

- *a detailed assessment of the potential impacts of the development on:*
  - *the quantity and quality of regional water supplies;*
  - *regional water supply infrastructure; and*
  - *affected licensed water users and basic landholder rights (including downstream water users);*
- *a detailed site water balance, 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;*
- *identification of any licensing requirements or other approvals under the Water Act 1912 and/or Water Management Act 2000;*
- *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) or water source embargo;*
- *a detailed description of the proposed water management system (including upgraded sewage system), water monitoring program and other measures to mitigate surface and groundwater impacts; and*
- *a flood impact assessment, which identifies impacts on local and regional flood regimes and resultant impacts on infrastructure and public safety, including any measures proposed to mitigate potential flood impacts.*

Additional matters for consideration in preparing the EIS were also provided in the correspondence attached to the DGRs from the NSW Office of Water (NOW) which amongst several more general water impact and assessment related requests included a request for a predictive assessment of the impact of the Proposal that includes identification of all surface water sources, descriptions of dependent ecosystems and users, and an assessment of predicted impacts to all users, hydrogeological features and water quality. Requirements were also provided by the Sydney Catchment Authority and Lithgow City Council. A consolidated list of the identified requirements and where each is addressed is presented in **Appendix 3**.

Based on the risk analysis undertaken for the Proposal (Section 3.3.1 and **Table 3.9**), the potential impacts relating to surface water and their risk rankings (in parenthesis) after the adoption of pre-existing or standard mitigation measures are as follows.

- Reduced flows to Yorkeys Creek and Coxs River (medium risk)
- Reduced availability of water to downstream users (low risk).
- Reduced volume of water available to local flora and fauna resulting in:
  - stress and possible reduction in viability of native vegetation (low risk); or
  - degradation of riparian or aquatic vegetation / ecosystems (medium risk).

- Discharge of dirty or contaminated water to local creeks and tributaries causing pollution of downstream waters (medium risk).
- Contamination of soil resources and limitation of future land use from discharge of dirty or contaminated water (low risk).
- Health-related impacts to people due to the consumption of contaminated water (low risk)
- Health-related impacts to livestock due to the consumption of contaminated water (low risk)
- Soil erosion causing loss of agriculturally productive capacity (medium risk).
- Erosion causing decreased availability of soil for rehabilitation (medium risk).

A review of the attributed risk levels, following the adoption of the recommended operational safeguards and controls, is provided in Section 6.2.1 and **Table 6.1**.

The surface water impact assessment for the Proposal was undertaken by Messrs Shane Stuart and Prasanna Rao of Groundwork Plus. The assessment is presented as Part 2 of the *Specialist Consultants Studies Compendium* and is referred to hereafter as "Groundwork Plus (2014)". This subsection of the EIS provides a summary of the surface water impact assessment, concentrating on those matters raised in the DGRs and related requirements provided by various government agencies.

4.5.2 The Existing Environment

4.5.2.1 Regional Catchments and Drainage

The Stage 2 Site is located within the Mid Coxs River catchment of the Hawkesbury-Nepean catchment. The Hawkesbury-Nepean catchment includes a number of significant creeks and rivers which drain runoff from the Mulwaree River in the south to the Capertee and McDonald Rivers in the north to the Pacific Ocean. The Mid Coxs River catchment also forms part of the Warragamba sub-catchment of the Sydney Drinking Water Catchment, as defined by the *State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011*, which provide the drinking water supply to Greater Metropolitan Sydney. **Figure 4.29** identifies the relevant regional catchments noted above.

The Coxs River is the most significant regional drainage feature and with its headwaters at Gardiners Gap, within Ben Bullen State Forest, flows through the Megalong Valley and parts of the Greater Blue Mountains Area with a catchment of approximately 2 630km^2. The river flows in a generally southerly direction and joined by 15 main tributaries including the Little, Jenolan, Kedumba, Kowmung and Wollondilly rivers, before reaching its confluence with the Warragamba River to form Lake Burragorang (behind Warragamba Dam), the largest of Sydney's water supply reservoirs.

The majority of the mid-catchment is highly degraded as the land has been extensively cleared and some creeks are highly modified by urban developments (CSIRO Land and Water, 2000). Flow within the Coxs River is influenced by Lake Wallace and Lake Lyell upstream of the Stage 2 Site which impound water for the City of Lithgow and Wallerawang Power Station.

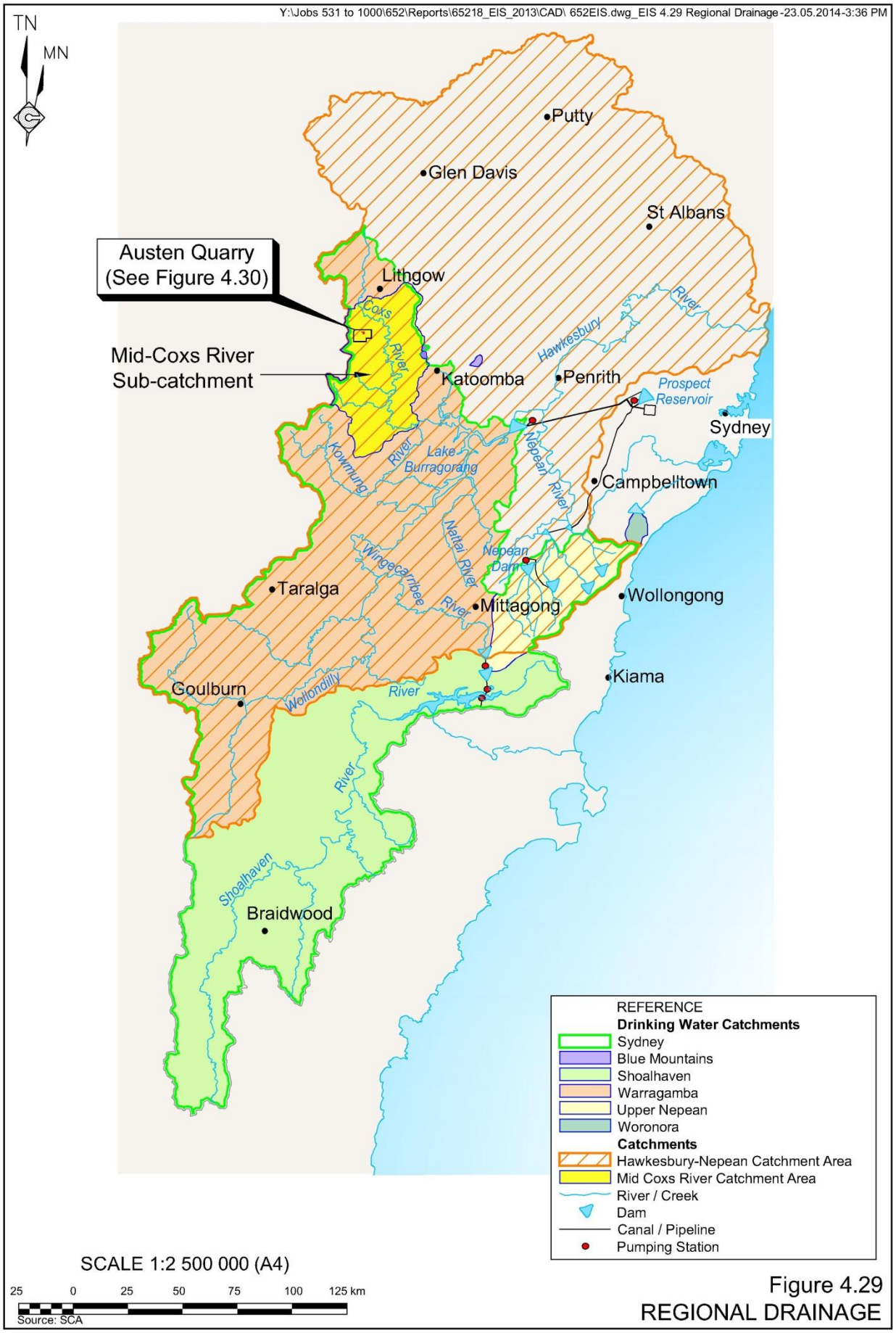


Figure 4.29
REGIONAL DRAINAGE

The segment of the Coxs River between the Stage 2 Site and Lake Burragorang has high public access and is utilised for recreational fishing, non-motor boating and irrigation water supply.

4.5.2.2 Local Catchments and Drainage

Figure 4.30 presents the local catchments draining the Stage 2 Site and Quarry Access Road. Three of these drain runoff directly into the Coxs River (via ephemeral flows within incised gullies of the local topography) and the fourth to Yorkeys Creek which in turn flows into the Coxs River.

Coxs River North

This catchment drains an area of approximately 107ha and incorporates seven mapped watercourses which flow into the Coxs River via a series of small ephemeral streams. This catchment has been highly modified by the existing extraction area and overburden emplacement (affecting five of the seven watercourses) and secondary processing area (affecting the remaining two mapped watercourses) of the Stage 2 Site, as well as by previous clearing in the northern section adjoining the Coxs River for grazing. Areas of relatively undisturbed vegetation occur on the slopes and ridge tops between the secondary processing area and extraction area Access Road (which drain onto the secondary processing area), as well as to the northeast of existing extraction area which drain into the Coxs River. Two dams (SD1 and SD2) located to the north of the extraction area are maintained by the Applicant for the storage of water captured within the extraction area and transferred for use in dust suppression as required.

The proposed extension to the Stage 1 extraction area would increase the area of disturbance within this catchment.

Coxs River South

This catchment drains an area of approximately 145ha via two main drainage pathways. The larger area, incorporating the existing overburden emplacement and a large proportion of the proposed Stage 2 extraction area flows to the Coxs River via an easterly-oriented stream. This larger drainage system contains 1st and 2nd order streams within the Stage 2 Site which combine to form a 3rd order stream to the east before discharging into the Coxs River. The smaller system flows into the Coxs River, north (upstream) of the larger drainage via an easterly flowing 2nd order stream and is largely outside the Stage 2 Site.

The majority of additional disturbance associated with the Proposal would be located within this catchment.

Coxs River West

This catchment has been largely cleared by the landowner for agricultural activities (grazing) and is traversed by the Quarry Access Road and associated water management infrastructure. No changes within this catchment are proposed.

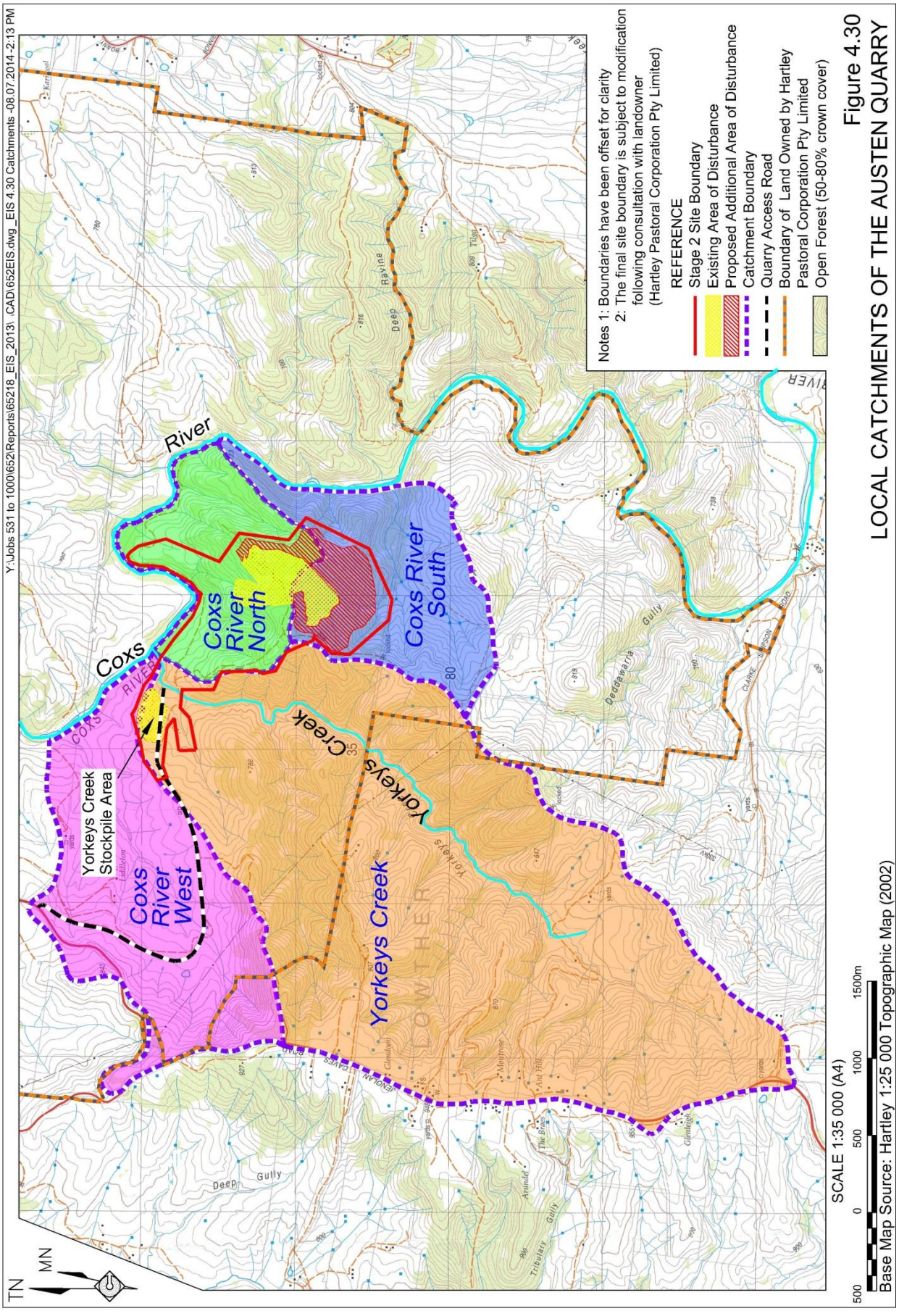


Figure 4.30
LOCAL CATCHMENTS OF THE AUSTEN QUARRY

Yorkeys Creek

Yorkeys Creek is a tributary of the Coxs River that consists of a shallow, ephemeral, erosional, freshwater stream. This catchment drains an area of approximately 761ha. The upper catchment is relatively undisturbed with only a small area historically cleared for grazing. The lower section in the vicinity of the Stage 2 Site has been modified to accommodate the secondary processing area, Yorkeys Creek crossing and Yorkeys Creek stockpile area. Water capture in two dams (SD5 and SD6) within this catchment on the Stage 2 Site is used for dust suppression. These dams are also used for accepting excess water captured on the secondary processing area.

No major changes within this catchment are proposed, although some minor modifications in the form of diversion of overflow from SD5 direct to Yorkeys Creek may be undertaken.

4.5.2.3 Stage 2 Site Catchments, Drainage and Surface Flows

Figure 4.31 presents the catchments draining the Stage 2 Site, as defined by Groundwork Plus (2014) based on level of disturbance, current use and existing stormwater management controls. For further information on the activities within each of these catchments, refer to *Section 3.2.1* and *Table 6* of Groundwork Plus (2014). **Table 4.12** presents the areas and peak runoff volumes determined by Groundwork Plus for each of these catchments in accordance with *Table 6.1* of *Managing Urban Stormwater: Soils and Construction – Volume 2E* (DECC, 2008b) and based on the following data and assumptions.

- Soils and exposed surfaces would have high runoff potential and have been assigned to Soil Hydrologic Group D.
- The 95th percentile 5-day rainfall event has been used by virtue of the longevity of the Proposal and sensitive nature of the receiving waters (within the Sydney Drinking Water Catchment). This is equivalent to 56.4mm (for Lithgow)
- A conservative volumetric runoff coefficient (C_V) value of 0.74 has been assumed for all disturbed and undisturbed catchments of the quarry.

4.5.2.4 Water Quality

The Applicant has undertaken monitoring of water quality within the Coxs River, Yorkeys Creek and selected water storages within the Stage 2 Site since 2003. The water quality results are presented in *Sections 3.3* and *8* of Groundwork Plus (2014). With respect to the receiving waters, for which quality criteria are to be established, there is limited chemical data available for background water quality of Yorkeys Creek. However, a comparison of the physico-chemical data indicates that the water quality of Yorkeys Creek is very similar to that of the Coxs River with only a slightly greater variation in EC and turbidity recorded.

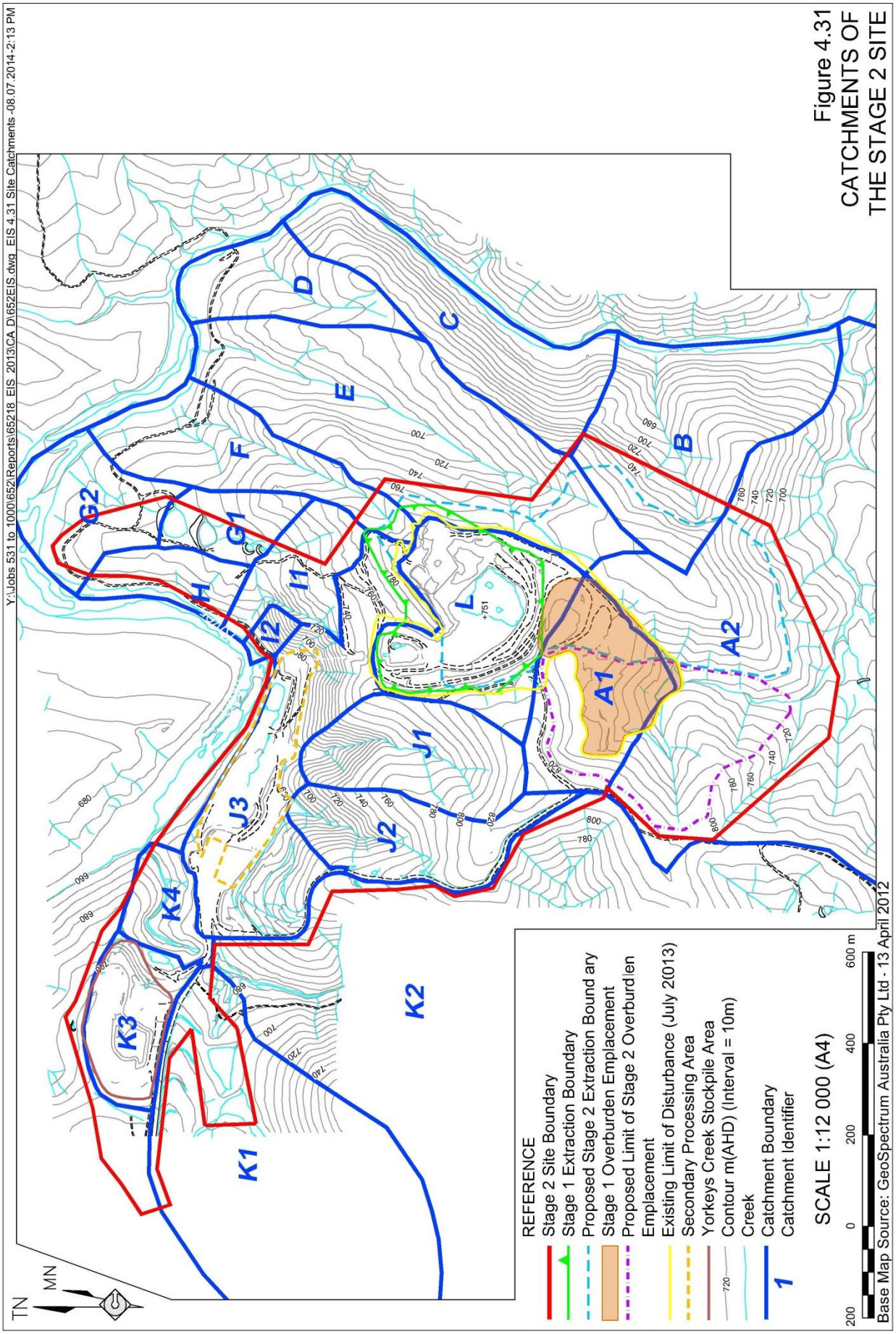

Y:\Jobs 531 to 1000\652\Reports\65218 EIS 2013\CA D\652EIS.dwg EIS 4.31 Site Catchments -08.07.2014-2:13 PM
Figure 4.31
CATCHMENTS OF
THE STAGE 2 SITE
A1
A2
B
C
D
E
F
G1
G2
H
I1
I2
J1
J2
J3
K1
K2
K3
K4
L
TN
MN
REFERENCE
Stage 2 Site Boundary
Stage 1 Extraction Boundary
Proposed Stage 2 Extraction Bound ary
Stage 1 Overburden Emplacement
Proposed Limit of Stage 2 Overburd len Emplacement
Existing Limit of Disturbance (July 2(013)
Secondary Processing Area
Yorkeys Creek Stockpile Area
Contour m(AHD) (Interval = 10m)
Creek
Catchment Boundary
Catchment Identifier
SCALE 1:12 000 (A4)
200 0 200 400 600 m
Base Map Source: GeoSpectrum Australia Pty Ltd - 13 April 2012

Table 4.12
Existing Stage 2 Site Catchments and Peak Runoff Volumes

Catchment[1]	Area (ha)	Runoff Volume (m^3)
A1	9.9	4 115
A2	104.9	43 764
B	17.8	7 425
C	12.9	5 388
D	7.0	2 905
E	24.8	10 330
F	9.6	4 011
G1	3.9	1 607
G2	7.5	3 118
H	3.9	1 607
I1	5.2	2 170
I2	0.9	355
J1	9.3	3 898
J2	8.6	3 585
J3	17.6	7 346
K1	42.6	17 784
K2	686.4	286 484
K3	6.0	2 508
K4	3.4	1 427
L	13.3	5 555
Note 1: see **Figure 4.31**		
Source: Modified after Groundwork Plus (2014) – Table 7.		

With respect to the water quality within the Coxs River Groundwork Plus (2014) reports the following.

- Electrical conductivity (salinity) is low (between 140µS/cm and 740µS/cm) indicative of a freshwater environment.
- pH is generally within the established limits for recreational (ANZECC/ARMCANZ, 2000) and drinking water (NHMRC, 2011) use of 6.5 to 8.5.
- Turbidity of the Coxs River and Yorkeys Creek is variable (0 to 1 300 NTU), reflecting variable flows within these watercourses between years and seasons.
- Biological Oxygen Demand (BOD) is generally below the NHMRC (2011) drinking water criteria of 5mg/L).

- Nitrogen was observed above ANZECC/ARMCANZ (2000) criteria within the extraction area sumps and SD2 which could reflect blasting activities within the extraction area. An elevated concentration was also observed in samples sourced from SD6 and Yorkeys Creek upstream of the Stage 2 Site. Groundwork Plus (2014) considers this reflects the surrounding land use, i.e. grazing, and illustrates that elevated nitrogen concentrations are a feature of local settings as a result of grazing and pasture improvement.
- Metals and Major Ions. Although based on a very limited sample size, only copper and NH_4 concentrations are above ANZECC/ARMCANZ (2000) criteria for Protection of Slightly to Moderately Disturbed freshwaters and Recreational Purpose respectively. These elevated values are considered a result of local geology and agricultural activities respectively.

4.5.2.5 Flooding

While the secondary processing area has been constructed on 'waterfront land', as defined by the *Water Management Act 2000*, it is not affected (and therefore not constrained) by local flooding. This assessment is made on the basis of a flood event in February 2005, considered a 1 in 150 year ARI event (Parsons Brinkerhoff, 2005), which did not inundate the secondary processing area. Incorporating an elevated hardstand and bund within 40m of the Coxs River channel, the secondary processing area is likely to affect flows within this stretch of the river when the water level is elevated. Notably, the bund and hardstand have been constructed in accordance with DA 103/94 and Permit No. PAR9012617, issued under the now repealed *Rivers and Foreshores Improvement Act 1948* (RFI Act). As noted in Section 1.5.1, an application for a controlled activity approval to replace PAR9012617 has been lodged with NOW, however, a determination of this application has yet to be received.

It is noted that the Proposal requires no new infrastructure or changes to existing land elevations that would impact on local and regional flood regimes. On the basis that no additional works within the potential flood zone of the Coxs River and Yorkeys Creek, construction of the secondary processing area in compliance with an RFI Act Permit No. PAR9012617, and the documented evidence as to the adequacy of construction within the riparian / flood zone, no further assessment of flooding is warranted. The surface water assessment of Groundwork Plus (2014) supports this conclusion.

4.5.3 Potential Impacts

4.5.3.1 Introduction

The Proposal has the potential to impact upon both the quality and quantity of surface water flowing from the Stage 2 Site. The following subsections identify the potential impacts that have been considered in the design of surface water management controls for the Stage 2 Site.

4.5.3.2 Pollution of Receiving Waters

The potential sources of water pollution from the proposed activities within the Stage 2 Site are as follows.

- Runoff from areas disturbed in advance of and during extraction activities.
- Runoff from stockpiles of topsoil, subsoil and overburden stockpiles.
- Surface runoff from product stockpiles.
- Surface runoff from rehabilitated areas prior to full stabilisation.
- Controlled discharges of water from water storages.
- Uncontrolled discharges of water from water storages.
- Runoff from hardstand areas including roads, processing and other areas.
- Leakage or spillage of hydrocarbons.

Suspended solids, i.e. sand, silt, or clay particles in water and hydrocarbons are likely to be the major sources of pollution.

Section 4.5.4 provides a summary of the design specifications for the controls to be implemented to reduce the potential risk of surface water contamination. Section 4.5.6 presents the residual impacts predicted following the implementation of these controls.

4.5.3.3 Changes to Surface Water Flows

With development of the Proposal, the area of the catchments delineated in **Figure 4.31** would change to reflect the proposed extraction area and overburden emplacement extension. This would also influence the peak runoff under the design (95^{th} percentile 5-day) rainfall event. **Table 4.13** presents the catchments and runoff volumes at the completion of the Proposal, i.e. of the final landform.

Hydrological modelling has been completed by Groundwork Plus (2014) based on the proposed sequence of development and various scenarios for capture, transfer and discharge of water. The proposed design of the surface water management system and associated operational controls presented in Section 4.5.4.1 reflect the final recommendations of Groundwork Plus (2014) with respect to optimal surface water management. Section 4.5.6 reviews the residual impacts on surface water flows, discharge and water quality assuming the implementation of these recommendations.

4.5.3.4 Erosion and Sedimentation

Uncontrolled runoff from active operational or cleared areas may lead to sheet, rill and/or gully erosion over areas of the Stage 2 Site. Recognising this potential, surface water management controls have been designed to provide controlled flow paths and minimise the number and velocity of water flows on the Stage 2 Site. Section 4.5.4.2 provides information on the erosion and sediment control measures to be implemented to reduce the potential risk of surface water contamination. Section 4.5.6 presents the residual impacts predicted following the implementation of these controls.

Table 4.13
Existing Stage 2 Site Catchments and Peak Runoff Volumes

Catchment	Area (ha)	Runoff Volume (m^3)
A1	16.5	6 885
A2	87.1	36 352
B	15.3	6 369
C	12.9	5 388
D	7.0	2 905
E	20.6	8 598
F	9.2	3 827
G1	3.9	1 607
G2	7.5	3 118
H	3.9	1 607
I1	5.2	2 170
I2	0.9	355
J1	9.3	3 898
J2	8.6	3 585
J3	17.3	7 229
K1	42.6	17 784
K2	686.4	286 484
K3	6.0	2 508
K4	3.4	1 427
L	31.8	13 285
Source: Modified after Groundwork Plus (2014) – Tables 13 and 14.		

4.5.4 Design and Operational Safeguards

4.5.4.1 Water Management System

Considering the various Stage 2 Site catchment areas, and peak runoff volumes under the design rainfall event (95^{th} percentile 5-day), Groundwork Plus (2014) reviewed the capacity of the various sediment basins and water storages of the Stage 2 Site. **Table 4.14** reviews the existing and proposed capacity of each structure against that calculated to provide the minimum water settlement and sediment storage volume in accordance with DECC (2008b).

As discussed in Section 4.5.2.3, and noted in **Table 4.14**, Groundwork Plus (2014) incorporated conservative assumptions for the catchment volumetric runoff coefficient (C_v) and sediment zone volume to calculate the minimum water settlement and sediment storage zone capacities for each catchment and basin. A C_v of 0.74 was used for all catchments, based on the assumption of the least permeable soil group (Soil Hydrologic Group D). This does not account for the elevated permeability likely on the overburden emplacement and undisturbed catchments with significant ground cover. The calculation used by Groundwork Plus (2014) to estimate sediment storage assumes 50% of the water settlement zone. This approach generally overestimates storage requirements (when compared to the 2 month soil loss method), especially when high runoff coefficients are assumed. Considering the conservative nature of the calculations completed by Groundwork Plus (2014), the minimum storage capacity requirements are likely to significantly overestimate the volume of runoff and sediment accumulating in these structures.

Table 4.14
Existing Water Storage Capacities

Water Storage*	Capacity	95th %ile 5-day Volume Requirement[1]	Surplus / Deficit	Comments
SB1[2]	6ML	11ML	-5ML	SB1 accepts overflow from SD3 and SD4.
SB2b (existing)	2.8ML	4ML	-1.2ML	SB2a, a small dam immediately upslope of SB2b, accepts all runoff initially and acts as a fore-bay to the main sediment basin.
SB2b (proposed)	4.5ML	4ML	0.5ML	
SB3a	3ML	6.2ML	-3.2ML	To be operated temporarily as a fore-bay to SB3b until decommissioned and incorporated into the overburden emplacement
SB3b	12.3ML	12.3ML	0	The optimum design of SB3b remains to be confirmed and would follow additional review of local conditions.
SD1	3.5ML	1.5ML	+2ML	Accepts water pumped from the extraction area sumps. Overflows to SD2.
SD2	5ML	1ML	+4ML	Linked via a pump to both SB1 and discharge point to the Coxs River.
SD5	4ML	22.8ML	-18.8ML	Overflows to SD6.
SD6	8ML	2ML	+6ML	Linked via a pump to SB1.

SB = Sediment Basin SD = Storage Dam * see **Figure 4.32**

Note 1: Groundwork Plus (2014) applied conservative assumptions in calculating the minimum water settlement and sediment storage zones:
- A runoff coefficient of 0.74 for soil hydrologic group D.
- Sediment storage = 50% water settlement volume.

Note 2: As noted in **Figure 4.32**, water from SB1 could be pumped to SD2 or SD6 for storage to maintain 2m freeboard below the discharge spillway.

Source: Modified after Groundwork Plus (2014) – Section 5

The conservative nature of the calculations notwithstanding, the following modifications to the water management system would be undertaken (see **Figure 4.32**).

- An additional sediment basin (SB3b) would be constructed beyond the final toe of the overburden emplacement. This would be constructed with a minimum storage capacity of 12.3ML within 6 months of the date on which the development consent is issued. SB3a would be retained as a basin fore-bay until such time as overburden emplacement development progresses over this.
- SB2b would be increased in capacity to at least 4.5ML to provide the minimum settlement and storage requirements for a 95th percentile 5-day rainfall event (with an additional allowance to account for water below effective pumping level) within 6 months of the approval of development consent.

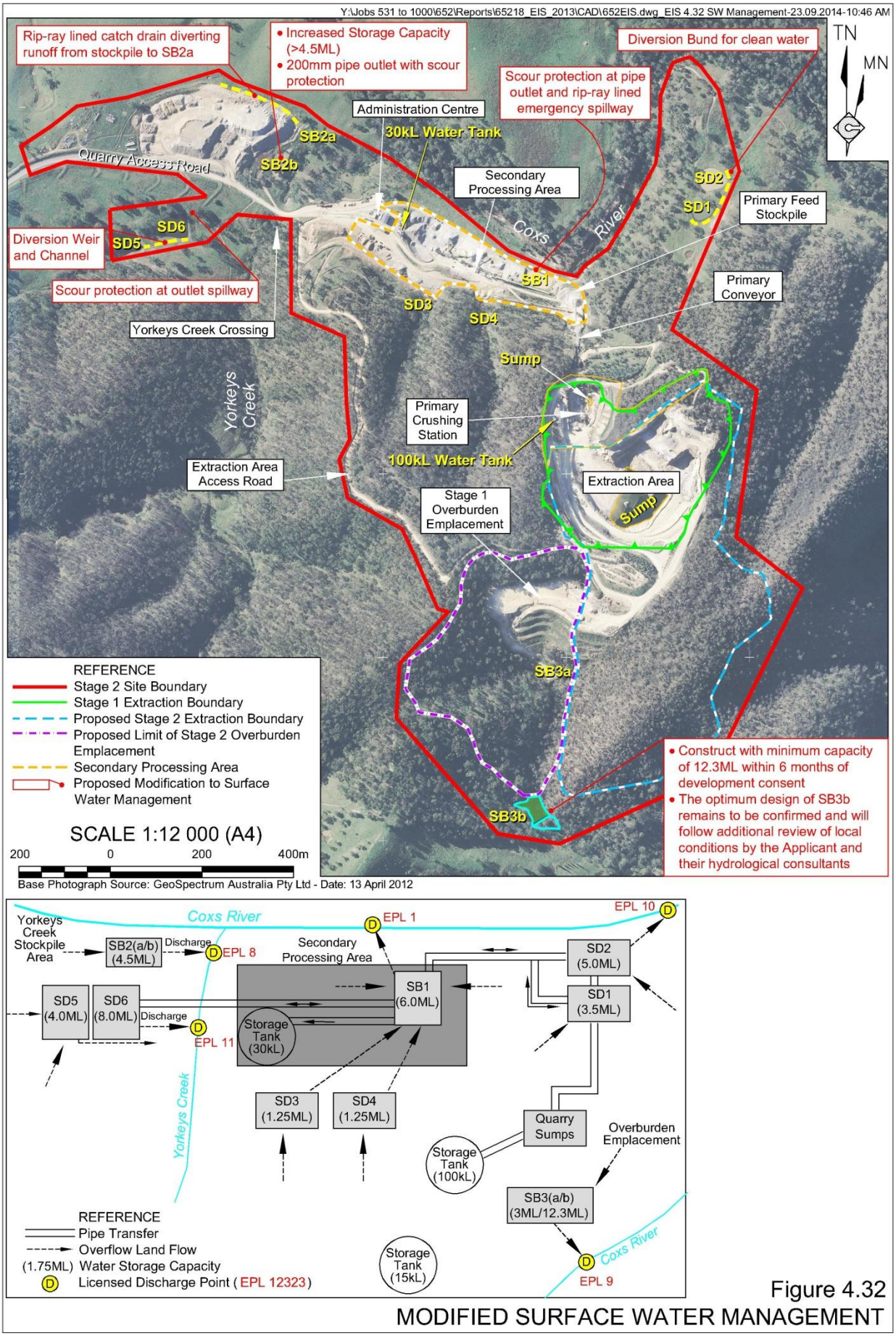


Figure 4.32
MODIFIED SURFACE WATER MANAGEMENT

- An additional diversion weir would be constructed between SD5 and SD6 such that except under exceptional circumstances (e.g. prolonged drought), overflow from SD5 would flow directly to Yorkeys Creek. This would increase the capacity available for SD6 to accept water from SB1 and thereby increase the effective water storage and sediment storage capacity of SB1.
- A diversion bund would be constructed to divert overland flows from the larger clean catchment (to the east) above SD1 and SD2. This would reduce volume of water reporting to these dams which would reduce the requirement for controlled discharge and maximise capacity to receive water from SB1.

The ability of the Applicant to increase the capacity of SB1 is constrained as follows.

- Available area. The condensed nature of the secondary processing area is such that the surface area cannot be increased.
- Basin depth. Any increase in depth would likely result in the intersection of subsurface flows associated with the Coxs River. To construct a deeper floor with an impermeable layer would risk geotechnical instability as a result of modified subsurface flows.
- Basin wall height. The height and general construction of the bund wall which forms the basin wall is based on significant review of geotechnical considerations following a failure of the initial dam in 2010. Modification of this design and current construction risks creating further instability in the bund wall.

As an alternative, the Applicant has installed a combined 900mm and 1 050mm pipe outlet with control valve which would enable the operator to control discharge from SB1. In conjunction with the additional capacity available within SD2 and SD6 (i.e. a combined 10ML greater than minimum storage capacity requirements), this should provide for greater control over the frequency and volume of discharges from SB1.

An important component of the Stage 2 Site water management system is, and would continue to be, the ability to discharge water from the various sediment basins and storage dams. In accordance with a Water Management Plan (WMP), which would be updated for the Stage 2 Site following the issue of development consent, the Applicant would apply procedures for the treatment and discharge of water. Subject to review and approval as part of the Stage 2 Site WMP, these procedures would provide for the following.

- A flocculating agent (approved for use by the EPA, e.g. NALCO 8187.15H) would be regularly applied to the sediment basins and storage dams for which controlled discharges are predicted (see Section 4.5.5).
- Discharge of water would be undertaken either:
  - once the sediment basin reaches the identified minimum water settlement and sediment storage capacity; or
  - once the water level in the water storage reaches a nominated level, e.g. discharge level of the installed SB1 discharge pipes; and
  - as soon as practical after a significant rainfall / runoff event resulting in the above.

It is noted that the Applicant would preferentially discharge water to one or more of the other storages on the Stage 2 Site rather than discharge it to the Coxs River. Discharge to the Coxs River or Yorkeys Creek would only occur when there is insufficient capacity within other Stage 2 Site water storages.

- Prior to a controlled discharge and within 24 hours of (and then weekly during) an uncontrolled discharge, a sample of the water would be taken to record various critical parameters (refer to Section 4.5.7). The Applicant would report any exceedance of Locally Derived Water Quality Objectives (refer to 4.5.6.1 and **Table 4.16**) to the EPA in accordance with the POEO Act.

4.5.4.2 Erosion and Sediment Control

The proposed erosion and sediment control features for the Stage 2 Site are presented as *Figures 6* to *18* of Groundwork Plus (2014). In reviewing these figures and the following descriptions, Groundwork Plus (2014) notes the following.

- The location and configuration of proposed structures are conceptual and could be subject to modification to suit future amendments to quarry staging. Designs and locations of the various structures would be formalised within an Erosion and Sediment Control Plan (ESCP) to be prepared following the issue of development consent. The ESCP would be reviewed annually and updated to reflect any changes to the Stage 2 Site and planned or implemented erosion and sediment control measures.
- All stormwater conveyance, retardation and diversion structures (including drains and bunds) would be designed for a 1 in 5 or 1 in 10 ARI design storm event.
- All diversion drains, drainage channels and catch drains would be rock and/or grass lined.
- The proposed sumps within the extraction area would be non-engineered storage structures and no attempt to draw to scale has been made.
- The operation and maintenance of sediment control devices requires that, in the event sediment retention capacity falls below 70% of its design capacity (e.g. following a storm event), these would be de-silted and made fully operational as soon as practicable following the event.
- The flow conveyance and retardation structures, i.e. catch drains, diversion bunds, and the provision of inlet and outlet scour protection for the retardation of flow velocity have been provided for the existing operational areas of the Stage 2 Site. These measures are conceptual and subject to modification as part of the ESCP to be prepared for the Stage 2 Site following the issue of development consent.

Noting the above, the following provides an overview of the erosion and sediment control features for the various component areas of the Stage 2 Site. Significant modifications or additions to current erosion and sediment control management are identified on **Figure 4.32**.

Secondary Processing Area

The full detail of the proposed erosion and sediment control features is provided by *Figure 9* of Groundwork Plus (2014). The primary features are as follows.

- Rip rap-lined catch drains aligned against the toe of the various slopes diverting flow to SB1.
- Diversion bunds constructed at the edge of the terraced level separating the administration centre from the secondary processing area.
- Additional conveyance structures to divert flows to SB1.
- Scour protection at the pipe outlet discharge point of SB1.
- A rip rap-lined emergency spillway from SB1.

Yorkeys Creek Stockpile Area, Catchment K1 (SD5 and SD6)

The full detail of the proposed erosion and sediment control features is provided by *Figure 10* of Groundwork Plus (2014). The primary features are as follows.

- A perimeter bund established around the Yorkeys Creek stockpile area.
- Rip rap-lined catch drains aligned against the toe of the stockpile diverting runoff to SB2a and SB2b.
- Increase in the capacity of SB2b to 4ML.
- A rock filter bund constructed to the east and west of SB2b to allow for natural seepage of runoff from the vegetated ground between the stockpile and SB2b.
- Installation of a 200mm pipe outlet with scour protection for discharge from SB2b to Yorkeys Creek.
- A diversion bund from the discharge point of SD5, around SD6 and to a scour protected discharge area of Yorkeys Creek.
- Scour protection at the in-flow and outlet spillways of SD5 and SD6.

Extraction Area Access Road

The full detail of the proposed erosion and sediment control features is provided by *Figure 8* of Groundwork Plus (2014). The primary features are as follows.

- Maintenance of the existing excavated sediment traps (ESTs) along the length of the road.
- Rip rap lining of roadside catch drains channelling runoff to the ESTs.
- 1.5m high diversion bund on the outer slope edge of the road to prevent uncontrolled release of water to this side (other than via an EST).
- Emergency spillways maintained from each EST.
- Rip rap lining provided to bunded channels which divert flows from the profiled lower slope west between the extraction area Access Road towards SB1.

Extraction Area and Overburden Emplacement

The full detail of the proposed progressive construction of erosion and sediment control features is provided by *Figures 11* to *18* of Groundwork Plus (2014). The primary features are as follows.

- Establishment of a perimeter bund around areas of construction for the relevant stage of development.
- Construction of diversion bunds, and bunded diversion channels, upslope of the perimeter of the impact footprint for each stage to divert runoff around areas of disturbance and into natural drainage.
- Construction of SB3b beyond the toe of the extended overburden emplacement with a capacity of 12.3ML. Scour protection would be installed on the inlet to, and emergency spillway from the basin.
- Construction of catch drains along the edge of each overburden emplacement lift diverting runoff to rock-lined chutes and ultimately SB3b via a bunded diversion channel.
- Maintenance of stormwater pipes between the extraction area sump, primary crushing station sump and SD1.

All structures would be designed in accordance with the relevant standard drawings and other design requirements of Landcom (2004) and DECC (2008b). The final design and information on other monitoring and maintenance activities to be implemented would be included in an Erosion and Sediment Control Plan for the Austen Quarry to be prepared following the issue of development consent.

4.5.4.3 Stormwater and Erosion and Sediment Control Monitoring and Maintenance

Table 4.15 provides the monitoring and maintenance program to be implemented by the Applicant for the various stormwater and erosion and sediment control structures.

4.5.5 Hydrological Modelling (Including a Site Water Balance)

4.5.5.1 Introduction

Groundwork Plus (2014) constructed an MS-Excel based daily probabilistic water balance model to analyse the frequency and volume of discharge from the various Stage 2 Site water storages under dry (15^{th} percentile) and wet (90^{th} percentile) rainfall scenarios (see **Table 4.1**) and incorporating dewatering of the extraction area based on the conceptual hydrogeological model for seepage generated by Ground Doctor (2014) (refer to Section 4.12). *Section 6.3* of Groundwork Plus (2014) provides the general assumptions made and applied as part of the water balance model.

The following subsections provide the results of the water balance assessment for the various water storages and sediment basins of the Stage 2 Site (see **Figure 4.32**), based on the application of the recommended water management measures nominated in Section 4.5.4.1 and erosion and sediment control features nominated in Section 4.5.4.2.

Table 4.15
Stormwater and Erosion and Sediment Control Monitoring and Maintenance Plan

Inspection	Minimum Frequency	Performance Criteria	Response
Inspect water conveyance structures such as catch drains, contour drains and diversions.	Following significant rainfall events	Erosion in areas adjacent to water conveying structures.	Eroded areas will be Rip rapped as soon as practicable.
		Overtopping of water conveying structures (identified by the scouring of the drain batters perpendicular to the direction of flow).	The drain will be cleaned of sediments and rip rapping replaced to the original design specifications. Rehabilitation with suitable grasses in the catchment of the drain may be required to reduce sediment loading.
		Deposition of material in the water conveying structure greater than half the design depth.	Sediment/grit will be removed from the structure and used in rehabilitation works.
Inspect potential sediment storage capacity of sediment dams.	Following significant rainfall events.	30% of the total sediment capacity remaining.	Sediment will be removed from the structure and used in Inspect potential rehabilitation works.
		Overtopping of the sediment dams.	To recycle dam water to ensure that adequate free storage is maintained for the collection and holding of runoff.
Inspect check dams, rock armouring and rip rap.	Following significant rainfall events.	Check dam walls have collapsed or rip rap has moved.	Larger sized rocks will be used in the construction of check dams and rip rap or the drain will be concreted or redesigned.
Inspect culverts, pipe inlets and outlets.	Following significant rainfall events.	Check for erosion of inlets and outlets.	Rip rap inflows and outflows of pipes where erosion has been observed.
		Debris build-up in pipe inlets or outlets or in culverts.	Remove debris.
		Overflow of pipes.	Check pipes for debris or blockages and remove the offending materials.
Note: Significant rainfall event >25mm/day			
Source: Groundwork Plus (2014) – Table 42			

4.5.5.2 Extraction Area

Assuming the continued dewatering of the extraction area, either by transfer of water to the 100kL water tank (200kL/week) or by discharge to SD1 and/or SB1, no uncontrolled discharges would occur from the extraction area. The average rate of discharge would vary between 0 and 1.13ML/day, which is within the capacity of the existing dewatering infrastructure (which could cater for up to 1.9ML/day). Groundwork Plus (2014) predicts that annual discharge to SD1 would vary from 0 during a dry weather (15^{th} percentile rainfall) conditions to 65.1ML during a wet weather (80^{th} percentile rainfall) conditions. The effect of this dewatering on the function of SD1 and SD2 is discussed in Section 4.5.5.3.

4.5.5.3 Storage Dams 1 and 2

The water balance modelling indicates that under both the dry and wet weather conditions, there would be no uncontrolled discharges of water from SD1 or SD2 (even considering dewatering of the extraction area – see Section 4.5.5.2).

Controlled discharge of water would be required following significant rainfall events to retain sufficient capacity within the water storages to accept water from the extraction area and runoff from the upslope catchments. Groundwork Plus (2014) predicts that the annual volume of controlled discharge to the Coxs River would vary between 7.5ML and 21.8ML under dry weather (15th percentile rainfall), and 37.2ML and 73.5ML under wet weather (90th percentile rainfall) conditions. Treatment and discharge would be undertaken as soon as practical following each rainfall / runoff event.

The total volume of controlled discharge would be reduced further by constructing a clean water diversion around SD2. This would reduce the total discharge volume requirement to between 1.9ML and 16.3ML under dry weather (15th percentile rainfall), and 29.2ML and 65.5ML under wet weather (90th percentile rainfall) conditions annually.

4.5.5.4 Sediment Basin 1

Assuming the transfer of water from SB1 to SD6 and SD2 to maintain the minimum 2m (2.34ML) freeboard within the basin, Groundwork Plus (2014) predicts up to five uncontrolled discharges of a combined 10.1ML under dry weather (15th percentile rainfall) conditions, and six uncontrolled discharges of a combined 46.9ML under wet weather (90th percentile rainfall) conditions, from SB1. This is a significant reduction from a predicted 10 discharges of 38ML (under dry conditions) and 23 discharges of 102.3ML (under wet conditions) predicted without the implementation of the management measures discussed in Section 4.5.4.1.

Groundwork Plus (2014) also modelled the performance of SB1 if the capacity was increased to 11ML in order to provide for water settlement and sediment storage capacity for a 5-day 95th percentile rainfall event. The modelling, which does not include the transfer of water from SB1 to SD6 and/or SD2[3], predicted this would result in 24 uncontrolled discharges totalling 60.1ML under dry weather (15th percentile rainfall) conditions and 22 uncontrolled discharges totalling 97ML under wet weather (90th percentile rainfall) conditions. The implementation of this option to increase the capacity of SB1, notwithstanding the constraints nominated in Section 4.5.4.1, would provide little overall benefit.

Although it is acknowledged there would be benefits in increasing the design storage capacity of SB1 to meet the regulatory requirements, this does not provide any greater benefit over the proposed water management strategy. As discussed in Section 4.5.4.1, there are significant constraints on increasing in the storage capacity of SB1, and it is assessed that the cost and possible indirect implications of undertaking this work is not warranted given the proposed water management strategy provides for greater control over discharges from the secondary processing area catchment.

[3] The active transfer of water between SB1 and other storage dams was not included in this scenario given the sediment basin would be constructed to the design requirements of Landcom (2004).

4.5.5.5 Storage Dams 5 and 6

On the basis of the water management proposed in Section 4.5.4.1, Groundwork Plus (2014) predicts up to 26 uncontrolled discharges totalling 8.7ML under dry weather (15th percentile rainfall) conditions and 22 uncontrolled discharges totalling 4.9ML under wet weather (90th percentile rainfall) conditions. Notably, this water is predominantly runoff from the sealed road and grassed paddocks.

4.5.5.6 Sediment Basin 2b

Constructed and maintained in accordance with the requirements of Landcom (2004) and DECC (2008b), Groundwork Plus (2014) predicts between 13 and 22 controlled discharges totalling 9.9ML to 21.5ML under dry weather (15th percentile rainfall) and wet weather (90th percentile rainfall) conditions respectively.

There would be no uncontrolled discharge under dry weather (15th percentile rainfall) conditions, with a predicted eight uncontrolled discharges totalling 1.2ML under wet weather (90th percentile rainfall) conditions.

4.5.5.7 Sediment Basin 3b

Based on the construction of a 12.3ML capacity structure, Groundwork Plus (2014) predicts between 17 and 22 controlled discharges totalling less than 65ML annually. Under dry weather (15th percentile rainfall) conditions there would be no uncontrolled discharges, however, a single 3 day discharge of 1.4ML is predicted under prolonged wet weather (90th percentile rainfall) conditions. It is noted that this is as expected when considering the guidance provided by *Table 6.1* of DECC (2008b).

4.5.6 Assessment of Impacts

4.5.6.1 Impact Assessment Criteria

Catchment Hydrology

There are no formal criteria with which to assess the impact of any changes to catchment hydrology, i.e. catchment area and peak runoff. The approach to identifying that any change has been minimised and any detrimental effects with respect to condition of the catchment or downstream water users is identified involved comparing existing catchment areas and peak runoff volumes with those predicted under the Proposal.

Erosion and Sediment Control

The objective is to minimise the potential for, and actual erosion and sedimentation of the Site. Criteria for total suspended solids (TSS) of water runoff apply.

Water Quality

Based on the use and sensitivity of the receiving waters of any discharge from the Stage 2 Site, the Environmental Values attributed to these with respect to the River Flow and Water Quality Objectives of the EPA are as follows.

- Ecosystem Protection (aquatic plants, fish and other flora and fauna habitat) for slightly to moderately disturbed stream (SMDS Protection).
- Agricultural use (Livestock Water Guideline).
- Drinking water for human consumption (Drinking Water Guideline).
- Recreation (Recreation Guideline).

Objectives for the quality of water discharged to the Coxs River and Yorkeys Creek for the identified Environmental Values of the receiving environment have been derived from the following sources.

1. The guidelines published by the Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMANZ) *Australian Water Quality Guidelines for Fresh and Marine Waters* (ANZECC/ARMANZ, 2000) for ecosystem protection, agricultural use and recreation.
2. The Australian Drinking Water Guidelines (NHMRC, 2011), or guidelines provided by the Annual Water Quality Monitoring Report 2011-12 of the Sydney Catchment Authority (SCA, 2012) (for those water quality characteristics that may be expected to be improved through treatment processes), for drinking.
3. Established Background Reference Condition for the upstream environment (where this exceeds the ANZECC/ARMANZ, 2000) nominated criteria, and where the number of samples exceeds the minimum recommended, e.g. turbidity.
4. Environment Protection Licence (EPL) 12323.

Table 4.16 provides the locally derived water quality objectives (LDWQOs) generated through consideration of the noted guidelines and data.

Table 4.16
Locally Derived Water Quality Objectives

Page 1 of 2

Type	Parameter	Numerical Guideline	Unit	Source	Background Reference Condition	Site Water Quality Objective
Physico-chemical	pH	6-8.5		SCA (2012)	7.2-7.7	6-8.5
	EC	-	µS/cm	Background Reference	322	322
	Dissolved Oxygen	-	%	-	-	-
	Biological Oxygen Demand	5	mg/L	Drinking Water		
	Turbidity	40	NTU	Background Reference	10	10
	Total Suspended Solids	30	mg/L	EPL 12323	8	30
	Total Dissolved Solids	2 500	mg/L	Livestock Water	250	2 500

Table 4.16 (Cont'd)
Locally Derived Water Quality Objectives

Type	Parameter	Numerical Guideline	Unit	Source	Background Reference Condition	Site Water Quality Objective
Metals / Metalloids	Al (pH<6.5)	200		Drinking Water		200
	Al (pH>6.5)	55	µg/L	SMDS Protection	-	55
	As	10		Drinking Water		10
	Ba	2 000				2 000
	Be	60				60
	Cd	0.2		SMDS Protection		0.2
	Cr (VI)	1				1
	Co	1.4				1.4
	Cu	1.4				1.4
	Pb	3.4				3.4
	Mn	100		Recreation		100
	Hg	0.06		SMDS Protection		0.06
	Ni	11				11
	V	100		Livestock Water		100
	Zn	8		SMDS Protection		8
Major Ions and Nutrients	NO_2	1	mg/L	Recreation	-	1
	NO_3	1.7		SMDS Protection		1.7
	NH_4	0.01		Recreation		0.01
	TN	1.4		SCA (2012)		1.4
	TP	0.05		Irrigation		0.05
	SO_4	250		Drinking Water		250

Source: Modified after Groundwork Plus (2014) – Table 47

State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011

With respect to the impacts of new developments within the Sydney drinking water catchment (see **Figure 4.29**), *State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011* states:

> "*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*."

A neutral or beneficial effect on water quality is defined as one that:

- has no identifiable impact on water quality; or
- contains any water quality impact on the development site and prevents it from reaching any watercourse, water body or drainage depression on site; or
- transfers any water quality impact outside of the site where it is treated and disposed of, to standards approved by the consent authority.

4.5.6.2 Catchment Hydrology

Comparison of the catchment areas and peak runoff volumes (refer to **Tables 4.12** and **4.13**) indicates that there would be a small reduction in the undisturbed catchments flowing to the Coxs River (Catchments A2, B, E and F on **Figure 4.31**) of approximately 25ha. Of this, the 7.1ha associated with the extension of the overburden emplacement would still report to the Coxs River, albeit via SB3b.

This small reduction in annual runoff volume (7.5ML) would be effectively imperceptible as:

- there are no dams which collect this runoff;
- the runoff flows into the Coxs River which would have annual flows of several orders of magnitude greater than this flowing past the Stage 2 Site each year; and
- this reduction in discharge would almost certainly be replaced through the controlled discharges of water documented in Section 4.5.5.

The proposed change to catchment hydrology is therefore unlikely to have any adverse impact on the local catchments or other users of surface water generated by runoff from the catchments of the Stage 2 Site.

4.5.6.3 Erosion and Sediment Control

With the exception of SB1, the proposed erosion and sediment controls presented on *Figures 6 to 18* of Groundwork Plus (2014) have been prepared after consideration of and in compliance with Landcom (2004) and DECC (2008b). The implementation of the proposed stormwater and erosion and sediment control measures monitoring and maintenance program would ensure that these structures function as intended and are maintained for the life of the Proposal.

Assuming the preparation and implementation of an Erosion and Sediment Control Plan (ESCP), which would provide the final designs or drawings and construction requirements for each of the structures identified, monitoring regime and maintenance measures, it is assessed that erosion and sedimentation on the Stage 2 Site would be minimised as far as reasonable practical.

In the case of SB1, increasing the capacity of this structure to achieve a water settlement and sediment storage volume equivalent to that required for the 95th percentile 5-day rainfall event is constrained by geotechnical, as well as practical factors (refer to Section 4.5.4.1). As discussed in Section 4.5.5.4, the management proposed for this structure, involving the regular transfer of water to SD6, would prove more effective in limiting the number and volume of discharges than increasing the capacity of the basin. As such, the proposed and ongoing management is likely to provide for equivalent if not more effective erosion and sediment control management.

4.5.6.4 Discharge of Water / Receiving Waters

On the basis there would be no additional chemicals or reagents used on the Stage 2 Site, erosion and sediment controls would be upgraded to reduce the potential for discharge, and considering the consistency of the geology in which the extraction area is located, the water quality results obtained from on-site water storages and sediment basins is indicative of the

water quality expected over the life of the Proposal. *Section 3* (and *Tables 9* to *14*) of Groundwork Plus (2014) review the water quality observed within the various catchments of the Stage 2 Site. On the basis of the observed water quality of the quarry water storages, Groundwork Plus (2014) analysed the potential impacts of discharges from the Stage 2 Site to the Coxs River and Yorkeys Creek against the LDWQOs presented in **Table 4.16**. Based on analysis of available data from the sediment basins and storage dams from which water would be discharged, **Table 4.17** identifies those parameters which may be discharged at concentrations exceeding the LDWQOs.

Table 4.17
Potential Exceedance of Locally Derived Water Quality Objectives

Guideline	SB1	SB2b	SB3b	SD2	SD6
SMDS Protection	Turbidity Al, Cd, Cu, Pb and Zn	Turbidity Al, Cd, Cu, Pb and Zn (total)	Turbidity Al , Zn & Cu (dissolved)	pH Turbidity Cu (dissolved	Turbidity TN, TP & NH_4 Cu (dissolved)
Recreation	Turbidity Mn	Turbidity Mn NH_4	Turbidity Mn NH_4	Turbidity	Turbidity Mn NH_4
Irrigation	TP	TP	TP		TP
Livestock watering	Al				Al
Drinking water	Turbidity Al	BOD Turbidity Al TN	TN	BOD	Turbidity BOD TN
Source: Modified after Groundwork Plus (2014) – Section 10.2.					

Groundwork Plus (2014) notes that the levels of EC (<770µS/cm) and pH (<8.7) of the water that would be discharged would pose no genuine risk to the Environmental Values of the receiving waters.

Groundwork Plus (2014) indicates that the likely concentrations of metals are reflective of the local geology and a comparison of total to dissolved metals concentration indicates that these are associated with the suspended sediment contained within the water, i.e. not from introduced sources. The suspended sediment levels would generally comply with the LDWQO (30mg/L), thereby limiting the total amount of these metals discharged. Furthermore, the required dilution to achieve compliance is low and provided almost immediately on release to the Coxs River.

Groundwork Plus (2014) considers the elevated nutrient levels (TN, TP and NH_4) likely to be associated with organic matter (e.g. manures, top-soil erosion) contained within the TSS component of discharge. While without sufficient dilution these could result in nuisance algal problems. The fact that TSS concentrations are likely to be complied with suggests the overall accumulation of these nutrients would remain low. Furthermore, discharge is most likely to occur during or following significant rainfall events and as such base flows in the Coxs River would quickly dilute the nutrient concentrations such that the noted algal bloom formation would not occur.

Turbidity could pose some risk to the receiving waters Environmental Values as aquatic ecosystems, recreational use and drinking water supply suitability. It is noted, however, that with flocculation of the water contained within the storages, the turbidity of the water is likely

to be significantly reduced prior to controlled discharge. Under conditions of uncontrolled discharge, during or following a significant rainfall event, the flow within the receiving waters would be substantially higher, resulting in higher suspended sediment loads and therefore elevated turbidity.

In accordance with the recommendations of Groundwork Plus (2014), and until a reference background level for the receiving waters is established, the Applicant would undertake sampling and analysis of water upstream and downstream of the discharge point at the time of discharge to demonstrate minimal or no impact on receiving water quality (refer to Section 4.5.7).

4.5.6.5 Geomorphological and Hydrological Effects

The likely volume of water to be discharged to Yorkeys Creek and the Coxs River on each occasion is insignificant when considered against the total volume of water flowing past the Austen Quarry each day. Furthermore, both Yorkeys Creek and the Coxs River are subject to significant variations in flow due to seasonal variation and storm surges in the pre-extraction setting. Consequently, the relatively small and infrequent discharges from the Stage 2 Site would almost certainly have no effect on the geomorphology or hydrology of these watercourses.

4.5.6.6 State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011

The following considers the potential impacts of the Proposal on receiving water as detrimental, neutral or beneficial.

- No uncontrolled releases of water would occur from the extraction area: Neutral Impact.
- While uncontrolled discharges are predicted from the Stage 2 Site potentially impacting on the Environmental Values of the receiving waters, the proposed modifications and additions to the water management system would reduce the predicted frequency and volume of these (compared against that currently expected): Beneficial Impact.
- The Proposal provides for the separation of runoff from undisturbed catchments upslope of SD1, SD2 and SD6 from disturbed catchments. Beneficial Impact.
- The Proposal provides for the upgrading of sediment basins SB2b and SB3b to comply with recommendations of Landcom (2004) and DECC (2008b): Beneficial Impact.

As is discussed further in Section 4.6, the development of the extraction area below the groundwater table would not result in any discernible change to the flow of groundwater to surface water in the local setting, i.e. neutral impact.

A neutral or beneficial impact on the affected catchments is therefore demonstrated and therefore the Proposal achieves the objectives of the SEPP.

4.5.7 Monitoring and Corrective Actions

4.5.7.1 Introduction

In addition to the monitoring and maintenance of stormwater and erosion and sediment control infrastructure presented in **Table 4.15**, the following monitoring of discharged water would be undertaken in accordance with the recommendations of Groundwork Plus (2014).

4.5.7.2 Parameters

Table 4.18 identifies the parameters to be monitored together with the sample type.

Table 4.18
Water Quality Monitoring Parameters

Parameter	Unit	Sample Type
pH	pH units	Grab Sample or In-situ
Turbidity	NTU	Grab Sample or In-situ
Total Suspended Solid	mg/L	Grab Sample
BOD_5	mg/L	Grab Sample
Total Al and Mn	µg/L	Grab Sample
Dissolved Cu	µg/L	Grab Sample
Ammonia	mg/L	Grab Sample
Total Nitrogen	mg/L	Grab Sample
Total Phosphorus	mg/L	Grab Sample
Visual Oil & Grease/Litter	Present/Absent	Visual observation
Source: Modified after Groundwork Plus (2014) – Table 48.		

The list of parameters would be regularly reviewed (i.e. annually) and revised as necessary based on water quality data collected.

4.5.7.3 Locations and Frequency

The proposed monitoring locations and frequency are presented in **Table 4.19** and **Figure 4.33**.

Table 4.19
Water Quality Monitoring Frequency and Points

Monitoring Point[1]	Description	Frequency
EPL Point 1	Release point from SB1	Prior to a controlled discharge and within 24 hours then weekly during uncontrolled discharge events
EPL Point 8	Release point from SB2b	
EPL Point 9	Release point from SB3(a/b)	
EPL Point 10	Release point from SD2	
EPL Point 11	Release point from SD6	
EPL Point 2	Upstream Coxs River	At commencement of, then weekly during site discharge events
EPL Point 3	Downstream Coxs River	
Note 1: see **Figure 4.33.**		
Source: Modified after Groundwork Plus (2014) – Table 49.		

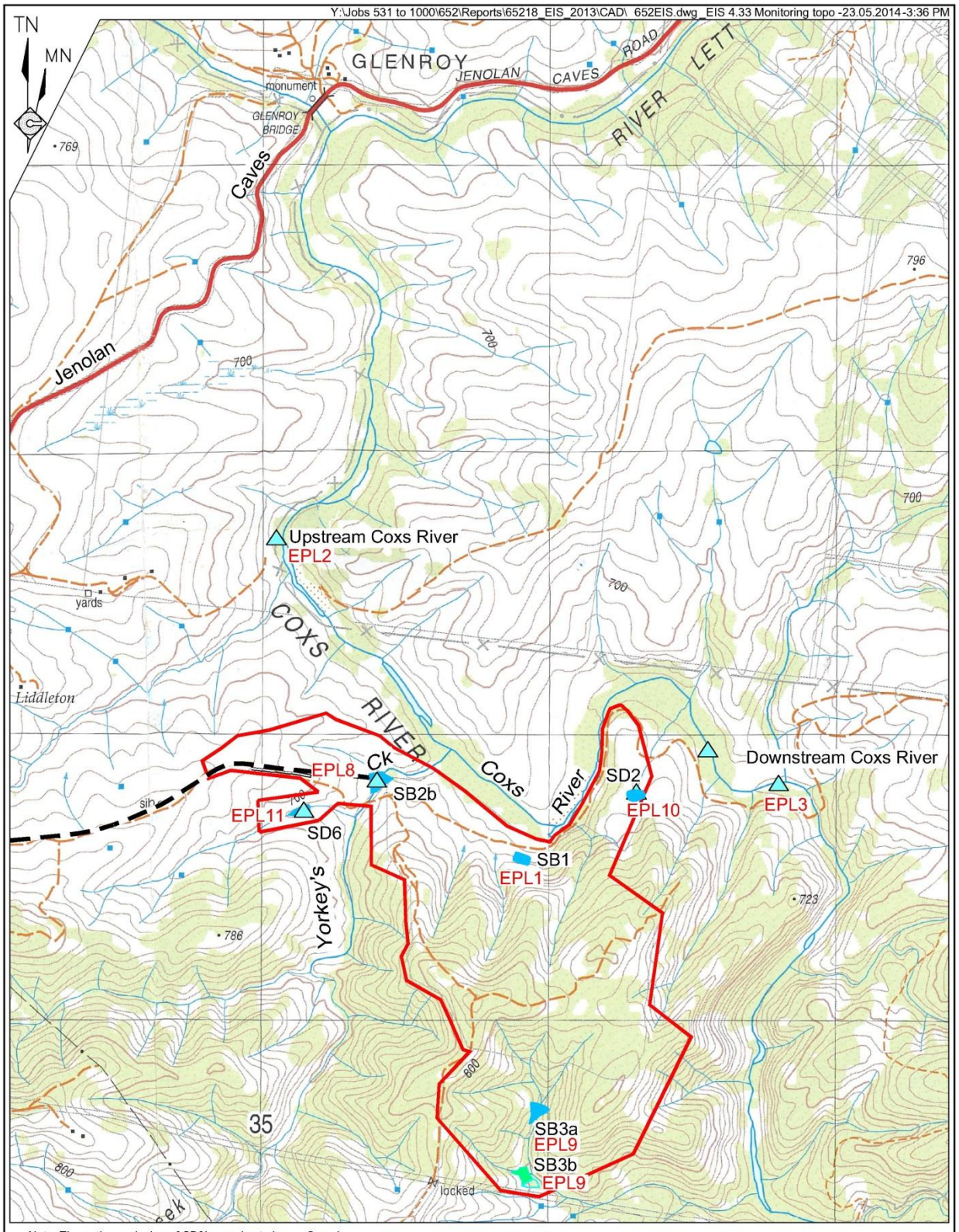


Figure 4.33
SURFACE WATER MONITORING LOCATIONS

4.5.7.4 Corrective Action

Should the concentration of any parameter either exceed the LDWQOs of **Table 4.16** or exceed the reference concentration taken at the time of discharge (whichever is greater), the Applicant would implement the corrective actions presented in **Table 4.20**.

Table 4.20
Potential Exceedance of Locally Derived Water Quality Objectives

Water Quality	Corrective Action(s)
Less than or equal to LDWQO, release limit prescribed by EPL or <10% above background, whichever is greater	Nil.
Greater than LDWQO, release limit prescribed by EPL or >10% above background, whichever is greater	Cease discharge if practicable, advise EPA, investigate cause, implement immediate action to rectify (i.e. re-treat/retest to confirm compliance or implementation of additional stormwater or erosion and sediment control(s) prior to recommencing control discharge.
Presence of visual oil and grease	Cease discharge if practicable, test for Oil and Grease and if >10mg/L advise EPA, investigate and implement immediate action to rectify and prevent reoccurrence. Engage contractor to remove visual contamination and appropriately dispose/recycle contaminated water off site at an appropriately licensed facility.
Source: Modified after Groundwork Plus (2014) – Table 51	

4.6 GROUNDWATER

4.6.1 Introduction

The DGRs issued for the Proposal identified "*Soil and **Water***" as a key issue for assessment within the EIS. With respect to groundwater, the DGRs require that the "*EIS include:*

- *a detailed assessment of potential impacts on the quality and quantity of existing surface and ground water resources, including:*
  - *detailed modelling of potential groundwater impacts;*
  - *impacts on riparian, ecological, geomorphological and hydrological values of watercourses, including environmental flows, in particular Coxs River;*
  - *whether the development can operate to achieve a neutral or beneficial effect on water quality in the drinking water catchment, consistent with the provisions of State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011;*
- *a detailed assessment of the potential impacts of the development on:*
  - *the quantity and quality of regional water supplies;*
  - *regional water supply infrastructure; and*
  - *affected licensed water users and basic landholder rights (including downstream water users);*

- *identification of any licensing requirements or other approvals under the Water Act 1912 and/or Water Management Act 2000; and*
- *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) or water source embargo;*
- *a detailed description of the proposed water management system …… and other measures to mitigate surface and groundwater impacts; ……"*

Additional matters for consideration in preparing the EIS were also provided in the correspondence attached to the DGRs from the NSW Office of Water (NOW) which amongst several more general water impact and assessment related requests included a request for a predictive assessment of the impact of the Proposal on all groundwater sources that includes impacts on connectivity, yield of groundwater, water quality, groundwater dependent ecosystems and existing groundwater users. A consolidated list of the identified requirements and where each is addressed is presented in **Appendix 3**.

Based on the risk analysis undertaken for the Proposal (Section 3.3.1 and **Table 3.9**), the potential impacts relating to surface water and their risk rankings (in parenthesis) after the adoption of pre-existing or standard mitigation measures are as follows.

- Reduction in the volume of water contained within the local aquifer / availability resulting in reduced yields of groundwater bores (low risk).
- Reduction in base flows / spring flows leading to:
  - reduced discharge to gully colluvium ('springs') (low risk);
  - degradation of riparian or aquatic vegetation / ecosystems (low risk); or
  - reduced availability of water to downstream users (low risk).
- Reduced availability to local users as a result of contamination (low risk).
- Degradation of groundwater dependent ecosystems due to contamination of groundwater (low risk).
- Contamination of surface flows (from contaminated recharge) resulting in reduced availability of water to downstream users (low risk).

A review of the attributed risk levels, following the adoption of the recommended operational safeguards and controls, is provided in Section 6.2.1 and **Table 6.1**.

A groundwater impact assessment for the Proposal was undertaken by Mr James Morrow of Ground Doctor Pty Ltd. The assessment is presented as Part 3 of the *Specialist Consultants Studies Compendium* and is referred to hereafter as "Ground Doctor (2014)". This subsection of the EIS provides a summary of Ground Doctor (2014), concentrating on those matters raised in the DGRs and related requirements provided by various government agencies. It is noted that Ground Doctor (2014) provides a qualitative assessment of the potential impacts to groundwater quality posed by the Proposal, rather than "*detailed modelling of potential groundwater impacts*" as nominated in the DGRs. This approach reflects the hydrogeological setting of the extraction area of the Stage 2 Site which is isolated from surrounding aquifers by topographic and surface drainage conditions (see Section 4.5.2).

4.6.2 Hydrogeological Setting

4.6.2.1 Local Hydrogeological Setting

This summary of the local hydrogeological setting considers:

- the NOW groundwater bore database within a 5km radius of the Stage 2 Site;
- an inspection of the Stage 2 Site conducted by Mr Morrow on 18 July 2013, including observations of open exploration drill holes; and
- discussions with Stage 2 Site personnel regarding observations of groundwater behaviour at the Stage 2 Site.

Water Sources and Standing Water Levels

Figure 4.34 displays the locations of 30 groundwater bores within a 5km radius of the Stage 2 Site. The majority of these bores are located between 4km and 5km of the Stage 2 Site and have recorded yields typically less than 0.5L/s. The recorded standing water levels (SWL) vary significantly (from 3.6m to 70m below ground surface) with the shallower SWLs where the water source is shallow alluvial or weathered rock (sedimentary sandstone, shale and siltstone) and deeper SWLs sourcing the fractured granite bed rock aquifers. Standing water levels correlate with changes in surface elevation.

Based on the observed water level (730m AHD) within an open vertical exploration drill hole (DD1) on the Stage 2 Site (see inset on **Figure 4.34**), the accumulation of water within a sump on the floor of the current extraction area (730m AHD) and observed seepage through fractures in the extraction area wall adjacent to the primary crusher (720m AHD), the SWL within the footprint of the Stage 1 extraction area has been established as being approximately 730m AHD.

Aquifer Properties

Notably, the SWL observed within the extraction area is significantly higher than the elevation of the Coxs River to the north and east, Yorkeys Creek to the west and an unnamed gully to the south. The presence of standing water at elevations above these 'drains', i.e. mounding, indicates that the groundwater occurring within the rhyolite is present as a direct result of infiltration of precipitation which falls on the elevated hilltops and ridges surrounding the extraction area. This mounding of groundwater has steep hydraulic gradients towards the surrounding rivers, creeks and gullies, approaching 15% to 20% towards the Coxs River, indicating that the water bearing factures within the rock have low permeability (Ground Doctor, 2014).

For the purpose of analysis of groundwater flow, Ground Doctor (2014) has assumed a low average permeability, equivalent to the yields of those registered bores identified within 5km of the Stage 2 Site, i.e. 0.5L/s. With respect to groundwater storage within the rhyolite hosted aquifer, a porosity of 0.4% is assigned to the rhyolite source rock and 0.7% of the overall rock volume (Ground Doctor, 2014).

Aquifer Boundaries

Based on the data obtained from the NOW groundwater bore database, the elevations of the Coxs River (630m to 660m AHD), Yorkeys Creek (700m AHD) and other local creeks, streams, valleys and gullies (typically less than 700m AHD) are lower than the observed SWL.

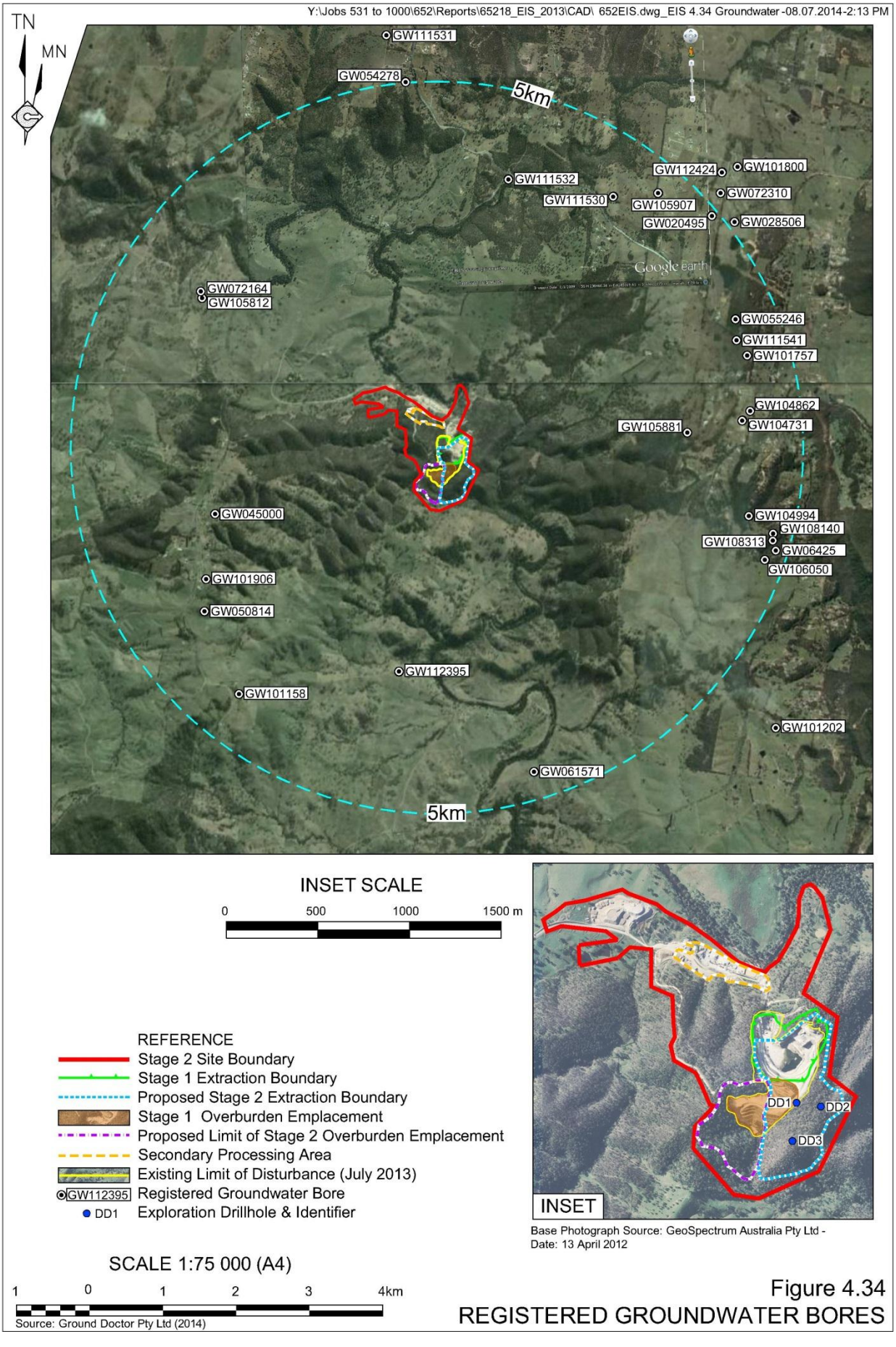


Figure 4.34
REGISTERED GROUNDWATER BORES

These would therefore function as groundwater discharge points and form a physical boundary limiting the lateral movement of groundwater between isolated fractured rock aquifers at elevations greater than the surrounding rivers, creeks and gullies. That is, the groundwater of the rhyolite hosted aquifer on the Stage 2 Site is isolated from adjacent aquifers due to the presence of gullies and low valleys in all directions from the Stage 2 Site.

Groundwater – Surface Water Interaction

The fractured rock aquifers within the local setting are recharged by a proportion of the rainfall on the elevated areas of and surrounding the Stage 2 Site. Ground Doctor (2014) estimates this proportion to be very small (<1%) due to the steep topography and shallow soils. The groundwater subsequently discharges to the surface on the lower slopes and watercourses. Groundwater is also likely to discharge into the adjacent Coxs River, which is the lowest point in the local landscape. Groundwater discharge to local drains equals groundwater recharge over the long term, however, groundwater levels will naturally fluctuate due to seasonal conditions. That is, during wet periods, increased recharge will result in higher standing water levels and increased discharge. During drier periods (reduced recharge), the standing water levels will fall leading to reduced discharge.

Water Quality

On the basis that the groundwater stored within the mounded aquifer is recently recharged rainfall as it flows towards the drains surrounding the Stage 2 Site, sampling has not been undertaken. Records of groundwater quality obtained from local bore logs provide descriptions of "good" or "fresh", as is expected given the location within an elevated area of the Central Tablelands (an upland environment). Electrical conductivity (EC) is expected to be below 1 400µS/cm with water suitable for all potential beneficial uses (Ground Doctor, 2014). Extensive petrological studies have been conducted of the rhyolite and other rocks indicating these are comprised of geochemically inert materials. Nil to a trace amount of pyrite has been identified and as such there is no acid rock drainage risk.

Groundwater Dependent Ecosystems

No Groundwater Dependent Ecosystems (GDEs) listed under Schedule 4 of the *Water Sharing Plan for the Greater Metropolitan Area Groundwater Sources 2011* (the Water Sharing Plan) occur on or adjoin the Stage 2 Site. Section 4.8.3.2.3 provides a further review of the type and likelihood of GDEs occurring on or adjoining the Stage 2 Site.

Summary

The occurrence of groundwater within the local setting is largely controlled as follows.

- SWLs correlate with changes in surface elevation, i.e. they are higher in more elevated areas and lower in low points within the landscape.
- The fractured rock aquifers have relatively low average permeability which allows for relatively steep groundwater gradients. This appears as groundwater mounding beneath ridgelines with steep gradient to discharge points in the adjacent valleys.
- There is likely to be very limited lateral connectivity between fractured rock aquifers due to the physical boundary to movement provided by the incised valleys and gullies (which generally occur at elevations lower than the SWL of the water-bearing fractures and into which the groundwater discharges).

4.6.2.2 Hydrogeology of the Stage 2 Site (Conceptual Site Model)

Based on the description of the local hydrogeological setting provided by Section 4.6.2.1, Ground Doctor (2014) has generated a Conceptual Site Model (CSM) of Stage 2 Site hydrogeology (upper panel of **Figure 4.35**. As a result of infiltration through the elevated volcanic ridges, and the low permeability of fractures within the rock, local mounding of groundwater between elevated areas occurs with discharge along drainage gullies and valleys. The SWL of the mounded groundwater (currently 730m AHD) will vary depending on rainfall conditions of the time, however, a steep groundwater gradient is observed (of between 15% and 20% to the Coxs River). Perched groundwater units could be present where local accumulation of rainwater occur within fractures above, but not connected to the regional water table. These are considered unlikely within the proposed extraction area due to the homogeneity of the geology.

As described in Section 4.6.2.1, the CSM illustrates that the occurrence of groundwater below the Stage 2 Site is influenced by the volume of rainfall infiltration and groundwater discharge. Groundwater levels will be steady when the volume of groundwater recharge (occurring by infiltration of rainfall) equals the rate of groundwater discharge to surface water from the lower slopes. The small proportion of rainfall recharge (less than 1%) is likely to be offset by the volume of groundwater discharge occurring from the lower slopes (draining to the Coxs River) or into the extraction area. During periods of low rainfall and infiltration, the volume of groundwater in storage and the groundwater elevation would decrease. Conversely, during periods of higher rainfall and infiltration, the volume of groundwater in storage and the groundwater elevation would increase.

To the north and east of the Stage 2 Site, the Coxs River presents a local barrier to lateral connectivity between fractured rock aquifers (see **Figure 4.35**). **Figure 4.36** also identifies the aquifer barriers presented by the incised gullies of the local topography, such as the one occupied by Yorkeys Creek, to the west and south. As a consequence of this lack of lateral connectivity, any changes to the groundwater regime of the Stage 2 Site would not influence the hydrogeological conditions of aquifers beyond these aquifer barriers.

4.6.3 Potential Impacts of the Stage 2 Extension

Impacts on groundwater could potentially constrain the Stage 2 Extension on the basis of the following three potential impacts.

Pollution of Groundwater

The removal of unsaturated rock from above the groundwater table increases the susceptibility of the aquifer to chemical contamination from surface spills. The potential sources of such spills and contamination include:

- fuel, oil or other hydrocarbon spills or leaks; and
- nitrates contained within explosives.

It is noted that the potential sources of contamination described above are a feature of current activities on the Stage 2 Site and therefore the proposed Stage 2 Extension poses no significant additional risk to groundwater quality. Furthermore, the risk of groundwater contamination through operational activities (including blasting and use of plant chemicals) is considered very low due to the low porosity characteristics of the rhyolite (0.4%) and its resistance to fracturing. This is likely to limit contamination due to blasting or spills from reaching the groundwater.

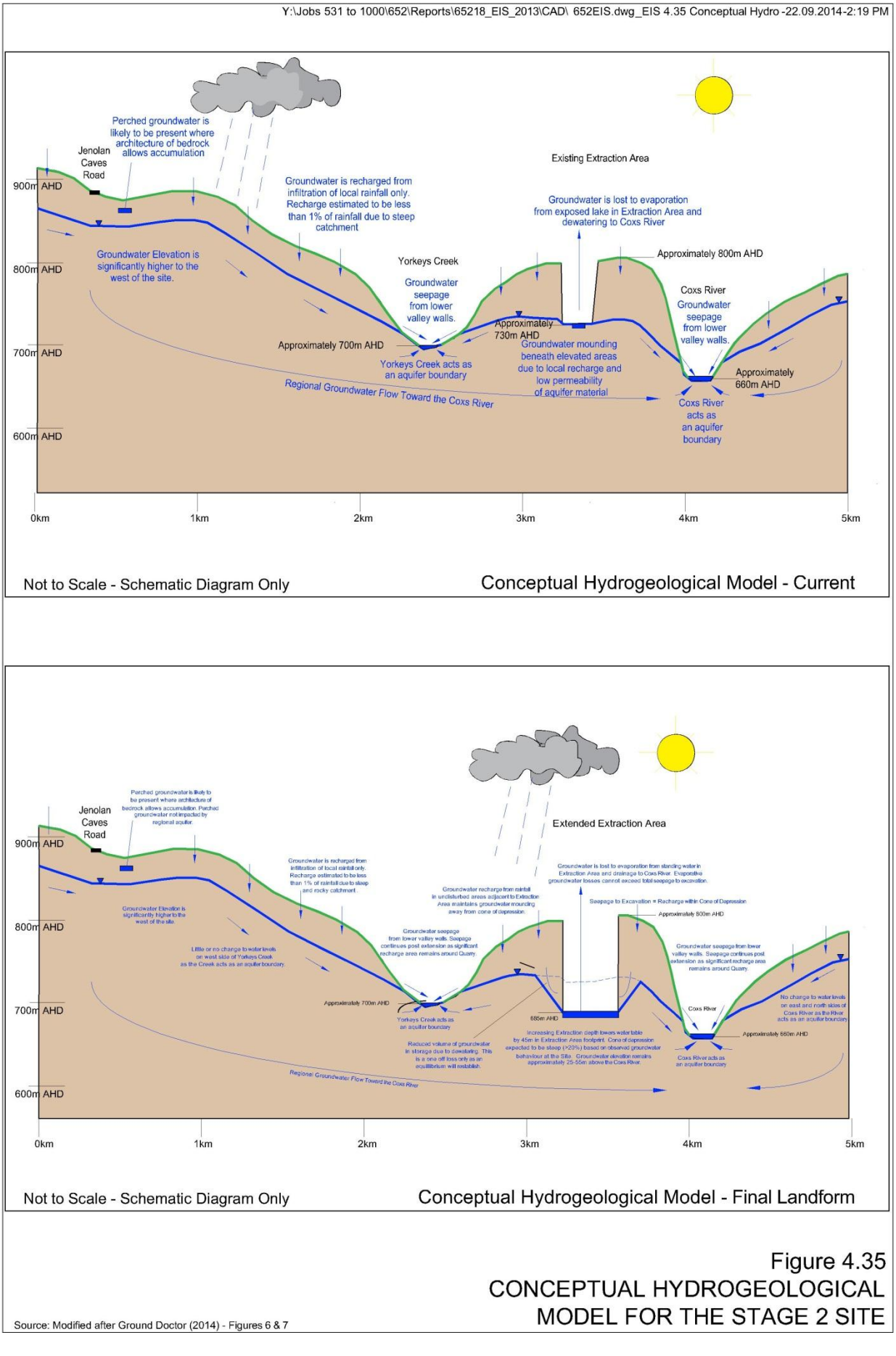


Figure 4.35
CONCEPTUAL HYDROGEOLOGICAL MODEL FOR THE STAGE 2 SITE

Source: Modified after Ground Doctor (2014) - Figures 6 & 7

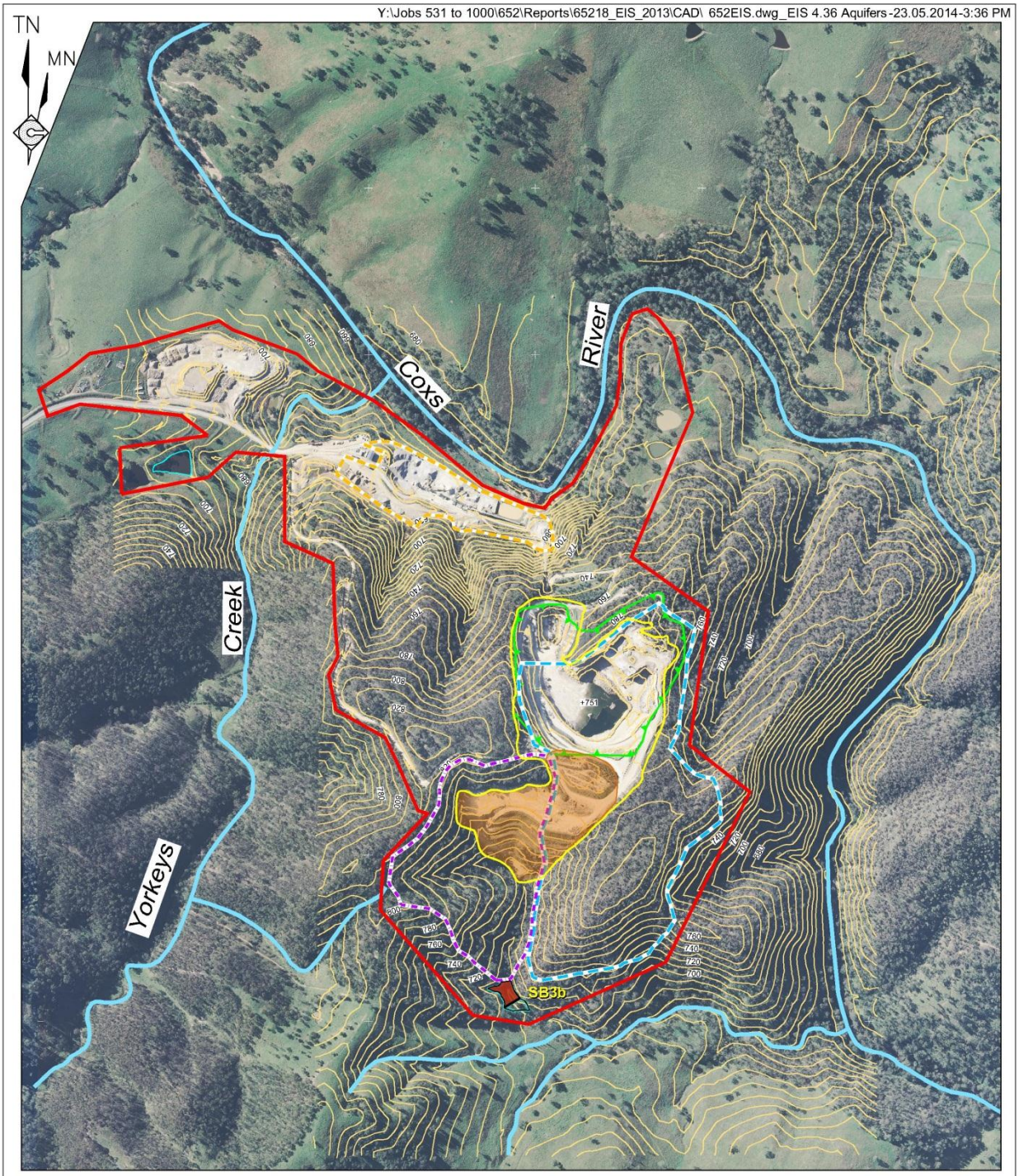


Figure 4.36
AQUIFER BARRIERS

Aquifer Interference and Groundwater Availability

The proposed increase in area and depth of the extraction area is likely to result in localised drawdown of the groundwater table. The Proposal is therefore considered an aquifer interference activity and requires assessment under the NSW *Aquifer Interference Policy* (DPI, 2012a).

Due to the lack of lateral connectivity between the groundwater source to be drawn down and those accessed by registered groundwater users surrounding the Stage 2 Site, no impact would occur to the availability of groundwater to these users.

As a result of the extraction being developed below the isolated groundwater table of the Stage 2 Site, there could be a minor reduction to the volume of water stored within the rhyolite hosted aquifer. A proportion of the groundwater retained in the rhyolite surrounding the extraction area, which previously may have flowed to the various drains surrounding the extraction area, e.g. Coxs River and local gullies, may seep into the extraction area. This seepage would be collected and either used for dust suppression or pumped to SD1 for entry into the Stage 2 Site water management system. A small proportion of the accumulated water would be lost via evaporation, however, on the basis that the water collected within SD1 would be periodically discharged to the Coxs River (see Section 4.5.5.3), combined with the increased runoff generated within the extraction area, there is unlikely to be any significant change to the overall water balance of the Coxs River.

Groundwater Licensing

As groundwater would be intercepted by the proposed extraction activities, this aquifer interfering activity requires approval. In accordance with Section 89J of the EP&A Act, which excludes the requirement for Water Management Works and Water Supply Approvals under the Sections 89 and 90 of the *Water Management Act 2000*, the development consent issued under Division 4.1 of Part 4 of the EPA&A Act would provide the necessary 'aquifer interference approval'.

Groundwater removed as a result of the proposed activities, through in-flow to the extraction area, evaporation or removal with the extracted rock, requires a Water Access Licence (WAL) with an appropriate allocation to be obtained and maintained by the Applicant. As discussed in Section 2.10.4, the Applicant has made application for a zero allocation WAL and intends on applying for a controlled allocation from the Coxs River Fractured Rock groundwater management unit for 20 units (20MLpa) in accordance with Controlled Allocation Order (Various Groundwater Sources) (No 1) (NSW Government, 2014).

4.6.4 Controls and Management Measures

4.6.4.1 Aquifer Interference and Groundwater Availability

The Applicant would maintain a sump(s) on the active floor of the extraction area to collect any water which seeps into the void, as the depth of extraction is developed below the SWL of the surrounding groundwater, as well as rainfall runoff. As water accumulates within the sump, it would either be used for dust suppression or periodically discharged to SD1 for addition to the Stage 2 Site water management system. Based on the modelling of Groundwork Plus (2014), between 1.9ML and 65.5ML of water would be discharged back to the Coxs River from SD1 and SD2 annually (see Section 4.5.5.3).

Based on the isolated nature of the hydrogeological setting discussed in Section 4.6.2, it is highly unlikely that the proposed extraction area would impact on the availability of groundwater beyond the identified aquifer barriers (see **Figure 4.36**). This notwithstanding, the Applicant proposes to install piezometers between the extraction area and the Coxs River to the east, and Yorkeys Creek to the west. The SWL within the piezometers would be monitored regularly to confirm that the extent of groundwater drawdown remains equivalent to that predicted by Ground Doctor (2014) (refer to Section 4.6.5.3).

To ensure the annual 'take' of groundwater each year remains within that which the Applicant retains a licensed allocation, the Applicant would apply the following methodology to calculating the two components of groundwater take.

- In Situ Groundwater. The groundwater contained with the removed rock would be a simple multiplication of volume by porosity. Readings of SWL from the piezometers surrounding the extraction area would be used to delineate the extent and gradient of drawdown beyond the extraction area. The loss of groundwater from this cone of depression would also be calculated by multiplying the volume of lost storage by porosity.
- Seepage. The delineated cone of depression would also be used to estimate annual seepage losses. By multiplying the area at surface of the drawdown by annual rainfall by average recharge (1%), the volume of recharge removed from the aquifer would be calculated.

As is discussed in Section 4.6.5.3, these calculations are likely to overestimate the volume of water reporting to the extraction and 'taken' from the aquifer.

The above notwithstanding, the Applicant would respond to any claim of a reduction in availability of groundwater resources. Should it be determined that the reduction in groundwater can be attributed to the Proposal, replacement or compensatory measures would be developed.

4.6.4.2 Groundwater Contamination

As noted by Ground Doctor (2014) and discussed in Section 4.6.3, the risk of groundwater contamination through operational activities (including blasting and equipment operation) is considered very low due to the low porosity characteristics of the rhyolite (0.7%) and its resistance to fracturing. Therefore, the safeguards and controls relating to the prevention of surface water contamination nominated in Section 4.5.4.1 apply equally to the prevention of groundwater contamination.

The quality of water contained within SD1 and SD2 would be monitored to provide an indication of the accumulation of any contaminants within the water which is retained in the extraction area sumps. An elevation in any contaminant, e.g. hydrocarbon or nitrate, would lead to further sampling and assessment of the water of the extraction area sumps.

4.6.5 Assessment of Impacts

4.6.5.1 Aquifer Properties and Groundwater Availability

The impact of the Proposal would be to lower the groundwater table within the extraction area and immediate surrounds. A conceptual model of Stage 2 Site hydrogeology following the completion of the Proposal is provided by the lower panel of **Figure 4.35**.

The main changes to the groundwater regime at the Stage 2 Site would occur as a result of the following.

- The physical removal of groundwater contained within the extracted rock and cone of depression extending from the base of the extraction area ('in situ groundwater').

  The groundwater contained within the pore space of the quarried rock would be removed. As the extraction area is developed further below the existing groundwater SWL, a hydraulic gradient towards the extraction area void would be created with groundwater flowing towards and seeping into the void. Ground Doctor (2014) describes this as a permanent drainage of groundwater from the aquifer within the cone of depression as a new post-extraction SWL around the perimeter of the extraction area floor (eventually 685m AHD) is established (see lower panel of **Figure 4.35**).

- Ongoing seepage from surrounding fractured rock during excavation and from the post quarrying landscape.

  Once the drainage of in situ groundwater is complete, the water balance would return to pre-quarry conditions where the volume of rainfall infiltration is equal to the volume of groundwater discharge into the adjacent drains. A portion of this recharge which occurs over the cone of depression would drain to the extraction area (and is referred to hereafter as the 'seepage' component of groundwater loss). As a result, during periods of higher infiltration, e.g. periods of heavy or sustained rainfall, groundwater seepage into the void of the final extraction area would be higher (as it would in other drains surrounding the extraction area) than during periods of low rainfall.

As illustrated by the post-quarry CSM (see lower panel of **Figure 4.35**), the lateral spread of any drawdown impacts would be limited by the low average permeability of the aquifer, manifested as hydraulic gradients of 15% to 20%. That is, recharge to the more elevated areas around the periphery of the extraction area would still occur with some mounding of groundwater expected. In particular, groundwater would continue to flow toward Yorkeys Creek as a result of groundwater recharge occurring in the undisturbed area between the extraction area and Yorkeys Creek.

Furthermore, while lowering of the groundwater table within and surrounding the extraction area would occur, even in the worst case scenario drawdown would be limited (not progress beyond) the physical topographic aquifer barriers of Yorkeys Creek to the west , the Coxs River to the north and east, and an unnamed gully to the south of the Stage 2 Site.

4.6.5.2 Groundwater Drawdown and Loss

In the absence of measured aquifer properties, Ground Doctor (2014) has relied upon an analytical approach to estimating the two components of groundwater loss, in situ groundwater and seepage (see Section 4.6.5.2).

This analytical approach is based on the following assumptions which are likely to significantly overstate the loss of groundwater associated with the Stage 2 Extension.

- All water contained within the pore spaces of the quarried rock is accounted for. It is assumed that rhyolite contains 1.1% water on average.
- The base of the entire final extraction area at an elevation of 685m AHD with 45m of drawdown assumed.
- The base of the final extraction area has been approximated as a circle with a diameter of 350m.
- The existing SWL of 730m AHD is assumed to continue away from the extraction area indefinitely. That is, the mounded nature of the groundwater which would result in a reduction in the SWL with distance from the extraction area, is not incorporated.
- An average hydraulic gradient of 20% which, based on 45m drawdown, would create a cone of depression propagating 225m away from the outer walls of the extraction area. The hydraulic gradient has been assumed to be linear away from the extraction area.
- Average rainfall at the site is 859mm/yr and groundwater recharge is approximately 1% of total rainfall.

In Situ Groundwater Losses

The volume of rock within the cone of depression can be estimated by calculating the volume of a conical cylinder with base diameter of 350m, upper diameter of 800m (estimated width of the cone of depression) and depth of 45m. This equates to a volume of approximately 11 685 000m^3, of which 1.1%[4] (128,500m^3) is groundwater (128.5ML).

While annual loss would be dependent on annual removal of rhyolite and overburden, if averaged over the 35 year operating period of the Stage 2 Extension, this corresponds to an average annual take of 3.7ML/yr.

Seepage Losses

Following the removal of the in situ groundwater from the extraction area and cone of depression, groundwater would continue to be lost from the aquifer as a result of seepage into the open extraction area. As described in Section 4.6.5.2, the average annual loss due to seepage would be equivalent to the amount of recharge which occurs within the cone of depression surrounding the extraction area.

[4] Based on porosity of the rhyolite and other rock.

Based on an average hydraulic gradient of 20%, the cone of depression would extend approximately 225m from the outer walls of the excavation, i.e. an area of 503 000m^2 when applying the assumptions described above. Assuming an average rainfall of 859mm/yr, the total volume of rainfall would be, on average, approximately 432 000m^3. As recharge has been assumed as 1% of annual rainfall, the average volume taken from the cone of depression would be 4 300m^3 (4.3ML/yr)[5].

4.6.5.3 Groundwater Quality

Assuming the implementation of the management controls to reduce the potential for hydrocarbon or other spills and leaks, and measures to be implemented in the event of a spill or leak, the risk of groundwater contamination as a result of the Proposal is considered to be as low as reasonably possible. It is worthy of note that after over 10 years of operating at the Austen Quarry, there have been no incidents of contamination events or discharges as a result of hydrocarbon or other contaminant spills and leaks. However, even in the event of a spill or leak within the extraction area, the potential for contamination to enter the groundwater would be low, as drawdown in surrounding rock is expected to maintain an inward (i.e. towards the excavation) gradient (Ground Doctor, 2014).

The rhyolite displays nil to trace sulphur and therefore has very little potential to generate acid when it is exposed to oxygen.

Recent water quality monitoring identified that concentration of nitrate in the extraction area sumps was slightly elevated (refer to *Table 9* of Groundwork Plus, 2014), however, as a result of natural dilution, this concentration decreases within the interim storage dams (SD1 and SD2) prior to discharge (refer to *Table 12* of Groundwork Plus, 2014). Furthermore, these concentrations are equivalent and lower than those measured in other dams which receive runoff from local paddocks, e.g. SD6 (refer to *Table 13* of Groundwork Plus, 2014).

As discussed in Section 2.13.3.2, it is expected that water would accumulate within the final landform, with a small proportion of this provided by groundwater. On the basis that the majority of the water accumulating within the final void will be surface runoff, the potential for the accumulation of salt or other contaminants is considered very low.

4.6.5.4 Aquifer Interference and Licensing

Aquifer Interference

The NSW *Aquifer Interference Policy* characterises aquifers as highly or less productive on the basis of yield (being greater or less than 5L/s) and salinity (TDS being greater or less than 1 500mg/L). The groundwater source to be impacted by the Proposal is defined as a "less productive" aquifer on the basis that bores within 5km of the Stage 2 Site typically have reported yields well below 0.5L/s or 10% of the threshold for being a highly productive bore.

[5] Ground Doctor (2014) notes that the estimate of seepage is based on the inferred maximum extent of drawdown associated with the Stage 2 Extension. In reality the cone of depression would increase in size gradually proportional to increased depth of the extraction area.

Ground Doctor (2014) assessed the likely impacts of the Proposal against the "*Minimal Impact Considerations*" of the NSW *Aquifer Interference Policy*. **Table 4.21** reproduces the results of Ground Doctor's assessment.

On the basis that the minimal impact is demonstrated, the *NSW Aquifer Interference Policy* does not require any more detailed study or assessment.

Groundwater Licensing

Table 4.21 demonstrates that the Proposal would not exceed the minimal impact thresholds of the NSW *Aquifer Interference Policy* and therefore development consent may be issued approving this aquifer interfering activity.

Table 4.21
Minimal Impact Considerations

Impact	Assessment
Water Table and Water Pressure 1. Less than or equal to 10% cumulative variation in the water table, allowing for typical climatic "post-water sharing plan" variations, 40m from any: a) high priority groundwater dependent ecosystem; or b) high priority culturally significant site; listed in the schedule of the relevant water sharing plan. A maximum of a 2m decline cumulatively at any water supply work. 2. If more than 10% cumulative variation in the water table, allowing for typical climatic "post-water sharing plan" variations, 40m from any: a) high priority groundwater dependent ecosystem; or b) high priority culturally significant site; listed in the schedule of the relevant water sharing plan if appropriate studies demonstrate to the Minister's satisfaction that the variation will not prevent the long-term viability of the dependent ecosystem or significant site. If more than a 2m decline cumulatively at any water supply work then make good provisions should apply.	Aquifer barriers prevent lateral connectivity between the groundwater to be drawn down below the Stage 2 Site and that accessed by registered groundwater supply works. Furthermore, the significant distance between the extraction area and closest registered bore (2.8km) would limit any impact should there be any residual connectivity.
Water Quality 1. Any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40m from the activity. 2. If the above condition is not met then appropriate studies will need to demonstrate to the Minister's satisfaction that the change in groundwater quality will not prevent the long-term viability of the dependent ecosystem, significant site or affected water supply works.	No change to groundwater quality is expected, i.e. the Proposal would not introduce contaminants or additional salt to the aquifer. In the event that water quality impacts did occur the potential for impacts to spread away from the extraction area would be low, as drawdown in surrounding rock is expected to maintain an inward (i.e. towards the excavation) gradient.
Source: Ground Doctor (2014) – Table 3.	

As noted in Section 2.10.4, the Applicant has lodged an application for a zero allocation WAL for groundwater within the Coxs River Fractured Rock Groundwater Source of the Water Sharing Plan. On receipt of this, an allocation for the annual volume of groundwater to be taken would be obtained in one of two ways.

1. An allocation would be obtained, either by purchase, lease or temporary transfer, from WALs held by third parties within the Coxs River Fractured Rock Aquifer Groundwater Source of the *Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources* (WSP, 2011). A search of publically available records has identified that there are only eight WALs for this Groundwater Source contained within allocations of between 0.5 and 21 units. The Applicant has made initial investigations as to the availability of the allocations attached to these WALs.
2. Through a controlled allocation of groundwater from the Minister for Natural Resources, Lands and Water (under delegation), it is noted that the NSW Government has issued a controlled allocation order for up to 327 units within the Coxs River Fractured Rock groundwater management unit (NSW Government, 2014). This represents approximately 5% of the LTAAEL for the Coxs River Fractured Rock management unit (6,806ML/yr) identified in the WSP (2011). The Applicant intends on applying for a portion of this controlled allocation by the deadline of 20 October 2014.

4.7 TERRESTRIAL ECOLOGY

4.7.1 Introduction

The DGRs issued for the Proposal identified "*Biodiversity*" as a key issue requiring that the "*EIS include:*

- *accurate estimates of proposed vegetation clearing and impacts on regionally significant remnant vegetation, or vegetation corridors;*
- *a detailed assessment of potential impacts of the development on any terrestrial or aquatic threatened species or populations and their habitats, endangered ecological communities and groundwater dependent ecosystems; and*
- *a detailed description of the measures taken to avoid, reduce or mitigate impacts on biodiversity including an appropriate biodiversity offset strategy."*

Additional matters for consideration in preparing the EIS were also provided in the correspondence attached to the DGRs from OEH which related to Biodiversity, Threatened Species, Flora and Fauna as follows.

- include an assessment of biodiversity impacts using the BioBanking Assessment Methodology or a detailed biodiversity assessment;
- identify vegetation communities and any threatened biota including an assessment of significance relative to all relevant legislation;

- include flora and fauna assessment reports; and
- document any requirements to refer the Proposal under the EPBC Act as a controlled action.

Also appended to the DGRs is correspondence from DTIRIS requesting an assessment of the ecological sustainability of the Proposal.

Based on the risk analysis undertaken for the Proposal (Section 3.3.1 and **Table 3.9**), the potential impacts relating to flora and fauna and their risk rankings (in parenthesis) after the adoption of pre-existing or standard mitigation measures are as follows.

- A reduction in remnant native vegetation resulting in a reduction in local biodiversity (high risk).
- Local or regional reduction in distribution of threatened species, populations and endangered ecological communities through clearing activities (high risk).
- Local or regional reduction in distribution of threatened species, populations and endangered ecological communities through indirect impacts such as dust, noise and lighting from the Site (medium risk).

A review of the attributed risk levels, following the adoption of the recommended operational safeguards and controls, is provided in Section 6.2.1 and **Table 6.1**.

The Terrestrial Ecology Impact Assessment for the Proposal was undertaken by Mr Nathan Smith and Dr Rhidian Harrington of Niche Environment and Heritage (Niche) and comprised the following three primary components.

1. Background research, literature review and field survey to establish the environmental setting and issues of conservation significance that would or could be impacted by the Proposal.
2. Assessment of the impact (and relative significance) of the Proposal on the local ecological setting.
3. Development and assessment of a biodiversity offset strategy for the Proposal (to compensate for the unavoidable impacts on the local ecological setting and issues of conservation significance.

The resulting report is presented as Part 4 of the *Specialist Consultants Studies Compendium* and is referred to hereafter as "Niche (2014a)". This subsection of the EIS provides a summary of the terrestrial ecology impact assessment, concentrating on those matters raised in the DGRs and related requirements provided by various government agencies. A consolidated list of the identified requirements and where each is addressed is presented in **Appendix 3**.

4.7.2 Assessment Methodology

4.7.2.1 Background Research and Database Review

In order to obtain information on flora and fauna to be targeted for survey, and identify species likely to be present and affected by the Proposal, Niche (2014a) undertook a desktop review of previous ecological studies of the Austen Quarry and relevant threatened species databases, e.g. the Atlas of NSW Wildlife.

Available literature included the original Environmental Impact Statement for the quarry (SKM, 1994) and a subsequent ecological constraints assessment over the site of the proposed overburden emplacement extension completed by OzArk Environment & Heritage Management (2007), along with annual monitoring reports (prepared by Biosis Research between 2005 and 2008, and OnSite Environmental between 2008 and 2013). These assessments and monitoring reports have identified five threatened bird species on the Stage 2 Site (Gang-gang Cockatoo, Hooded Robin, Scarlet Robin, Flame Robin and Varied Sittella, as well as one threatened plant Silver-leafed Mountain Gum). Monitoring has not identified the ongoing quarry operations as having any significant adverse impact on local vegetation, bird or frog assemblages.

In December 2013, Niche (2014a) conducted searches of the following databases for records of, or potential habitat for threatened species within a 10km radius of the Stage 2 Site, to produce a list of potentially occurring threatened and migratory species.

- The Atlas of NSW Wildlife.
- The NSW Threatened Species Profiles Database.
- The Commonwealth Department of the Environment (DoE) Protected Matters Search Tool

4.7.2.2 Field Investigations

4.7.2.2.1 Introduction

Although the studies summarised in Section 4.7.2.1 provide a valuable database of threatened species records within the Stage 2 Site, additional field surveys were completed by Niche (2014a) in order to add to the knowledge of the locations of threatened species on the Stage 2 Site. Section 3 of Niche (2014a) provides a detailed description of the survey techniques undertaken with Sections 4.7.2.2.2 and 4.7.2.2.3 providing a general overview of the survey methods. **Figure 4.37** presents an illustration of the survey coverage over the Stage 2 Site.

4.7.2.2.2 Flora

Vegetation Mapping

Floristic plots and transects were established, and BioBanking Site attribute data collected, to allow for floristic analysis to be completed in accordance with the BioBanking Assessment Methodology (BBAM) (DECC, 2008c).

Rapid Data Point (RDP) survey was also undertaken to complement the full floristic plot information and allow for the mapping of vegetation communities to be refined (ground-truthed). RDPs provide summaries of floristic information at specific points in the field such as:

- dominant species, estimated cover and height for each layer of vegetation present usually including canopy, mid-storey, shrubs and ground-cover;
- vegetation condition, BBAM (moderate-good, low and cleared) and other habitat or notable features; and
- physical attributes of the site (vegetation structure, soil type, elevation, slope, aspect, physiographical position).

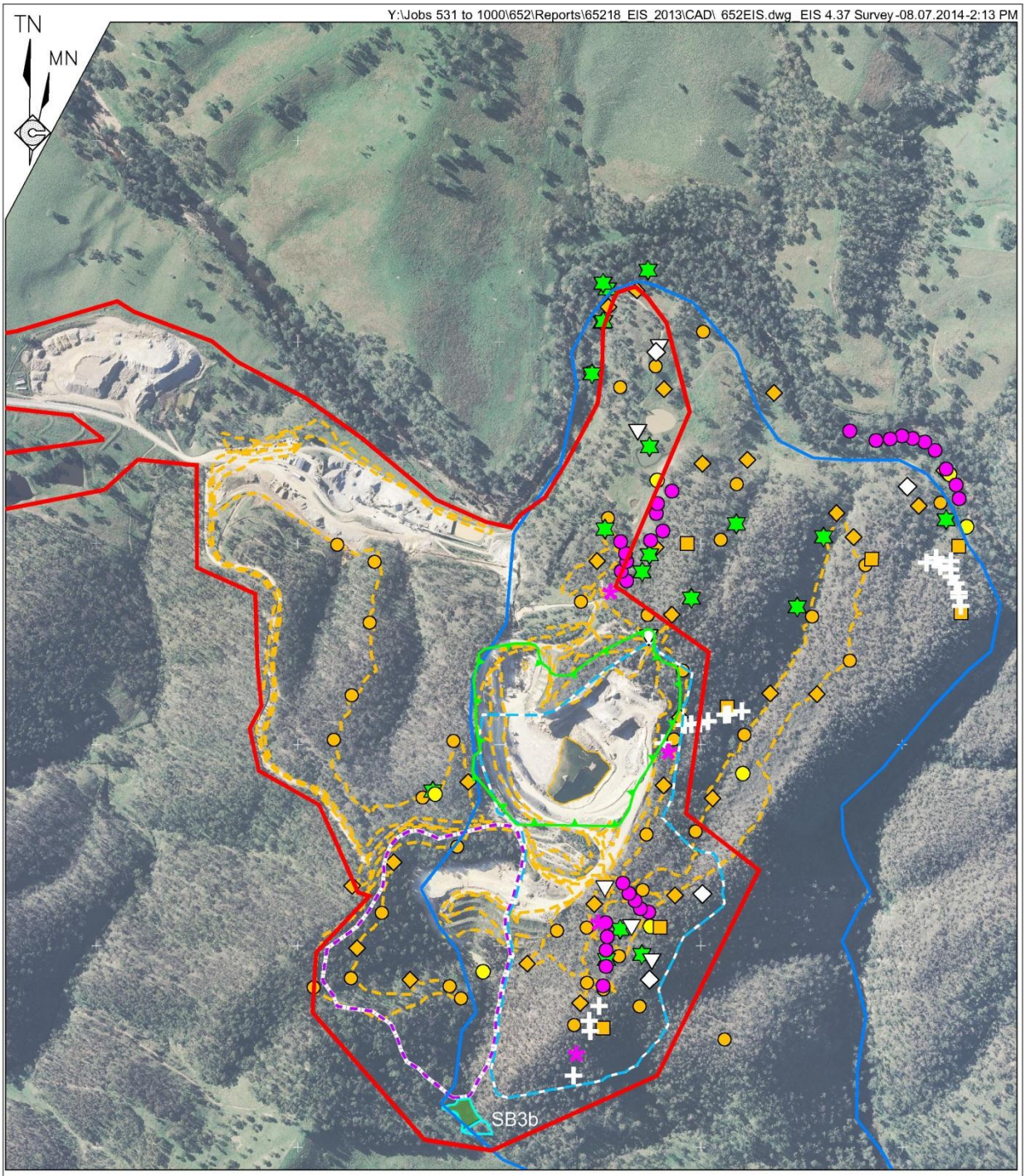


Figure 4.37
FIELD SURVEY EFFORT OF THE STAGE 2 SITE

The data collected was subject to full floristic analysis to define vegetation communities over the Stage 2 Site. These vegetation communities were subsequently aggregated and aligned to Revised Biometric Vegetation Types (RBVTs), Keith Formation and Keith Class.

Threatened Species Survey

Aerial photograph interpretation was undertaken to identify potential habitat for the threatened species identified through literature review and database searches as likely to occur within the Stage 2 Site.

Once on site, and targeting the areas of potential habitat, the Random Meander method was used to identify threatened plant species. On identification of threatened plants, these were marked by GPS and counted. Where the threatened plant population was too large for individuals to be marked and counted, the density of the population was estimated and a population estimate calculated by multiplying the density with the area of habitat.

Niche (2014a) notes that the field surveys were carried out in Summer, Autumn and Winter, outside of the peak flowering period for the threatened flora species likely to occur on the Stage 2 Site. Notably, the threatened species likely to occur are conspicuous and do not require flowers for identification. If present, these species were likely to have been identified (along with *Eucalyptus pulverulenta*) during the threatened flora survey carried out for previous assessments and monitoring programs (see Section 4.7.2.1).

4.7.2.2.3 Fauna

Habitat Assessment

Niche (2014a) recorded the following fauna habitat characteristics and parameters.

- Aspect and slope of the site.
- Dominant vegetation, floristic composition and structure (informed by the native vegetation survey).
- Composition of ground layer (bare earth, litter, fungi, moss, lichen etc.).
- Presence and relative abundance of key habitat features (e.g. tree hollows, large logs, exfoliating rock, flowering resources, aquatic features).
- Condition and disturbance factors.
- Vegetation age structure.

These characteristics were used to define the major (macro) habitat types within the Stage 2 Site, as well as provide information on micro habitats present which could influence the presence of native fauna.

Targeted fauna survey

Field fauna survey was targeted towards those species identified through background research and database review as likely to occur. Field surveys were undertaken on three occasions covering eight days and eight nights in February and March 2012. The field survey, designed

and undertaken to meet the minimum survey requirements of OEH using a range of the most suitable techniques (DEC 2004), incorporated the following.

- Arboreal Elliot trapping targeting Squirrel glider and other arboreal mammals.
- Infra-red and white-light camera trap targeting Spotted-tailed quoll and other ground dwelling omnivores/scavengers.
- Hair tubes targeting ground dwelling and arboreal mammals.
- Ultrasonic call detection targeting microchiropteran bat species.
- Trip line surveys targeting microchiropteran bat species.
- Diurnal bird surveys.
- Spotlighting surveys targeting owls and arboreal mammals.
- Call playback targeting Powerful owl, Barking owl, Masked owl, Sooty owl.
- Rock rolling and herpetological searches targeting frogs and reptile species.
- Frog chorus survey and aquatic habitat (spotlight) surveys.
- Opportunistic observations.

Section 3.4.2 and *Appendix 4* of Niche (2014a) provide a more detailed summary of the fauna field survey undertaken.

4.7.2.3 Identification of Subject Species

After consideration of known records, habitat features, results of the field surveys and professional judgement of Niche, a 'likelihood of occurrence' rating was attributed to threatened species initially identified as potentially occurring on the Stage 2 Site (see **Table 4.22**).

Table 4.22
Likelihood of Occurrence Categories

Page 1 of 2

Likelihood	Threatened Flora/EEC Criteria	Threatened and Migratory Criteria
Known	The species/EEC has been observed on or immediately surrounding the Stage 2 Site.	The species has been observed on or immediately surrounding the Stage 2 Site.
High	It is likely that a species/EEC inhabits or utilises habitat within the Stage 2 Site for one or both of the following reasons. • Preferred habitat present and is in good condition. • There are a high number of records of the species within the locality.	It is likely that a species inhabits or utilises habitat within the Stage 2 Site for one or more of the following reasons. • Preferred habitat present and is in good condition. • Species is dependent on habitat within the study area on a permanent or seasonal basis. • There are a high number of records of the species within the locality.

Table 4.22 (Cont'd)
Likelihood of Occurrence Categories

Likelihood	Threatened Flora/EEC Criteria	Threatened and Migratory Criteria
Moderate	It is possible that a species/EEC inhabits or utilises habitat within the Stage 2 Site for one or more of the following reasons: • Potential habitat for a species/EEC occurs on the site but is in a disturbed condition. • Records for the species occur within the locality. • Species is cryptic and was not seasonally targeted.	It is possible that a species inhabits or utilises habitat within the Stage 2 Site for one or more of the following reasons: • Potential habitat for a species occurs on the site and the species may occasionally utilise that habitat. • Species unlikely to be wholly dependent on habitat present within the Stage 2 Site. • Species was not seasonally targeted or surveyed using optimal techniques for detection.
Low	It is unlikely that the species/EEC inhabits the Stage 2 Site for one or more of the following reasons: • species has a low number of previous records in the locality • non-cryptic species that was not recorded during targeted field surveys. • habitat for the species is not considered to be present within the Stage 2 Site.	It is unlikely that the species inhabits the Stage 2 Site for one or both of the following reasons: • If present, the species would likely be a transient visitor. • The Stage 2 Site contains only very common habitat for this species which the species does not rely on for its ongoing local existence.
None	The species/EEC is not considered to be present within the Stage 2 Site for one or more of the following reasons: • The habitat within the Stage 2 Site is unsuitable for the species/EEC. • The species has not been recorded previously within the Stage 2 Site or locality. • The Stage 2 Site is beyond the known limit of the species distribution.	The species is not considered to be present within the Stage 2 Site for one or more of the following reasons: • The habitat within the Stage 2 Site is Unsuitable for the Species/EEC. • The Species has not been recorded previously within the Stage 2 Site or locality. • The Stage 2 Site is beyond the known limit of the species distribution.
Source: Niche (2014a)		

Subject species were identified as having a moderate, high or known likelihood of occurrence, and for which known or potential habitat would be impacted. These species would require formal assessment of significance in accordance with the EP&A Act (Seven Part Test) for NSW listed species or EPBC Act (Significant Impact Criteria) for Commonwealth listed species.

4.7.3 Ecological Setting and Issues of Conservation Significance

4.7.3.1 Flora of the Stage 2 Site

4.7.3.1.1 Vegetation Communities

Following the methodology for vegetation mapping described in Section 4.7.2.2, Niche (2014a) described six vegetation communities (and two derived communities) within the Stage 2 Site (see **Table 4.23**).

Section 4.3.2 of Niche (2014a) provides a more detailed description of the structure and dominant species within each vegetation community, including a description of the two derived communities of C3, namely:

- C3a: Forest Red Gum native grassland; and
- C3b: Forest Red Gum exotic grassland.

Table 4.23
Vegetation Communities of the Stage 2 Site

Vegetation Community	Revised Biometric Vegetation Type	Formation[1]	Class[1]	Regional Status (% cleared)[2]	Conservation Status
C1: Brittle Gum – Broad-leaved Peppermint open forest	HN570 – Red Stringybark - Brittle Gum - Brittle Gum dry open forest of the tablelands, South Eastern Highlands	Dry Sclerophyll Forests (Shrubby sub-formation)	Southern Tableland Dry Sclerophyll Forests	55% (not regionally significant)	Not an EEC
C2: Silver-leafed Mountain Gum mallee woodland					Contains *Eucalyptus pulverulenta* (not an EEC)
C3: Forest Red Gum grassy open forest	HN527 – Forest Red Gum - Yellow Box woodland of dry gorge slopes, southern Sydney Basin and South Eastern Highlands	Dry Sclerophyll Forests (Shrub/grass sub-formation)	Central Gorge Dry Sclerophyll Forests	50% (not regionally significant)	Not an EEC
C4: Rough-barked Apple gully forest					Not an EEC
C5: Stringybark – Apple Box open forest	HN501 – Apple Box - Broad-leaved Peppermint dry open forest of the Abercrombie - Tarlo area, South Eastern Highlands	Grassy Woodlands	Tableland Grassy Woodlands	30% (not regionally significant)	Not an EEC
C6: River Oak riparian open forest	HN574 – River Oak open forest of major streams, Sydney Basin and South East Corner	Forested Wetlands	Eastern Riverine Forests	40% (not regionally significant)	Not an EEC

Note 1: after Keith (2004)

Note 2: Within Hawkesbury Nepean CMA Region

Source: Modified after Niche (2014a) – Section 4.3.1

The distribution of these communities on the Stage 2 Site is displayed on **Figure 4.38** and **Table 4.24** identifies the area of each contained within the Stage 2 Site, the impact footprint of the Stage 2 Extension and the proposed biodiversity offset area.

Table 4.24
Distribution of Vegetation Communities of the Stage 2 Site

Vegetation Community	Survey Area (ha)	Impact Area		Proposed BOA (ha)
		direct (ha)	Indirect (ha)	
C1: Brittle Gum – Broad-leaved Peppermint open forest	64.9	17.3	1.3	46.3
C2: Silver-leafed Mountain Gum mallee woodland	1.9	-	-	1.9
C3: Forest Red Gum grassy open forest	28.0	4.4	0.8	22.8
C3a: Forest Red Gum native grassland	0.8	-	-	0.8
C3b: Forest Red Gum exotic grassland	9.7	-	-	9.7
C4: Rough-barked Apple gully forest	2.4	-	-	2.4
C5: Stringybark - Apple Box open forest	5.2	4.8	0.4	-
C6: River Oak riparian open forest	10.4	-	-	10.4
Total Native Vegetation	**123.3**	**26.5**	**2.5**	**94.3**

Source: Modified after Niche (2014a) – Tables 12 and 16

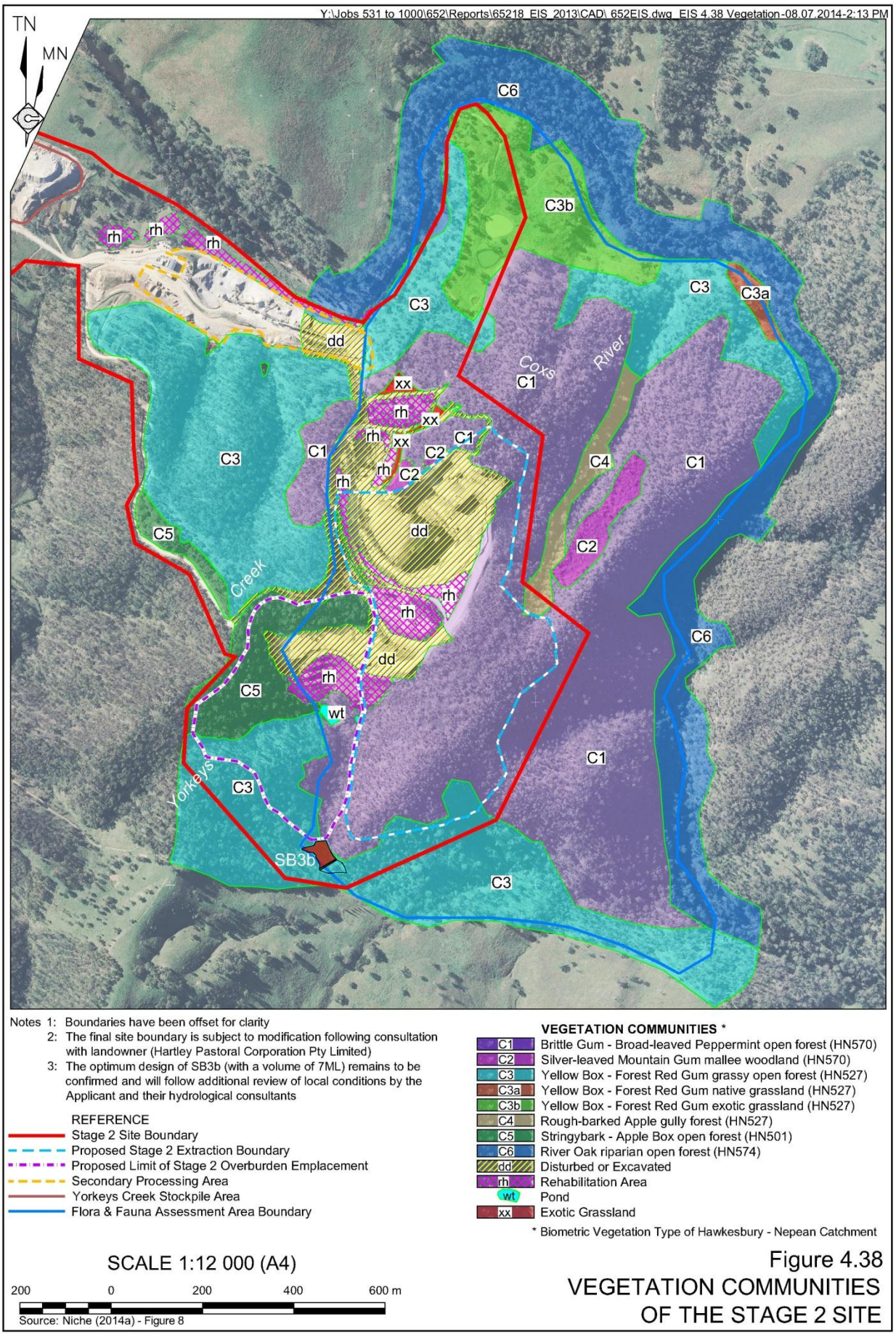


Figure 4.38
VEGETATION COMMUNITIES OF THE STAGE 2 SITE

4.7.3.1.2 Flora Species

A total of 214 species were recorded, including 41 weeds (19%) and one threatened flora species, Silver-leafed Mountain Gum (*Eucalyptus pulverulenta*). This species, listed as vulnerable on both the TSC and EPBC Acts, was recorded as a common to dominant species during the field survey.

Contribution to the conservation of the Silver-leafed Mountain Gum forms a component of the current development consent (DA 103/94) for the Austen Quarry (see **Box 2.1**). While DA 103/94 does not require Silver-leafed Mountain Gum to be included in rehabilitation of the Austen Quarry, the Applicant has included the planting of this species in the revegetation of the overburden emplacement.

Figure 4.39 presents the distribution of this species on the Stage 2 Site, based on actual counts and calculations based on plant density within its core habitat. Considering the occurrence of the Silver-leafed Mountain Gum within rehabilitation areas of the quarry, the Stage 2 Site is estimated to contain 3 815 individuals occurring as follows.

- 2 283 within core areas of natural habitat (to remain undisturbed).
- 146 naturally occurring outside the core areas (90 to be removed).
- 1 386 planted within rehabilitation areas (631 to be removed).

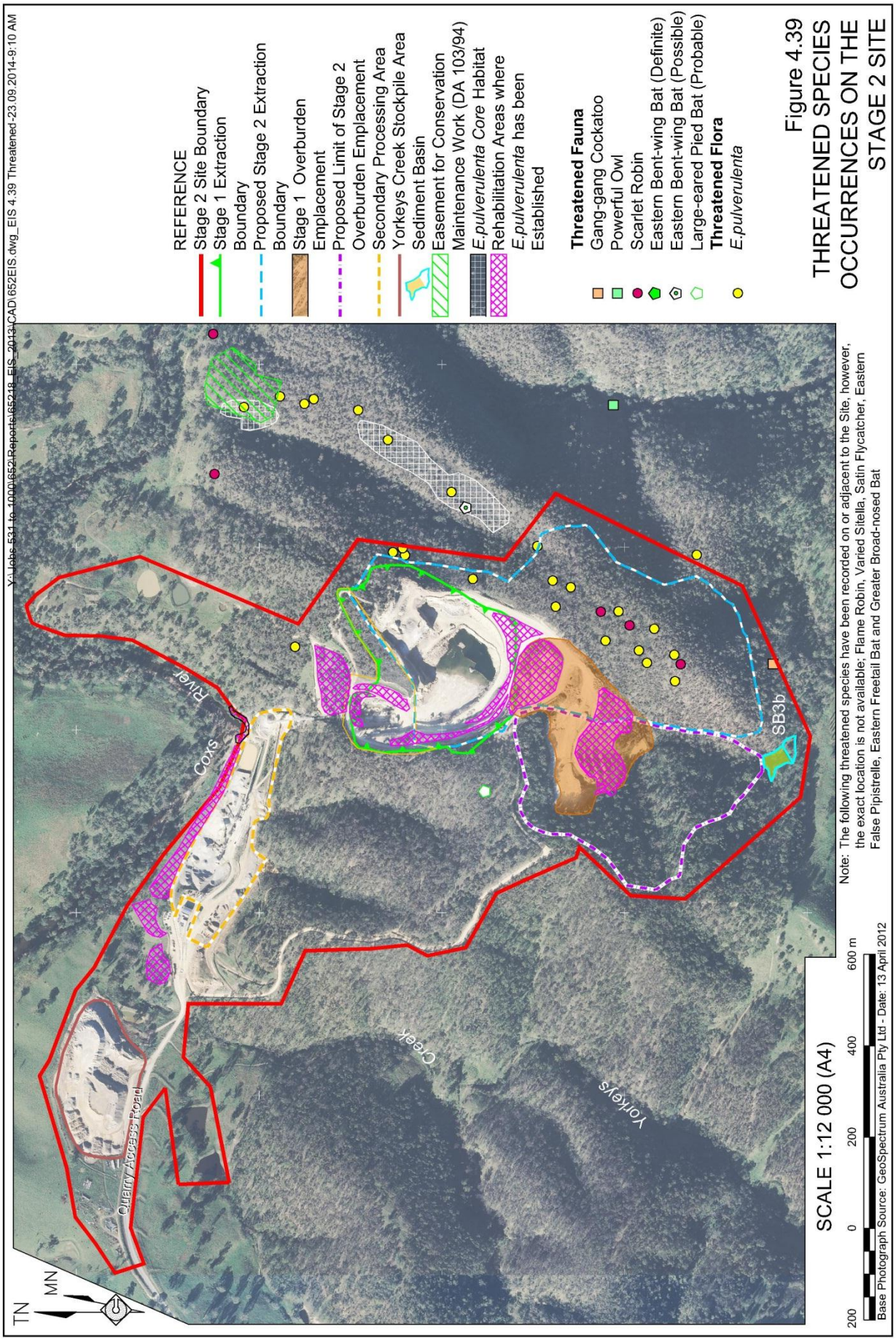
Notably, this represents a more than doubling of the population of Silver-leafed Mountain Gum identified by Lembit (1994). The original local population was recorded as 1 680, having been estimated based on quadrat surveys completed over the original quarry site and surrounds.

4.7.3.1.3 Noxious Weeds

Seven Class 4 (of *the Noxious Weeds Act 1993*) noxious weeds were identified within the Stage 2 Site, namely:

- *Eragrostis curvula* (African lovegrass);
- Rubus fruticosus agg. spp. (Blackberry);
- *Nassella trichotoma* (Serrated tussock);
- Conium maculatum (Hemlock);
- *Onopordum spp.* (Scotch, Stemless, Illyrian and Taurian thistles);
- Hypericum perforatum (St. John's wort);
- *Rosa rubiginosa* (Sweet briar).

As Class 4 weeds, their growth must be managed in a manner that reduces their numbers, spread and incidence and continuously inhibits its reproduction.


REFERENCE
Stage 2 Site Boundary
Stage 1 Extraction Boundary
Proposed Stage 2 Extraction Boundary
Stage 1 Overburden Emplacement
Proposed Limit of Stage 2 Overburden Emplacement
Secondary Processing Area
Yorkeys Creek Stockpile Area
Sediment Basin
Easement for Conservation
Maintenance Work (DA 103/94)
E.pulverulenta Core Habitat
Rehabilitation Areas where E.pulverulenta has been Established
Threatened Fauna
Gang-gang Cockatoo
Powerful Owl
Scarlet Robin
Eastern Bent-wing Bat (Definite)
Eastern Bent-wing Bat (Possible)
Large-eared Pied Bat (Probable)
Threatened Flora
E.pulverulenta
Figure 4.39
THREATENED SPECIES OCCURRENCES ON THE STAGE 2 SITE
Y:\Jobs 531 to 1000\652\Reports\652i8_EIS_2013\CAD\652EIS.dwg_EIS 4.39 Threatened-23.09.2014-9:10 AM
River
Coxs
Creek
Yorkeys
SB3b
Quarry Access Road
TN
MN
SCALE 1:12 000 (A4)
200 0 200 400 600 m
Base Photograph Source: GeoSpectrum Australia Pty Ltd - Date: 13 April 2012
Note: The following threatened species have been recorded on or adjacent to the Site, however, the exact location is not available; Flame Robin, Varied Sitella, Satin Flycatcher, Eastern False Pipistrelle, Eastern Freetail Bat and Greater Broad-nosed Bat

4.7.3.2 Fauna of the Stage 2 Site

4.7.3.2.1 Fauna Habitat

Four dominant fauna habitat types were identified within the Stage 2 Site, generally aligned with the vegetation formations nominated in **Table 4.23**.

- Ridge Forest (Dry Sclerophyll Forest – shrubby sub-formation).

  Associated with Communities C1, and C2, this habitat occurs along the mid-upper slopes and ridges, the vegetation is predominantly in good condition with little evidence of significant past disturbance, except for some tracks and edge-effects due to adjacent extraction. While, there is a relatively low diversity of canopy and mid-storey species and the ground cover is patchy, a variety of habitat features for resident fauna are provided. Tree hollows and fallen logs are present, however, these are generally <30cm in diameter. Rock was prominent in some areas, however, exfoliating rock slabs were generally absent.

- Gully Forest (Dry Sclerophyll Forest – shrub/grass sub-formation).

  Associated with Communities C3, C4 and C5, this habitat occurs along the mid-lower slopes of the Site where there is a better developed soil profile and a higher moisture regime. The habitat values offered vary, generally with history of previous grazing which has decreased the diversity of the understorey and ground cover vegetation. Habitat features include occasional small and medium sized hollows and fallen logs and small patches of rocky areas on steeper sections (although mainly of rock embedded into the soil which limits the value as reptile habitat).

- Riparian Forest (Forested Wetlands)

  Associated with Community C6, this habitat includes large *Casuarina cunninghamiana* and *Eucalyptus viminalis* trees forming dense foliage in places. Casuarina offer important food resources for particular fauna species such as Glossy Black-cockatoos. Large logs within these riparian areas also offer important habitat to particular species and create in-stream woody debris. Occasional medium and small hollows were present.

- Cleared Areas

  These areas, primarily associated with ongoing operations at the quarry offer limited habitat value apart from occasional foraging.

4.7.3.2.2 Fauna Species

Niche (2014a) observed a total of 89 vertebrate fauna species (86 native and 3 introduced) within the Site including five threatened fauna species listed on the TSC and/or EPBC Acts, namely:

- Gang-gang Cockatoo;
- Powerful Owl;
- Scarlet Robin;
- Eastern Bentwing-bat; and
- Large-eared Pied Bat.

The locations of the threatened species identified on the Stage 2 Site are provided on **Figure 4.39**. It is noted that an additional seven species have been previously recorded on or adjacent to the Stage 2 Site during the previous surveys and monitoring described in Section 4.7.2.1. While the exact locations of these identifications are not available, the species recorded are as follows.

- Flame Robin.
- Hooded Robin.
- Varied Sittella.
- Satin Flycatcher (recorded within the riparian corridor of the Coxs River adjoining the Stage 2 Site).
- Eastern False Pipistrelle.
- Eastern Freetail-bat.
- Greater Broad-nosed Bat.

Niche (2014a – *Appendix 9*) provides a complete list of the fauna recorded who report that the low diversity and abundance of arboreal and small ground dwelling mammals recorded is attributable to the low density or seasonal variability of foraging resources. For ground dwelling mammals, it may also be due to a lack of ground and mid-storey vegetation cover and from a lack of ground habitat features (rock outcrops and logs).

4.7.3.3 Subject Species

Niche (2014a) identify the subject species for the Proposal as those either known to occur on the Stage 2 Site or considered as having a moderate or high likelihood of occurrence, i.e. those species that would potentially be impacted by the Proposal. Following consideration of the results of desktop and field surveys of the Stage 2 Site and surrounds, Niche (2014a) identified 24 subject species (no vegetation communities) with:

- 13 known to occur;
- 5 with a high likelihood of occurrence; and
- 6 with a moderate likelihood of occurrence.

Table 4.25 provides a list of the subject species identified for the Stage 2 Site, also identifying the additional assessment completed in accordance with the TSC Act and/or EPBC Act.

4.7.3.4 Groundwater Dependent Ecosystems

Section 4.8.3.2.3 considers the likelihood of occurrence of Groundwater Dependent Ecosystems (GDEs) of the Stage 2 Site and surrounds.

Table 4.25
Subject Species of the Stage 2 Site

Species	TSC Act	EPBC Act	Likelihood of Occurrence	NSW Seven Part Test required (Yes/No)	Commonwealth Significance Assessment required (Yes/No)
Woodland Birds					
Flame Robin – *Petroica phoenicea*	V	-	Known	Yes	No
Hooded Robin – *Melanodryas cucullata*	V	-	Known	Yes	No
Scarlet Robin – *Petroica boodang*	V	-	Known	Yes	No
Varied Sittella – *Daphoenositta chrysoptera*	V	-	Known	Yes	No
Psittacines (Parrots)					
Gang-gang Cockatoo – *Callocephalon fimbriatum*	V	-	Known	Yes	No
Little Lorikeet – *Glossopsitta pusilla*	V	-	High	Yes	No
Forest Owls					
Powerful Owl – *Ninox strenua*	V	-	Known	Yes	No
Migratory Birds (EPBC Act)					
Fork-tailed Swift – *Apus pacificus*	-	M	Moderate	No	Yes
Rainbow Bee-eater – *Merops ornatus*	-	M	High	No	Yes
Satin Flycatcher – *Myiagra cyanoleuca*	-	M	Known	No	Yes
White-throated Needletail –*Hirundapus caudacutus*	-	M	Moderate	No	Yes
Microbats					
Eastern Bentwing-bat – *Miniopterus schreibersii oceanensis*	V	-	Known	Yes	No
Eastern False Pipistrelle – *Falsistrellus tasmaniensis*	V	-	Known	Yes	No
Eastern Freetail-bat – *Mormopterus norfolkensis*	V	-	Known	Yes	No
Greater Broad-nosed Bat – *Scoteanax rueppellii*	V	-	Known	Yes	No
Large-eared Pied Bat – *Chalinolobus dwyeri*	V	V	Known	Yes	Yes
Southern Myotis – *Myotis macropus*	V	-	High	Yes	No
Yellow-bellied Sheathtail-bat – *Saccolaimus flaviventris*	V	-	High	Yes	No
Mammals (other than microbats)					
Grey-headed Flying-fox – *Pteropus poliocephalus*	V	V	Moderate	Yes	Yes
Koala – *Phascolarctos cinereus*	V	V	Moderate	Yes	Yes
Squirrel Glider – *Petaurus norfolcensis*	V	-	Moderate	Yes	No
Spotted-tailed Quoll – *Dasyurus maculatus*	V	E	High	Yes	Yes
Plants					
Eucalyptus aggregata – Black Gum	V	-	Moderate	Yes	No
Eucalyptus pulverulenta – Silver-leafed Mountain Gum	V	V	Known	Yes	Yes
V = Vulnerable E = Endangered M = Migratory					
Source: Modified after Niche (2014a) – Table 2					

4.7.4 Design and Operational Safeguards

4.7.4.1 Introduction

In line with Step 4 of the *Draft Guidelines for Threatened Species Assessment* (DEC/DPI, 2005), the Applicant has designed the Proposal to minimise impacts on threatened species by avoiding, then mitigating and finally offsetting impacts. The following subsections present the design features, operational controls and management measures proposed to avoid, then minimise and then offset impacts on local flora and fauna.

Given the proposed direct impacts on the Silver-leafed Mountain Gum, impact avoidance, mitigation and offset measures specific to this species are referenced.

4.7.4.2 Avoidance of Impacts

The following impact avoidance measures have been adopted by the Applicant in the design of the Proposal. It is noted that these reflect many of the impact avoidance measures currently implemented at the quarry, however, these have been included as they are considered relevant to the overall assessment of the Proposal.

- The primary crushing station is located within the impact footprint of the extraction area, thereby avoiding the necessity for additional clearing for a separate location.
- No further extension of the processing or stockpiling areas is proposed.
- The Stage 2 extraction area has been modified and designed to avoid the core habitat areas of the Silver-leafed Mountain Gum (see **Figure 4.41**). Where possible, impacts on non-core occurrences of this species have also been avoided.
- Two small patches of Community C2 (Silver-leafed Mountain Gum mallee woodland) which have to date been excluded from the extraction area to act as a visual screen are planned to remain undisturbed for the life of the Proposal.

4.7.4.3 Minimisation and Mitigation of Impacts

In addition to the impact avoidance measures noted in Section 4.7.4.2, the following impact minimisation and mitigation would be implemented by the Applicant.

- By continuing to operate a conveyor between the primary crushing station and secondary processing area, the number of internal truck movements would be significantly reduced on the extraction area Access Road. By reducing the number of movements, the potential for road kill of native fauna would be greatly reduced.
- By establishing a 10m wide buffer around the proposed areas of disturbance, the potential indirect impacts of the Proposal are accounted for and can be appropriately offset (refer to Section 4.7.4.4). The outer boundary of the 10m wide buffer would also identify the edge of an exclusion zone, which would be enforced to prevent access to surrounding vegetation and therefore unforeseen impacts.

The adequacy of the 10m buffer is justified by Niche (2014a) on basis that the only unmitigated edge effect would be minor weed invasion, as a result of the altered microclimate, within 2m to 3m of the disturbance edge. The nominated 10m buffer therefore likely overstates and compensates for potential indirect impacts.

- Following completion of clearing operations, fence, as appropriate, sections of the Site not required for ongoing operations to limit access by non-authorised personnel.
- Undertake vegetation clearing operations, where practicable, between April and September to limit adverse impacts on tree dependent avifauna and microchiropteran bats.
- Salvage tree trunks, major limbs and, if practicable, minor branches for use in rehabilitation. If these material are stockpiled, signs would be erected noting the significance and importance of this material for future rehabilitation and habitat creation.
- The revegetation of the final landform has been designed to provide for the re-establishment of native vegetation communities over the overburden emplacement area, extraction area and secondary processing area (see **Figure 2.9**). Furthermore, and in line with the rehabilitation undertaken to date, the revegetation of the final landform would include the Silver-leafed mountain gum.
- The blended topsoil/subsoil would be directly translocated onto rehabilitation areas as often as possible to maximise the opportunity for retention of the natural seed stock, and thereby maximise the revegetation of the final landform with endemic species.
- A program of weed control would be undertaken, firstly to remove/reduce weeds in soils prior to soil stripping activities and secondly following re-vegetation to ensure native plants are not overgrown during their early periods of growth.
- Install appropriate erosion and sediment control measures prior to vegetation clearing activities (to reduce the potential for pollution of downstream riparian and aquatic habitat).
- Limit vehicle speeds within the Stage 2 Site to limit the potential for vehicle trauma to wildlife.

4.7.4.4 Offsetting of Impacts

In accordance with Step 4 of DEC/DPI (2005), the Applicant has proposed a Biodiversity Offset Area (BOA) to offset impacts on vegetation, fauna habitat and the Silver-leafed Mountain Gum population where these cannot be avoided or mitigated. Details of the proposed BOA are set out in Section 2.14, **Figure 2.11** and **Table 2.9**. The objective when defining the area and composition of the BOA is to achieve an outcome compliant with OEH (2011) and the minimum 90% direct offset benchmark of the EPBC Act Offsets Policy.

4.7.5 Impact Assessment

4.7.5.1 Introduction

This subsection assesses the residual impacts of the Proposal on terrestrial ecology, and in particular considers the adequacy of the proposed BOA and residual impacts on threatened flora and fauna (in accordance with Step 3 of DEC/DPI, 2005). This step involves identifying not only the magnitude and duration of impacts, but also the significance of the impacts as related to the conservation importance of the habitat, individuals and populations likely to be affected.

4.7.5.2 Biodiversity Offset Strategy

4.7.5.2.1 NSW Offsets Policy (OEH, 2011)

Niche (2014a) has used the BioBanking Assessment Methodology (BBAM) (DECC, 2008c), in accordance with the *NSW OEH Interim Policy on Assessing and Offsetting Biodiversity Impacts of Part 3A, State Significant Development (SSD) and State Significant Infrastructure (SSI) Projects* (OEH, 2011) ("the OEH Interim Policy"), to quantify the nature and extent of offsets required for impacts within the Site (the BBAM 'Development Site') and provide within the proposed BOA.

Tables 2.8 and **2.9** of Section 2.14 provide the output generated by the BBAM credit calculator for the Development Site and BioBank Site.

The following reviews the matching of credits between the Development Site and proposed BOA considered against the Tier 1 ('Improve or Maintain'), Tier 2 ('No Net Loss') or Tier 3 ('Mitigated Net Loss') benchmarks.

Tier 1 'Improve or Maintain' Standard

Ecosystem Credits:

The proposed BOA achieves the "Improve or Maintain" benchmark for the following Revised Biometric Vegetation Type (RBVT).

- HN527: Forest Red Gum - Yellow Box woodland of dry gorge slopes, southern Sydney Basin and South Eastern Highlands (Communities C3 and C4)

The 134 credits generated by the Development Site would be retired against 439 credits of the BOA (leaving a surplus of 305 credits).

Of the 620 ecosystem credits required for HN570: Red Stringybark - Brittle Gum - Inland Scribbly Gum dry open forest, 461 are provided by the proposed BOA and would be retired (leaving a deficit of 159 ecosystem credits).

The proposed BOA does not provide for vegetation equivalent to HN501: Apple Box - Broad-leaved Peppermint dry open forest resulting in a deficit of 148 ecosystem credits.

The availability of ecosystem credits on the Biodiversity Credit Market and the acquisition of alternative offset sites as methods to offset the small deficit at a Tier 1 'Improve or Maintain' was reviewed by Niche (2014a). This review identified that there are currently no ecosystem credits available for purchase for either HN570 or HN501 within the Bathurst CMA sub-region or the adjacent CMA sub-regions.

Two equivalent RBVTs, providing 310 ecosystem credits, were identified within the Oberon and Wollemi CMA subregions, however, Niche (2014a) considers the acquisition of these or alternate offset lands unnecessary for the following reasons.

- The Threatened Species Profile of the three RBVTs that require offsetting (HN501, HN527 and HN570) are very similar. Combined, these require a combined 902 ecosystem credits. The combined ecosystem credits of HN570 and HN527 within the proposed BOA is 900. Therefore, if considered in relation to the value provided by the proposed offset to the threatened fauna likely to inhabit the area to be disturbed, Niche (2014a) consider the proposed BOA would provide an improve or maintain outcome in relation to threatened fauna.
- There is greater value to local biodiversity by providing for the offset in the same locality as the disturbance. That is, locally occurring threatened fauna would be provided with a conserved area immediately adjacent to the impact site, as opposed to within another catchment entirely, e.g. Oberon or Wollemi.
- The vegetation proposed to offset the ecosystem credit deficits is provided for by vegetation which is more highly cleared in the catchment, hence considered to be of greater conservation significance.

Further justification of this assessment based on the benefits of this local offset to threatened fauna, conservation levels in the proposed BOA and the classification of these RBVTs is provided in *Section 7.3.1* of Niche (2014a).

Species Credits:

The 11 100 species credits generated by the proposed BOA would achieve the Tier 1 benchmark with a surplus of 8 credits (11 100 – 11 092) (Niche, 2014a).

Tier 2 'No Net Loss' Standard

As none of the RBVTs are considered EECs, or over cleared within the Hawkesbury Nepean CMA region, they do not qualify as red flags and therefore Tier 2 does not apply.

Tier 3 'Mitigated Net Loss' Standards

Ecosystem credits

"Mitigated Net Loss" considers when the ecosystem credits generated by the Development Site are not provided for by the proposed BOA. Various assessment criteria are specified by OEH (2011) to enable determination as to whether the proposed BOA achieves the Tier 3 benchmark. The two RBVTs which do not meet a Tier 1 outcome (completely) are considered as follows.

- HN570: Red Stringybark - Brittle Gum - Inland Scribbly Gum dry open forest (deficit of 159 credits) (Communities C1 and C2).

  This deficit can be reconciled by retiring ecosystem credits against those surplus credits (305) of HN527 (which is of same Keith Formation and within the same IBRA bioregion - Criteria (a) of *Appendix B* of OEH 2011). The proposed BOA therefore provides for a mitigated net loss outcome for HN570.

- HN501: Apple Box - Broad-leaved Peppermint dry open forest (deficit of 148 credits).

  Niche (2014a) has calculated that the 148 ecosystem credit deficit for HN501 is equivalent to an area of 16ha (in accordance with the OEH Credit Converter applied in accordance with Criteria (d) or (e) of *Appendix B* of OEH (2011). HN527 and HN574 (for which surplus credits remain) generate 11.8 credits/ha (542 credits created over 46.1 hectares) requiring 189 ecosystem credits (16 x 11.8) from either to be retired. As 249 surplus ecosystem credits are available from HN527 and HN574 combined, the proposed BOA provides for a mitigated net loss outcome for HN501, with a surplus of 60 ecosystem credits.

On the basis of the above, the proposed BOA achieves the Tier 1 'improve or maintain' benchmark for 66% and Tier 3 (mitigated net loss) for 34% of the native vegetation that would impacted by the Stage 2 Extension.

Evaluation against OEH Offset Principles

The following considers the adequacy of the proposed Biodiversity Offset Strategy against the seven principles nominated in the *Draft Biodiversity Offsets Policy for Major Projects* (OEH, 2014).

1. **Before offsets are considered, impacts must first be avoided and unavoidable impacts minimised through mitigation measures. Only then should offsets be considered for the remaining impacts.**

   Section 4.7.4.2 considers the impact avoidance measures incorporated into the design of the Proposal. In particular, the impact on the Silver-leafed Mountain Gum has been minimised through avoidance of core habitat areas. Section 4.7.4.3 nominates the measures that would be implemented to further minimise or mitigate the impact footprint of the Proposal.

   There are no other practically applicable measures available to the Applicant to further reduce the direct impact footprint or potential for indirect impacts. Notably, the offset accounts for the 2.5ha buffer area surrounding the direct impact footprint.

2. **Offset requirements should be based on a reliable and transparent assessment of losses and gains.**

   The development and assessment of the proposed BOA has been undertaken in accordance with BBAM, considered best practice by OEH (2014).

3. Offsets must be targeted to the biodiversity values being lost or to higher conservation priorities.

The proposed BOA meets the Tier 1 (Improve or Maintain) benchmark for the majority (66%) of the vegetation impacted and for disturbance to Silver-leafed Mountain Gum in its entirety. The remaining 34% of vegetation impacted would meet the Tier 3 (Mitigated Net Loss) benchmark in accordance with the various criteria of OEH, (2011). The Proposal therefore provides for:

– direct like-for-like offsetting for the majority of the vegetation impacted;

– equivalent vegetation formation for a proportion of the remaining area (HN570); and

– an appropriate quantum of vegetation for the remainder (HN501).

In the case of HN501, the vegetation assigned to retire the credit deficit (HN527 and HN574) are both more highly cleared (50% and 40%) than this RBVT (30%) and therefore of higher conservation value.

Justification for not obtaining available 'like for like' ecosystem credits more distant from the Stage 2 Site is provided in the discussion on Tier 1, 2 and 3 Standards.

4. Offsets must be additional to other legal requirements.

It is noted that the area of the proposed BOA is not held under any other agreement (conservation or otherwise) nor is it currently used for offsetting other disturbance. Notably, a conservation area previously established in accordance with the condition of DA 93/104 for the purpose of conserving Silver-leafed Mountain Gum (refer to **Box 2.1**) has been excised from the proposed BOA and not included in any credit calculations. The conservation value of this area would, however, be enhanced by the conservation of the surrounding vegetation by way of Voluntary Conservation Agreement (VCA), addition to OEH estate, BioBanking Site, covenant on title, or other means.

5. Offsets must be enduring, enforceable and auditable.

At this time, the mechanism for conserving the proposed BOA, e.g. through VCA, BioBanking Site, covenant on title, etc. has not been formalised. However, once an in-principle agreement for the BOA is obtained from the consent authority, the Applicant would implement an 'in perpetuity' conservation arrangement.

6. Supplementary measures can be used in lieu of offsets.

The calculations of Niche (2014a) confirm that the land-based offset would be sufficient and practical, and therefore supplementary measures are not required.

7. **Offsets can be discounted where significant social and economic benefits accrue to NSW as a consequence of the proposal.**

   The calculations of Niche (2014a) confirm that the land-based offset would be sufficient and practical, and therefore there is no necessity to discount the offset to account for social and economic benefits.

4.7.5.2.2 Commonwealth Environmental Offsets Policy

The *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy* (the 'EPBC Offset Policy') was applied to the Proposal as potential impacts on the Silver-leafed Mountain Gum were considered to be significant enough to warrant determination of the Proposal as a 'Controlled Action'. The EPBC Offsets Policy promoted by the Commonwealth Department of the Environment (DoE) was followed to address its five key aims.

- To ensure the efficient, effective, timely, transparent, proportionate, scientifically robust and reasonable use of offsets under the EPBC Act.
- To provide greater certainty and guidance on how the offset was developed.
- To deliver improved environmental outcomes.
- To outline the appropriate nature and scale of offsets and how it was determined.
- To provide guidance on acceptable delivery mechanisms for offsets.

Niche (2014a – *Section 8*) provides a detailed review of the various parameters and factors required to be considered and quantified in accordance with the DoE publication "*How to use the Offsets Assessment Guide*" (DSEWPaC, 2012). In summary, the proposed BOA would protect and manage in perpetuity for conservation 1 850 naturally occurring individual plants representing a 257% offset of the impact to 721 plants (the vast majority of which [631] have been planted as part of the rehabilitation of the Stage 1 overburden emplacement). The conservation value of the offset, which is located within intact remnant habitat, is therefore far higher than the majority of the disturbance (to Silver-leafed Mountain Gum), within recently established rehabilitation areas.

Evaluation against DoE Offset Principles

The Commonwealth Offsetting Policy (DSEWPaC, 2012) lists eight requirements that must be met in order to achieve a suitable offset for impacts on threatened biodiversity as listed within the EPBC Act. The eight requirements are considered below in relation to the provision of the proposed offset for *Eucalyptus pulverulenta*. These requirements reflect closely the OEH Offset Principles addressed in Section 4.7.5.2.1.

1. **Suitable offsets must deliver an overall conservation outcome that improves or maintains the viability of the protected matter.**

   The calculations of Niche (2014a) confirm that the land-based offset would provide well in excess of the 90% requirement of the Commonwealth Offsetting Policy.

2. Suitable offsets must be built around direct offsets but may include other compensatory measures.

The calculations of Niche (2014a) confirm that the land-based offsets provide an 'improve or maintain' outcome for Silver-leafed Mountain Gum and therefore, other indirect measures are not required.

3. Suitable offsets must be in proportion to the level of statutory protection that applies to the protected matter.

The 1 850 Silver-leafed Mountain Gum individuals within the proposed BOA provides a direct like-for-like species offset for the 721 individuals that would be removed. Application of the Commonwealth Offsetting Policy Offsets Calculator confirms this achieves an offset value in excess of 250%.

4. Suitable offsets must be of a size and scale proportionate to the residual impacts on the protected matter.

The scale of the offset, as compared to the impact, has been calculated by the EPBC Offsets Calculator at 257%, i.e. the proposed offset is 2.5 times larger in terms of the number of individuals required.

5. Suitable offsets must effectively account for and manage the risks of the offset not succeeding.

The offset site will be subject to good governance arrangements to ensure it is managed and secured 'in perpetuity'. At this time, the mechanism for conserving the proposed BOA, e.g. through VCA, BioBanking Site, covenant on title, etc. has not been formalised. However, once acceptance of the BOA is obtained from the consent authority, the Applicant would implement an in perpetuity conservation arrangement.

6. Suitable offsets must be additional to what is already required, determined by law or planning regulations, or agreed to under other schemes or programs.

It is noted that the area of the proposed BOA is not held under any other agreement (conservation or otherwise) nor is it currently used for offsetting other disturbance. Notably, a conservation area previously established in accordance with the condition of DA 93/104 for the purpose of conserving Silver-leafed Mountain Gum has been excised from the proposed BOA and not included in any credit calculations. The conservation value of this area would, however, be enhanced by the conservation of the surrounding vegetation by way of Voluntary Conservation Agreement (VCA), addition to OEH estate, BioBanking Site, covenant on title, or other means which would guarantee the security and management of the BOA into perpetuity.

7. Suitable offsets must be efficient, effective, timely, transparent, scientifically robust and reasonable.

The EPBC Act Offsets Assessment Guide was utilised in this assessment to assess the proposed offset to the impacts on Silver-leafed Mountain Gum. Furthermore, all survey effort met the draft survey guidelines as required by OEH (DEC, 2004) and all data collected during the assessment has been supplied. The assessment is therefore transparent, scientifically robust and reasonable.

8. Suitable offsets must have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced.

The offset site will be subject to good governance arrangements to ensure it is managed and secured in perpetuity. Appropriate plans of management would be developed, including monitoring, and legal security would be guaranteed through a suitable planning mechanism such as a VCA, BioBanking Agreement, covenant on title, or other means.

At this time, the mechanism for conserving the proposed BOA, however, once an in-principle agreement of the BOA is obtained from the consent authority, the Applicant would implement an in-perpetuity conservation arrangement.

4.7.5.3 Clearing of Native Vegetation

The clearing of approximately 26.5ha native vegetation is the main ecological impact that would result from the Proposal, as it would lead to a reduction in available habitat for a number of threatened species which currently utilise the Stage 2 Site.

Magnitude of Impact

Table 2.8 summarises the approximate areas of each vegetation community within the Stage 2 Site to be cleared. Notably, no EECs would be cleared, nor are any of the RBVTs to be disturbed over cleared (>70%) in the Hawkesbury Nepean CMA region.

Duration of Impact

The duration of the impacts is a consideration of the permanence and reversibility of impacts and considers both the resilience of the vegetation cleared and proposed mitigation measures proposed. Resilience is a measure of the capacity of an area to naturally regenerate.

The affected vegetation communities are moderately to highly resilient as they are composed of relatively intact and natural soil profiles and are therefore likely to contain diverse soil seed banks. Remnants of each of these communities remain in the local area, upon which genetic material would be drawn in the expansion of these communities within the final landform and conservation and amelioration areas. Whilst the resilience of the remnant bushland to be removed would be reduced, the proposed mitigation measures nominated in Section 4.7.4.3, which include soil translocation, revegetation using locally endemic species, management of weeds, and erosion and sediment control would aid to re-establish ecological structure and function. Tubestock of the threatened Silver-leafed Mountain Gum propagated from seed collected on site would continue to be a component of this rehabilitation work.

Significance of Impacts

The significance of impacts consider both aspects related to the vegetation communities themselves, i.e. relative distribution, importance as habitat to threatened species, regional and local representation, as well as the mitigation and offset measures proposed.

The vegetation to be cleared is typical of that on and surrounding the Stage 2 Site and within the local area and region. Notably, there would be no clearing of EECs or over cleared vegetation types with the residual impacts on vegetation offset by the proposed BOA to achieve a Tier 1 (66%) improve or maintain and Tier 3 (34%) mitigated net loss outcome for biodiversity.

On the basis of the above, the impact is considered significant but appropriately mitigated and offset in regards to State and Commonwealth policies and guidelines.

4.7.5.4 Impacts on Habitat Corridors

The Stage 2 Site forms part of a larger east-west habitat corridor linking vegetation on and to the west of the Stage 2 Site with vegetation contained in OEH estate to the east (Blue Mountains National Park) and north (around Hartley). Notably, these corridors are threatened by residential and rural-residential development with the Little Hartley area.

The vegetated corridor of the Coxs River which adjoins to the Stage 2 Site to north is approximately 100m wide. This corridor contains some property infrastructure and roads, reducing the habitat connectivity, but would not be affected further by the Proposal. To the south of the extraction area and overburden emplacement is a more intact vegetated corridor of approximately 320m wide. The proposed extension of the extraction area and overburden emplacement would reduce this to approximately 110m, although reinstatement of the corridor would follow rehabilitation. Notably, the width of the corridor would remain within the 100m to 500m class, and the over-storey and mid-story/groundcover condition within the connected landscape would remain at benchmark levels, when considered using the BioBanking Assessment Methodology and Credit Calculator Operational Manual (DECC, 2009). Therefore, considered against the standards nominated by DECC (2009), the corridor remains within the same condition class.

The fact that the corridor remains within the same condition class notwithstanding, Niche (2014a) has further reviewed the effects of this corridor reduction on local fauna. Mobile fauna, such as large mammals, are unlikely to be affected, however, there may be some temporary reduction in the movement of small non-mobile animals and arboreal fauna. This impact is more than compensated for by the conservation provided for by the BOA, which includes the southern habitat corridor.

4.7.5.5 Key Threatening Processes

The Proposal is likely to exacerbate the following key threatening processes (KTPs) listed under the TSC Act and EPBC Acts:

- Clearing of native vegetation.
- Loss of hollow-bearing trees.

- Removal of dead wood and dead trees.
- Climate change (human-caused)

Consideration of these KTPs is provided as part of the Assessments of Significance completed by Niche (2014a) for the subject species and summarised in Section 4.7.5.7.

4.7.5.6 Critical Habitat

Critical habitat has not been declared under the TSC Act or EPBC Act for any species, population or community that occurs within the Stage 2 Site.

4.7.5.7 Impacts on Threatened Species

The following sections consider the magnitude, extent and significance of the Proposal on the subject species (see Section 4.7.3.3). The significance of the impacts have been assessed by Niche (2014a) based on:

- the importance of individual species, populations and/or plants and/or subpopulations that are likely to be affected by the Proposal in maintaining the long-term viability of the species, population or ecological community; and
- the importance of habitat features that are likely to be affected by the Proposal in maintaining the long-term viability of the species, population or ecological community.

  The following provides an overview of the Assessments of Significance completed by Niche (2014a) (which can be viewed in full as *Appendices 10* and *11* of Niche, 2014a).

Threatened Flora

Impacts on threatened flora are restricted to removal of 751 individual Silver-leafed Mountain Gum plants (631 of which occur in unnatural habitat). Niche (2014a) confirms that the Proposal would have a significant impact which would be adequately offset by the conservation and protection of (at least) 1 850 individuals and core natural habitat within the proposed BOA. No other significant impacts on threatened flora are considered likely.

As noted in Section 2.15.3, an alternative extraction area extension was initially considered by the Applicant (see **Figure 2.12**). This extraction area would have required a slightly larger impact footprint and therefore provide a slightly larger life of quarry resource. By modifying the limit of extraction, however, a number of identified Silver-leafed Mountain Gum plants would be avoided (see **Figure 4.39**). It would be impractical to modify the limit of extraction further to avoid additional Silver-leafed Mountain Gum plants.

Threatened Fauna

Impacts to threatened fauna as a result of the Stage 2 Extension would occur through the removal of native vegetation which provides foraging, breeding or roosting habitat. For example, roosting, torpor and breeding activities of threatened tree-roosting bats may be impacted by the clearing of hollow-bearing trees. Nesting and breeding activities for threatened

birds, e.g. Scarlet Robin, could also be disturbed by clearing activities leading to abandonment of nest sites or loss of fledgling chicks. In each case, the surrounding areas to the Stage 2 Site contain significant areas of equivalent habitat into which each of the subject species considered has the capacity to relocate or use in preference to the Stage 2 Site.

4.7.5.8 Groundwater Dependent Ecosystems

Figure 4.38 provides site validated mapping of the occurrence and distribution of terrestrial GDEs based on mapped vegetation units. Of the mapped vegetation, Niche (2014a) reports that only the River Oak riparian forest along Coxs River is reliant on water availability for survival. Niche (2014a) considers that seasonal flows and storm surges are more likely to determine the viability of vegetation along the Coxs River than the availability of groundwater base flows. Small changes to groundwater availability (such as to base flows) would not significantly impact the River Oak riparian forest along the Coxs River.

Section 4.8.5.2 provides further discussion of potential impacts to sub-surface GDEs.

4.7.5.9 Cumulative Impacts

The Austen Quarry is largely isolated from other extractive industry, mining or similar development with no other equivalent development occurring within 15km of the Stage 2 Site (see **Figure 4.40**). Furthermore, all disturbance associated with the Proposal has been identified and accounted for when considering impacts on biodiversity. The only potential for cumulative impacts on biodiversity therefore, is if considered against the major contributor to vegetation clearing in the region, agriculture. Given the vastly different scales of impact between the Proposal and historic agriculture, the most appropriate approach to assessing cumulative impact is through an assessment of impact on habitat corridors and threatened species population viability.

Section 4.7.5.4 considers the effect of the Proposal on local habitat corridors, and while there would be a reduction in the width of habitat connectivity to the south of the extraction area, a viable corridor would be retained. Furthermore, the rehabilitation of the extraction area and overburden emplacement, and establishment of a BOA, would ultimately reinstate and provide for the long-term conservation of this habitat corridor.

With respect to impacts on threatened species, it is noted that the assessments of the significance conducted by Niche (2014a) do not consider the impacts of the Proposal on each species in isolation. Causes of local or regional decline, such as increased clearing or other factors influenced by development, are necessarily considered. Furthermore, the proposed BOA has been developed in accordance with the BBAM, which takes into consideration catchment and state wide issues, including proportional clearance, associated with different vegetation and habitat types.

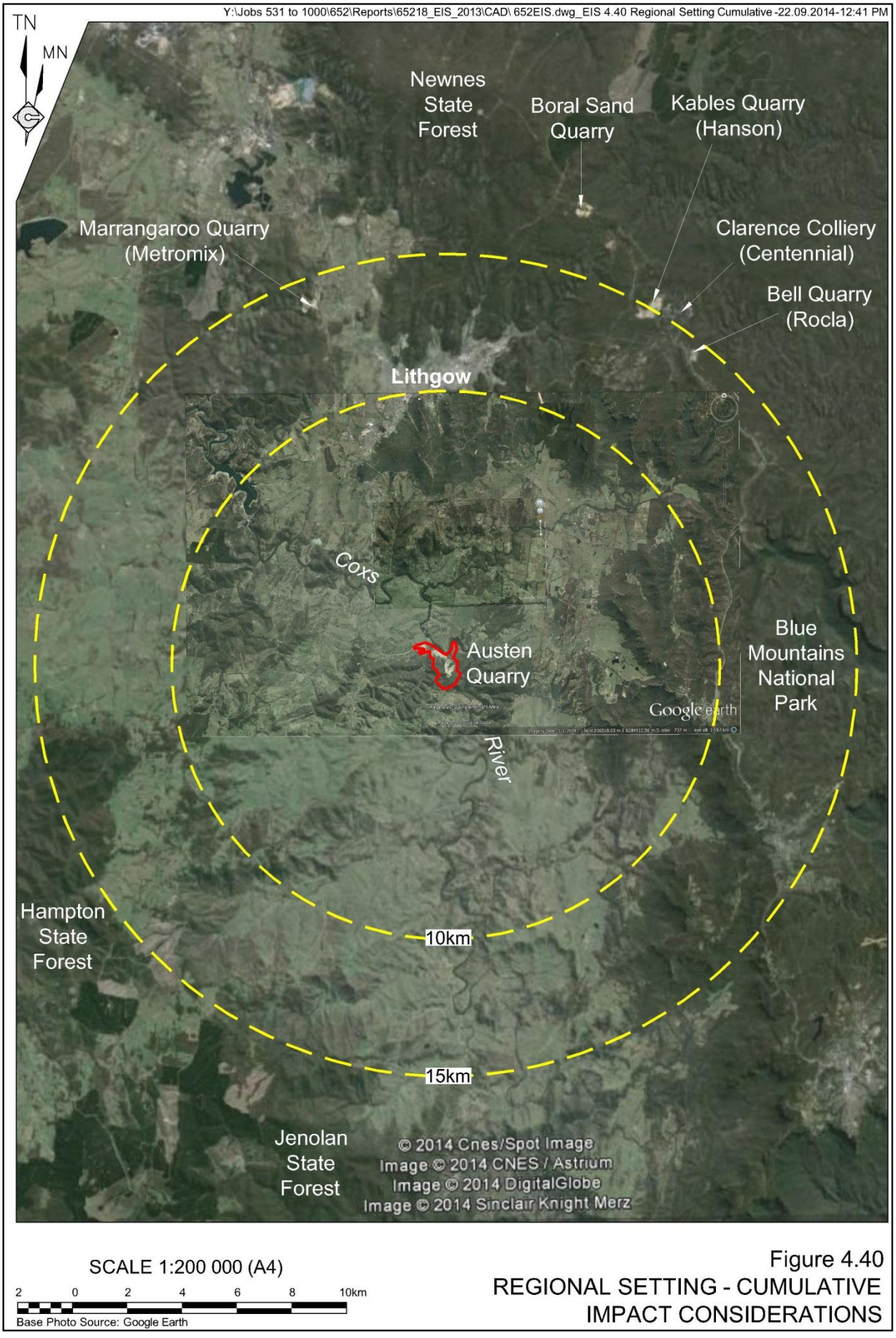


Figure 4.40
REGIONAL SETTING - CUMULATIVE IMPACT CONSIDERATIONS

4.7.5.10 Conclusion

Niche (2014a) conclude that the Proposal is unlikely to have a significant impact on subject threatened species, except for Silver-leafed Mountain Gum. Niche (2014a) clearly demonstrates that the proposed BOA will achieve an 'improve or maintain' outcome in relation to Silver-leafed Mountain Gum under both State and Commonwealth offsetting policies and guidelines. Residual impacts to native vegetation will also be adequately offset within State and Commonwealth policies and guidelines.

4.8 AQUATIC ECOLOGY

4.8.1 Introduction

The DGRs issued for the Proposal identified "*Biodiversity*" as a key issue incorporating some elements of aquatic ecology that will be assessed in the following subsections. The DGRs require that the "*EIS include a quantitative assessment of the potential:*

- *impacts of the development on any terrestrial or aquatic threatened species or populations and their habitats, endangered ecological communities and groundwater dependent ecosystems; and*

Additional matters for consideration in preparing the EIS were also provided in the correspondence attached to the DGRs from DTIRIS which related to aquatic habitat protection requirements and can be briefly summarised as including:

- a series of general requirements for assessing the impact to the aquatic environment including identifying existing and likely populations, aquatic habitat descriptions and existing aquatic environment uses;
- considerations for assessing
  - dredging and reclamation works,
  - activities that may damage marine vegetation;
  - activities that may block fish passage;
  - threatened aquatic species; and
  - impacts to fishing and aquaculture. And
- ensuring appropriate management of riparian buffer zones

Based on the risk analysis undertaken for the Proposal (Section 3.3.1 and **Table 3.9**), the potential impacts relating to aquatic ecology and their risk rankings (in parenthesis) after the adoption of pre-existing or standard mitigation measures are as follows.

- Pollution of local waterways resulting in detrimental effects to flora and fauna (Medium Risk).
- Reduced local distribution of threatened species, populations and endangered ecological communities (Medium Risk).
- Degradation of riparian or aquatic vegetation / ecosystems (Low to Medium Risk).

- Sedimentation or hydrocarbon pollution event impacting on aquatic ecosystem (temporary to long term impact (Low to Medium Risk).
- Degradation of groundwater dependent ecosystems (Low Risk).

A review of the attributed risk levels, following the adoption of the recommended operational safeguards and controls, is provided in Section 6.2.1 and **Table 6.1**.

An aquatic ecology assessment for the Proposal was completed by Mr Max Best of Cardno Ecology Lab ("Cardno"). The assessment is presented as Part 5 of the *Specialist Consultants Studies Compendium* and is referred to hereafter as "Cardno (2014)". This subsection of the EIS provides a summary of the aquatic ecology assessment, concentrating on those matters raised in the DGRs and related requirements provided by various government agencies. A consolidated list of the identified requirements and where each is addressed is presented in **Appendix 3**.

4.8.2 Assessment Methodology

4.8.2.1 Desktop Assessment (Identification of Issues of Conservation Significance)

In order to assess the potential impacts of the Proposal on aquatic ecology, Cardno (2014) established the issues of conservation significance that would be, or could be affected by the current and proposed operations on the Stage 2 Site. This was achieved through a review of NSW and Commonwealth databases and associated literature (e.g. catchment studies, assessment guidelines and relevant monitoring programs). A complete description of this reference material reviewed and its application to the Proposal is provided by *Section 3* of Cardno (2014), an overview of which is as follows.

Matters of National Environmental Significance (Commonwealth EPBC Act)

Cardno (2014) used the Protected Matters Search Tool, a database maintained by the Department of the Environment (DOE), to identify threatened aquatic species and communities listed under the EPBC Act that occur or may occur in the Lithgow City LGA. This search included the entire LGA to ensure that mobile, threatened species that may periodically move into areas affected by the Proposal were taken into consideration.

Cardno (2014) also reviewed the Key Threatening Processes (KTPs) listed under the EPBC Act for relevance to the Proposal.

Matters of NSW Environmental Significance (TSC Act / FM Act)

Cardno (2014) completed a search of the online Record Viewer developed by the Threatened Species Unit of the former I&I NSW for information regarding records and distribution of threatened and protected species of fish in the Lithgow City LGA and Hawkesbury-Nepean CMA. Cardno (2014) also completed a search of the NSW BioNet (managed by OEH) for records of threatened flora and fauna sightings within Lithgow City LGA held in the Atlas of NSW Wildlife as well as information on known and predicted distributions of vegetation communities, endangered populations and key threatening processes listed under the TSC Act occurring within the Lithgow City LGA.

Cardno (2014) also reviewed the TSC Act and FM Act in order to identify KTPs or critical aquatic habitats relevant to, or potentially impacted by the Proposal.

Groundwater Dependent Ecosystems (GDEs)

Cardno (2014) reviewed the *Risk Assessment Guidelines for GDEs* produced by the NSW Office of Water (Serov et al. 2012) to establish the type of GDEs that could be affected by the Proposal. Cardno (2014) established that the Proposal could potentially impact on two GDEs, namely:

- Base flow streams (surface water ecosystems); and
- Sub-surface phreatic aquifer ecosystems.

To assess the potential for surface GDEs on or adjoining the Stage 2 Site, Cardno (2014) accessed the Atlas of GDEs maintained by the Bureau of Meteorology (BoM). This database uses spatial environmental data to indicate potential interaction between groundwater and both terrestrial vegetation communities (phreatophytes) and surface aquatic ecosystems (base flow streams).

As the Atlas of GDEs does not provide information on sub-surface GDEs, Cardno (2014) referred to recent literature on sub-surface aquifer ecosystems (Humphreys 2006, Eberhard et al. 2007, Hancock and Boulton 2008, Pryce et al. 2010, Tomlinson and Boulton 2010, Serov et al. 2012) and applied this to local hydrogeological conditions (as described by Ground Doctor, 2014) (refer to Section 4.12.2).

Cardno (2014) also considered Schedule 4 of the Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources area (Coxs River Fractured Rock groundwater source), however, none of the listed GDEs occurs within or adjacent to the Stage 2 Site.

4.8.2.2 Field Survey and Establishment of Local Aquatic Conditions

Cardno (2014) reviewed historic sampling and analysis of local conditions within the Coxs River undertaken in accordance with the NSW Australian Rivers Assessment System (AUSRIVAS) sampling methods (Turak et al. 2004) since 2005. Cardno (2014) also undertook additional sampling and analysis (of aquatic fauna and water quality) in September 2013.

The sites sampled between 2005 and 2011 are paired sites situated at four locations on the Coxs River spread between Glenroy Bridge and Duddawarra Bridge (approximately 2.5km north and 5km south of the Stage 2 Site respectively). The sites sampled in 2013 were chosen to complement the long-term monitoring sites, as well as provide information on catchments not previously sampled or assessed. **Figure 4.41** identified the locations of the sites sampled and analysed by Cardno (2014).

On the basis of the historic and 2013 sampling and analyses, Cardno (2014) compared electrical conductivity (EC), dissolved oxygen (DO), pH and turbidity measurements with the upper and lower default trigger values (DTVs) for slightly disturbed rivers in south-east Australia (ANZECC/ARMCANZ, 2000). These trigger values provide an indication of risk to environmental value, with measurements within the upper and lower DTV range indicative of a low risk and those outside the range indicating that the environmental value may not be protected. The aquatic flora, fauna, water quality and other conditions of each site sampled were also analysed by Cardno (2014) in order to assign a Fish Habitat Type (in accordance with the *Fish Habitat Assessment Criteria* of DPI, 2013) and Class (in accordance with the *Riparian, Channel and Environmental (RCE) method* of Chessman et al. 1997), and assess aquatic fauna against AUSRIVAS reference conditions.

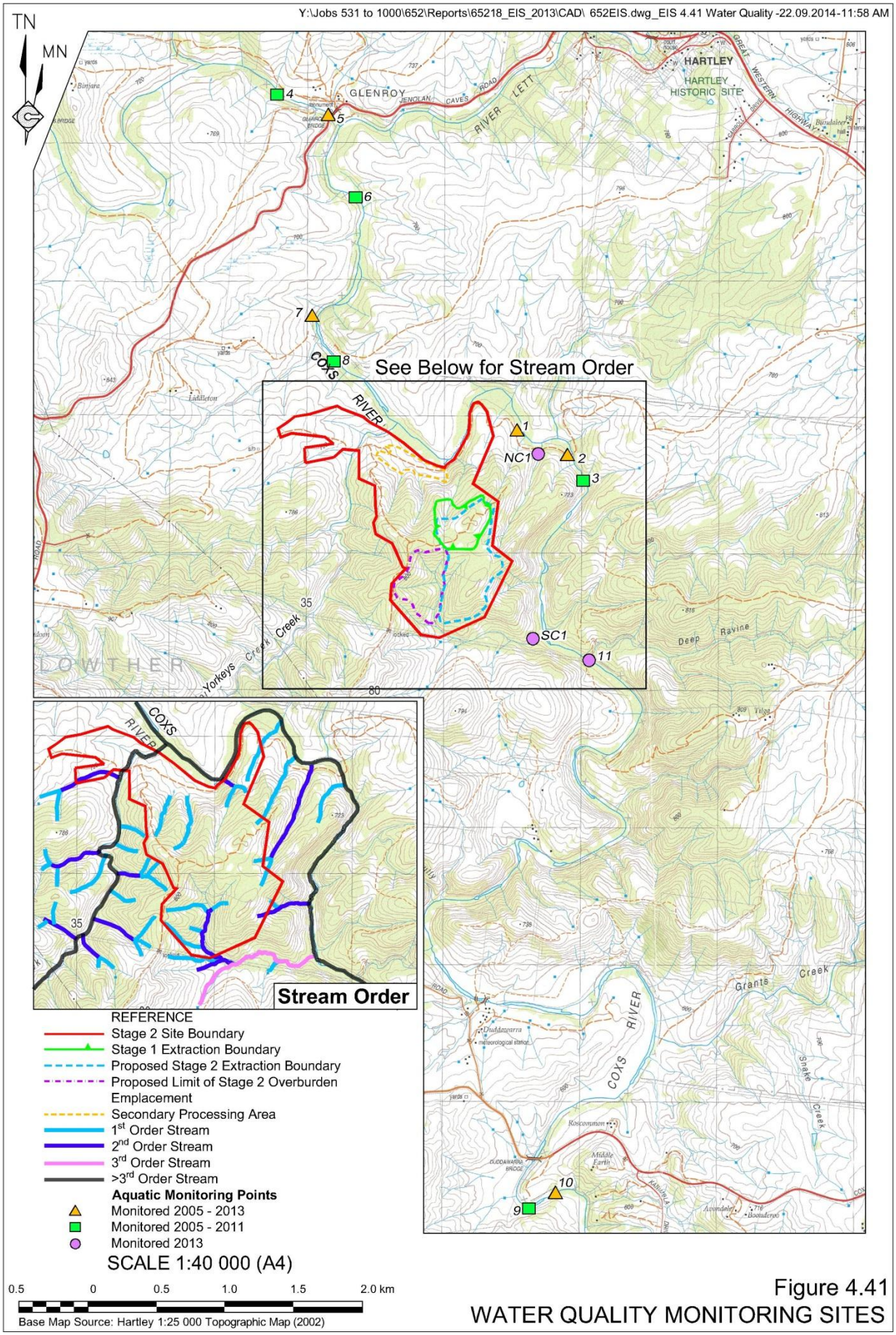


Figure 4.41
WATER QUALITY MONITORING SITES

4.8.2.3 Identification of Potential Impacts, Review of Mitigation Measures and Assessment of Likely Impact

Having established the local conditions on which the Proposal could impact, Cardno (2014) carefully reviewed the proposed activities to establish the potential impacts of the Proposal on the receiving aquatic environment.

The potential impacts were considered for the following phases of the Proposal.

- Development – including access preparation, vegetation clearing, soil and overburden stripping and erosion and sediment control installation.
- Operation – including the various resource extraction, processing, overburden management and dewatering activities.
- Decommissioning and Rehabilitation – including plant decommissioning, final landform preparation and revegetation.

Notably, these phases are likely to be undertaken concurrently (but in different sections of the Stage 2 Site) throughout the life of the Proposal.

Impact avoidance, mitigation and management measures were recommended by Cardno (2014) and on the assumption that these would be implemented completed an assessment of the likely impact of the Proposal on aquatic ecology.

Cardno (2014) also completed a specific assessment of significance for those threatened species and KTPs identified as potentially impacted or enhanced as a result of the Proposal.

4.8.3 Local Setting

4.8.3.1 Local Catchments

The Stage 2 Site is located within the Mid Coxs River catchment of the Hawkesbury-Nepean catchment. CSIRO Land and Water (2000) identifies the majority of this catchment as highly degraded as a result of extensive clearing and modification to some creeks by urban developments. Notably, the flow regime of the section of the Coxs River within which the Stage 2 Site is located has been impacted by land clearing, regional climatic variations, and the construction and operation of Lyell Dam (CSIRO Land and Water, 2000). Hydrological data analysed by Cardno (2014) identify that the volume of water flowing within the Coxs River is highly variable and while regulated by Lake Wallace and Lake Lyell upstream of the Stage 2 Site, which impound water for the City of Lithgow and Wallerawang Power Station, there are periods of far higher flows coinciding with high rainfall or flood events. The substantial increase in discharge would likely influence the aquatic environment and biota, particularly in the weeks and months after these events (Cardno, 2014).

A more detailed description of the regional, local and Stage 2 Site catchments is provided in Section 4.5.2 and **Figures 4.29**, **4.30** and **4.31**.

4.8.3.2 Issues of Conservation Significance

4.8.3.2.1 Threatened Species, Populations and Communities

Following a review of the databases and literature noted in Section 4.6.2.1, Cardno (2014) determined that of the nine species listed under the TSC Act, FM Act and EPBC Act as potentially occurring within the vicinity of the Stage 2 Site, only one could reasonably be expected to occur (Macquarie Perch) (see **Table 4.26**).

Table 4.26
Threatened Species Potentially Occurring within the Site

Species name	TSC Act	FM Act	EPBC Act	Likelihood of occurrence
Australian Grayling			Vulnerable	Unlikely
Murray Cod			Vulnerable	Unlikely
Trout Cod		Endangered		Unlikely
Silver Perch		Vulnerable		Unlikely
Macquarie Perch		Endangered	Endangered	**Possible**
Adams Emerald Dragonfly		Endangered		Unlikely
Sydney Hawk Dragonfly		Endangered		Unlikely
Giant Dragonfly	Endangered			Unlikely
Source: Modified after Cardno (2014) – Table 3-1.				

No threatened ecological community listed under the EPBC Act, TSC Act or FM Act occur on, adjacent to, or immediately downstream of the Stage 2 Site.

Three threatened populations of freshwater fish are listed under the FM Act, however, the distribution range of these does not include the Coxs River of Yorkeys Creek. No threatened populations of aquatic organisms are listed under the TSC Act.

No critical aquatic habitats listed under the TSC Act or FM Act are found on, adjacent to or immediately downstream of the Stage 2 Site.

4.8.3.2.2 Key Threatening Processes

The KTPs listed under the EPBC Act, TSC Act and FM Act that may be relevant to the impact of the Proposal on aquatic ecology are as follows.

- *Fisheries Management Act 1994.*
  - Degradation of native riparian vegetation along New South Wales watercourses; and
  - In-stream structures and other mechanisms that alter natural flows.
- *Threatened Species Conservation Act 1995.*
  - Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands.
- *Environment Protection and Biodiversity Conservation Act 1999.*
  - Novel biota and their impact on biodiversity.

4.8.3.2.3 Groundwater Dependent Ecosystems

Surface GDEs

According to the BoM Atlas of GDEs, the Coxs River and Yorkeys Creek are surface water ecosystems with a moderate to high potential for groundwater interaction (see **Figure 4.41**). These ecosystems are likely to receive some base flow from the surface expression of groundwater.

The BoM Atlas of GDEs also identifies, at a coarse desktop level, vegetation communities with a moderate to high potential for groundwater interaction. Niche (2014a) has reviewed the vegetation of the Site and surrounds, with reference to the validated vegetation mapping of **Figure 4.38**, and refined the desktop level assessment of the BoM Atlas of GDEs. Niche (2014a) confirms that only the River Oak riparian forest vegetation community which occurs within the Coxs River riparian zone, equivalent to the areas noted in the BoM Atlas of GDEs as having high potential for groundwater interaction (see **Figure 4.42**), could be influenced by changes to local base flows. Niche (2014a) note further, however, that seasonal flows and storm surges during high rainfall events are likely to be far more deterministic of the condition of this vegetation than base flows of groundwater.

Cardno (2014) also notes that *Angophora floribunda* is dominant along the 2nd order watercourse upstream of NC1 (see **Figure 4.41**) and the associated community (C4: Rough-barked Apple gully forest) also has the potential to be groundwater dependent (see **Figure 4.42**).

Sub-surface GDEs

Cardno (2014) reports that sub-surface GDEs, such as hyporheic fauna (fauna inhabiting water in the hyporheic zone - the area of interaction between surface and groundwater) and stygofauna (groundwater dwelling organisms), have the potential to occur within and surrounding the Stage 2 Site.

- Hyporheic habitat is usually associated with stream beds that maintain subterranean flow. As discussed in Section 4.6.5, the Proposal is not predicted to impact on groundwater flows at a distance of 225m from the extraction area and therefore hyporheic habitat, if presented adjacent to the Coxs River, would not be affected.
- Stygofauna can inhabit a variety of subterranean habitats, however, are unlikely to occur within the rhyolite hosted aquifer as this has low porosity (0.7%) and is isolated from surrounding groundwater by the adjacent gullies, creeks and Coxs River (Ground Doctor, 2014). If present, stygofauna are most likely to occur within perched aquifers, which are unlikely within the rhyolite hosted aquifer to be impacted due to the homogeneity of the local geology, or within alluvium, which would not be affected by the Proposal.

It is concluded that the potential for stygofauna to be present is very low.

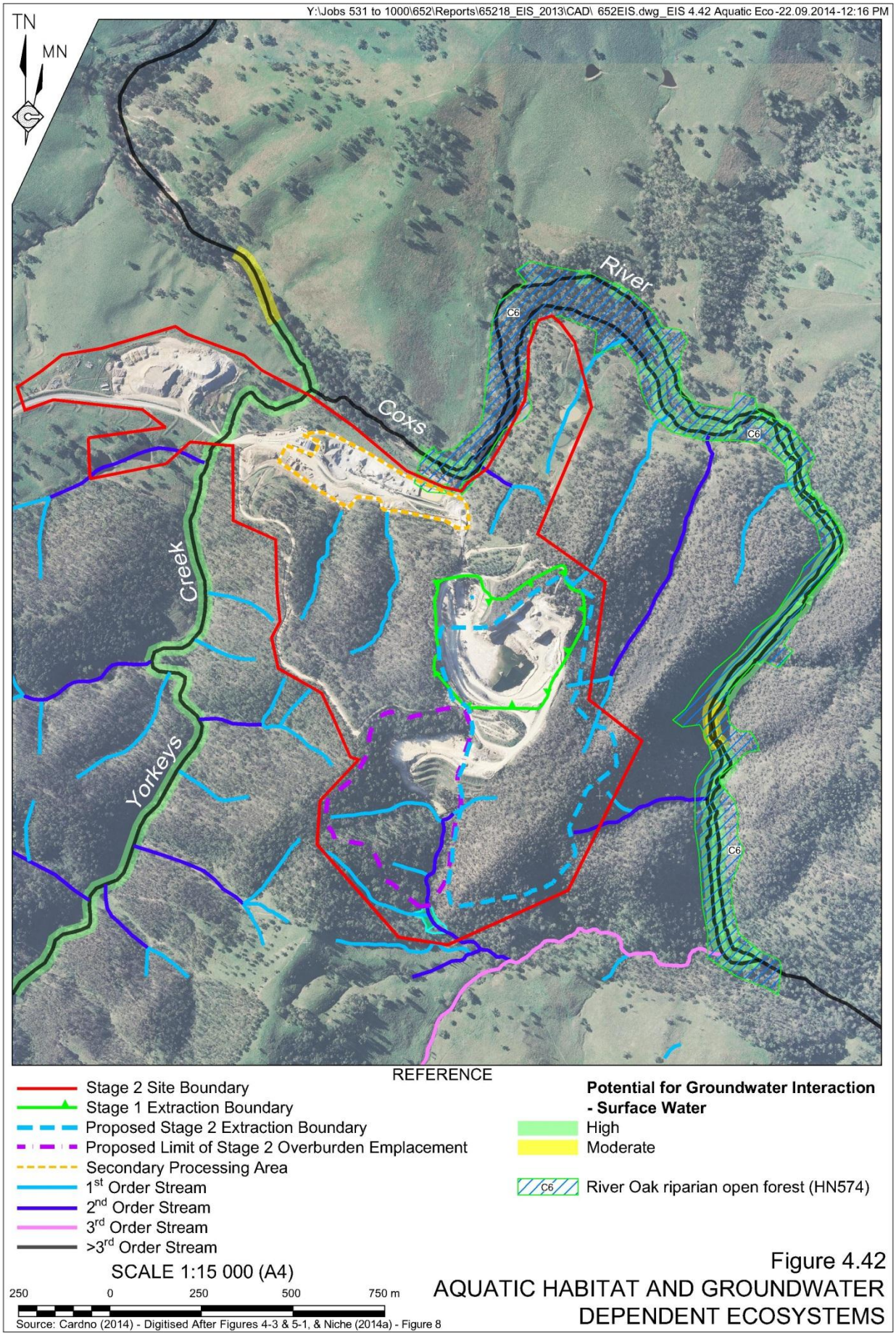


Figure 4.42
AQUATIC HABITAT AND GROUNDWATER DEPENDENT ECOSYSTEMS

4.8.3.3 Aquatic and Water Quality Conditions

Section 4 of Cardno (2014) provides a detailed review of the aquatic flora, fauna, habitat and water quality within the receiving environment. **Tables 4.27** to **4.29** provide a summary of the local conditions derived from the field sampling and analyses completed by Cardno and others since 2005.

Table 4.27
Water Quality

Location *	Electrical Conductivity	pH	Dissolved Oxygen	Turbidity
Upstream Control (Coxs)	↑	↑	↓	✓
Quarry Control (Coxs)	↑	✓	↓	✓
Quarry Treatment (Coxs)	↑	✓	↓	✓
Downstream Control (Coxs)	↑	✓	↓	✓
North Tributary (NC1)	✓	✓	↓	↑
South Tributary (SC1)	↑	✓	↓	↑

* Refer to **Figure 4.40.**
↑ = Median values above the relevant ANZECC/ARMCANZ (2000) guidelines.
↓ = Median values below the relevant ANZECC/ARMCANZ (2000) guidelines.
✓ = Median values within the target range of the relevant ANZECC/ARMCANZ (2000) guidelines.
Shaded cells represent poorer water quality.

Source: Modified after Cardno (2014) – Table 4-3.

Table 4.28
Aquatic Habitat Characteristics

Location *	Riparian Channel Environment Score	Fish Habitat Sensitivity (Type)	Fish Habitat Class (Class)
Upstream Control (Coxs)	41	1	1
Quarry Control (Coxs)	41	1	1
Quarry Treatment (Coxs)	43	1	1
Downstream Control (Coxs)	42	1	1
North Tributary (NC1)	35	N/A	3
South Tributary (SC1)	35	3	3

* Refer to **Figure 4.40.**
Shaded cells represent poorer habitat.

Source: Modified after Cardno (2014) – Table 4-4.

Notably, the receiving environment at all locations fell outside the ANZECC/ARMCANZ (2000) targets for at least one of the parameters measured, indicative of a catchment which has been subject to relatively high levels of disturbance and modification (refer to Section 4.6.3.1).

The modified Riparian Channel Environment (RCE) scores (after Chessman *et al.* 1997) indicate the aquatic habitat in the Coxs River was in a better overall condition than in the tributary creeks. All sites on the Coxs River were considered highly sensitive, major fish habitat, whereas the tributary sites generally did not contain important fish habitat.

Aquatic macroinvertebrate fauna and fish indicators for the Coxs River suggest the river in the vicinity of the Stage 2 Site is in good condition and conducive to a positive fauna assemblage.

Table 4.29
Aquatic Fauna Characteristics

Location *	Macroinvertebrate		Fish
	OE50 taxa (edge)	OE50 taxa (riffle)	
Upstream Control (Coxs)	Band A	Band A	✓
Quarry Control (Coxs)	Band A	Band A	✓
Quarry Treatment (Coxs)	Band A	Band A	✓
Downstream Control (Coxs)	Band A	Band B	✓
North Tributary (NC1)	N/A	N/A	N/A
South Tributary (SC1)	N/A	N/A	N/A
* Refer to **Figure 4.40.** Band A = Equivalent to reference condition. Band B = Below (but not well below) reference condition. ✓ = native fish present. Shaded cells represent poorer assemblage.			
Source: Modified after Cardno (2014) – Table 4-5			

4.8.4 Potential Impacts and Avoidance, Mitigation and Management Measures

4.8.4.1 Introduction

The following subsections provide a summary of the potential impacts of the Proposal on local aquatic conditions, habitats or species along with the impact avoidance, mitigation and management measures to be adopted by the Applicant. Section 4.6.5 provides an overview of the likely residual impacts considering the adoption of these.

4.8.4.2 Land Preparation

Land preparation refers to the activities such as vegetation clearing and soil stripping and management undertaken in preparation for major earthworks, i.e. overburden removal and extraction of rhyolite.

Potential Impacts

The development of the extraction area and overburden emplacement could result in the following impacts.

- Discharge of sediment or nutrient-laden runoff from cleared areas, including access tracks and roads into watercourses.
- Subsequent alteration to the benthic sub-stratum of the receiving waters, smothering of aquatic habitats and increase turbidity levels (leading to decreased photosynthesis by aquatic plants and other impacts on aquatic fauna).
- Accidental release of lubricating oils, hydraulic fluids or fuel from earthmoving equipment could result in the input of toxic hydrocarbons into the creeks and their watercourses.

Avoidance, Mitigation and Management Measures

Following from the recommendations of Cardno (2014), the following impact avoidance, mitigation and management measures would be implemented.

- Areas of riparian zone and aquatic habitat disturbed would be restricted to those within the impact footprint of the Stage 2 Extension.
- Should development works, e.g. access roads, be required in the vicinity of watercourses, these would be designed and completed in accordance with the NSW DPI Policy and *Guidelines for Fish Habitat Conservation and Management* (DPI, 2013).
- An Erosion and Sediment Control Plan (ESCP) would be prepared for the Proposal as part of the *Water Management Plan*. Prepared in accordance with DECC (2008b), the ESCP would delineate the limits to disturbance noted above and provide the locations, designs and maintenance requirements for structures aimed at preventing discharge of sediment or nutrient-laden water.
- Temporary erosion and sediment control measures such as sediment fences, sandbag weirs, temporary drains, and temporary silt traps would be installed prior to any construction works.
- Discharge of water would be managed in accordance with the recommendations of Groundwork Plus (2014). These strategies, aimed at minimising the potential for uncontrolled discharges to the Coxs River and Yorkeys Creek, are discussed further in Section 4.5.4.
- A bunded area for storage of fuels, oils, refuelling and appropriate maintenance of vehicles and mechanical plant would be maintained within the Administration Area.
- Re-fuelling, washing and maintenance of vehicles and plant within 30m the Coxs River and its watercourses would be prohibited.
- Any spillages or leaks would be immediately reported and spill containment response immediately enacted to restrict the spread into or within watercourses.

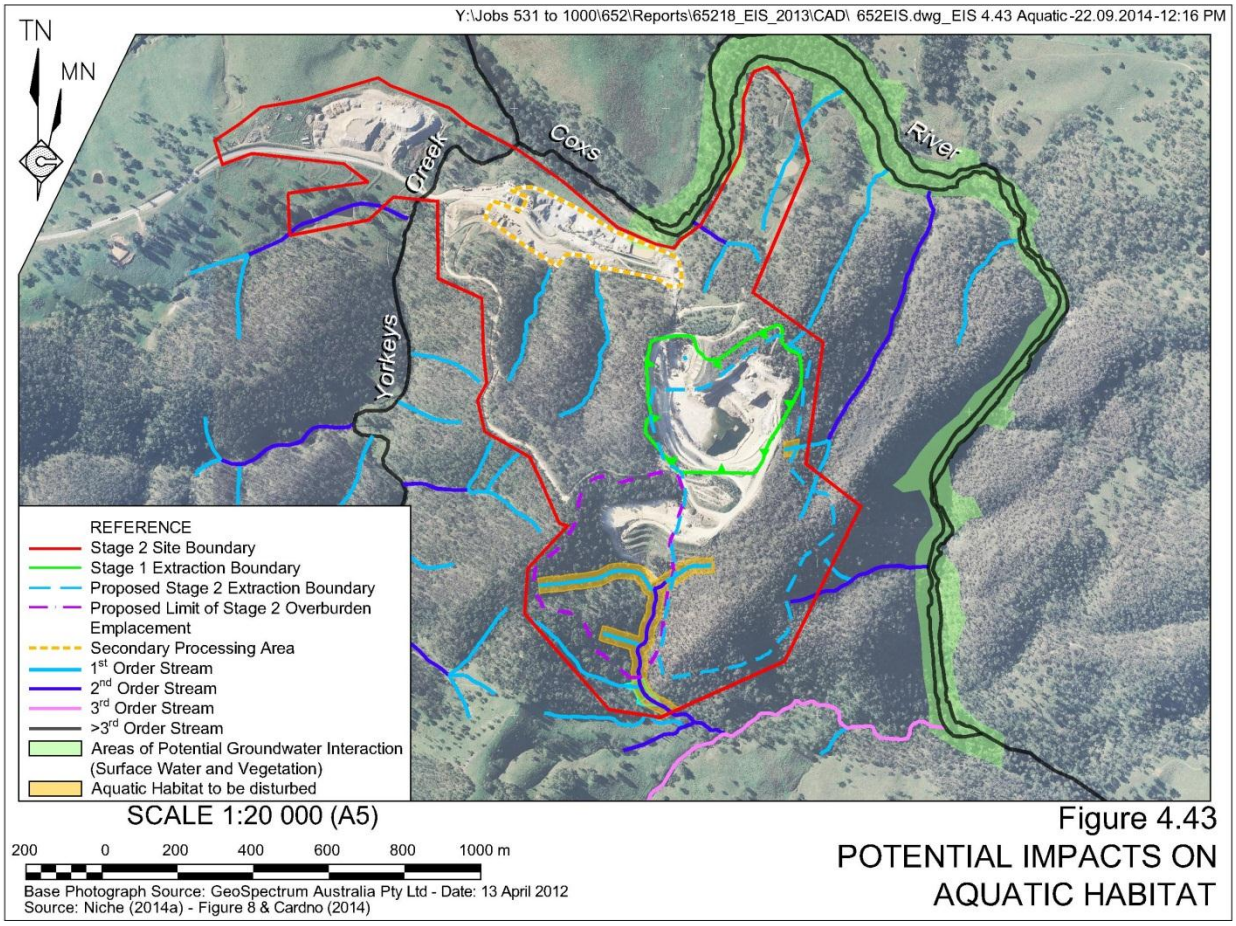
4.8.4.3 Quarry Operation

4.8.4.3.1 Resource Extraction and Overburden Emplacement

Potential Impacts

The extension of the extraction area and overburden emplacement would result in the direct removal or backfilling aquatic habitat contained within 1st and 2nd order streams in the upper reaches of the Coxs River North and South Catchments (see **Figure 4.43**) resulting in:

- the loss of approximately 800m of aquatic habitat associated with the 1st and 2nd order streams;
- the loss of any aquatic flora and fauna resident within this habitat; and
- discharge of water with elevated sediment loads as a result of erosion from the overburden emplacement.



Avoidance, Mitigation and Management Measures

No specific measures are available to avoid the loss of approximately 800m of aquatic habitat and associated aquatic flora and fauna from the upper reaches of the North and South Catchment tributary. Following from the recommendations of Cardno (2014), the following impact mitigation and management measures would be implemented.

- Areas to disturbed would be restricted to those within the impact footprint of the Stage 2 Extension.
- Installation of erosion and sediment control structures over the Stage 2 Site.
- As for the development phase, an ESCP would be prepared for the Stage 2 Extension. The ESCP would delineate the limits to disturbance as noted above and provide the locations, designs and maintenance requirements for structures aimed diverting, capturing and storing water on the Stage 2 Site.
- Management of water captured on the Stage 2 Site in accordance with the recommendations of Groundwork Plus (2014) (refer to Section 4.5.4), most notably the controlled discharge of water, once water quality criteria are confirmed, to maintain environmental flows.

4.8.4.3.2 Dewatering

Potential Impacts

Dewatering of the extraction area would reduce the SWL of the groundwater table below the Stage 2 Site (refer to Section 4.12.5). However, Ground Doctor (2014) has assessed the likely post-extraction hydrogeological conditions and concludes that the SWL would remain more elevated than the surrounding water courses (see Section 4.6.5.1 and **Figure 4.35**), with a hydraulic gradient still maintained towards these water courses (including Yorkeys Creek and the Coxs River). The potential for groundwater to continue to discharge into the surrounding areas due to this gradient would help to maintain pre-development conditions and significant changes to the current site water balance are not expected. On the basis of the isolated nature of groundwater reduction, Cardno (2014) consider the likely impact on base flows to these watercourses to be nil to negligible for Coxs River.

A small reduction in the available groundwater to the base flows of the gullies within the predicted cone of depression, i.e. 225m from the perimeter of the extraction area, may occur.

Avoidance, Mitigation and Management Measures

The dewatering of the extraction area and subsequent reduction in the groundwater SWL cannot be avoided, however, impacts to base flows would be mitigated by ensuring that treated water captured in the Stage 2 Site sediment basins and storage dams is regularly discharged to Yorkeys Creek and the Coxs River in accordance with the recommendations of Groundwork Plus (2014) (refer to Section 4.5.4).

The Applicant would also implement a monitoring program to estimate the actual volume of groundwater flowing into the extraction area. Should this significantly exceed the predictions of Ground Doctor (2014) (refer to Section 4.12.5), a more detailed, quantitative investigation would be undertaken to review potential impacts on surrounding surface and groundwater dependent ecosystems.

4.8.4.3.3 Water Retention and Use

Potential Impacts

Increased retention and operational use of water, as a result of the larger disturbance footprint, could result in the following impacts.

- Reduced runoff and environmental water available to downstream aquatic ecosystems.
- Changes to flows regime within in the Coxs River South catchment as a result of increasing the volume of Sediment Basin SB3b (although as an operational requirement, this water would be regularly discharged following treatment to restore the required water settlement capacity);
- Reduced groundwater quality through movement of contaminated water from on-site into the underlying aquifer;
- Elevated erosion at pipe outlet points associated with increased operational use and transfers.

Avoidance, Mitigation and Management Measures

Following from the recommendations of Cardno (2014), the following impact avoidance, mitigation and management measures would be implemented.

- Potential sources of contamination to water storages would be segregated from the catchments to these.
- Appropriate wet weather storage would be maintained;
- Appropriate off-take depth at water pumping sites would be maintained and scour protection at pipe outlet points would be installed.

4.8.4.3.4 Water Discharge

Potential Impacts

In accordance with the recommendations of Groundwork Plus (2014), water would be regularly discharged from the Stage 2 Site (refer to Section 4.5.4). Potential impacts of water discharge could include:

- release of sediment-laden water into the aquatic environment leading to detrimental effects on aquatic flora and fauna;
- release of water containing other aquatic contaminants into the aquatic environment leading to detrimental effects on aquatic flora and fauna; and
- increased erosion around the discharged points, resulting in detrimental effects on aquatic flora and fauna.

Avoidance, Mitigation and Management Measures

Following from the recommendations of Cardno (2014), the following impact avoidance, mitigation and measures would be implemented.

- The sediment basins and storage dams of the Stage 2 Site would be constructed and maintained and monitored in accordance with the recommendations of Groundwork Plus (2014) (refer to Section 4.5.4.2) and EPL 12323, to ensure discharges are within the specified limits.
- The sediment basins and storage dams would be managed and appropriate wet weather storage would be maintained to ensure sufficient freeboard is available to accommodate normal wet weather events and minimise uncontrolled discharge to the environment.
- The discharge points would be constructed to prevent excess erosion and in particular, to prevent potential overflow and undermining of water control structures that could lead to catastrophic failure of retention basins.

4.8.4.3.5 Groundwater Quality

Contamination of local groundwater by water containing hydrocarbons or elevated nitrate concentration, which could have a deleterious effect on subsurface organisms if present, is highly unlikely due to the hydraulic gradient which would be developed during and following

extraction (see Section 4.6.5.1). This would provide for the in-flow (seepage) of groundwater into the extraction area, not the reverse (Ground Doctor, 2014). Furthermore, the characteristic low porosity of the rhyolite (0.7%), and its resistance to fracturing, reduced permeability and the potential for movement of water through the strata.

The reduced potential for impact notwithstanding, the Applicant has committed to undertaking monitoring of groundwater with water quality analysis to be undertaken periodically to confirm no contamination of local groundwater.

4.8.4.4 Quarry Decommissioning and Rehabilitation

Potential Impacts

As a consequence of vegetation removal, landform re-profiling, soil respreading, weed management and revegetation, potential impacts could include:

- erosion of the final landform resulting in discharge of water containing sediments and contaminants such as fertilisers and herbicides to the receiving waters.

Cardno (2014) also note that the construction of new landscape features, such as riparian vegetation and the geomorphology of drainage features and dams during rehabilitation could impact on aquatic ecosystems if they are inappropriate for the local landform. This could lead to slumping and/or increased erosion/mass wasting and associated impacts to downstream aquatic ecosystems.

Avoidance, Mitigation and Management Measures

Following from the recommendations of Cardno (2014), the following impact avoidance, mitigation and measures would be implemented.

- Minimisation of exposed (unvegetated) areas of the final landform.
- Implementation of an ESCP incorporating the decommissioning and rehabilitation phase.
- Stabilisation of all earthworks, watercourses and disturbed areas in the short to medium term.
- Design and construction of a final landform that is stable and safe with minimal erosion.

4.8.5 Assessment of Impacts

4.8.5.1 Aquatic Habitat and Conditions

4.8.5.1.1 Land Preparation

Ultimately, the impact of land preparation activities on the aquatic environment of the receiving waters would be a function of:

- the proximity of these works to the Coxs River and associated watercourses; and
- the effectiveness of the proposed management measures.

Cardno (2014) has assessed that the activities associated with land preparation of the Stage 2 Extension are unlikely to cause significant impacts on existing aquatic habitats, aquatic flora or aquatic fauna, provided that appropriate measures to avoid, minimise and manage impacts are implemented. The most notable measures being the implementation of an ESCP and minimisation of uncontrolled discharges from sediment basins and storage dams through adoption of the water transfer and management system recommended by Groundwork Plus (2014) (refer to Section 4.5.4).

Given the various sediment basins of the Stage 2 Site would be managed to retain sufficient water settlement and sediment storage capacity for a 95th percentile 5-day rainfall event (see Section 4.5.4.1) the potential for uncontrolled discharge of water from these structures would be minimised (see Section 4.5.5). Conditions under which an uncontrolled discharge may occur would almost certainly coincide with periods of elevated flows and level within the Coxs River and Yorkeys Creek when background suspended sediment levels would be naturally elevated. Cardno (2014) notes that the aquatic flora and fauna that occur in the watercourses within and adjacent to the Stage 2 Site would be fairly tolerant of such short term increases in sediment load as occur during periodic rainfall events.

4.8.5.1.2 Quarry Operation

The loss of aquatic habitat from the upper catchments of those watercourses within the impact footprint of the Stage 2 extraction area and overburden emplacement is considered to be a minor and localised impact (Cardno, 2014). Cardno (2014) also reports that through appropriate water management associated with erosion and sediment control, dewatering, retention, operational use and discharge, the potential impacts on receiving aquatic ecosystems identified would be largely mitigated.

It is therefore considered that the ongoing extraction and overburden emplacement activities would not cause significant impacts on aquatic habitats, aquatic flora or aquatic fauna, provided that appropriate measures to avoid, minimise and manage impacts are implemented.

4.8.5.1.3 Quarry Decommissioning and Rehabilitation

Cardno (2014) concludes that the activities undertaken during the decommissioning and rehabilitation phase would be unlikely to cause significant impacts on aquatic habitats, aquatic flora or aquatic fauna, provided that appropriate measures to avoid, minimise and manage impacts are implemented.

4.8.5.1.4 Conclusion

It is worthy of note that the Proposal represents an extension of operations that have been undertaken within the local setting since 2005. As is documented in Cardno (2014), the results of monitoring aimed at identifying any detrimental impacts on the health of the local aquatic environment has comprehensively demonstrated that quarry operations undertaken to date have been undertaken within the local setting without adverse impacts. It is acknowledged that the impact footprint of the quarry would be increased, however, as the proposed activities would remain unchanged with appropriate water management strategies in place, there is no reason to believe that the impacts of the extended operations would be significantly different to those of the current operations.

4.8.5.2 Groundwater Dependent Ecosystems

The occurrence of surface GDEs on and surrounding the Stage 2 Site is limited to the River Oak riparian forest vegetation community which occurs within the riparian zone of the Coxs River (Niche, 2014a). The impact on the condition of this vegetation of a minor reduction in groundwater storage of the rhyolite hosted aquifer, and/or a very minor reduction in the availability of groundwater to contribute to flows in the upper slopes of the gullies discharging to the Coxs River (within the cone of depression) is considered to be insignificant when compared to the impact of seasonal flows and storm surges during high rainfall events (Niche, 2014a).

The potential for impact on hyporheic fauna is nil to negligible as Ground Doctor (2014) does not predict any impact on the hyporheic zone, i.e. stream bed, of the Coxs River.

The potential for stygofauna to be present within the rhyolite hosted aquifer is considered to be very low (see Section 4.8.3.2.3). However, even if present, the extent of the groundwater drawdown is anticipated to be restricted to a distance of approximately 225m from all sides of the extraction area (Ground Doctor 2014). Hence, the spatial extent of impact would be highly restricted. Furthermore, dewatering of the extraction area and cone of depression would only be accelerating the natural discharge of groundwater which naturally occurs to surrounding gullies and the Coxs River.

4.8.5.3 Threatened Species and Key Threatening Processes

4.8.5.3.1 Macquarie Perch

Cardno (2014) completed an assessment of the significance of the Proposal on the only threatened species considered as possibly occurring along the stretch of the Coxs River potentially impacted. Cardno (2014) concluded that it would be unlikely that the Proposal would have a significant effect on known Macquarie Perch populations within the Coxs River downstream of the Stage 2 Site. There is, however, a potential that the cumulative impacts of extractive industries within the upper Coxs River could have an impact on this species with respect to water quality and hydrological pressures, although the Proposal is considered to be a small component of the overall cumulative potential impact.

4.8.5.3.2 Key Threatening Processes

Each of the KTPs identified as relevant to the Proposal have been reviewed by Cardno (2014) in relation to how the Proposal may influence these.

- Novel biota and their impact on biodiversity.

  Considering that no additional water transfers are proposed, aquatic pest species found in the catchment are unlikely to be introduced into new habitats and amplification of this KTP is therefore considered highly unlikely.

- Degradation of native riparian vegetation along New South Wales watercourses.

  There is a potential that native riparian vegetation could be degraded if altered groundwater dynamics associated with dewatering of the extraction area restrict water to these communities. However, Cardno (2014) consider the likelihood of

this being significant and widespread is low, as groundwater impacts are expected to be restricted spatially (to the immediate surrounds of the extraction area) and temporally (until a new groundwater – surface water interaction equilibrium is established – see **Figure 4.35**).

Where extraction and overburden placement will take place, there would be an unavoidable loss of approximately 800m of aquatic habitat, flora and fauna from the upper reaches of the North and South Catchment tributaries. Cardno (2014) consider this to be minimal on a regional scale.

- In-stream structures and other mechanisms that alter natural flows / alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands.

  There is likely to be some alteration of the natural flow of water in the Coxs River North and South Catchments associated with the extension of the extraction area and overburden emplacement. Additionally, some in-stream structures such as sediment basins may affect the natural flow of water. In the case of sediment basins, these structures are considered a necessary measure to prevent sediment impacts downstream.

  Notably, no work is proposed to occur on the major waterways around the Stage 2 Site (Yorkeys Creek or the Coxs River) and therefore there is limited scope for the Proposal to amplify this KTP.

4.8.6 Monitoring

The Applicant has committed to continuing to monitor from the sites identified on **Figure 4.41** in accordance with the AUSRIVAS methodology. Monitoring related to water quality is described and discussed in Section 4.5.7.

4.9 NOISE

4.9.1 Introduction

The DGRs issued for the Proposal identified "*Noise*" as a key issue requiring that the "*EIS include a quantitative assessment of the potential:*

- *construction, operational and transport noise impacts;*
- *reasonable and feasible mitigation measures, including evidence that there are no such measures available other than those proposed; and*
- *monitoring and management measures, in particular real-time, attended noise monitoring.*

Additional matters for consideration in preparing the EIS were also provided in the correspondence attached to the DGRs from the EPA which related to both noise and vibration impacts and request that: *the Proponent must carry out a detailed Noise Impact Assessment and Modelling that addresses:*

- *off-site road noise impacts focusing on current versus proposed hours of operation — consistent with the NSW Road Noise Policy (DECCW, 2011);*
- *construction noise impacts — consistent with the NSW Interim Construction Noise Guideline (DECC, 2009);*
- *operational noise impacts — consistent with the NSW Industrial Noise Policy (EPA, 2000) and the Assessing Vibration: a technical guidelines (DEC, 2006); and*
- *mitigation and management strategies.*

Also appended to the DGRs is correspondence from DTIRIS and Lithgow City Council requesting detailed information and assessment related to noise and vibration impacts including mitigation measures and consideration of noise and vibration impacts on the Glenroy Bridge and camping (grassed) area.

Based on the risk analysis undertaken for the Proposal (Section 3.3.1 and **Table 3.9**), the potential impacts relating to noise and vibration and their risk rankings (in parenthesis) after the adoption of pre-existing or standard mitigation measures are as follows.

- Increased noise levels from fixed and/or mobile plant, equipment and trucks on site resulting in:
  - annoyance and/or disturbance to local residents, businesses and other landowners (medium risk);
  - adverse effects on physical or mental health (medium risk);
  - increased community and regulatory scrutiny (medium risk);
  - relocation of and/or reduction of local native fauna species due to noise disturbance (medium risk);
  - reduced agricultural productivity of livestock (low risk).
- Increased noise levels from trucks transporting quarry products resulting in:
  - annoyance and/or disturbance to local residents, businesses and other landowners (medium risk);
  - adverse effects on physical or mental health (medium risk); or
  - increased community and regulatory scrutiny (medium risk).
- Noise from blasting resulting in:
  - adverse effects on physical or mental health (medium risk); or
  - increased community and regulatory scrutiny (low risk).

- Vibration from blasting resulting in:
  - reduced local amenity (medium risk); or
  - structure damage to buildings (low risk); or
  - increased community and regulatory scrutiny (medium risk).

A review of the attributed risk levels, following the adoption of the recommended operational safeguards and controls, is provided in Section 6.2.1 and **Table 6.1**.

The noise impact assessment for the Proposal was undertaken by Mr Felipe Torres and Mr Daniele Albanese of Benbow Environmental. The assessment is presented as Part 6 of the *Specialist Consultants Studies Compendium* and is referred to hereafter as "Benbow (2014a)". This subsection of the EIS provides a summary of the noise impact assessment, concentrating on those matters raised in the DGRs and related requirements provided by various government agencies. A consolidated list of the identified requirements and where each is addressed is presented in **Appendix 3**.

4.9.2 Existing Noise Climate

4.9.2.1 Introduction

The existing meteorological and acoustic environment surrounding the Stage 2 Site has been reviewed in order to determine the atmospheric conditions under which noise modelling is required, as well as to establish noise criteria at representative receivers surrounding the Austen Quarry and adjacent to the transport route. The following subsections provide a summary of the existing noise sources, meteorological conditions and background noise levels against which noise criteria are set.

4.9.2.2 Existing Noise Sources

Existing noise levels in the vicinity of the Stage 2 Site are influenced by a range of sources including traffic on Jenolan Caves Road and local roads, agricultural equipment, flow of the Coxs River, stock, wind in trees, wildlife, as well as noise associated with existing Austen Quarry operations.

4.9.2.3 Meteorological Conditions

Wind and temperature inversions may affect the transmission of noise from source to surrounding receivers and, as noted in Section 4.1.2.5, Benbow (2014a) has generated a site-representative meteorological data file using data collected from the on-site meteorological station and The Air Pollution Model (TAPM). **Figure 4.1** presents the seasonal wind rose plots generated by this meteorological data file.

The analysis of wind vector components up to 3m/s at angles of ±45° relative to each primary direction established that winds at speeds of 0.5 to 3.0m/s were recorded from the northwest for more than 30% of the time during Autumn and Winter. In accordance with the INP, therefore, noise modelling needs to consider this directional wind condition as a noise enhancing condition to receivers to the southwest of the Site.

Temperature inversion conditions are generally associated with F-class stability conditions, represented by still/light winds and clear skies during the night time or early morning period (stable atmospheric conditions). Benbow (2014a) analysed the 2012-2013 weather data of the on-site meteorological station and identified that during winter approximately 60% of the nights presented temperature inversion conditions. As the INP specifies that a temperature inversion is a feature of the local atmospheric setting when occurring more on than 30% of winter nights, these noise enhancing conditions must be included in the assessment of noise impact generated by the Proposal.

4.9.2.4 Background Noise Levels

In order to determine ambient (background) noise levels, three noise loggers were placed at representative locations surrounding the Austen Quarry and transport route. The locations of these noise monitoring locations (A, B and C) are presented on **Figure 4.44**. A description of each location is provided in **Table 4.30**.

Table 4.30
Noise Monitoring Locations

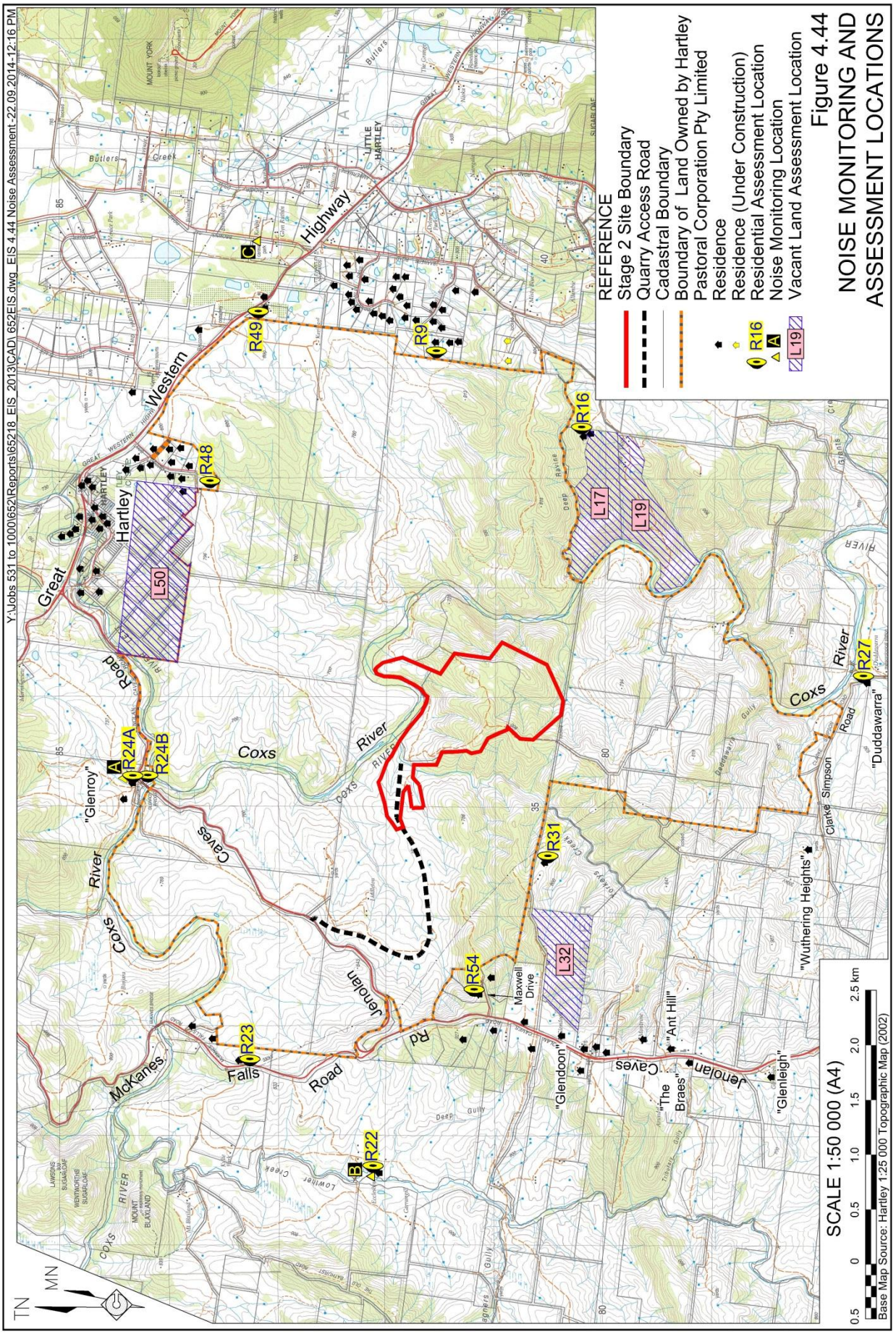
Location[1]	Property Reference (Lot, DP)	Address	Distance to the Quarry
A	10, 830372	200 Jenolan Caves Road	2 600m
B	100, 1058004	770 Jenolan Caves Road	3 000m
C	41, 865372	66 Dicker Drive, Little Hartley	5 000m
Note 1: see **Figure 4.44**			

Unattended long-term noise monitoring was undertaken from 4 to 13 June 2013 at all three locations and attended noise monitoring was conducted at the commencement and conclusion of the monitoring period at each. The measured noise levels have been considered as representative of the existing ambient noise environment of the area.

Noise levels were continuously monitored at 15-minute intervals and the data analysed to determine the L_{90} noise level on each day of monitoring, i.e. the noise level which is exceeded 90% of the time. The L_{90} Rating Background Noise Level (RBL) was then calculated as the median L_{90} noise level over the duration of the noise survey. **Table 4.31** provides the calculated RBLs for the three noise logger locations.

Table 4.31
Measured Ambient Noise Levels

Location	Measured Noise Level (dB)										
	Average L_1			ABL (Median L_{90})			Average L_{eq}			Road Traffic Noise	
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	Day ($L_{Aeq(15\ hour)}$)	Night ($L_{Aeq(9\ hour)}$)
A	74	69	57	39	39	38	63	58	56	63	53
B	72	66	53	27	22	21	59	54	51	59	50
C	52	50	47	35	34	30	47	46	41	-	-
Source: Modified after Benbow (2014a) – Tables 3-2 to 3-4											


Y:\Jobs 531 to 1000\652\Reports\65218_EIS_2013\CAD\652EIS.dwg_EIS 4.44 Noise Assessment-22.09.2014-12:16 PM
REFERENCE
Stage 2 Site Boundary
Quarry Access Road
Cadastral Boundary
Boundary of Land Owned by Hartley Pastoral Corporation Pty Limited
Residence
Residence (Under Construction)
Residential Assessment Location
Noise Monitoring Location
Vacant Land Assessment Location
Figure 4.44
NOISE MONITORING AND ASSESSMENT LOCATIONS
SCALE 1:50 000 (A4)
0.5 0 0.5 1.0 1.5 2.0 2.5 km
Base Map Source: Hartley 1:25 000 Topographic Map (2002)
TN MN
R9
R16
R22
R23
R24A
R24B
R27
R31
R48
R49
R54
L17
L19
L32
L50
Great Western Highway
Hartley
Coxs River
Jenolan Caves Road
McKanes Falls Road
Maxwell Drive
"Glenroy"
"Glendoon"
"Ant Hill"
"The Braes"
"Glenleigh"
"Wuthering Heights"
"Duddawarra"
Clarke Simpson
Butlers Creek
Lowther Creek

The following provides a summary of the dominant noise sources recorded at each monitoring location.

- At 200 Jenolan Caves Road (Location A), the acoustic environment was dominated by truck pass-bys, occasional loud bird noise and constant noise generated by the flow of the Coxs River.
- At 770 Jenolan Caves Road (Location B), the acoustic environment was dominated by traffic on Jenolan Caves Road, insect and bird noise.
- At 66 Dicker Drive (Location C), the acoustic environment was dominated by traffic hum and occasional louder truck pass-bys from the Great Western Highway, traffic on local roads, birds with Austen Quarry drilling faintly audible.

Benbow (2014a) notes that the constant noise source from the flowing Coxs River is unrepresentative of the RBL of the remainder of the local setting hence this location has not been considered for the purpose of establishing the noise criteria. On the basis of the results collected at Locations B and C, Location B presents the lowest background levels (<30dB(A)) and Benbow (2014a) has therefore been considered these noise levels in derivation of the project specific noise levels (see Section 4.9.3).

4.9.3 Environmental Noise and Vibration Criteria

4.9.3.1 Introduction

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

For the purposes of defining noise criteria relevant to the on-site operations of the Proposal, the following times are relevant to the daytime, evening, night-time periods (Monday to Saturday).

- Daytime – 7:00am to 6:00pm
- Evening – 6:00pm to 10:00pm
- Night-time – 10:00pm to 7:00am

For Sundays and public holidays, the night-time period extends from 10.00pm to 8.00am.

For the purposes of considering road traffic noise, only two periods are considered.

- Daytime – 7:00am to 10:00pm (15 hours).
- Night-time – 10:00pm to7:00am (9 hours).

4.9.3.2 Operational Noise Assessment Criteria

The Environment Protection Authority released the NSW *Industrial Noise Policy* (INP) in January 2000 (EPA, 2000). The INP provides a framework and process for deriving operational noise criteria for development consents under the EP&A Act and setting operational

noise limits in environment protection licences under the POEO Act. The Proposal is a scheduled activity under Schedule 1 of this latter Act. The INP specifies two noise criteria, namely:

- an intrusiveness criterion which requires that the equivalent continuous noise level ($L_{Aeq,15min}$) from a specific industrial source at a privately-owned receptor should not exceed the background noise level by more than 5 decibels; and
- an amenity criterion which aims to maintain noise amenity throughout a community over the whole daytime, evening or night-time periods and considers cumulative noise from all industrial sources.

A fundamental difference between the intrusiveness and the amenity criteria is the time period over which the noise is measured and this is further discussed below.

Intrusiveness Criteria

The intrusiveness criteria require that $L_{Aeq(15min)}$ noise levels from a newly introduced source during the day, evening and night do not exceed the existing rating background level (RBL) by more than 5dB. This is expressed as $L_{Aeq(15min)} \leq RBL + 5 - K$, where $L_{Aeq(15min)}$ is the L_{eq} noise level from the source measured over a 15 minute period and K is a series of adjustments for various noise characteristics. Benbow (2014a) considers the inclusion of a shoulder period between 5:00am and 7:00am when background noise levels may steadily rise from night time noise levels. However, as Benbow (2014a) has taken a conservative approach to the establishment of an RBL (<30dB(A)[6]), a separate shoulder period is not required. A single intrusive criteria of 35dB(A) has been established for the Proposal at all surrounding residences.

Amenity Criteria

The amenity assessment is based on noise criteria specific to the land use. As there are no existing industries within the local setting, the base amenity industrial criterion does not apply. For sensitive receptors located in and around the Stage 2 Site, the rural-residential category is suitable. The amenity criteria for active recreation areas could also be considered given the proximity of the Coxs River. **Table 4.32** presents the base amenity criteria for the Stage 2 Site.

Table 4.32
Amenity Noise Criteria

Receptor	Indicative Area	Time Period	Recommended Noise Level L_{eq} period (dB(A))	
			Acceptable	Maximum
Residential	Rural	Day	50	55
		Evening	45	50
		Night	40	45
Active Recreation Area	All	When in use	55	60
Source: Benbow (2014a) - Table 4-2.				

[6] The INP states that when the readings are below 30dB, a noise level equal to 30dB shall be considered.

Low Frequency Noise Criteria

Low frequency noise is typically defined as noise with frequencies below 100Hz, and includes infrasound, i.e. frequencies <20Hz. The INP states that where there is a difference of 15 decibels or more between C and A weighted noise levels[7], than a correction factor of 5dB is applicable.

Sleep Disturbance Criteria

The occurrence of maximum noise levels over a very short time period (referenced and measured as the $L_{A(1min)}$ noise level) have potential to cause sleep disturbance to nearby residents. The World Health Organisation recommends individual noise events to be contained under 45dB(A) L_{Amax} (internal) in order to minimise sleep disturbance[8].

Based on the above, an appropriate sleep disturbance criteria of 45dB(A) L_{Amax} (internal) was considered for all residential premises surrounding the Stage 2 Site. Benbow (2014a) notes that this approach of setting an internal limit, as opposed to an external limit, has been applied to similar noise assessments that consider night-time site operations and vehicle movements and has been accepted as a suitable noise management approach that is fair and reasonable.

On the basis that a 10dB(A) reduction in sound pressure level is provided by the façade and ceiling of the house (based on windows being partially open), the L_{Amax} (sleep disturbance) criteria measured at the house façade would be 55dB(A).

Project Specific Noise Criteria

Table 4.33 provides a summary of the Project Specific Noise Criteria to be applied to on-site (operational) noise of the Proposal.

Table 4.33
Project Specific Noise Criteria – On-Site Operations

Receiver Location	Period	Intrusive Criterion $L_{Aeq(15\ minute)}$	Amenity Criterion $L_{Aeq(15\ minute)}$	Project Specific Noise Limit $L_{Aeq(15\ minute)}$	Site Sleep Disturbance L_{Amax}
All Residential Receivers	Day	35	50	35	-
	Evening	35	45	35	-
	Night (5:00am – 7:00am)	35	40	35	55
Source: Modified after Benbow (2014a) – Table 4-7.					

[7] The A-Weighted noise level effectively cuts off the lower and higher frequencies that the average person cannot hear, i.e. it provides for the noise actually heard by the human ear. The C-Weighted noise level includes the higher and particularly lower frequency noise and is used to assess potential damage that may be caused by the imperceptible component of loud noise.

[8] Section 5.4 of the NSW Road Noise Policy (DECCW, 2011) provides further guidance on the effects of disruption of a person's normal sleep patterns due to noise, reporting that:

- maximum internal noise levels below 50-55 dB(A) are unlikely to awaken people from sleep; and
- one or two noise events per night, with maximum internal noise levels of 65-70 dB(A), are not likely to affect health and well being significantly.

While the INP does not declare criteria for the assessment of noise emissions impacting on vacant land, historically the DP&E and EPA have required that the $L_{Aeq(15min)}$ noise level should not exceed the Project Specific Noise Criteria on more than 25% of the property.

4.9.3.3 Off-Site Traffic Noise Criteria

Total Traffic Noise Criteria

Criteria for assessment of noise from traffic on public roads are set out in the NSW Road Noise Policy (RNP) (DECCW, 2011). Under this policy, the Jenolan Caves Road would be considered as an arterial road type and therefore assessed against the criteria for the "arterial or sub-arterial road" category (see **Table 4.34**).

Table 4.34
Criteria for Traffic Noise – Total

Road Category	Type of Land Use	Noise Level Criterion	
		Day (7:00am to 10:00pm)	Night (10:00pm to 7:00am)
Arterial	Existing residences affected by additional traffic on existing freeway/arterial/sub-arterial roads generated by land use development	$L_{Aeq,15hr}$ 60dB(A)	$L_{Aeq,9hr}$ 55dB(A)
Source: Modified after Benbow (2014a) - Table 4-5.			

Relative Increase Criteria

In addition to the total traffic noise level criteria, the RNP also outlines relative increase criteria for residential land uses (see **Table 4.35**).

Table 4.35
Criteria for Traffic Noise – Relative Increase

Road Category	Type of Land Use	Noise Level Criterion	
		Day (07.00am to 10.00pm)	Night (10.00pm to 07.00am)
Arterial	New road corridor/redevelopment of existing road/land use development with potential to generate additional traffic on existing road	Existing traffic $L_{Aeq,15hr}$ + 12dB(A) (external)	Existing traffic $L_{Aeq,9hr}$ + 12dB(A) (external)
Source: Modified after Benbow (2014a) - Table 4-6.			

Sleep Disturbance

The sleep disturbance criteria for off-site traffic noise is the same as that for on-site operational noise.

Project Specific Noise Criteria

Based on the noise levels measured at Locations A, B and C, and distance between the façade of each residence and the road surface, Benbow (2014a) used SoundPLAN v7.2 to determine the existing road traffic noise levels. Benbow (2104a) has identified the residences located along Jenolan Caves Road between the Site Entrance and the Great Western Highway as the receptors most affected by traffic noise.

Table 4.36 provides the existing road traffic noise as calculated by Benbow (2014a) as well as a summary of the Project Specific Noise Criteria to be applied to off-site (traffic) noise of the Proposal.

Table 4.36
Project Specific Noise Criteria – Off-Site Road Noise

Reference	Existing Road Traffic Noise Levels[1]		Total Traffic Noise Criteria		Relative Increase Criteria		Sleep Disturbance Criteria L_{Amax} (Outdoor)
	Day $L_{Aeq\ (15\ hour)}$	Night $L_{Aeq\ (9\ hour)}$	Day $L_{Aeq\ (15\ hour)}$	Night $L_{Aeq\ (9\ hour)}$	Day $L_{Aeq\ (15\ hour)}$	Night $L_{Aeq\ (9\ hour)}$	
R22	46.4	36.4	60	55	58	48	55dB(A)
R23	44.8	34.8	60	55	57	47	
R24A	67.8	57.8	60	55	80	70	
R24B (grassed area)	67.8	57.8	60	55	80	70	
R24B (cottages)	63.7	53.7			76	66	
R48	52.4	42.4	60	55	64	54	
Note 1: Calculated based on measured noise levels at Locations A, B and C – see **Figure 4.43**							
Source: Modified after Benbow (2014a) - Table 4-8.							

4.9.3.4 Blasting Criteria

The EPA has adopted recommended airblast and ground vibration levels published by the Australian and New Zealand Environment and Conservation Council (ANZECC). These recommended levels are based on prevention of human discomfort and have been adopted as the assessment criteria for the blasting assessment for residential receptors.

- The maximum vibration level for airblast should not exceed 115dB linear peak on more than 5% of the total number of blasts over 12 months. The maximum level should not exceed 120dB linear peak at any time.
- Peak particle velocity (PPV) from ground vibration should be less than 5mm/s for more than 5% of the total number of blasts over 12 months. The maximum level should not exceed 10mm/s at any time.

Building damage assessment criteria are nominated in AS 2187.2-1993 *Explosives – Storage, Transport and Use Part 2: Use of Explosives*, however, as the ANZECC annoyance criteria are more stringent, these are taken as the governing criteria for the Proposal.

4.9.4 Design and Operational Safeguards

The Proposal has been designed with an objective to minimise the noise generated by extraction, processing and transport activities. The design features and operational noise controls of the Project to meet this objective are as follows.

Design Features

- No additional processing equipment is proposed with all fixed plant to remain in current locations, i.e. noise from processing operations would remain the same as that currently generated.

- The continued operation of the primary conveyor between the primary crushing station and secondary processing area reduces noise emissions significantly by avoiding the requirement for truck movements between the extraction and processing areas.
- By sequencing the proposed Stage 2 extraction area to reduce the visual exposure of the extraction operations, noise attenuation is also provided.

Operational Safeguards

- All hours of operation presented in Section 2.11.1 would be strictly adhered to.
- The maximum number of truck movements per hour and per day nominated in Section 2.8.3 would be adhered to.
- All drivers would be required to sign the chain of responsibility documentation requiring a high standard of driver performance, avoidance of using exhaust brakes in built-up areas and travel at the required speeds.
- The internal road network would be graded as required to limit body noise from empty trucks.
- All equipment on site would be regularly serviced to ensure sound power levels of each item remains at or below that nominated for noise modelling purposes (see *Table 5-1* of Benbow, 2014a).
- Noise monitoring would be undertaken at nearby residences and the results and performance of the site operations discussed with local residents and landholders. Monitoring is further discussed in Section 4.9.7.
- Maintenance work on all plant and equipment would be confined to standard daytime operational hours where practicable. Any inaudible maintenance could be undertaken beyond these core hours.

4.9.5 Assessment Methodology

4.9.5.1 Operational Noise

Assessment of operational noise was undertaken by Benbow (2014a) using the Concawe algorithm within SoundPLAN v7.2. The model allows for the prediction of noise, at specified receptors, by calculating the contribution of each noise source. The Sound Power Level of each noise source on the Stage 2 Site was measured by Benbow (2014a).

Noise modelling was carried out for three operating scenarios, representative of Stages A, C and E of the extraction sequence (see **Figure 2.6**). **Figures 4.45** to **4.48** illustrate the locations of the noise sources for each scenario, each of which are modelled as occurring concurrently for 100% of a 15 minute averaging period. Based on the local meteorological conditions discussed in Section 4.3.2.3, each scenario was modelled under the following conditions.

- Condition A – neutral (calm) conditions.
- Condition B – 3°C/100m temperature inversion with 2m/s wind from source to receiver.
- Condition C – 3m/s wind blowing from northwest.

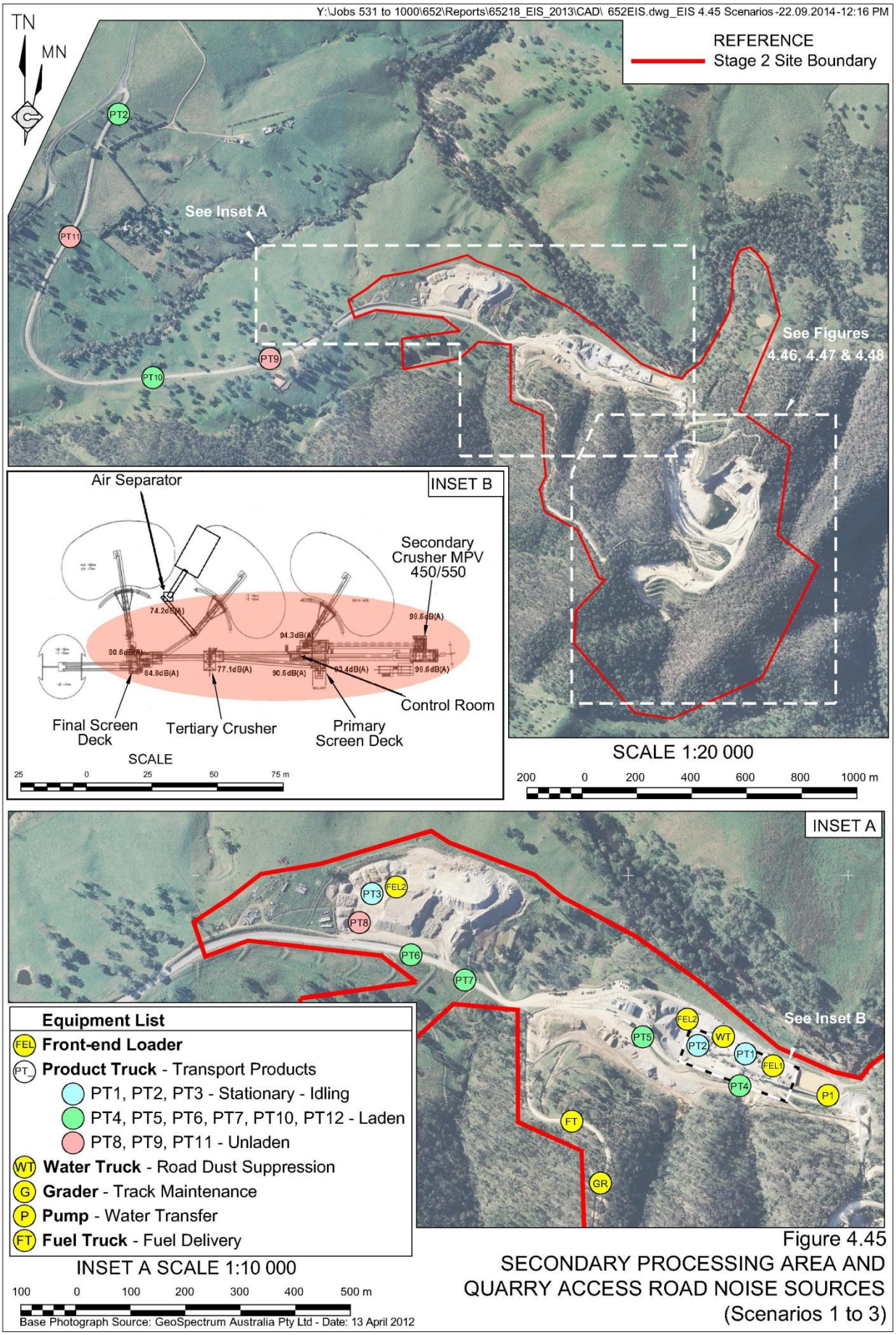


Figure 4.45
SECONDARY PROCESSING AREA AND QUARRY ACCESS ROAD NOISE SOURCES (Scenarios 1 to 3)

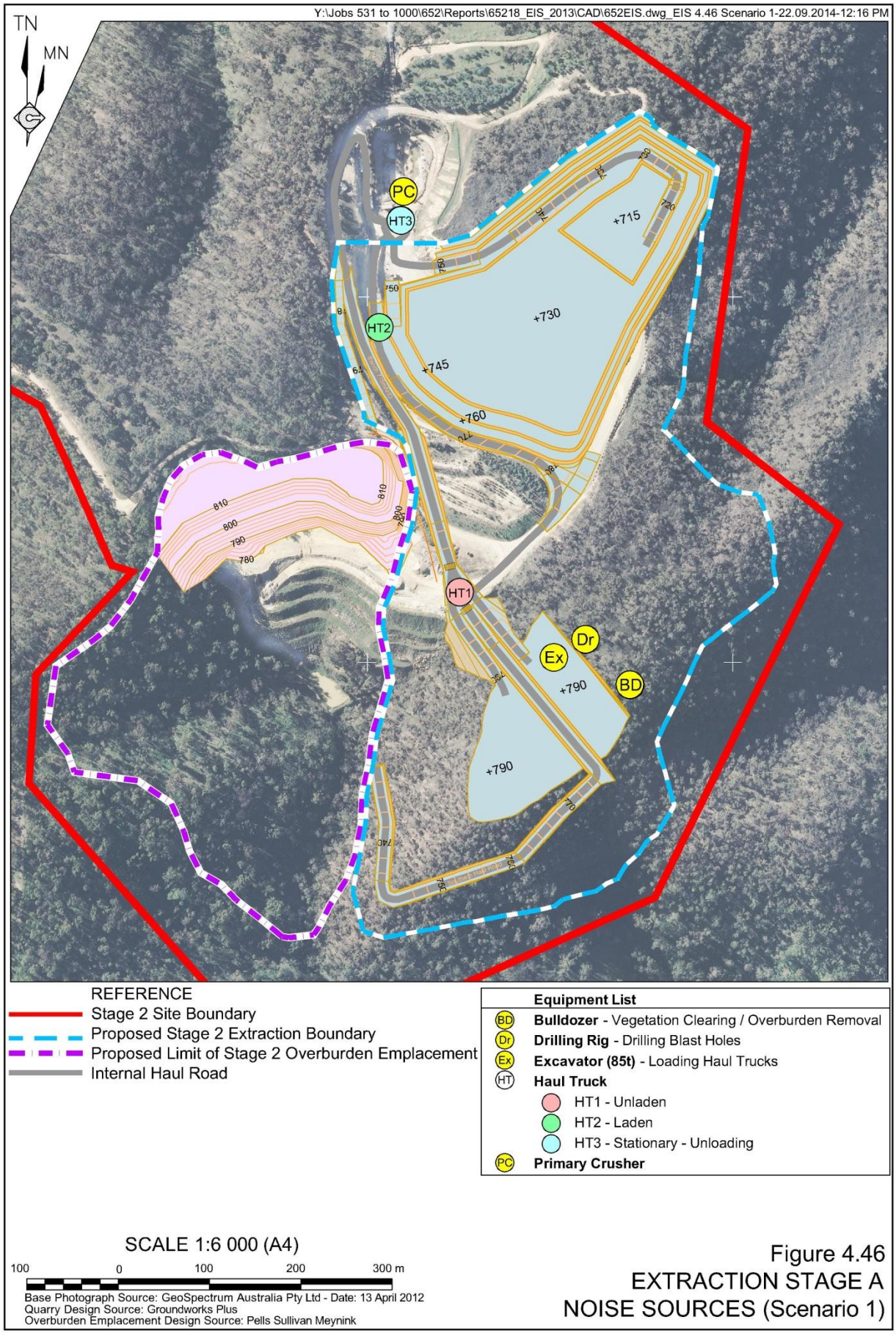


Figure 4.46
EXTRACTION STAGE A
NOISE SOURCES (Scenario 1)

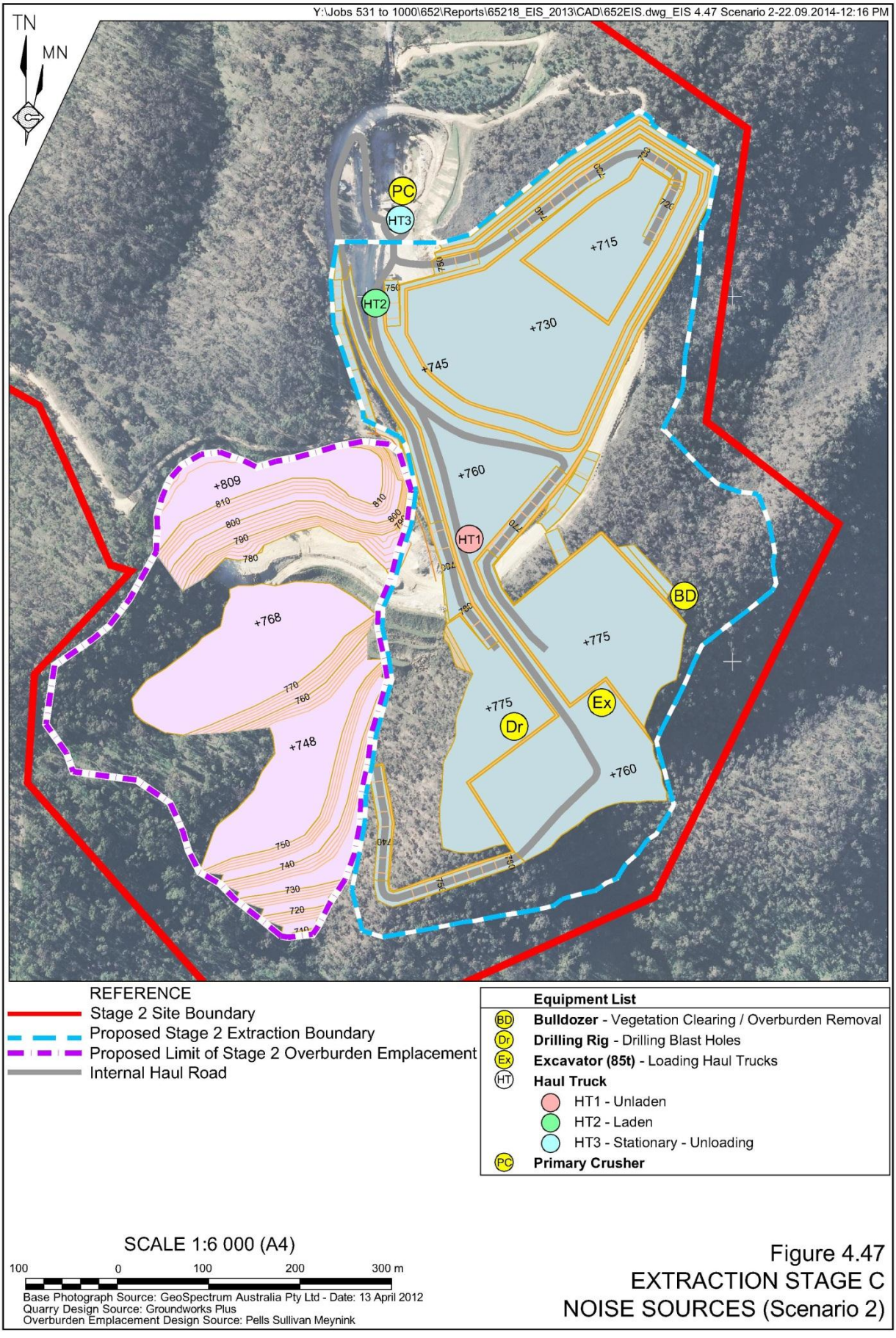


Figure 4.47
EXTRACTION STAGE C
NOISE SOURCES (Scenario 2)

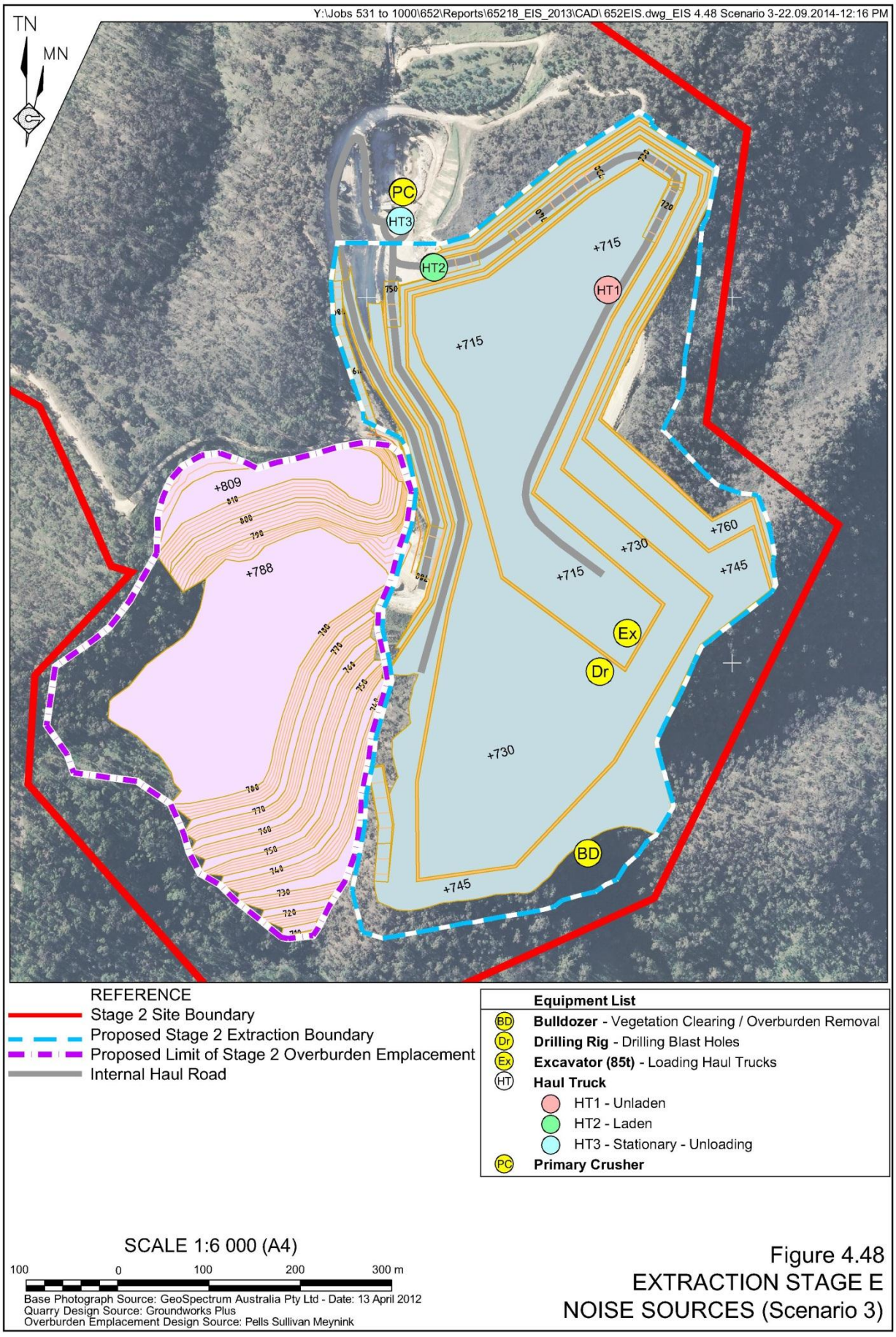


Figure 4.48
EXTRACTION STAGE E
NOISE SOURCES (Scenario 3)

Considering the nominated noise sources, meteorological conditions and local topography, the $L_{Aeq(15\ minute)}$ noise level[9] received at 11 representative residential receivers closest to the Stage 2 Site was predicted.

4.9.5.2 Operational Noise on Vacant Lands

For the purpose of assessing impacts on vacant land surrounding the Stage 2 Site, the most proximal undeveloped blocks to the north, southeast and southwest were identified and included in the noise model prepared by Benbow (2014a) as receptors. **Table 4.37** and **Figure 4.44** identify the location of the vacant land, with noise levels predicted for each of the three operating scenarios described in Section 4.9.5.1.

Table 4.37
Vacant Lands

Reference[1]	Property	Approximate Distance
L17 and L19	Lot 11 and Lot 4 DP1113701	1 000m
L32	Lot 2 DP870895	1 650m
L50 (Subdivision)	Various lot subdivisions	2 300m
Note 1: see **Figure 4.44**		

4.9.5.3 Traffic-related Noise

Benbow (2014a) also used SoundPLAN v7.2 to model the traffic-related noise levels likely to be received at residential receivers adjoining the transport route incorporating the following inputs / assumptions.

- A total of 440 truck movements have been considered when calculating the $L_{Aeq(15\ hour)}$ and 60 truck movements have been considered between a shoulder period of 5:00am and 7:00am (the only period during the night time when transport is proposed). This equates to the maximum number of truck movements anticipated from the Proposal, which would be reached only occasionally (two or three periods) during the life of the Proposal (see Section 2.8.3).
- A shoulder period was applied to the assessment of night time noise, in accordance with guidance provided by the RNP, to more accurately assess road traffic noise during the night time period (which would only occur between the hours of 5:00am and 7:00am).
- Average truck speed of 50km/h. This assumption was applied as Benbow (2014a) believe this to be a reasonable average when considering the hills and curves of Jenolan Caves Road between the Austen Quarry and the Great Western Highway. Furthermore, a reduced average speed will overestimate the predicted traffic noise contribution and is therefore considered conservative.

[9] L_{Aeq} refers to the Equivalent Continuous Level of noise, i.e. it represents the equivalent continuous sound which would contain the same sound energy as generated by noise which varies over time. Therefore, the $L_{Aeq(15\ minute)}$ effectively provides the average noise level over a 15 minute period.

The distance from the façade of relevant residences along Jenolan Caves Road (refer to **Table 4.36**) was again used in the calculation of an equivalent continuous noise level for the daytime ($L_{Aeq(15\ hour)}$) and night time ($L_{Aeq(9\ hour)}$) periods, as well as a maximum ($L_{A(max)}$) noise level for the night time period, for the combined background and Proposal-related traffic.

4.9.5.4 Blasting

Analysis of the results of blast monitoring undertaken throughout the life of the Austen Quarry to date has been used to assess the likely impact of blasting against the criteria nominated in Section 4.9.3.4.

4.9.6 Assessment of Impacts

4.9.6.1 Operational Noise

The predicted noise levels for each scenario under the assessed meteorological conditions for Scenarios 1 to 3 are provided in **Table 4.38** for the 11 representative privately owned residential receptors (see **Figure 4.44**).

It is noted that compliance with the Project Specific Noise Criteria is predicted at all receivers except under temperature inversion conditions for Scenarios 1 and 2 at Receiver R31 and Receiver R48. The maximum predicted exceedance at Receiver R48 is 0.3dB(A) and is considered by Benbow (2014a) to be negligible given the conservative approach to the assessment. The maximum predicted exceedance at Receiver R31 is 1.3dB(A) and in reality unlikely to occur for the following reasons.

- The prediction assumes that a temperature inversion occurs concurrently with wind blowing from the north or northeast. As illustrated by **Figure 4.1**, northerly and northeasterly winds are very infrequent feature of the local setting. The neutral weather condition and wind blowing from northwest condition represent the conditions which will be present for the majority of the time.
- The prediction assumes all equipment and vehicles located within the processing area, extraction area and stockpile area are operating at full capacity and simultaneously. This circumstance is unlikely as from the commencement of Stage 2 Site operation at 6:00am, various inspections, meetings and other activities generally occur such that operation at full capacity is unlikely before 7:00am.

On further analysis of the predicted exceedance at Receiver R31, Benbow (2014a) identifies that the main operational noise contribution would be the drill rig. The Applicant notes that drilling rarely commences before 7:00am (i.e. outside the period when inversions are likely to be at their strongest). Acknowledging the possible exceedance of noise criteria under a combination of inversion and other noise enhancing conditions, the Applicant has committed to undertaking a noise compliance assessment during the first twelve months of operations. This noise compliance assessment would review the operational noise levels at Receiver R31 during periods of early morning drilling. Should non-compliance with criteria be identified, the Applicant would implement an additional restriction on operations with drilling to be prohibited before 8:00am during those months when inversion conditions prevail (nominally March to September). Should further non-compliance with criteria be recorded, alternative measures such as the use of mobile noise barriers, would be considered.

Table 4.38
Predicted Operational Noise Levels

Receiver	Neutral Weather Conditions				Temperature Inversion[1]		Northwest (3m/s) Wind			
	Day	Evening	Night	Night	Night	Night	Day	Evening	Night	Night
	L_{Aeq}			L_{Amax}	L_{Aeq}	L_{Amax}	L_{Aeq}			L_{Amax}
Scenario 1 – Stage A										
R9	<20	<20	<20	35.7	25.6	41.4	25.8	25.8	25.8	41.6
R16	22.0	22.0	22.0	22.3	28.0	28.3	27.9	27.9	27.9	28.3
R22	<20	<20	<20	<20	<20	22.5	<20	<20	<20	<20
R23	24.9	24.9	24.9	36.7	30.7	42.3	<20	<20	<20	29.3
R24A	28.2	28.2	28.2	43.3	34.0	48.7	22.1	22.1	22.1	36.7
R24B	27.4	27.4	27.4	42.8	33.3	48.2	21.3	21.3	21.3	36.2
R27	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
R31	30.5	30.5	30.5	45.2	**36.1**	50.0	31.7	31.7	31.7	46.0
R48	29.5	29.5	29.5	40.3	35.3	45.8	28.6	28.6	28.6	41.4
R49	20.2	20.2	20.2	28.2	26.2	33.5	23.4	23.4	23.4	33.4
R54	29.9	29.9	29.9	35.8	34.7	40.5	32.0	32.0	32.0	33.8
Scenario 2 – Stage C										
R9	20.5	20.5	20.5	35.7	26.6	41.4	26.8	26.8	26.8	41.6
R16	23.9	23.9	23.9	<20	30.1	20.0	30.0	30.0	30.0	20.0
R22	<20	<20	<20	<20	<20	22.5	<20	<20	<20	<20
R23	24.9	24.9	24.9	36.7	30.7	42.3	<20	<20	<20	29.3
R24A	28.1	28.1	28.1	43.3	33.9	48.7	22.0	22.0	22.0	36.7
R24B	27.4	27.4	27.4	42.8	33.2	48.2	21.2	21.2	21.2	36.2
R27	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
R31	30.7	30.7	30.7	45.2	**36.3**	50.0	31.7	31.7	31.7	46.0
R48	29.5	29.5	29.5	40.3	35.2	45.8	28.6	28.6	28.6	41.4
R49	<20	<20	<20	28.2	25.8	33.5	23.2	23.2	23.2	33.4
R54	29.9	29.9	29.9	35.8	34.7	40.5	32.0	32.0	32.0	33.8
Scenario 3 – Stage E										
R9	<20	<20	<20	35.7	20.5	41.4	22.2	22.2	22.2	41.6
R16	<20	<20	<20	<20	23.9	20.0	<20	<20	<20	20.0
R22	<20	<20	<20	<20	<20	22.5	<20	<20	<20	<20
R23	25.1	25.1	25.1	36.7	25.2	42.3	<20	<20	<20	29.3
R24A	27.9	27.9	27.9	43.3	28.1	48.7	21.8	21.8	21.8	36.7
R24B	27.0	27.0	27.0	42.8	27.4	48.2	20.9	20.9	20.9	36.2
R27	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
R31	27.3	27.3	27.3	45.1	30.7	50.0	31.4	31.4	31.4	46.0
R48	29.3	29.3	29.3	40.0	35.0	45.8	28.5	28.5	28.5	41.4
R49	<20	<20	<20	28.2	<20	33.5	22.9	22.9	22.9	33.4
R54	29.9	29.9	29.9	45.2	34.6	40.5	32.0	32.0	32.0	33.8

Note 1: In accordance with the INP, temperature Inversion assessed during night time periods only.

Source: Modified after Benbow (2014a) - Tables 5-3 to 5-5

$L_{A(max)}$ noise levels are not predicted to exceed 46dB(A) at any of the closest receivers considered.

Benbow (2014a) completed a frequency analysis for the predicted noise levels and confirmed that no tonal components or low frequency noise were found at the residential receptors considered.

4.9.6.2 Operational Noise at Vacant Lands

Noise contour maps for each of the vacant lots identified on **Figure 4.44** under each of the operational scenarios are provided as *Figures 5.8* to *Figure 5.19* of Benbow (2014a).

In summary, the predicted noise levels at each of the receptors identified as vacant land did not exceed the Project Specific Noise Criteria levels by more than 15%. Notable results are as follows.

- Exceedance over approximately 8% to 10% of the land at Receptor L17 (Scenario 2).
- Exceedance over approximately 10% to 15% of the land at Receptor L50 (all scenarios).
- Exceedance over approximately 1% of the land at Receptor L32 (Scenario 1).

Noise levels for all other scenarios were within the Project Specific Noise Criteria for 100% of the area. Compliance with the DP&E and EPA applied criteria (see Section 4.9.3.2) would be achieved.

4.9.6.3 Road Traffic Noise

Based on the noise monitoring undertaken at the Locations A and B (see **Figure 4.44**), Benbow (2014a) was able to calculate the existing road traffic noise at five residential receivers between 7m and 1 380m from the road edge. The contribution of traffic noise from the Proposal was also calculated and **Table 4.39** presents the calculated noise level, additional contribution from quarry generated traffic, cumulative road traffic noise levels for the day time and night time periods and maximum noise level for the night time period.

Table 4.39
Predicted Road Traffic Noise Levels

Receiver	Proposal Contribution		Non-Proposal Contribution		Cumulative Road Traffic Noise Levels				Sleep Disturbance L_{Amax}
	Day $L_{Aeq\ (15\ hour)}$	Night $L_{Aeq\ (9\ hour)}$	Day $L_{Aeq\ (15\ hour)}$	Night $L_{Aeq\ (9\ hour)}$	Day $L_{Aeq\ (15\ hour)}$	Increase	Night $L_{Aeq\ (9\ hour)}$	Increase	
R22	35.7	27.9	46.3	36.1	46.7		36.7		64.6
R23	34.2	26.4	44.6	34.5	45.0		35.1		63.1
R24A	57.1	49.3	67.7	57.5	68.1		58.1		86.0
R24B (grassed area)	57.1	49.3	67.7	57.7	67.8	+0.3	58.3	+0.2	86.0
R24B (cottages)	53.0	45.2	63.3	53.4	63.7		54.0		81.9
R48	41.8	34.0	52.2	42.1	52.6		42.7		70.7

Source: Modified after Benbow (2014a) - Table 6-1.

The traffic generated by the Proposal would result in an increase in road traffic noise of only 0.3dB(A) during the day time and 0.2dB(A) at night. Therefore, the Proposal would comply with the total traffic noise criteria where existing road traffic noise is below the criteria (R22, R23 and R48) or relative increase noise criteria where existing road traffic noise is above the criteria (R24A and R24B).

Benbow (2014a) notes that given the proximity of some of the residences to the transport route, most of the vehicles that drive along Jenolan Caves Road would exceed the sleep disturbance criteria with a noise logger placed 10m from Jenolan Caves Road identifying numerous night-time truck movements events with L_{Amax} levels exceeding 55dB(A). Benbow (2014) concludes that elevated L_{Amax} noise levels from vehicle pass-bys are an existing feature of the noise environment for residences adjoining Jenolan Caves Road (and the Great Western Highway) and that the Proposal generated traffic would not add significantly to this.

While the assessment of Benbow (2014a) is considered an accurate reflection of the likely road traffic noise to be generated over the life of the Proposal, road noise was also considered with all 500 truck movements during the daytime period. Notably, over a 15 hour period this would only result in an overall increase of the Hy-Tec-related $L_{Aeq(15hour)}$ road traffic noise level of approximately 0.5dB(A). This is considered to be negligible for the purpose of this assessment considering that the noise contribution from the site-related truck movements is well below the existing road traffic noise levels.

4.9.6.4 Blasting

On the basis that the quarry easily currently complies with air blast overpressure and ground vibration criteria (the blast monitor at Hartley has rarely if ever registered overpressure or vibration), and that blasting will remain consistent with current size and practice, Benbow (2014a) assesses that these levels would continue to readily meet the levels stipulated in EPL 12323.

4.9.7 Monitoring

4.9.7.1 Noise

Based on the recommendation of Benbow (2014a), the Applicant proposes to commission a program of attended noise monitoring within 12 months of approval to validate the predictions of the noise modelling and confirm compliance with operational noise criteria.

On the basis that this illustrates noise levels well below the Project Specific Noise Criteria, it is proposed to only undertake further noise monitoring in response to substantiated noise-related complaint.

4.9.7.2 Blasting

The Applicant proposes to continue to monitor blasts at the long term blast monitoring location in the historic Hartley village.

4.10 AIR QUALITY

4.10.1 Introduction

The DGRs issued for the Proposal identified "Air Quality and Greenhouse Gases" as key issues requiring that the "EIS include a quantitative assessment of the potential:

- *construction and operational impacts, with a particular focus on dust emissions;*
- *dust generation from blasting and processing, as well as diesel emissions;*
- *reasonable and feasible mitigation measures to minimise dust and diesel emissions, including evidence that there are no such measures available other than those proposed; and*
- *monitoring and management measures, in particular real-time air quality monitoring.*
- *Scope 1, 2 and 3 greenhouse gas emissions and the assessment of reasonable and feasible measures to minimise greenhouse gas emissions and ensure energy efficiency.*

Additional matters for consideration in preparing the EIS were also provided in the correspondence attached to the DGRs from the EPA which related to air quality impacts and requested that: *the Proponent must carry out an Air Quality/Odour Assessment and Modelling that addressed:*

- *Point source emissions from plant and equipment and potential impacts.*
- *Fugitive source emissions from exposed areas and other surfaces.*
- *Mitigation and management strategies.*

Also appended to the DGRs is correspondence from DTIRIS requesting detailed information and assessment related to dust impacts and associated mitigation measures.

Based on the risk analysis undertaken for the Proposal (Section 3.3.1 and **Table 3.9**), the potential impacts relating to air quality and their risk rankings (in parenthesis) after the adoption of pre-existing or standard mitigation measures are as follows.

- Nuisance/amenity impacts from dust deposited on window sills, cars, surfaces etc. (medium risk).
- Adverse health impacts (if PM_{10} levels are excessive) (medium risk).
- Increased community and regulatory scrutiny (medium risk).
- Reduced local water quality caused by airborne solids (medium risk).
- Reduced condition of local vegetation or value as fauna habitat (low risk).
- Contribution to greenhouse effect (medium risk).

A review of the attributed risk levels, following the adoption of the recommended operational safeguards and controls, is provided in Section 6.2.1 and **Table 6.1**.

The air quality impact assessment for the Proposal was undertaken by Mr Duke Ismael of Benbow Environmental. The assessment is presented as Part 7 of the *Specialist Consultants Studies Compendium* and is referred to hereafter as "Benbow (2014b)". This subsection of the EIS provides a summary of the air quality impact assessment, concentrating on those matters raised in the DGRs and related requirements provided by various government agencies. A consolidated list of the identified requirements and where each is addressed is presented in **Appendix 3**.

4.10.2 Background Air Quality

4.10.2.1 Air Emissions

Dust generation is the main air quality issue relevant to the Proposal in terms of air quality. Airborne contaminants that can be inhaled into the human respiratory system are classified on the basis on their physical properties such as being gases, vapours or particulate matter. Particulate matter refers to a category of airborne particulates, typically less than 30 microns (µm) in diameter and ranging down to 0.1µm. This type of dust is termed Total Suspended Particulate (TSP).

Emissions of particulate matter less than 10µm (termed PM_{10}) are considered important pollutants to human health as their ability to penetrate the respiratory system can cause cardiovascular and respiratory diseases, pulmonary and heart diseases, as well as reduced lung capacity.

Particles that are too large to remain in suspension in the air are referred to as 'deposited dust' and are typically in the order of greater than 35µm in diameter. Even though these particles lack the ability to cause significant harm to humans, they can contribute to reductions in amenity and therefore are considered within the assessment, e.g. dust on window sills or cars.

Greenhouse gases would be produced as a consequence of the Proposal primarily through the use of diesel fuel to power generators and mobile equipment on the Stage 2 Site, and fumes from blasting. Greenhouse gases would also be produced indirectly as a consequence of the Proposal through the extraction and processing of raw materials to produce diesel and consumption of diesel by road trucks involved in product transportation.

4.10.2.2 Local Sources

Discounting minor dust and other air emissions from vehicle traffic and other residential-based activities (which are generally short-lived and localised emissions), Benbow (2014b) identifies quarry operations as the only significant source of dust and particulate emissions within the local setting. This conclusion is based on site visits undertaken by Benbow who report in Benbow (2014b) "*the area within proximity to the quarry is considered to show no visible plumes of dust emanating from the quarry or from other sources or activities in the area, nor could large amount of deposits be observed beyond the entrance of the site, which could be attributable to Austen Quarry*".

It is noted that local agricultural activities such as cattle grazing, cultivation, etc. would generate dust. Benbow (2014b) note that these activities would make minimal contribution to the overall particulate matter concentrations of the local setting. These activities have short-lived impacts impacting only a few metres from the source. In contrast, the dust and particulate impacts from the quarry operations are predicted to reach up to hundreds of metres. On this

basis, the magnitude of impact from the quarry will define the overall background dust and particulate concentration at the locations surrounding the Stage 2 Site potentially affected by quarry emissions. As a consequence, Benbow (2014b) has not established background concentrations for the air emissions noted in Section 4.10.2.1, with the assessment to rely on the predicted emissions directly attributable to the Proposal.

Notably and notwithstanding the above, dust deposition monitoring undertaken at three sites to the south and east of the Stage 2 Site since 2003 (see **Figure 4.49**) illustrates relatively low dust deposition levels (see **Table 4.40**).

Table 4.40
Dust Deposition Monitoring Result Summary

	Location[1]								
	AQD-1 Sawmill Paddock			**AQD-2 Baaners Lane**			**AQD-3 Bald Hill**		
Period (July – June)	**Insoluble Solids (g/m^2/month)**	**Ash**		**Insoluble Solids (g/m^2/month)**	**Ash**		**Insoluble Solids (g/m^2/month)**	**Ash**	
		g/m^2/ month	**%**		**g/m^2/ month**	**%**		**g/m^2/ month**	**%**
2003-2004	0.7	0.3	42.2	1.2	0.5	37.6	0.9	0.2	23.3
2004-2005	0.7	0.5	42.6	0.7	0.3	28.2	2.6	1.5	35.6
2005-2006	2.5	1.7	69.5	0.7	0.4	59.4	2.6	1.5	59.1
2006-2007	2.4	0.7	30.7	0.5	0.4	66.0	2.6	2.1	81.4
2007-2008	2.7	1.2	44.4	0.7	0.4	57.1	1.5	0.6	40.0
2008-2009	4.0	0.5	11.6	0.6	0.4	21.2	1.0	0.6	28.6
2009-2010	2.6	1.7	66.1	2.1	1.9	27.3	2.4	2.4	27.0
2010-2011	0.8	0.6	69.6	0.4	0.2	10.6	1.1	0.4	13.6
2011-2012	0.7	0.2	35.0	0.4	0.1	34.7	0.2	0.2	100
2012-2013	1.1	0.4	39.4	0.8	0.3	40.0	0.6	0.2	36.2
Total Average	1.9	0.8	49.2	0.8	0.5	39.9	1.6	1.1	49.4

Note 1: See **Figure 4.49** for gauge locations

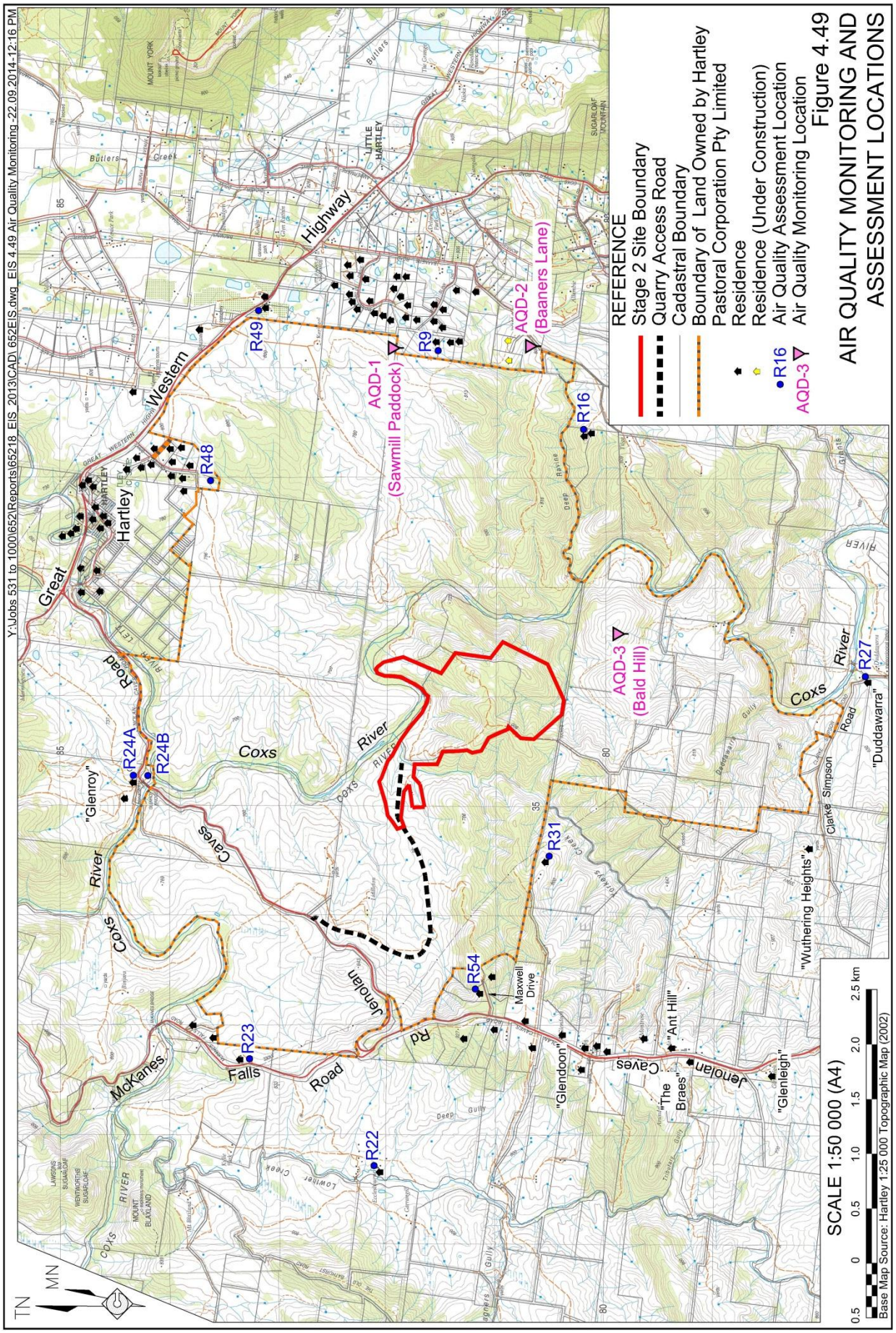
Source: Hy-Tec

4.10.3 Potential Sources of Air Contaminants

4.10.3.1 Particulate Emissions

Activities of the Proposal that would generate particulate emissions are related to the following specific operational and on-site transportation activities.

- Extraction activities (drilling/blasting, excavator, front-end loaders, bulldozers, trucks loading).
- Crushing and screening (dry only).
- Transfer of materials through conveyors.
- Vehicle movements on unsealed roads.
- Product loading and despatch.
- Wind erosion from disturbed areas.


Y:\Jobs 531 to 1000\652\Reports\652018 EIS 2013\CAD\ 652EIS.dwg EIS 4.49 Air Quality Monitoring -22.09.2014-12:16 PM
REFERENCE
Stage 2 Site Boundary
Quarry Access Road
Cadastral Boundary
Boundary of Land Owned by Hartley Pastoral Corporation Pty Limited
Residence
Residence (Under Construction)
Air Quality Assessment Location
Air Quality Monitoring Location
Figure 4.49
AIR QUALITY MONITORING AND ASSESSMENT LOCATIONS
AQD-1 (Sawmill Paddock)
AQD-2 (Baaners Lane)
AQD-3 (Bald Hill)
R9
R16
R22
R23
R24A
R24B
R27
R31
R48
R49
R54
Great Western Highway
Hartley
Great Western Road
Coxs River
Caves Road
Jenolan Caves Road
McKanes Falls Road
Maxwell Drive
"Glenroy"
"Glendoon"
"Ant Hill"
"The Braes"
"Glenleigh"
"Wuthering Heights"
"Duddawarra"
Clarke Simpson
Butlers Creek
Lowther Creek
SCALE 1:50 000 (A4)
0.5 0 0.5 1.0 1.5 2.0 2.5 km
Base Map Source: Hartley 1:25 000 Topographic Map (2002)
TN MN

Attachment 2 of Benbow (2014b) provides an inventory of predicted dust emission from each of these sources (based on various assumptions regarding emission factors, locations and periods of operation or occurrence).

4.10.3.2 Greenhouse Gas and Other Gas Emissions

The primary source of greenhouse gas emissions from the Proposal would be direct emissions as a result of the combustion of diesel by on-site generators and mobile equipment, and also, to a minor extent, emissions from blasting. Greenhouse gases would also be generated indirectly by the Proposal through the extraction and processing of raw materials to produce the diesel fuel consumed on the Stage 2 Site.

Although carbon dioxide (CO_2) would be the principal gas produced, greenhouse gases emitted as a result of the Proposal would also include carbon monoxide (CO), methane (CH_4), oxides of nitrogen (NO_x), SO_2 and non-methane volatile organic compounds (NMVOCs). All greenhouse gas emission levels have been correlated and expressed in CO_2 equivalent units by way of an index entitled the 'Global Warming Potential' (GWP) created by the Intergovernmental Panel on Climate Change (IPCC 1996).

4.10.4 Assessment Criteria

Goals Applicable to PM_{10}

The NSW EPA PM_{10} assessment goals, as expressed in the "*Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*" (DEC 2005), are:

- a 24 hour maximum of 50µg/m^3; and
- an annual average of 30µg/m^3.

Goals Applicable to Total Suspended Particles

The annual goal for Total Suspended Particles (TSP), as recommended by the National Health and Medical Research Council (NHMRC), is quoted as 90µg/m^3.

Goals Applicable to $PM_{2.5}$

The ambient Air Quality NEPM was amended in 2003 to extend its coverage to $PM_{2.5}$. This document references the following goals, namely:

- a 24-hour maximum of 25µg/m^3; and
- an annual average of 8µg/m^3.

Goals Applicable to Deposited Dust

The EPA identifies that dust-related nuisance occurs when annual average levels exceed 4g/m^2/month and is subsequently the goal applicable to the Proposal.

As for noise emissions, the DP&E and EPA have historically required air quality criteria be complied with at discrete receivers, e.g. residences, as well as over at least 75% of vacant land with the potential to be developed for the purpose of a residence.

4.10.5 Environmental Controls and Management

The Applicant proposes to continue its mitigation practices that limit the generation of dust from the potential sources of air contaminants identified in Section 4.4.3. Current dust mitigation practices are as follows.

- During periods of extended dry weather and/or high winds, when dust emissions have the potential to occur as a result of quarrying activities, dust is managed through the use of a water truck to supress emissions.
- The primary crushing station is located within the extraction area below surrounding ground level.
- The primary conveyor between the Primary Crushing Station and secondary processing area reduces the distance haul trucks are required to travel.
- Conveyor transfer points are partially enclosed.
- The Quarry Access Road is sealed from Jenolan Caves Road to Yorkeys Creek.
- All other internal roads are surfaced with well graded materials to limit dust lift-off.
- All vehicles travelling on internal unsealed roads are limited to a speed appropriate for the conditions and safety, i.e. less than 40km/hr.
- Load sizes would be limited to ensure product does not extend above truck sidewalls.
- Care would be taken to avoid spillage during loading.
- Dump heights from trucks, front-end loaders and conveyors would be minimised.
- Exposed areas that are not covered in gravel under dry and windy conditions would be watered (visible dust plumes being the trigger for this action).
- As far as practicable, blasts would be scheduled to avoid higher wind conditions, especially when northerly, northwesterly or northeasterly winds prevail (which may result in a plume of particulate matter towards the most affected receiver to the southwest).
- A complaints management system would be adopted to ensure that all complaints are dealt with through investigation and implementation of corrective treatments.
- Truck queuing, unnecessary idling of trucks and unnecessary trips would be reduced through logistical planning, where possible.

The Applicant has and would continue to implement the following measures to minimise the emissions of greenhouse gases during the ongoing life of the Proposal.

- Optimise quarry design to minimise:
  - travel distances for equipment; and
  - rehandling of overburden, products and by-products.
- Use mobile equipment which is regularly maintained and serviced to maximise efficiency.
- Minimise the quarry footprint to reduce land disturbance and travel distances for mobile equipment.
- Optimise the design of the Processing Plant to:
  - maximise the use of gravity to move material throughout the plant reducing the need for pumping; and
  - maximise the use of energy efficient motors in major items of equipment.

As noted above, the use of conveyors to transfer raw materials from the extraction area to secondary processing area reduces the consumption of diesel fuel by haul trucks and therefore greenhouse gas emissions.

4.10.6 Assessment Methodology

4.10.6.1 Particulate Matter Emissions

The overall approach to the assessment undertaken by Benbow (2014b) follows the EPA published guidelines for the assessment of air pollution sources using dispersal methods (DEC 2005). DEC (2005) specifies how assessments based on the use of atmospheric dispersion models should be completed. The atmospheric dispersion modelling conducted by Benbow (2014b) is based on an advanced modelling system using The Air Pollution Model (TAPM) and CALMET/CALPUFF.

The proposed operations were analysed and estimates of dust emissions for the key dust generating activities made by Benbow (2014b)[10]. Emission factors developed both in Australia, and by the US EPA, were applied to estimate the amount of dust produced by each activity. The emission factors applied are considered to be the most reliable, contemporary methods for determining dust generation rates.

The proposed development sequence of the Proposal has been analysed and detailed dust emissions inventories prepared by Benbow (2014b) for the same three operational scenarios used for noise modelling (see **Figures 4.45** to **4.48**). These years are considered to be representative of the various stages of operations throughout the life of the Proposal.

[10] Particulate emissions from Site diesel emissions were not included by Benbow (2014b) as vehicles on the Great Western Highway and Jenolan Caves Road generate far greater diesel emissions. Further, the separation distances of Site diesel emissions from receivers is greater than from road generated sources.

It is noted that while the same operational scenarios have been used for the noise and air quality assessments, some differences in emission sources are noted. These relate to those sources of noise which do not result in air emissions and include the following.

- Water truck. This is a negligible source of dust due to its low speed and the fact it traverses dampened road surfaces.
- Diesel pump. The diesel pump emits no dust and no particulate emissions of any consequence.
- Air separator. This is an enclosed process and has no uncontrolled dust emissions.

Other noise sources identified for various plant operation, e.g. unloading and manoeuvring haul truck, laden and unladen truck, refer to differing noise emissions. Dust emissions are attributed to each item of plant or mobile equipment in accordance with the dust emission inventory.

Dispersion modelling predictions incorporating the generated meteorological model into the CALPUFF dispersion model program for dust deposition, TSP and PM_{10} concentrations were generated by Benbow (2014b) for the 11 representative privately-owned residences identified in **Figure 4.49**.

To assess the impact of the Proposal, the incremental contribution of dust, TSP, PM_{10} and $PM_{2.5}$ predicted at each representative residence was compared against the air quality criteria nominated in Section 4.10.4. Notably, when considering maximum PM_{10} 24 hour emissions Benbow (2014b) adopted two modelling approaches for each of the three operating scenarios.

1. A conservative approach which assumed blasting every day. In doing so, emissions from blasting were considered under the wind conditions of every day of the generated meteorological file.
2. A randomised approach which considers the emissions on only 26 randomly selected days and hours (between 9:00am and 5:00pm). In order to eliminate the bias associated with selecting the number of days throughout the year, the 26 randomly selected days and hours were generated using a computer program through its random number generating module. The emissions were then calculated under the specific wind conditions for that day/hour of the generated meteorological file.

4.10.6.2 Greenhouse Gas Emissions

The World Resources Institute/World Business Council for Sustainable Development 'Greenhouse' Gas Protocol (WRI/WBCSD, 2004) establishes an international standard for accounting and reporting of GHG emissions. The GHG Protocol has been adopted by the International Standard Organisation, endorsed by GHG initiatives (such as the Carbon Disclosure Project) and is compatible with existing GHG trading schemes.

Three 'scopes' of emissions (Scope 1, Scope 2 and Scope 3) are defined for GHG accounting and reporting purposes. Scope 1, or 'direct emissions', refers to those emissions that occur from sources that are owned or controlled by the reporting entity. Scope 2 refers to indirect emissions associated with purchased electricity consumption. Scope 3 refers to those emissions that are a consequence of the operations, but which arise from sources not owned or controlled by the Applicant. Proposal-related GHG sources included in the assessment are as follows.

- Scope 1.
  - On-site diesel use (generators for power to buildings and fixed plant, and consumption by mobile plant).
  - Blasting using ANFO explosive.
- Scope 2: Nil.
- Scope 3: Indirect emissions associated with the extraction and production of diesel.

Inventories of GHG emissions were calculated by Benbow (2014b) using published emission factors. Different gases have different greenhouse warming effects (referred to as global warming potentials) and emission factors take into account the global warming potentials of the gases created during combustion. The estimated emissions are referred to in terms of carbon dioxide equivalent, or CO_2-e, emissions by applying the relevant global warming potential. The greenhouse gas assessment has been conducted using the National Greenhouse Account Factors (NGA Factors) published by the Department of Industry, Innovation, Climate Change, Science, Research and Tertiary Education (DIICCSRTE, 2013).

4.10.7 Assessment of Impacts

4.10.7.1 Deposited Dust and Particulate Matter Impacts

Residential Receivers

Tables 4.41 and **4.42** summarise the annual average predicted particulate matter and deposited dust concentrations at 11 representative residential receivers surrounding the Stage 2 Site (see **Figure 4.49**) for the three scenarios noted in Section 4.4.6.1 and illustrated on **Figures 4.45** to **4.48**. **Table 4.41** presents the annual average incremental contribution for PM_{10}, $PM_{2.5}$, TSP of the Proposal and **Table 4.42** presents the maximum 24 hour concentration of PM_{10} and $PM_{2.5}$ received at the 11 representative receivers, under the 365 day and 26 random day models discussed in Section 4.10.6.1.

The results of the dispersion modelling presented in **Table 4.41** illustrate that the emissions attributable to the Proposal would comply with the annual average air quality criteria.

The results of the dispersion modelling presented in **Table 4.42** illustrate maximum 24-hour $PM_{2.5}$ concentrations are all predicted to be well below the nominated criteria.

When considering the 24-hour maximum PM_{10} results, the incremental emission attributable to the Proposal approached the criteria, most notably at Residence R31, where a maximum 24-hour concentration of 35.4µg/m^3, 48.4µg/m^3, and 39.9µg/m^3 was predicted for Scenarios 1, 2 and 3 respectively under the 365 blast days model. On consideration of a more realistic model (considering 26 random blast events), the predicted maximum 24-hour PM_{10} concentration was reduced for all three scenarios to 34.0µg/m^3, 42.8µg/m^3, and 20.4µg/m^3.

Table 4.41
Summary of Annual Average Particulate Matter Concentration

Residence[1]	PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)	TSP ($\mu g/m^3$)	Dust Deposition (g/m^2/month)
Criteria	***30***	***8***	***90***	***4***
Scenario 1				
R9	4.2	0.41	4.21	<0.01
R16	9.0	0.77	9.01	0.01
R22	3.6	0.14	3.61	<0.01
R23	5.1	0.25	5.11	<0.01
R24A	4.0	0.47	4.08	0.04
R24B	4.0	0.47	4.10	0.05
R27	3.1	0.20	3.11	<0.01
R31	8.6	0.90	8.64	0.02
R48	4.7	0.25	4.71	<0.01
R49	2.6	0.16	2.61	<0.01
R54	11.0	0.38	11.01	0.01
Scenario 2				
R9	0.6	0.43	1.2	<0.01
R16	1.2	0.85	2.4	<0.01
R22	0.2	0.14	0.4	<0.01
R23	0.4	0.25	0.8	<0.01
R24A	0.6	0.47	1.2	0.01
R24B	0.3	0.22	0.6	<0.01
R27	0.6	0.47	1.2	0.01
R31	1.1	0.91	1.2	<0.01
R48	0.3	0.25	0.6	<0.01
R49	0.2	0.16	0.4	<0.01
R54	0.5	0.38	1.0	<0.01
Scenario 3				
R9	0.3	0.45	0.31	<0.01
R16	0.6	0.88	0.61	<0.01
R22	0.2	0.14	0.21	<0.01
R23	0.3	0.25	0.31	<0.01
R24A	0.5	0.49	0.51	0.01
R24B	0.4	0.49	0.41	0.01
R27	0.2	0.21	0.21	<0.01
R31	1.1	0.91	1.11	<0.01
R48	0.2	0.26	0.21	<0.01
R49	0.2	0.17	0.21	<0.01
R54	0.4	0.39	0.41	<0.01

Note 1: See **Figure 4.48** for Representative Residence Locations.

Source: Modified after Benbow (2014b) – Tables 4-5, 4-6 & 4-7.

Table 4.42
Summary of Maximum 24-Hour PM_{10} and $PM_{2.5}$ Concentrations

Residence*	PM_{10} ($\mu g/m^3$)		$PM_{2.5}$ ($\mu g/m^3$)	
Criteria	**50**		**25**	
Blast Days	**365**	**26**	**365**	**26**
Scenario 1				
R9	13.3	18.1	0.73	1.66
R16	28.3	32.4	1.48	1.62
R22	11.4	8.0	0.44	0.90
R23	13.9	20.9	0.68	1.24
R24A	12.4	9.1	0.77	0.01
R24B	12.9	9.6	0.77	0.01
R27	7.3	10.7	0.46	0.06
R31	35.4	34.0	1.58	1.99
R48	12.1	9.5	0.65	0.16
R49	6.6	20.5	0.37	0.08
R54	23.3	12.7	1.33	1.16
Scenario 2				
R9	12.8	16.2	0.73	1.75
R16	25.5	25.5	0.46	2.50
R22	9.3	5.6	0.72	0.66
R23	13.1	23.1	0.76	1.77
R24A	11.8	8.5	0.76	0.06
R24B	11.7	8.4	0.46	0.06
R27	7.5	15.1	0.46	0.09
R31	48.4	42.8	1.63	1.51
R48	12.9	9.7	0.64	0.12
R49	8.5	18.1	0.36	0.11
R54	24.4	13.9	1.33	1.20
Scenario 3				
R9	6.6	11.9	0.78	<0.01
R16	10.9	15.5	1.62	<0.01
R22	6.0	2.8	0.46	<0.01
R23	8.3	16.3	0.7	<0.01
R24A	8.5	5.1	0.79	<0.01
R24B	8.8	5.4	0.79	<0.01
R27	4.0	7.0	0.48	<0.01
R31	39.9	20.4	1.68	<0.01
R48	7.2	7.6	0.66	<0.01
R49	4.2	15.5	0.38	<0.01
R54	18.2	5.8	1.32	<0.01

* See **Figure 4.48** for Representative Residence Locations.

Source: Modified after Benbow (2014b) – Tables 4-9, 4-10 & 4-11.

Notably, no exceedances to the NSW EPA-derived assessment criteria have been predicted, even under the conservative modelling scenarios chosen. The predicted impacts illustrate that blasting is the critical activity on the Stage 2 Site likely to generate elevated PM_{10} emissions at surrounding residences. Due to the low frequency nature of blast events, these are only likely to significantly influence maximum 24-hour concentrations. Benbow (2014b) notes that the actual impact of any blast event would be defined by the wind direction, with winds from the northwest (north and northeast[11]) resulting in elevated PM_{10} concentration at Residences R31 and R16 (the two most affected). When the proportional occurrence of these winds were analysed, these winds were found to represent 45% (see **Figure 4.1**), representing approximately 3 940 hours. Benbow (2014b) note that the second most dominant winds present throughout the year are from the south (a frequency of approximately 17% equating to 1 489 hours) which would reduce the concentration of PM_{10} received at Residences R31 and R16 significantly.

The modelling predictions and additional analyses indicate that through a review of meteorological forecasting, the Applicant would be able to schedule blasts (on most occasions) for periods of emission mitigating wind conditions. Given that both the very conservative 365 day blast model and conservative 26 random blast models predict compliance with criteria, and that the likelihood of blasting coincident with northwesterly winds (which predict the highest PM_{10} concentrations) would be minimised, Benbow (2014b) concludes that sufficient predictive information is provided to indicate future compliance with NSW EPA criteria.

Vacant Land

No vacant land is significantly closer to the air emission sources than the discrete residential receivers assessed. As the predicted emission concentrations at the residential receivers are well below the criteria levels, there is no reason to suggest that emissions would be significantly higher on vacant land of equivalent distance from the sources of emissions.

4.10.7.2 Greenhouse Gas Emissions

The greenhouse gas emissions of the Project have been estimated by considering anticipated activity levels on the Stage 2 Site, standard heat of combustion figures and default emission factors provided in the NGA Factors document (DIICCSRTE, 2013).

Scope 1 Emissions

- **Diesel Usage**

  An average of 840kL and 720kL of diesel would be consumed annually by on-site generators and mobile plant respectively generating 4 209.10t of carbon dioxide equivalents ($CO_{2\text{-}e}$).

- **Explosives**

  Annual use of explosives for blasting has been estimated as 7 200kg of ANFO, generating 1.36t $CO_{2\text{-}e}$.

[11] Combined winds from the north and northeast represent a very small proportion of winds (<5%).

Scope 3 Emissions

- **Diesel Production**

  Based on the quantities of diesel noted above, 319.14t $CO_{2\text{-}e}$ of indirect emissions would be generated from the extraction and production of diesel upstream of the Proposal.

Table 4.43 summarises these calculated greenhouse gas emissions.

Table 4.43
Greenhouse Gas Emissions from the Proposal

Emission Source	Annual Consumption	Emission Factor			Calculated Emissions t CO_{2}-e/annum
		CO_2	CH_4	N_2O	
Scope 1					
Diesel Combustion – Generators	840kL	69.9	0.2	0.5	2 266.44
Diesel Combustion – Mobile Plant	720kL	69.9	0.2	0.5	1 942.66
Explosive Use	7.2t	0.189			1.36
Total Scope 1					4 210.46
Scope 3					
Diesel Production	1 560kL	5.3			319.14
Total Scope 3					319.14
Total					4 529.46
Source: Modified after Benbow (2014b) – Tables 5-1 & 5-2					

The total amount of greenhouse gas emissions from the Proposal is approximately 4 529.5t $CO_{2\text{-}e}$ per annum (0.00412t $CO_{2\text{-}e}$ per tonne of rock product sales). Compared against the 2012 annual estimate for national Australian greenhouse emissions of 551 900 000t $CO_{2\text{-}e}$ (Commonwealth of Australia, 2013), the annual contribution from the Proposal is very small (0.0008%).

4.10.8 Monitoring

The Applicant proposes to continue the program of monthly dust deposition monitoring for the Proposal. The results of all deposited dust monitoring would be documented for the quarry. All results would be included in the Annual Review prepared in compliance with the development consent.

4.11 INDIGENOUS HERITAGE

4.11.1 Introduction

The DGRs issued for the Proposal identified "*Heritage*" as a key issue requiring that the "*EIS include:*

- *an Aboriginal cultural heritage assessment (including both cultural and archaeological significance) which must:*
  - *demonstrate effective consultation with Aboriginal communities in determining and assessing impacts, and developing and selecting mitigation options and measures; and*
  - *outline any proposed impact mitigation and management measures (including an evaluation of the effectiveness and reliability of the measures).*

Additional matters for consideration in preparing the EIS were also provided in the correspondence attached to the DGRs from the OEH which request that "the EIS should contain the following.

- *A description of the Aboriginal objects and declared Aboriginal places located within the area of the proposed development.*
- *A description of the cultural heritage values, and significance of the Aboriginal objects, places and values for the Aboriginal people who have a cultural association with the land.*
- *A description of how the requirements for consultation with Aboriginal people as specified in clause 80C of the National Parks and Wildlife Regulation 2009 have been met.*
- *The views of those Aboriginal people regarding the likely impact of the proposed development on their cultural heritage.*
- *A description of the actual or likely harm posed to the Aboriginal objects or declared Aboriginal places from the proposed activity;*
- *A description of any practical measures that may be taken to protect and conserve those Aboriginal objects or declared Aboriginal places.*
- *A description of any practical measures that may be taken to avoid or mitigate any actual or likely harm, alternatives to harm or, if this is not possible, to manage (minimise) harm.*

Based on the risk analysis undertaken for the Proposal (Section 3.3.1 and **Table 3.9**), the potential impacts relating to indigenous heritage and their risk rankings (in parenthesis) after the adoption of pre-existing or standard mitigation measures are as follows.

- Damage or destruction of identified Aboriginal artefacts, sites or values (low risk).
- Damage or destruction of not yet identified Aboriginal artefacts, sites or values (low risk).
- Cumulative reduction of the in-situ archaeological record (low risk).

A review of the attributed risk levels, following the adoption of the recommended operational safeguards and controls, is provided in Section 6.2.1 and **Table 6.1**. The indigenous heritage impact assessment for the Proposal was undertaken by Ms Amanda Atkinson of Niche Environment and Heritage. The assessment is presented as Part 8 of the *Specialist Consultants Studies Compendium* and is referred to hereafter as "Niche (2014b)". This subsection of the EIS provides a summary of the indigenous heritage impact assessment, concentrating on those matters raised in the DGRs and related requirements provided by various government agencies. A consolidated list of the identified requirements and where each is addressed is presented in **Appendix 3**.

4.11.2 Method of Investigation

4.11.2.1 Introduction

For the purposes of the Indigenous Cultural Heritage Assessment undertaken by Niche (2014b), the area of assessment incorporates only the proposed extensions to the extraction and overburden emplacement areas. The remaining areas of the Stage 2 Site remain unchanged from existing operations and are managed under the existing protocols and other management measures established in conjunction with the approval of Stage 1 and the conditions provided in DA 103/94.

4.11.2.2 Consultation

Consultation with Aboriginal stakeholders commenced in July 2013 and continued throughout the preparation of the EIS. All consultation was conducted in accordance with the *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (ACHCRs) (DECCW 2010). Letters were sent to the following stakeholders notifying them of the Proposal and requesting that they provide a list of registered Aboriginal stakeholders with an interest in the area.

14 June 2013

- Office of Environment and Heritage (OEH).
- Bathurst Local Aboriginal Land Council (Bathurst LALC).
- The Registrar, National Native Title Tribunal.

2 July 2013

- NTS Corp Limited.
- Office of the Registrar, *Aboriginal Land Rights Act 1983*.
- Hawkesbury-Nepean Catchment Management Authority.
- Lithgow City Council.

Based on the responses received from the above, and the knowledge of Niche of Aboriginal representative groups of the local area, a list of potential stakeholders was compiled and these groups were sent further letters on 11 July 2013 seeking registrations of interest for inclusion in consultation related to the assessment of the Proposal.

An advertisement was published in the *Lithgow Mercury* newspaper on 4 July 2013, in accordance with *Sections 4.12* and *4.13* of the ACHCRs, inviting Aboriginal parties to register an interest in the project.

As a result of the above consultation, the following stakeholders were confirmed as the Registered Aboriginal Parties (RAPs) to the Proposal.

- Bathurst Local Aboriginal Land Council.
- Dhuuluu-Yala Aboriginal Corporation.
- Gundungurra Aboriginal Heritage Association.
- Mingaan Wiradjuri Aboriginal Corporation.
- Tocomwall.
- North East Wiradjuri Company.
- Warrabinga Native Title Claimants.
- Wiradjuri Traditional Owners.

A letter was provided to the RAPs on 21 August 2013 providing the details of a field survey of the proposed extraction area extension. Those parties that confirmed their interest in attending the field survey were provided with an overview of the Proposal and the Stage 2 Site location. The first survey was undertaken on 27 August 2013. Representative of the following RAPs participated.

- Mingaan Wiradjuri Aboriginal Corporation.
- Wiray-dyraa Maying-gu Native Title Group.
- North East Wiradjuri Company.
- Warrabinga Native Title Claimants.

Stakeholders that participated in the field study were asked to provide any shared knowledge or provide comments on Aboriginal cultural values of the Site.

A second field survey was undertaken on 19 November 2013 to assess the proposed Stage 2 overburden emplacement area. Those RAPs who participated in the first survey were invited to participate in the second survey. The following RAPs participated in the second survey.

- Wiray-dyraa Maying-gu Native Title Group.
- North East Wiradjuri Company.

Copies of the draft assessment report were provided to all RAPs in February 2014. No comments relating to the draft report or cultural values have been received.

4.11.2.3 Background Research

Landscape and Historical Context

A review of the landscape and historical occupation of the Stage 2 Site and surrounds was completed to provide a context for the development of a predictive model and assessment of the likelihood of Aboriginal sites or artefacts being present within the Stage 2 Site. The review of the landscape context completed by Niche (2014b) included local soils, geography, topography, flora, fauna and hydrology. The review of the historical context was based on recorded Aboriginal occupation of the area, known tribal boundaries and land use and development after contact with Europeans.

The results of the contextual review are provided in detail in Niche (2014b) and discussed in Section 4.7.3.1 of this document.

Register and Database Searches

A desktop search of registered Aboriginal sites and artefacts within the vicinity of the Stage 2 Site was conducted on 3 June 2013 and 11 June 2013 and included the following registers and databases.

- Australian Heritage Database (which includes places listed in the World Heritage List, National Heritage List, Commonwealth Heritage list, Register of the National Estate and areas that are under consideration).
- Aboriginal Heritage Information Management System (AHIMS) (an area of approximately 5km x 5km centred on the Stage 2 Site).
- NSW State Heritage Register and State Heritage Inventory.
- Lithgow City Council Local Environmental Plan 1994

Archaeological Background

A review of previous archaeological surveys of the area surrounding the Stage 2 Site (including Stockton and Holland, 1974, Mills and Wilkinson, 1993, Australian Museum Business Services, 2002, OzArk, 2003, OzArk, 2004, Comber, 2009, Niche Environment and Heritage, 2012, and Ridgeway, undated) is provided in Niche (2014b). In summary, previous assessments found the landscape surrounding the Stage 2 Site is rich in Indigenous cultural material. Coxs River has also been identified as an important feature for the people living there before European arrival. Excavations undertaken by Stockton and Holland (1974) and OzArk (2003, 2004) have shown the potential for stone artefacts to be present in moderate numbers.

Predictive Model

A predictive model was developed to guide the field surveys given the presence of registered sites within a 5km radius of the Stage 2 Site and to assist with potential visibility issues during the surveys.

A detailed overview of the predictive model is provided in Niche (2014b). In summary, while the Stage 2 Site is located in an area close to a perennial water source that would indicate the presence of camp sites, the moderate to steep sided hill slopes and ridge lines are unsuitable for camp sites and activities associated with these camps. However, towards the lower end of drainage channels, areas of flat ground, rock outcrops or sandstone escarpments, if present, could provide for Indigenous cultural material.

4.11.2.4 Field Surveys

The first field survey of the Stage 2 Site was conducted on 27 August 2013. The survey team consisted of archaeologists Amanda Atkinson and Lydia Sivaraman (Niche), Austen Quarry Manager, Lee Attard, and the RAPs noted in Section 4.7.2.2.

The Stage 2 overburden emplacement area was surveyed separately on 25 November 2013. The entire impact area was surveyed by archaeologist Renée Regal (Niche), Austen Quarry Environmental Manager, Malcolm McDonald, and the RAPs noted in Section 4.11.2.2.

Due to the steep terrain of many of the areas involved in the survey, an opportunistic methodology was used and only accessible areas were surveyed. The survey team was driven along an access track to a ridge top and the extent of the ridge top was traversed until it became too steep to continue. *Figure 11* of Niche (2014b) displays the areas traversed by the field surveys recorded using a non-differential GPS.

4.11.3 Results

4.11.3.1 Results of Background Research

The landscape and historical context of the local area indicate that Aboriginal camp sites are likely to exist based on the readily available food and water resources in the vicinity of Coxs River. In addition, recorded history indicates the presence of several tribal groups in the area at the time of European arrival. However, the steep slopes and ridge lines of the Stage 2 Site indicate little likelihood of Aboriginal sites or artefacts.

The search of the AHIMS database identified 49 previously recorded Aboriginal archaeological sites within the search area (see **Figure 4.50**). This record includes the two open camp sites (artefact scatters) identified by a previous survey of the Austen Quarry (Mills and Wilkinson, 1993)[12]. The dominant site types of the AHIMS record are isolated finds (25 in total) and open camp sites (18 in total). No recorded sites occur within the proposed extension area, however, the two open camp sites (artefact scatters) recorded by Mills and Wilkinson (1003) are located within 500m of the extraction area (see **Figure 4.50**). The presence of the sites listed on AHIMS, including the sites described by Mills and Wilkinson (1993), are consistent with the predictive model prepared by Niche (2014b).

No Indigenous heritage items or sites listed on any of the remaining registers were identified within, or in close proximity to the Stage 2 Site.

4.11.3.2 Results of the Field Survey

Details of the survey coverage and a landform summary are available in Niche (2014b). No Aboriginal objects or places were found during the two field surveys. No cultural values were made known during the field work.

[12] The report prepared by Mills and Wilkinson (1993) recommended that the artefacts be salvaged and displayed in the local NPWS office in Hartley.

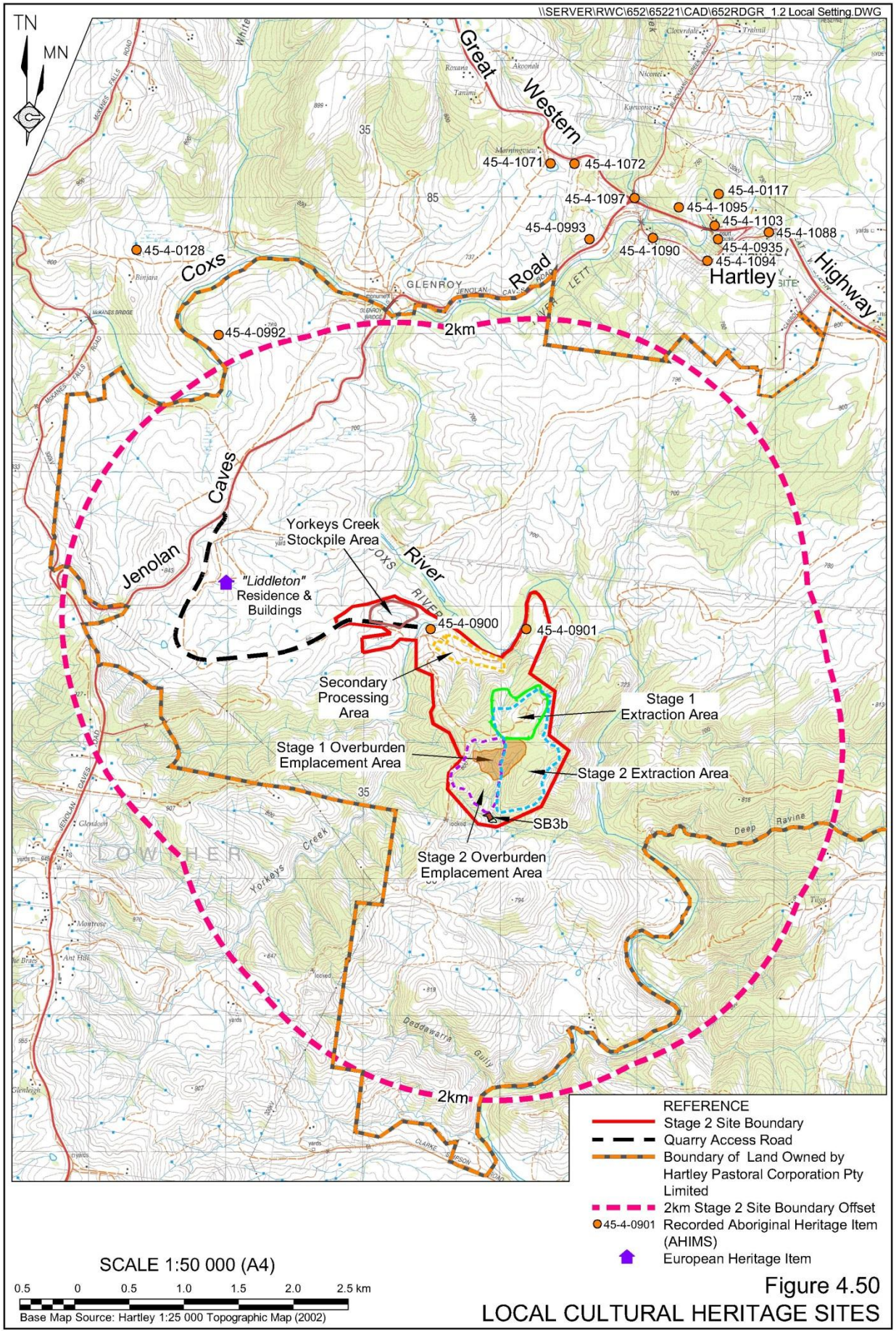


Figure 4.50
LOCAL CULTURAL HERITAGE SITES

4.11.3.3 Significance Assessment

As no items of Indigenous heritage significance were located within the areas to be disturbed, no significance is attributable to these areas in relation to Indigenous heritage values.

The lack of Indigenous heritage significance notwithstanding, Niche (2014b) was issued to the RAPs as a draft for review on the 1 February 2014. No comments on Niche (2014b) or cultural values were received prior to the issue of the final report in September 2014.

4.11.4 Environmental Controls and Management

As a result of the field and background investigations and consultation with the RAPs established for the Proposal, Niche (2014b) confirms that there are no constraints on either cultural or archaeological grounds to the Proposal. However, the Applicant is aware of the possibility of these items occurring unexpectedly, especially given the historical and landscape context of the Stage 2 Site and proximity to the Coxs River. The Applicant is committed to extending the existing management measures that are currently in use and which include the following.

1. Inclusion of Indigenous heritage protocols and obligations within induction processes required to be completed by all staff and sub-contractors prior to commencing work on the Stage 2 Site.
2. A requirement to halt all works in the immediate area if Aboriginal cultural objects are uncovered. The Stage 2 Site procedure then requires contact to be made with a suitably qualified archaeologist and/or Aboriginal community representative to determine the significance of the object(s). The site would be appropriately registered with in the AHIMS (managed by OEH) along with the proposed management outcome for the site. No further work would be undertaken until a management strategy for the site is prepared in consultation with Aboriginal community representative(s), and relevant permits are obtained.
3. A requirement to halt all works in the immediate area if human remains are located during the project to prevent any further impacts to the remains. The NSW Police, the Aboriginal community and OEH would then be notified. If the remains are found to be of Aboriginal origin and the Police consider the site not an investigation site for criminal activities, OEH would be further notified of the situation and works would not resume in the designated area until approval in writing is provided by OEH. In the event that a criminal investigation ensues, works would not to resume in the designated area until approval in writing (has been received) from NSW Police and OEH.
4. All reasonable efforts would be made to avoid impact to Indigenous cultural heritage values at all stages of the development works. If impacts are unavoidable, mitigation measures would be negotiated with the Aboriginal community and OEH.

4.11.5 Assessment of Impacts

Based on the results of the Indigenous Heritage Assessment completed by Niche (2014b), the Proposal, would not impact items or sites of Indigenous cultural heritage value. The proposed management measures would ensure that appropriate care and protection is provided to any sites which may be present and identified at a later stage.

4.12 HISTORIC HERITAGE

4.12.1 Introduction

The DGRs issued for the Proposal identified "*Heritage*" as a key issue requiring that the "*EIS include:*

- *a historic heritage assessment (including archaeology) including a statement of heritage impact (including significance assessment) for any State significant or locally significant historic heritage items and outline any proposed mitigation and management measures*

Based on the risk analysis undertaken for the Proposal (Section 3.3.1 and **Table 3.9**), the potential impacts relating to historic heritage and their risk rankings (in parenthesis) after the adoption of pre-existing or standard mitigation measures are as follows.

- Loss or destruction of items of heritage significance (low risk).

A review of the attributed risk levels, following the adoption of the recommended operational safeguards and controls, is provided in Section 6.2.1 and **Table 6.1**.

The historic heritage impact assessment for the Proposal was undertaken by Ms Amanda Atkinson and Mr Cameron Harvey of Niche Environment and Heritage. The resulting report is presented as Part 9 of the *Specialist Consultants Studies Compendium* and is referred to hereafter as "Niche (2014c)". This subsection of the EIS provides a summary of the historic heritage impact assessment, concentrating on those matters raised in the DGRs. A consolidated list of the identified requirements and where each is addressed is presented in **Appendix 3**.

4.12.2 Methods

The *Heritage Act 1977* (the Act) is a statutory tool designed to conserve environmental heritage in NSW. It is used to regulate development impacts on the state's historical heritage assets. The Act defines a heritage item as 'a place, building, work, relic, moveable object or precinct'. The Act also distinguishes between items of local and State heritage significance.

To assist with the assessment of the environmental heritage, the *Heritage Manual* 1996 provides guidelines endorsed by the NSW Heritage Council which explain the three steps to manage heritage items in the NSW context. These steps are:

- investigate significance;
- assess significance; and
- manage significance.

To assess the significance of potential historical heritage items located within the Stage 2 Site, a desktop search of heritage listed items was completed, as well as a search of the recorded history of the land on which the Stage 2 Site is located. Finally, a field survey of the Stage 2 Site was completed to provide a physical assessment of the Stage 2 areas for potential items of heritage significance.

4.12.3 Desktop Review

4.12.3.1 Heritage Register Searches

A desktop search of the Stage 2 Site on the following heritage databases was conducted by Niche (2014c) on 3 June 2013.

- Australian Heritage Database (which includes places listed in the World Heritage List, National Heritage List, Commonwealth Heritage list, Register of the National Estate and areas that are under consideration).
- NSW State Heritage Register.
- State Heritage and Conservation Register.
- Lithgow City Council Local Environmental Plan 1994 (Draft Lithgow LEP 2013).

No heritage sites listed on any of these registers were identified within the Stage 2 Site.

4.12.3.2 Stage 2 Site History

A comprehensive review of the history of the land on which the Stage 2 Site is located and the surrounding area is provided in Niche (2014c). The following provides a brief overview of this history.

The Stage 2 Site was located within an historical estate known as 'Liddleton', granted to John Maxwell in May 1832. Despite extensive development of the estate, no known buildings were erected within the Stage 2 Site although as Maxwell was one of the largest pastoral farmers in the area, there is potential for ancillary farming outbuildings, early roads and fencing within his estate. The above notwithstanding, the Stage 2 Site is a small portion of the original 'Liddleton' Estate and so the potential of any historical items associated with the Estate is small.

The 'Liddleton' homestead is still used as a residence and is located on the lower slopes approximately 1km north of the Austen Quarry in the Coxs Valley. It is likely that outbuildings would have been built close to the homestead for ease of access and early roads would most likely be associated with the homestead. Fences may be found on the river flats and lower slopes along the outer edges of the Stage 2 Site. At one time, 'Liddleton' became part of a wildlife refuge before being purchased in July 1978 by the Hartley Pastoral Company. Approval for the Austen Quarry was granted in 1994 with development commencing in 2005 within the Stage 2 Site.

4.12.4 Field Survey

4.12.4.1 Methodology

The field survey for the Proposal was conducted concurrently with the Indigenous heritage field survey on 27 August 2013. The survey team consisted of archaeologists Amanda Atkinson and Lydia Sivaraman (Niche) and Austen Quarry Manager, Lee Attard.

The overburden emplacement area was surveyed separately (and also concurrently with the Indigenous heritage field survey) on 25 November 2013. The entire impact area was surveyed by archaeologist Renée Regal (Niche) and Austen Quarry Environmental Manager, Malcolm McDonald.

Due to the steep terrain of many of the areas involved in the survey, an opportunistic methodology was used and only accessible areas were surveyed. The survey team was driven along an access track to a ridge top and the extent of the ridge top was traversed until it became too steep to continue. Figure 11 of Niche (2014c) displays the areas traversed by the field surveys recorded using a non-differential GPS.

4.12.4.2 Results

No historical heritage items were identified during the field surveys, nor were any areas of archaeological potential for historical heritage items identified.

An extended discussion of the methodology and results of the field surveys is provided in Niche (2014c).

4.12.5 Controls and Management

Although no sites have been identified which would constrain the Proposal, and it appears unlikely that items of historical heritage value would be unexpectedly discovered during the proposed works, the Applicant understands the possibility of this occurring. Existing protocols for the management of heritage items discovered on the Stage 2 Site including reporting obligations under the *Heritage Act 1977* would be maintained should the Proposal be approved. This includes the following procedures.

1. Inclusion of historic heritage protocols and obligations within induction processes required to be completed by all staff and sub-contractors prior to commencing work on the Stage 2 Site.
2. Cessation of works in the immediate area if historic heritage objects are uncovered due to the development activities to prevent any further impacts to the object(s). A suitably qualified archaeologist would be contacted to determine the significance of the object(s). The NSW Heritage Council would subsequently be notified and consulted in developing management strategies
3. Works would not to resume in the designated area until approval in writing has been received from OEH.

4.12.6 Assessment of Impacts

As no items of historical heritage significance were located in the search of heritage databases or in the recorded history of the area, and no items were located in the field surveys of the areas to be disturbed, the Stage 2 Site is assessed to have no significance for historic heritage values.

In the absence of historical heritage items or areas of archaeological potential identified during the assessment, the impact of the proposed extension of Austen Quarry to items or areas of historic heritage will be nil.

4.13 HAZARDS

4.13.1 Introduction

The DGRs issued for the Proposal identified "*Hazards*" as a key issue requiring that the "*EIS address:*

- *potential hazards paying particular attention to public safety, including bushfires.*

On careful review of the local setting, proposed operations and potential for impact on public safety, the following hazards have been identified as relevant to the Proposal and assessed in the following subsections.

- Bush fire. An assessment of the existing bush fire prone land within the Stage 2 Site and surrounds and potential hazard to Stage 2 Site assets and public safety has been completed by RWC (refer to Section 4.13.2).
- Hazardous material management. The identification of the Stage 2 Site as a potentially hazardous industry, as defined by State Environmental Planning Policy 33 – Hazardous and Offensive Development (SEPP 33), has been completed by RWC (refer to Section 4.13.3).
- Traffic Incident. Based on the overall assessment of traffic impacts completed by GTA Consultants Pty Ltd (GTA, 2014) summarised in Section 4.2, RWC has completed an assessment of the hazard to public safety associated with the proposed transport operations of the Proposal (refer to Section 4.13.4).
- Public misadventure. The potential for misadventure on the Stage 2 Site by a member of the public, either an approved visitor or unauthorised entrant, and the controls in place to minimise the risk of such an occurrence has been assessed by RWC (refer to Section 4.13.5).

4.13.2 Bush Fire Hazard

4.13.2.1 Introduction

This bush fire hazard impact assessment for the Proposal was undertaken by Mr Alex Irwin of RWC with assistance from Mr Lee Attard and Mr Darryl Thiedeke of Hy-Tec Industries. Particular attention has been paid to the NSW Rural Fire Service contribution to the DGRs

which requested that the Applicant consider preparing a Fire Emergency Evacuation Plan in accordance with the NSW Rural Fire Service document *Guide for Developing a Bush Fire Emergency Evacuation Plan*.

4.13.2.2 Bush fire Prone Land and Existing Bush fire Hazard

4.13.2.2.1 Bush fire Prone Land

Figure 4.51 identifies the existing bush fire prone land status of the Stage 2 Site and surrounds as nominated in the Lithgow City Council *Bush Fire Prone Land Map* (*Figure 11* of LCC, 2011). The mapping indicates that the Stage 2 Site is currently classed as bush fire prone. The mapping also shows that the bush fire prone land is linked to other areas of bush fire prone land.

Section 79BA of the EP&A Act details the requirement for developments to conform to the specifications and requirements of RFS (2006), however, Subsection (1B) states Section 79BA does not apply to Statement Significant Development. While the requirement for a bush fire assessment in accordance with that document is not required, the procedure detailed in that document has been adopted to identify the potential hazard for the Proposal. Management of the identified hazards are then addressed.

4.13.2.2.2 Bush fire Hazard (Bush fire Attack Category)

In identifying the hazard associated with the bush fire prone land of the Stage 2 Site, the document produced by the Rural Fire Service (RFS) for DP&E entitled "*Planning for Bush Fire Protection*" (RFS, 2006), the updated *Appendix 3* released in 2010, and AS3959.2009 has been used. This requires consideration of various features of the local setting such as the dominant vegetation type(s) within and surrounding the Stage 2 Site, topography and Fire Danger Index (FDI) as follows.

Vegetation Classification

With the exception of the areas disturbed for the purpose of the existing Austen Quarry, and a small cleared area adjacent to the Coxs River to the north of the extraction area, the majority of the Stage 2 Site retains open forest or woodland vegetation (Niche, 2014a). The vegetation has therefore been classified into the following two formations based on the classifications provided in RFS (2006).

- Dry Sclerophyll Forest (open forest) – maximum fuel load of 25t/ha.
- Grasslands – maximum fuel load of 6t/ha

The vegetation to the south and east of the Stage 2 Site, and along the riparian corridor of the Coxs River, is similar to the vegetation occurring within the Stage 2 Site as it is dominated by open forest and grassy woodlands. Cleared land (grasslands) begins to dominate to the west and north of the Stage 2 Site with more isolated patches of forest and woodland present, predominantly along watercourses, elevated land or areas with greater topographic relief.

Slope Classification

Slopes within the Stage 2 Site vary from less than 1:10 (V:H) (6°) in the vicinity of the Coxs River to in excess of 1:3 (V:H) (>18°) on the flanks of the ridge lines that dominate the Stage 2 Site.

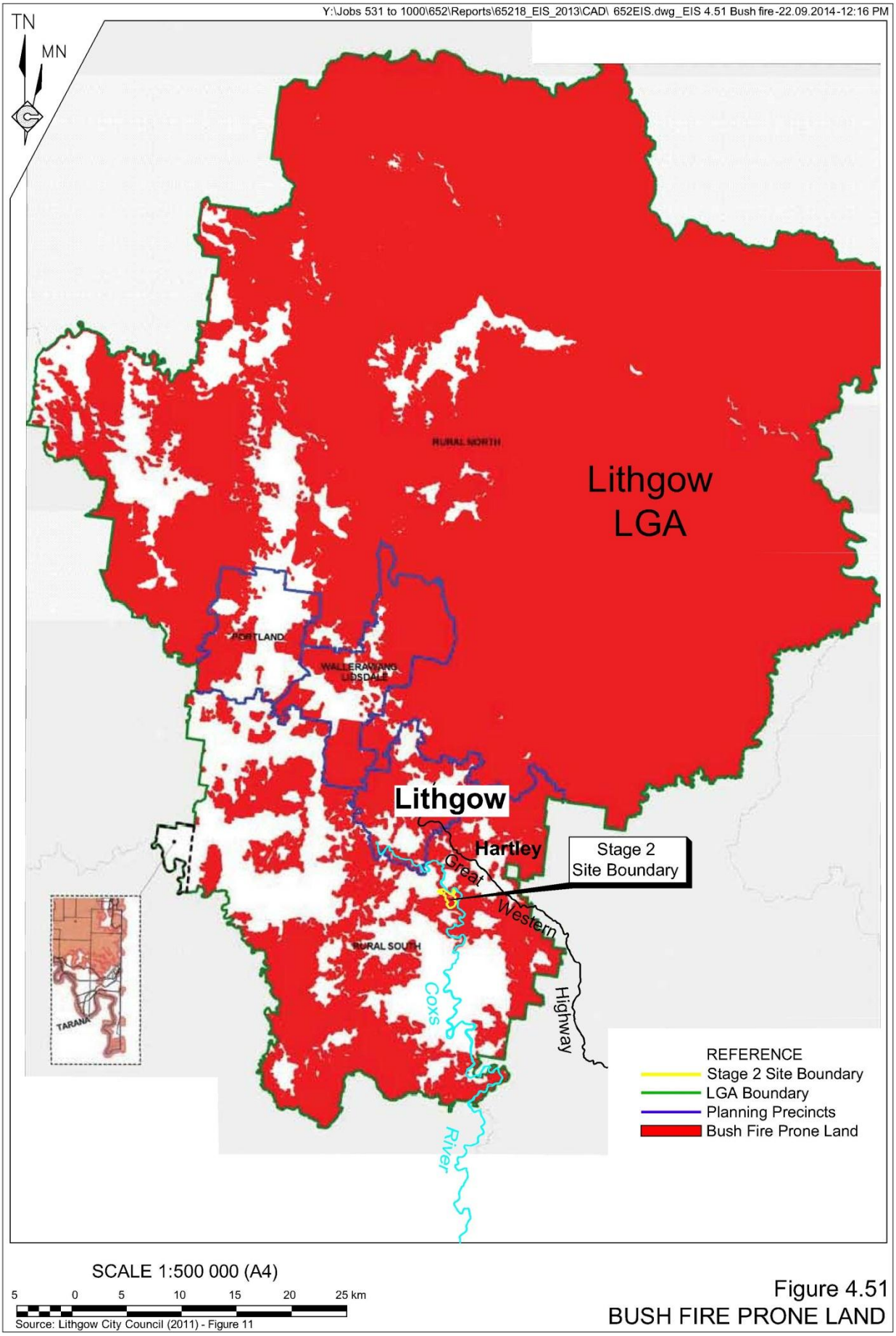


Figure 4.51
BUSH FIRE PRONE LAND

Fire Danger Index (FDI)

Table A2.3 of RFS (2006) nominates Lithgow City LGA as occurring within the Central Ranges NSW Fire Area which is designated a Fire Danger Index (FDI) of 80 for a 1 in 50 year event. This FDI is a number that has been determined by the NSW Rural Fire Service based upon assumed fuel loads within certain geographical regions (usually based upon local government area boundaries). The FDI, a combination of air temperature, relative humidity, wind speed and drought, is used to determine the Fire Danger Rating on a particular day. A FDI of 1 (low-moderate) means that a fire will not burn or will burn so slowly that it can be easily controlled, whereas an FDI of 100 (Catastrophic) means that the fire will burn so fast and hot that it is uncontrollable. An FDI of 80 (Extreme) means that a fire will likely be uncontrollable, unpredictable and fast moving with flames in the tree tops and embers likely to start spot fires up to 6km ahead of the main fire.

Bush fire Attack Category

Table 4.44 provides the bush fire hazard (referred to as the bush fire attack category in RFS, 2006) calculated for activities within 100m of vegetation from a combination of the FDI, vegetation formation, the maximum slope and the proximity of activities to the bush fire hazard. It should be noted that the bush fire hazard assessment takes into account not only the vegetation and associated bush fire hazard within the Stage 2 Site, but also the vegetation immediately surrounding the Stage 2 Site and the general local area.

Table 4.44
Bush Fire Attack Category

Vegetation Classification	Slope	Distance to Activities	Bush fire Attack Category
Dry Sclerophyll Forest (Open Forest)	>15 ° to 20°	20m	Flame Zone
	>10 ° to 15°	20m	Flame Zone
Grassy Woodlands (Woodlands)	>15 ° to 20°	20m	Flame Zone
	>10 ° to 15°	20m	Flame Zone
Grasslands	0 ° to <5°	>100m	Low
Sourced: Based on AS3959.2009			

Activities located further than 100m from the vegetation have a Category of Bush fire Attack classification of "low".

The following descriptions of the predicted bush fire attack and levels of exposure are provided for the Category of Bush Fire Attack (or bush fire hazard) in AS3959.2009.

- BAL-Low. There is insufficient risk to warrant specific construction requirements.
- BAL-FZ. Direct exposure to flames from fire front in addition to heat flux and ember attack.

It is noted that the bush fire attack category, determined in accordance with RFS (2006) and AS3959.2009, relates primarily to building requirements within bush fire prone land. That is, there is no correlation between the bush fire attack category and permissibility of extractive industry on the Stage 2 Site. The categorisation of the activities as being within the flame zone category does, however, illustrate the importance of an effective Fire Emergency Evacuation Plan.

4.13.2.3 Bush fire Management Objectives

The objectives of RFS (2006), considered in this assessment of bush fire management of the Proposal, are to:

- afford occupants of any building adequate protection from exposure to a bush fire;
- provide for a defendable space to be located around buildings;
- provide appropriate separation between a hazard and buildings which, in combination with other measures, prevent direct flame contact and material ignition;
- ensure that safe operational access and egress for emergency service personnel and residents is available;
- provide for ongoing management and maintenance of bush fire protection measures, including fuel loads in the Asset Protection Zone (APZ); and
- ensure that utility services are adequate to meet the needs of fire fighters (and others assisting in bush fire fighting).

4.13.2.4 Safeguards and Controls

4.13.2.4.1 Management Measures

The Applicant would implement the following management and mitigation measures to minimise risks associated with starting bush fires within the Stage 2 Site.

- Ensure refuelling is undertaken within designated fuel bays or within a cleared area of the Stage 2 Site.
- Ensure vehicles are turned off during refuelling.
- Ensure no smoking policy is enforced in designated areas of the Stage 2 Site.
- Ensure fire extinguishers are maintained within all site vehicles and refuelling areas.
- Ensure a focus on housekeeping by all personnel.
- Ensure that a water cart (with suitable pumps and hoses) is available to assist in extinguishing any fire ignited.

Specific measures to manage a local bush fire event would incorporate the following.

- An Outer Protection Area (OPA) of at least 45m would be maintained around the administration centre. The OPA would have the tree and shrub layer removed and a removed or restricted understorey. As defined by *Appendix 2* of RFS (2006), the OPA would reduce the potential length of flames by slowing the rate of spread, filtering embers and reducing the likelihood of crown fire.

- Fuel loads within the OPA would be monitored and reduced as required, i.e. no re-growth of shrub or tree vegetation would be allowed, grass growth would be monitored and cut back as necessary. Specialist advice would be sought, either from the NSW RFS or Lithgow City Council in relation to appropriate fuel load management within the OPA.
- The extraction area access road would be regularly maintained to ensure safe access and egress from the open cut in the event an evacuation is called.
- Water contained within SD1 to SD6, as well as SB1, would be easily accessible for management of ember attack on the buildings of the administration centre or bush fire control generally. Access to this combined 29ML capacity storage would be provided to the NSW RFS in the event of a major bush fire incident in the local area.
- Training (with biennial refresher training) would be provided to site personnel in relation to specific fire fighting tasks and procedures.
- In the event of a local bush fire event, all personnel would be required to assemble at the designated Emergency Assembly Area (car park). A head count would be undertaken to confirm all site personnel and visitors are accounted for. At this time, instructions as to specific procedures to be followed, i.e. site protection or evacuation, would be provided in accordance with the Emergency and Evacuation Management Procedures and advice provided by the NSW RFS.

Notwithstanding the preparation and implementation of the above, the Applicant would ensure that all personnel recognise the authority of the NSW RFS and other emergency services, e.g. NSW Police, and adhere to any and all instructions provided by these authorities. Furthermore, access to all Stage 2 Site facilities and water storages would be provided to the RFS and any reasonable assistance offered.

4.13.2.4.2 Emergency Management

A Bush fire Emergency Evacuation Plan has not been prepared for the Stage 2 Site, however, the information requirements of such a plan, as nominated in *Guide for Developing a Bush Fire Emergency Evacuation Plan* (RFS, 2004), have been compiled (and supplied to the local RFS station in March 2013). The following reviews the 12 steps of a Bush fire Emergency Evacuation Plan.

- Step 1. Introduction.

  Details of the Austen Quarry operation, i.e. location, nearest cross road, number of persons employed and contacts (primary, secondary and after hours), have been compiled and supplied to the RFS.

- Step 2. Background Information on Premises.

  A detailed description of the operations undertaken on the Stage 2 Site, operating plant and equipment, chemicals and dangerous goods maintained on the Stage 2 Site and emergency equipment maintained on the Stage 2 Site have been compiled and supplied to the RFS.

- Step 3. Roles and Responsibilities.

  Stage 2 Site management have provided to the RFS a list of quarry personnel who could be responsible for escorting emergency services from the entrance on Jenolan Caves Road to the appropriate area of the Stage 2 Site.

  The Site Emergency Response Plan, a copy of which has been provided to the RFS, nominates the emergency contact for the Stage 2 Site, first aid personnel, fire wardens and medical practitioner contact.

- Step 4: Consultation with Emergency Services.

  On 13 March 2013, a letter providing the details described in this section was supplied to the local RFS station.

  An Emergency Contacts list has also been prepared for the quarry including, amongst other, contacts for:

  – ambulance, police, fire brigade;
  – State Emergency Service;
  – Lithgow Hospital;
  – Lithgow City Council; and
  – DRE Mines Inspector.

  The Emergency Contacts list also nominates the information to be supplied in the event an emergency call is to be made.

- Step 5: Safe Refuge / Step 6: Transportation.

  No specific safe refuge or specification of transport has been nominated. However, an Emergency Assembly Area has been nominated and given the isolate nature of the Stage 2 Site, this is considered sufficient for the purpose of this aspect of an evacuation plan.

- Step 7: Identifying 'Designated Assembly Points'.

  The Emergency Response Plan for the Stage 2 Site identifies the Emergency Assembly Area (adjacent to the Stage 2 Site car park).

- Step 8: Accounting for Persons.

  No formal procedure for accounting for all occupants on the Stage 2 Site in the event of a bush fire emergency is maintained on the Stage 2 Site, primarily due to the presence of multiple contracted personnel on the Stage 2 Site at any given time. It is noted that all Stage 2 Site personnel are provided with training in the

application of the Emergency Evacuation Procedure for the Stage 2 Site and all visitors to the Stage 2 Site are provided with an induction nominating the Emergency Assembly point and procedure in the event of an emergency.

- Step 9: Contacting Family Members.

  This step is not considered relevant for the nature of the Stage 2 Site involved. Next of kin information is held for all Stage 2 Site personnel, and required to be provided by contractors inducted onto the Stage 2 Site, should contact need to be made.

- Step 10: Security after Evacuating.

  This step is not considered relevant for the nature of the Stage 2 Site involved.

- Step 11: Stage 2 Site Layout.

  The Emergency Response Plan for the Stage 2 Site provides the Stage 2 Site layout including assembly point and first aid station. The RFS has been provided with the details of emergency equipment and infrastructure maintained on the Stage 2 Site.

- Step 12: Statement of Action.

  No formal statements of action have been generated for the Stage 2 Site. However, the Stage 2 Site fire wardens and first aid representatives have been provided with appropriate training and all personnel are required to complete and confirm (by signatory to a register) training on the Stage 2 Site emergency evacuation procedure. This is considered adequate for a Stage 2 Site the size and type of the Austen Quarry.

4.13.2.5 Assessment of Impacts

The Proposal would not result in an increase to the number and type of ignition sources in the local area. It is acknowledged, however, that the Stage 2 Site is located on bush fire prone land (as mapped by LCC, 2011) and has an elevated bush fire attack category (see Section 4.13.2.4.2). The risk of a fire being initiated on the Stage 2 Site and or detrimental impacts on public safety and assets in the event a local bush fire would continue to be minimised through the implementation of the nominated management and mitigation.

4.13.3 Traffic Incident

4.13.3.1 Potential Incident

Road registered heavy vehicles and light vehicles would continue to enter and exit the Stage 2 Site from Jenolan Caves Road, via the Great Western Highway. While it is noted that the Austen Quarry has operated since 2005 without any significant traffic-related incident, there remains the potential for an accident involving a quarry-related vehicle and a vehicle driven by a member of the public. This potential is illustrated by the number of crashes recorded on Jenolan Caves Road between the Great Western Highway (see **Figure 4.11**).

4.13.3.2 Safeguards and Hazard Reduction Strategies

The risk associated with an incident between a Proposal-related vehicle (road registered heavy vehicle or light vehicle) and a vehicle driven by a member of the public would be managed by a combination of route selection, fleet management and driver behaviour.

Route Selection

- Entry and exit to the quarry would continue to be restricted to the Channelised Right (CHR) / Basic Left (BAL) intersection of the Quarry Access Road and Jenolan Caves Road.
- Transportation through the Blue Mountains to Sydney markets would be restricted to the Great Western Highway (delivery to local markets within the Blue Mountains would require the use of local roads).
- For local deliveries of quarry products within the Blue Mountains, the route would be confirmed prior to commencement of deliveries and specific travel requirements (such as speed limiting, scheduling to avoid certain periods) identified and enforced.

Fleet Management and Driver Behaviour

- The Applicant operates a Management Plan for all truck traffic associated with the Austen Quarry providing for safe standard procedures and guidelines for all trucks entering and exiting Austen Quarry.
- The plan details the responsibilities of each staff member or contractor and the specific tasks and required record keeping relevant to trucks on and off site. It also details product despatch routes and any specific travel requirements including speed limiting, where necessary.
- The Applicant operates a Chain of Responsibility System which is a comprehensive and integrated management system that provides a means for dealing with a wide range of health and safety issues such as driving hours, fatigue, mass and dimensions, load restraints, speed, vehicle standards, and the transportation of dangerous goods. The system recognises that all people within the chain of responsibility for transporting aggregates play a role in ensuring the health and safety of workers and the communities through which they travel and provides for:
  - driver training;
  - a Driver Fatigue Manual;
  - a Driver-Vehicle Checklist;
  - random vehicle checks; and
  - signage and delivery dockets.

Emphasising the relative merit of the systems implemented by the Applicant to manage aggregate delivery, the Austen Quarry was awarded the OH&S Practical Innovation Award for the quarry's Driver Vehicle Check procedures at the 2009 Cement Concrete and Aggregates Australia (CCAA) annual awards. The Applicant was further recognised at the CCAA NSW 2013 Environmental Health and Safety Awards with an OH&S Best Performance Award for the Chain of Responsibility: Driver Vehicle Check system.

4.13.3.3 Assessment of Impacts

Risks associated with an incident between a Proposal-related vehicle (road registered heavy vehicle or light vehicle) and a vehicle driven by a member of the public are considered low given the proposed hazard reduction measures and strategies.

4.13.4 Hazardous Materials Management

4.13.4.1 SEPP 33 Risk Screening

Additional matters for consideration in preparing the EIS were also provided in the correspondence attached to the DGRs from the EPA and Lithgow City Council which requested that the EIS identify all hazardous materials, mitigation measures to deal with potential impacts and detail management plans.

In addressing these requests, an assessment as to whether the Proposal would represent a hazardous or potentially hazardous industry under State Environmental Planning Policy (SEPP) 33 has been completed. This section presents a risk screening completed in accordance with "*Hazardous and Offensive Development Application Guidelines Applying, SEPP 33, January 2011*" (DP&E, 2011) to provide a classification of the Proposal under SEPP 33.

Industries or projects determined to be hazardous or potentially hazardous would require the preparation of a Preliminary Hazard Analysis (PHA) in accordance with Clause 12 of SEPP 33. No further assessment under SEPP 33 is required for projects not considered potentially hazardous following a SEPP 33 Risk Assessment.

4.13.4.2 Hazardous Materials on the Stage 2 Site

Hazardous materials are defined within DoP (2011) as substances falling within the classification of the *Australian Code for Transportation of Dangerous Goods by Road and Rail* (Dangerous Goods Code) (NTC, 2011). Based on this definition, the hazardous materials to be stored on the Stage 2 Site, quantities and storage location are summarised in **Table 4.45**.

The Applicant has confirmed that no Class 1 explosives are or would be stored on the Stage 2 Site. As is the current practice, a blasting contractor is responsible for the design, purchase, transport and use of explosives for the purpose of blasting. Section 4.13.4.3 provides a review of the operational safeguards and controls in place to ensure the risk associated with explosives use at the quarry is minimised.

Table 4.45
Hazardous Materials Storage on the Stage 2 Site

Hazardous Material	Classification	Description	Storage Quantity	Storage Location
Diesel Fuel	Class 3 (C1)	Combustible liquids: flashpoint above 61°C but not exceeding 150°C	2 tanks • 31.4kL • 10kL	Self-bunded tanks within bunded and covered fuel bay
Lubricating oils and greases	Class 3 (C2)	Combustible liquids flashpoint above 150°C	• Engine oil: 2 000L in 20L units • Lubricants: various 44 Gallon (205L) drums	Bunded and covered fuel bay
Source: Hy-Tec (pers. comm. L. Attard)				

Transport information for the hazardous materials of the Stage 2 Site is summarised in **Table 4.46**.

Table 4.46
Hazardous Materials Transport to the Stage 2 Site

Hazardous Material	Classification	Threshold		Average No. of Loads per Annum
		Annual	Weekly	
Diesel Fuel	Class 3 (C1)	-	-	48
Ammonium Nitrate	Class 5.1	500	30	18
Source: Hy-Tec				

4.13.4.3 Operational Safeguards and Controls

Hydrocarbons (Class 3)

The diesel fuel, oils and lubricants would continue to be stored within a bunded and covered storage shed. Furthermore, the diesel tanks are self-bunded to reduce the risk of rupture in the event of an incident with a vehicle or mobile plant. Quarry personnel would continue to be provided with instruction as to the correct refuelling, vehicle maintenance and other activities involving these materials to minimise the potential for spillage. Smoking or operation of open flames within and around the storage facility would be strictly prohibited.

Explosives (Class 1)

Ammonium nitrate, for purpose of ANFO explosive, would only be imported to the quarry on the day of blasting and would not be stored on the Stage 2 Site. Transportation of the ammonium nitrate is and would continue to be by a licensed and accredited blast contractor. The Applicant requires that the truck carrying ammonium nitrate is weighed on entry to the quarry, and again on exit, to ensure that all is accounted for and in accordance with blast design. The Applicant also requires that primers and detonators brought to site are counted on arrival and again on exit for the same reason. The Applicant requires that only personnel or contractors with appropriate shot-firing or other certificates for the handling or management of explosives and blasting are involved in blast design and implementation. Finally, the Applicant has prepared a procedure in the event of a misfire or other event requiring a blast be 'slept' over night. In effect, all detonators would be disconnected and access to the area prevented until such time as appropriate measures are taken to confirm safety and initiation of the blast / re-blast.

4.13.4.4 Assessment and Conclusion

As the diesel fuel (Class 3 - C1) and lubricating oils and greases (Class 3 - C2) are not stored adjacent to any other hazardous materials, DP&E (2011) does not require these to be considered further with respect to storage of hazardous materials.

The total annual movements of ammonium nitrate are below the quantity threshold in SEPP 33 and there are no thresholds associated with the transport of combustible liquids (diesel fuel). The Proposal is therefore not considered potentially hazardous with respect to transport.

Based on the risk screening method of DP&E (2011), the Proposal does not represent potentially hazardous industry under SEPP 33.

4.13.5 Public Misadventure

4.13.5.1 Potential Incident(s)

The Stage 2 Site includes many hazards to public safety including mobile equipment, operating plant, voids, high stockpiles, dams and native fauna amongst others. The potential therefore exists for public misadventure incidents such as trips and falls, traffic accident, crush injury, rock fall / strike and/or snake bite.

It is noted that such incidents could occur to both Site personnel, authorised visitors, if not properly informed of risks and appropriate safety measures, and unauthorised entrants to the Stage 2 Site.

4.13.5.2 Safeguards and Hazard Reduction Strategies

Measures would be implemented to ensure the safety of visitors, contractors and employees, as well as ensuring the security of facilities and equipment from unauthorised access. It is the Applicant's policy that each person employed on, or visiting the Stage 2 Site would be provided with a safe and healthy working environment. In order to achieve this, the Applicant would implement a recruitment, induction and training program to:

- ensure compliance with statutory regulations and maintain constant awareness of new and changing regulations;
- require all quarry personnel and visitors to wear / use Personal Protective Equipment relevant to the activities being undertaken or areas being worked in / visited;
- eliminate or control safety and health hazards in the working environment in order to achieve the highest possible standards for occupational safety in the industry;
- ensure the suitability of prospective employees through a structured recruitment procedure;
- provide relevant occupational health and safety information and training to all personnel;
- develop and constantly review safe working practices and job training;

- provide effective emergency arrangements for all on-site personnel, visitors and general public protection;
- maintain good morale and safety awareness through regular employee assessment and counselling; and
- ensure all contractors adopt and maintain Applicant's policy objectives and safety standards at all times.

While unauthorised access to the Stage 2 Site cannot be absolutely prevented, the Applicant would implement the following measures and controls to primarily restrict unauthorised entry and secondarily reduce the risk to any trespasser on the Stage 2 Site.

- Lock the gate on Jenolan Caves Road outside standard operating hours.
- Use of locks on equipment when site personnel are not working on or with this equipment or plant.
- Installation of and maintenance of safety signage around the Stage 2 Site and perimeter fencing, where necessary.
- Instruct all visitors entering and departing the Stage 2 Site to enter the Stage 2 Site office or weighbridge for registration including time of arrival and departure, and an induction, if required.
- Install appropriate controls to ensure that the stability of the open cut, overburden emplacement and stockpiles.

4.13.5.3 Assessment of Impacts

The Applicant has operated the Austen Quarry with few incidents leading to injury demonstrating the effective implementation of the safeguards and hazard reduction strategies nominated in Section 4.13.5.2. Continued application of these safeguards and strategies would maintain the risk of public misadventure incidents on the Stage 2 Site as low as practically achievable.

4.14 AGRICULTURAL RESOURCES

4.14.1 Introduction

The development of extractive industries needs to be balanced with the continued use and preservation of productive agricultural resources. The term 'agricultural resources' is used here to describe the land upon which agriculture is dependent, the water that is used to sustain it and the industry and secondary businesses that develop to directly supply and support agriculture. As the Proposal is for the purposes of an extractive industry, the following assessment of the potential impact of the Proposal on agricultural resources has been based upon the key issues identified by *Agriculture Issues for Extractive Industry Development* prepared by the Resources Planning & Development Unit of the NSW Department of Primary Industries (DPI, 2012b).

4.14.2 Agricultural Planning Principles

The following considers the Proposal in relation to the principles identified in DPI (2012b) for coexistence of sustainable agriculture and extractive industries.

Extractive industry developments are consistent with strategic plans and zone objectives

Development for the purpose of extractive industry is permissible with consent on land zoned Rural (General) 1(a). Furthermore, the Proposal is consistent with the Lithgow Land Use Strategy 2010-2030 (LCC, 2011) insofar as it would enhance the mineral resources industry within the LGA, recognised as a significant contributor to the local economy and social setting, whilst maintaining a large buffer to existing and potential residential / rural residential style development.

It is also noted that the recently exhibited Biophysical Strategic Agricultural Land (BSAL) map covering the Stage 2 Site does not identify the Stage 2 Site or any lands surrounding this as BSAL.

Extractive industry developments are designed and managed to minimise environmental impacts

The assessments completed throughout Section 4 of this document confirm that, with the adoption of the various operational safeguards, controls, management and mitigation measures and impact offsets proposed, the Proposal would be developed in compliance with relevant criteria and with minimal and managed impact on the surrounding environment where specific criteria are absent.

Land use conflicts are minimised, amenity values are protected and the expectations of local communities are managed

The area of the HPC owned property proposed for development of the quarry extension is currently not actively managed for agriculture. As discussed in Section 4.9.4.4, the only potential land use conflict is associated with passive biodiversity conservation, with this suitably mitigated and offset by the proposed rehabilitation program and biodiversity offset strategy.

As assessed in Sections 4.7 and 4.8, the Proposal would result in minimal change to the local noise environment and air quality. While there would continue to be trucks travelling between the Great Western Highway and the quarry, operations would largely continue unnoticed to the majority of land owners and residents surrounding the Stage 2 Site. The visibility of the extraction area and overburden emplacement from lookouts, public roads and private land within the Lithgow City and Blue Mountains City LGAs is noted, however, as discussed in Section 4.4, this impact would be reduced as far as practically possible by the proposed extraction sequence, rehabilitation plans and other methods. Overall, the Proposal would have a limited impact on the amenity of the local setting.

Rehabilitation is undertaken progressively and any permanent changes to productive capacity are clearly justified

Section 2.13 provides a detailed rehabilitation plan for the Stage 2 Site, with the proposed extraction sequence designed to allow for early rehabilitation of the most exposed components of the overburden emplacement. As nominated in Section 4.2.3.3, the land and soil capability of those areas be disturbed is low (Class 6) and the final landform would be returned to an equivalent capability on rehabilitation.

Proposals are clearly justified in a regional context and identify the merits and community benefit of the proposal

The need for hard rock resources produced by the Austen Quarry as a critical component for construction has been discussed in Section 2.2. The relative merit of the Proposal from a socio-economic perspective is considered in further detail in Section 4.15. In summary, however, when considering the minimal impact of the Proposal on the local and regional community against the benefits generated through local employment and provision of important construction materials locally, it is considered the Proposal provides a net socio-economic benefit.

Consider the following potential impacts and identify suitable mitigation responses for the following

- Impacts on agricultural resources.

  The land to be disturbed within the Stage 2 Site has severe limitations for agriculture (Class 6).

- Transport and access changes.

  The Proposal would not result in any changes to local transport or access arrangements.

- Rehabilitation plans.

  As discussed in Section 2.13, the Stage 2 Site would be progressively rehabilitated with land returned to a land capability equivalent to the pre-disturbance environment and an emphasis placed upon a nature conservation land use.

- Consultation with rural stakeholders.

  Section 3.2.2 documents the consultation program undertaken by the Applicant.

- Mitigation and monitoring.

  The various mitigation measures and monitoring strategies of the Proposal are documented throughout Section 4.

4.14.3 Agricultural Resource Impacts

Given the area of additional impact associated with the Proposal is located entirely on land with severe limitations for agriculture (refer to Section 4.9.2.3) which would not result in the removal of any agricultural production, a detailed review of local agricultural resources of the region is not considered necessary.

4.14.4 Water Resources

As the Proposal would not require large volumes of water, with the water required to be drawn from existing licence entitlements, the impact on agricultural production within the region would be negligible and does not require further consideration.

4.14.5 Transport and Access Changes

While the Proposal would continue to require the use of Jenolan Caves Road and the Great Western Highway to transport quarry products, this would not impact on the access of agricultural producers to markets, industry services and infrastructure. Notably, the transport route for quarry products would not impact on Travelling Stock Reserves or require any road closures or realignments.

4.14.6 Rehabilitation Plans

Rehabilitation of the Stage 2 Site has been designed to re-instate pre-disturbance land uses in the form of:

- passive biodiversity conservation with occasional grazing for fuel control over the extraction area, overburden emplacement and secondary processing area; and
- grazing and occasional cropping over the Yorkeys Creek stockpile area.

Section 2.13 describes the proposed rehabilitation of the Stage 2 Site in sufficient detail to demonstrate long-term impacts on surrounding land uses would be minimised and sustainable future land use optimised.

4.14.7 Consultation

Consultation with the adjoining landowners and users has been undertaken (see Section 3.2.2), however, no issues were raised in relation to agricultural resources or production.

4.14.8 Mitigation and Monitoring

As noted above, the Proposal would have minimal impact on agricultural resources and/or production. This notwithstanding, various mitigation measures and monitoring programs to manage the following are provided throughout the EIS.

- Rehabilitation (see Section 2.13).
- Dust generation and dispersal (see Section 4.8.5).
- Erosion and sediment control (see Section 4.10.5).
- Water quality (see Section 4.10.5).
- Bush fire and other hazards (see Section 4.13).

4.14.9 Conclusion

The Proposal would have negligible impact on agricultural resources and production.

4.15 SOCIO-ECONOMIC SETTING

4.15.1 Introduction

The DGRs issued for the Proposal identified "*Socio-Economic*" as a key issue requiring that the "*EIS include:*

- *potential impacts on local and regional communities, including impacts on social amenity;*
- *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*
- *a detailed assessment of the costs and benefits of the development as a whole, and whether it would result in a net benefit for the NSW community.*

Additional matters for consideration in preparing the EIS were also provided in the correspondence attached to the DGRs from the Lithgow City Council which requests that the Applicant consider entering into a Voluntary Planning Agreement with the Lithgow City Council.

Based on the risk analysis undertaken for the Proposal (Section 3.3.1), the potential impacts relating to socio-economic issues and their risk rankings (in parenthesis) after the adoption of pre-existing or standard mitigation measures are as follows.

- A change in local community structure as a result of income disparity (low risk)
- Perceived loss of amenity at local and neighbouring properties resulting in a change in social activities and impact on feelings of wellbeing derived from associated location (medium risk).
- Actual or perceived loss of amenity at local accommodation locations resulting in impacts to the business viability of local tourist related businesses (medium risk).

A review of the attributed risk levels, following the adoption of the recommended operational safeguards and controls, is provided in Section 6.2.1 and **Table 6.1**.

The socio-economic impact assessment for the Proposal was undertaken by Mr Alex Irwin and Mr Nicholas Warren of R.W. Corkery & Co with assistance from Mr Lee Attard and Mr Darryl Thiedeke of Hy-Tec Industries. This subsection of the EIS provides a summary of the socio-economic impact assessment, concentrating on those matters raised in the DGRs and related requirements provided by various government agencies. A consolidated list of the identified requirements and where each is addressed is presented in **Appendix 3**.

4.15.2 The Existing Socio-economic Setting

4.15.2.1 Overview

The Stage 2 Site is located within the Central West of NSW approximately 3.5km south-southwest of the village of Hartley and 10km south of Lithgow and within the Lithgow City Local Government Area (LGA).

Communities surrounding the Stage 2 Site include the following.

- Adjoining Landowners – includes the owners of properties that adjoin the land owned by HPC.
- The Local Community – includes nearby landowners, residents of Hartley Village and Little Hartley who are considered to have an interest in the Proposal due to the proximity of the Austen Quarry to their homes.
- The Lithgow Community – both residents and businesses in the Lithgow LGA including the town of Lithgow and small villages such as Wallerawang, Marrangaroo, Hampton, Portland and Sodwalls.
- The Blue Mountains Community – mostly residents but some businesses that are impacted by the transport of quarry products along the Great Western Highway through the Blue Mountains.

The following subsections include a brief overview of the socio-economic setting in the Lithgow City LGA and the Census-specific State Suburb (SS) of Hartley.

4.15.2.2 Population

Table 4.47 presents the census population data from the ABS 2006 census and ABS 2011 census for the state suburbs of Hartley and Little Hartley, as well as the Lithgow LGA with NSW statistics provided for comparison (ABS 2006; ABS 2011a). It is noted that the population decrease for the state suburb of Hartley is most likely due to a change in the collection areas between 2006 and 2011. The state suburb of Little Hartley was not available as a collection area in the 2006 census (potentially due to the relatively recent residential development of the areas off Coxs River Road and Baaners Lane) but has been included to provide an indication as to the population in this area surrounding the Stage 2 Site. Land use zoning included in the Lithgow City Council *Local Environmental Plan (LEP) 1994* establishes the suburb of Hartley as Rural (General) while the suburb of Little Hartley is zoned as Rural (Small holdings) suggesting that Little Hartley is a housing growth area within the Lithgow LGA. Population growth in the Lithgow City LGA was slightly lower than the State average between the 2006 and the 2011 census.

Table 4.48 presents the ABS 2011 census population statistics for the Hartley State Suburb, Lithgow LGA and NSW, broken down into age groups (ABS 2011a). In summary, both the Hartley SS and Lithgow LGA have a slightly lower proportion of population aged 20-34 which is consistent with an area that does not offer many tertiary study opportunities. It is also of note that both the Lithgow LGA and Hartley SS have a higher proportion (much higher in the case of the Hartley SS) of population aged 45 to 64.

Table 4.47
Population Statistics

	Hartley SS			Little Hartley SS			Lithgow City LGA			NSW		
	2006	2011	%	2006[1]	2011	%	2006	2011	%	2006	2011	%
Total	497	299	-40	NA	536	-	19 756	20 160	2	6 549 177	6 917 658	6
Males	251	167	-33	NA	274	-	10 017	10 290	3	3 228 451	3 408 878	6
Females	246	132	-46	NA	262	-	9 739	9 870	1	3 320 726	3 508 780	6

Note 1: Census data not available for the Little Hartley SS in 2006.

Source: ABS Census 2006 and 2011.

Table 4.48
Age Statistics

Age Bracket	Hartley SS		Lithgow City LGA		NSW	
	No.	%	No.	%	No.	%
Children						
0-4	12	4.0	1 276	6.3	458 736	6.6
5-14	37	12.4	2 495	12.4	873 776	12.6
Studying or Working						
15-19	17	5.7	1 275	6.3	443 416	6.4
20-24	15	5.0	1 104	5.5	449 685	6.5
25-34	18	6.0	1 977	9.8	941 496	13.6
35-44	41	13.7	2 498	12.4	971 626	14.1
45-54	64	21.4	3 025	15.0	950 452	13.8
Approaching Retirement or Retired						
55-64	50	16.7	2 855	14.2	810 290	11.7
65-74	27	9.0	2 117	10.5	541 689	7.8
75-84	12	4.0	1 153	5.7	336 756	4.9
84+	5	1.7	386	1.9	139 735	2.0
Total	**299**		**20 160**		**6 917 657**	

Source: ABS Census 2011.

4.15.2.3 Employment

Table 4.49 presents employment statistics from the ABS 2011 Census for the Hartley SS, Lithgow LGA and NSW (ABS 2011a). These results indicate that Hartley SS has a higher labour force participation rate while Lithgow has a lower rate than the NSW average. The Lithgow LGA unemployment rate was 7.7% at the 2011 Census. This may be the result of the higher than average proportion of the population looking for full time work in the Lithgow LGA. Most recent labour force statistics sourced from the ABS in September 2013 indicate the NSW unemployment rate has fallen to 5.6% (ABS 2013)[13] but gives no indication of the current employment rate in either the Lithgow LGA or Hartley SS.

[13] ABS 2013 6202.0 - Labour Force, Australia

Table 4.49
2011 Employment Statistics

	Hartley SS		Lithgow LGA		NSW	
	No.	**%**	**No.**	**%**	**No.**	**%**
Employed						
Full-time[1]	97	38.2	4 951	30.2	2 007 925	29.0
Part-time	52	20.5	2 553	15.6	939 464	13.6
Employed, away from work[2]	6	2.4	344	2.1	120 121	1.7
Employed, hours not stated	4	1.6	214		70 821	1.0
Total		**159**		**8 062**		**3 138 331**
Unemployed, looking for work						
Full-time work	3	1.9	417	5.2	116 697	3.7
Part-time work	3	1.9	205	2.5	79 829	2.5
Total		**6**		**622**		**196 526**
Labour Force Participation						
Total labour force		165		8 684		3 334 857
Not in labour force		67		8 684		1 933 275
Labour force status not stated		22		6 801		317 017
Total Persons		**254**		**16 385**		**5 585 149**
Labour force participation		**65.0%**		**53.0%**		**59.7%**

Note 1: Employed, worked full-time' is defined as having worked 35 hours or more in all jobs during the week prior to Census Night.

Note 2: Comprises employed persons who did not work any hours in the week prior to Census Night.

Source: ABS Census 2011

4.15.2.4 Industry Employment

Table 4.50 presents industry employment statistics from the 2011 ABS Census for the Hartley SS, Lithgow LGA and NSW (ABS 2011a). The residents within Hartley SS are involved in a range of industries with the two most common being retail trade and education and training followed by transport, postal and warehousing. This is most likely a result of the Hartley SS representing a "dormitory" suburb for employers within the City of Lithgow. Notably, when the Lithgow LGA is considered, the most significant industry is mining (including extractive industries) (which is well above the NSW average), followed by retail and health care (which are both equivalent to NSW average).

The significance of the mining industry (and primary industries in general) is recognised in the Lithgow Land Use Strategy 2010-2030 (LCC, 2011) (refer also to Section 3.2.3.4.2). Not only does this industry provide direct employment within the LGA, it is likely to provide a stimulus to employment levels within the retail and health care sectors. There are no statistics available which segregate employment generated by extractive industries from mining within the Lithgow LGA. While employment generated by extractive industries is expected to only represent a small proportion (<10%), it is worthy of note that employment provided by extractive industries, as opposed to coal or metalliferous mining, tends to be more stable and less subject to fluctuation related to market movements.

Table 4.50
Industry Employment Statistics

Industry	Hartley SS		Lithgow LGA		NSW	
	No.	%	No.	%	No.	%
Agriculture, forestry & fishing	7	4.4	216	2.7	69 576	2.2
Mining	10	6.3	997	12.4	31 186	1.0
Manufacturing	3	1.9	542	6.7	264 865	8.4
Electricity, gas, water & waste services	0	0.0	351	4.4	34 203	1.1
Construction	9	5.6	471	5.8	230 057	7.3
Wholesale trade	3	1.9	157	1.9	138 890	4.4
Retail trade	25	15.6	803	10.0	324 727	10.3
Accommodation & food services	12	7.5	672	8.3	210 380	6.7
Transport, postal & warehousing	19	11.9	464	5.8	155 027	4.9
Information media & telecommunications	0	0.0	51	0.6	72 488	2.3
Financial & insurance services	0	0.0	133	1.6	158 422	5.0
Rental, hiring & real estate services	0	0.0	77	1.0	51 554	1.6
Professional, scientific & technical services	7	4.4	248	3.1	247 295	7.9
Administrative & support services	6	3.8	274	3.4	102 354	3.3
Public administration & safety	9	5.6	682	8.5	192 634	6.1
Education & training	25	15.6	503	6.2	248 951	7.9
Health care & social assistance	16	10.0	885	11.0	364 321	11.6
Arts & recreation services	0	0.0	79	1.0	46 330	1.5
Other services	9	5.6	289	3.6	117 615	3.7
Inadequately described/Not stated	0	0.0	167	2.1	77 455	2.5
Total	**160**		**17 529**		**3 138 330**	

Source: ABS Census 2011

4.15.2.5 Income

A summary of income statistics for the Lithgow LGA and Hartley SS is presented in **Table 4.51** (ABS 2011a). In summary, income statistics for both the Lithgow LGA and Hartley SS are below the NSW average with a household in the Lithgow LGA earning $341 or 28% less than the NSW average. Both areas also have a higher proportion of people in the low income bracket and a lower percentage of people in the high income bracket compared to the NSW average.

Table 4.51
Income Statistics

Income	Hartley SS	Lithgow LGA	NSW
Median individual income ($/weekly)	555	450	561
Median family income ($/weekly)	1 166	1 190	1 477
Median household income ($/weekly)	958	896	1 237
Less than $600 gross weekly income	31.9%	34.7%	24.2%
More than $3,000 gross weekly income	8.5%	7.7%	12.3%
Source: ABS Census 2011.			

4.15.2.6 Housing

Table 4.52 presents a summary of the housing cost statistics for the Hartley SS, Lithgow LGA and NSW (ABS 2011a). The statistics indicate that although housing prices are slightly higher in the Hartley SS, rent in this area is one third of the NSW average. Both housing prices and median rent were lower for the Lithgow LGA. The high proportion of unoccupied private dwellings in Hartley indicates this is a popular area for "weekender" accommodation.

Table 4.52
Household Statistics 2011 Census

	Hartley SS	Lithgow LGA	NSW
Median housing loan repayment ($/monthly)	2 167	1 452	1 993
Median rent ($/weekly)	100	170	300
Dwelling owned outright	51 (46.4%)	3 131 (40.2%)	820 006 (33.2%)
Dwelling owned with mortgage	37 (33.6%)	2 429 (31.2%)	824 293 (33.4%)
Dwelling rented	19 (17.3%)	1 895 (24.3%)	743 050 (30.1%)
Average number of persons per bedroom	1.0	1.1	1.1
Average household size	2.6	2.3	2.6
% Unoccupied private dwellings	31.7%	14.4%	9.7%

The total number of households in the Lithgow LGA and Hartley SS at the time of the 2011 census was 7 787 and 110 respectively. Of these households, both the Lithgow LGA and Hartley SS had a higher proportion of dwellings owned outright and fewer households renting than the NSW average.

4.15.2.7 The Socio-economic Indexes for Areas

The Socio-economic Indexes for Areas (SEIFA) (ABS 2011b), is a suite of four summary measures prepared by the ABS from the 2011 Census information that provide a reference for a given area on issues of advantage, disadvantage, education and opportunity, and finally access to economic resources. For each index, geographic areas in Australia are given a SEIFA number. The ABS defines relative socio-economic advantage or disadvantage in terms of people's access to material and social resources, and their ability to participate in society with the designated numbers indicating how disadvantaged that area is compared with other areas in Australia.

The Lithgow LGA is in the 2nd decile for the index of Relative Socio-economic Disadvantage. In contrast, the nearby Bathurst Regional LGA is in the 6th decile while the Mid-Western Regional LGA is in the 4th decile. This indicates that, relative to the rest of the country, the Lithgow LGA has a high level of disadvantage. The Lithgow LGA was also in the 1st decile for the index of Education and Occupation indicating that the LGA has a high proportion of people without qualifications, without jobs, or with low skilled jobs.

4.15.2.8 Regional Amenity and Tourism

The Stage 2 Site is located beyond the western boundary of the Blue Mountains National Park (which covers an area of 268 987ha). The park covers much of the Blue Mountains and Jenolan Caves. Both areas are within the Greater Blue Mountains World Heritage Area. These areas are popular tourist destinations for both scenic and adventure activities, with the Jenolan Caves, an area of national heritage significance, receiving over 230 000 visitors annually. Traffic counts of the Jenolan Caves Road indicate that the highest levels of use for the tourist areas are during the weekend and therefore at a time when quarry operations are at their lowest. Accurate counts of visitors to the Blue Mountains National Park is not possible, however, it is considered a highly significant tourist destination and natural heritage feature.

Other locally significant tourist, or natural heritage, sites include the following.

Coxs River

From its headwaters at Gardiners Gap, within Ben Bullen State Forest, the Coxs River is a perennial watercourse forming part of the larger Hawkesbury-Nepean catchment and Sydney Drinking Water Catchment. Flowing through the Megalong Valley within the Greater Blue Mountains Area World Heritage Area, the Coxs River provides for fishing, bushwalking and other recreational activities. Adjoining the Stage 2 Site on the northern and eastern boundaries, it is identified as a regionally significant fishing watercourse. While there are no areas in the vicinity of the Stage 2 Site dedicated to fishing, the river remains a significant fish habitat (refer to Section 4.8.3).

Hassans Walls

To the east of Lithgow, the sandstone escarpments rise from the Hartley valley with the most prominent vantage point being Hassans Walls Lookout. While visitation numbers to the Hassans Walls lookout, other lookouts and walking tracks are not available, it is identified as a tourist feature of significance within the Lithgow LGA based on the views provided towards the western escarpment of the Blue Mountains and valleys in between.

Mount York

Located on the western edge of the Blue Mountains escarpment, Mount York is a local tourist destination featuring the Mount York Obelisk and providing a major car park and tourist information. The Mount York Obelisk is a historic feature commemorating Blaxland, Lawson and Wentworth for their crossing of the Blue Mountains in 1813, as well as other historic figures who had assisted in pioneering the route over the Mountains, including Evans, Cox and Macquarie[14]. Mount York also provides the starting or end point for bush walks (largely focussed on the historic passage of Blaxland, Lawson and Wentworth).

[14] http://monumentaustralia.org.au/themes/landscape/settlement/display/22369-mount-york-obelisk

Common features of these and other tourist features of the local setting is the natural heritage which can be viewed or experienced. This can be summarised as providing a regional amenity characterised by quiet rural activities within a larger wilderness which provides the backdrop for both passive and adventure driven activities.

It is noted that the quarry has been operating alongside and with little impact to either regional amenity or tourism since 2005.

4.15.2.9 Community Aspirations

The *Our Place…Our Future Community Strategic Plan 2013-2026* (the Plan) (LCC, 2013) was adopted by Lithgow City Council in late 2013 and describes the community's strategic vision for the LGA. The Plan was developed following extensive community consultation and highlights concerns such as the low level of population growth, ageing population, and the issues of youth leaving the area to seek jobs and tertiary education in other areas. The Plan also highlights several positive developments such as the recent establishment of two university campuses being the Notre Dame Rural Medical Clinic and the University of Western Sydney Outreach Campus.

Broadly, the Plan describes the following key activity areas.

- Caring for Our Community.
- Strengthening Our Economy.
- Developing Our Built Environment.
- Enhancing Our Natural Environment.
- Responsible Governance and Civic Leadership.

4.15.3 Potential Impacts of the Proposal on the Socio-economic Setting

The impact of the Proposal on the socio-economic setting of the local area and region would occur primarily as a consequence of the following.

Employment and Economic Stimulus

The long-term security of operations at the Austen Quarry would provide long-term employment security for up to 20 direct positions (an increase of four from existing operations), as well as indirect employment to truck drivers (many of whom would reside locally). Additional investment in the quarry, in the form of plant upgrades and other general improvements, driven by the long-term security of the Stage 2 Site, would provide additional employment and stimulus to local services.

The flow-on effects from the secure wage stream to quarry personnel would provide stimulus to local retail and other service industries within the Lithgow LGA.

Reduced Amenity of Local and Regional Tourist Attractions

Considered in detail in Section 4.4, the proposed quarry extension would be visible from several tourist attractions, most notably Hassans Walls within the Lithgow LGA and Mount York within the Blue Mountains City LGA. If not managed appropriately, the amenity value of these lookouts could be compromised reducing the visitation experience.

Environmental Emissions Impacting on Lifestyle

Increased emissions of dust and noise, or impacts on local water resources and vegetation, could impact on the lifestyle of local residents who have chosen the local setting for the amenity value described in Section 4.15.2.8.

The Social Impact of Road Transport Through the Blue Mountains

The Applicant acknowledges the concern of residents of the Blue Mountains over road safety and the potential danger posed to residents and businesses adjacent to the Great Western Highway as the quarry product travel through the Blue Mountains. These issues have been discussed in detail in Section 4.3 and it is reiterated that heavy vehicle traffic generated by the Proposal would only represent a small proportion of total heavy vehicle traffic travelling through the Blue Mountains. In terms of social impacts, the presence of trucks in these areas may impact feelings of general well-being and amenity for residents. It is considered unrealistic, however, to suggest that the proportion of heavy vehicle traffic attributable to the Applicant would have any measureable effect on local businesses.

4.15.4 Safeguards and Mitigation Measures

In addition to the mitigation measures and management procedures relating to amenity aspects such as transportation, visibility, noise and air quality described previously in Section 4, the Applicant would implement the following management and mitigation measures to ensure that benefits for the community surrounding the Stage 2 Site arising from the Proposal are maximised and adverse impacts are minimised. Where possible, these measures have been categorised to reflect the particular aspect that would be addressed by each.

Social and Community

- Proactively consult with those residents who may be adversely impacted by the Proposal.
- Continue to engage with local community members through the use of an ‘open door’ policy for any member of the community who wishes to discuss any aspect of the Proposal.
- Form and maintain a Community Consultative Committee (CCC), including representative members of the local community and Lithgow City Council. The CCC would be an important forum for reviewing and discussing environmental monitoring and performance, and discussing possible improvements that could be made to operations to improve environmental (and social) performance.
- Regularly brief the CCC on activities at the Quarry and seek feedback in relation to Proposal-related impacts whether real or perceived. In addition, seek advice in relation to the most appropriate manner in which to provide assistance to the community in an effective, fair and equitable manner.

- Continue to maintain the community complaints response system.
- Continue to encourage employees to be actively engaged in the communities in which they live and provide working arrangements, where practicable, that facilitate such engagement.
- Continue to support community organisations, groups and events, as appropriate, and review any request by a community organisation for support or assistance throughout the life of the Proposal. Evidence of this is provided by the $5 000 donation made by the Applicant in late 2013 to the (LCC) Mayor's Bush fire Appeal.

Responsible Road Use

- Continue to implement the nationally recognised Hy-Tec Chain of Responsibility: Driver Vehicle Check system to preserve, as much as practically possible, the safety of all road users and the communities through which product transport trucks will pass.
- Require each truck driver (and their representative contracting company) to confirm (through signature) understanding as to expectations with respect to:
  - driver compliance with all road laws, and on-site requirements, alertness, driving behaviour, response to other motorists and the use of all relevant equipment e.g. truck covers;
  - compliance of the vehicle with all relevant laws and guidelines with respect to safety checks, noise levels and emissions of them; and
  - acknowledgement and agreement to the Applicant's program of random checks of both the driver's and vehicles records.

Employment and Training

- Continue to give preference when engaging new employees to candidates who live within the Lithgow LGA over candidates with equivalent experience and qualifications based elsewhere.
- Continue to encourage and support participation of locally based employees and contractors in appropriate training or education programs that would provide skills and qualifications that may be of use at the Stage 2 Site (and potentially elsewhere within the extractive, mining or related industries).

Economic Contribution and Development

- Continue to give preference, where practicable, to suppliers of equipment, services or consumables located within the Lithgow LGA.
- Develop and implement a Voluntary Planning Agreement (VPA) to offset any additional costs incurred on Lithgow LGA infrastructure and services as a consequence of the ongoing operations at Austen Quarry.

General

- Continue to adhere to all operating conditions, e.g. restrictions on hours of operation and the required standard of facility.
- Implement the recommendations provided in each of the specialist assessments of the Proposal.

4.15.5 Impact Assessment

4.15.5.1 Regional Socio-economic Considerations

A review of the socio-economic setting for the Lithgow LGA highlights the importance of maintaining employment and encouraging diverse industries and economic growth opportunities for the region. The SEIFA statistics for the area suggest higher than average levels of disadvantage and fewer opportunities for employment and education. This is also evident in the lower than average income levels (see **Table 4.51**) and lower numbers of people aged 25-34 (see **Table 4.48**) which may be considered a key age for people establishing careers, investing in housing and starting families. Conversely, the LGA has a higher proportion of people nearing, or in retirement, commonly indicative of an ageing population.

The above statistics demonstrate the critical importance of employment retention and creation within the Lithgow LGA. As discussed in Section 4.15.2.4 (and **Table 4.50**), the most important industries of employment are mining (including extractive industries), health care and retail trade. Notably, the retail sector and to a lesser extent health care sector, rely on the employment and wealth creation of other sectors. As noted, the mining sector provides the greatest contribution to this within the Lithgow LGA highlighting the continued importance of the mining and extractive industry to the existing economic health of the LGA.

On the basis of the regional significance of employment retention and creation generally, and mining sector specifically within the Lithgow LGA, the Proposal presents as a regionally significant development given it would provide a long-term and secure source of employment (both directly and indirectly) and economic stimulus to other businesses within the LGA. The following subsections evaluate the economic and social impacts of the Proposal in more detail.

4.15.5.2 Evaluation of Economic Impacts

Existing operations at the Austen Quarry support the employment of 16 full time staff at the Stage 2 Site and it is estimated that indirect employment through the contracting of transport operations, maintenance and other supply services provides full time employment for at least 40 additional people. The Applicant also estimates that the quarry's annual contribution to the local economy through wages, purchases, local contractors, suppliers (e.g. diesel fuel) and transport operators exceeds $5 million.

If the Proposal is approved, the Applicant has estimated the need for an additional four personnel and therefore (based on the multiplier established for the existing operation) additional indirect employment for six additional people. The annual contribution through wages, local purchases, and business to local contractors, suppliers and transport operators would also be increased. It is worthy of note that the contribution of the Austen Quarry to the

Lithgow LGA economy is well understood and appreciated by the LCC. Following the receipt of the $5 000 donation to the Mayor's Bush fire Appeal, the Lithgow City Mayor (Councillor Maree Statham) stated "*Hy-Tec run a great business here in the Lithgow area and provide many valuable jobs for local people*" (Lithgow Mercury, 19 December 2013). The Proposal would extend the operational life, and thus the economic benefit, of the quarry from the current end date of 2020 for a further 30 years i.e. until at least 2050.

The extended operational life of the quarry would also benefit complementary local industry, e.g. construction, and feasibility of local infrastructure projects such as roads given the raw materials required for these industries and project would be more easily available and less expensive than if they had to be sourced from outside the region, e.g. Sydney, Bathurst or Orange (East Guyong). The flow-on effect, both economically and socially, of the employment and other benefits derived from such industry and projects would also be significant (if difficult to accurately predict or estimate).

Possible negative economic impacts of the Proposal are considered negligible.

- The distance (buffer) between the quarry and other properties and residences is substantial and therefore, no devaluation of property or house prices can be inferred. In fact, the general contribution economic security and stimulus provided by the Proposal would likely provide a boost for local real estate.
- There would almost certainly not be any drain on local services and infrastructure given the current and proposed future workforce are already resident in the region, i.e. they are already being catered for.
- There would almost certainly be no drain on the labour force available to other industries. The proposed increase in employment is modest and likely to be drawn either from those currently or recently unemployed following workforce reductions in the local coal and power generation industry. The employment statistics of **Tables 4.49** and **4.50** support the fact that there is currently ample capacity within the local labour market (high unemployment) from appropriate industry (high proportional representation of employment in mining and other industry with equivalent skill requirements).

4.15.5.3 Evaluation of Social Impacts

The Proposal would not substantially alter the method of extraction, extraction equipment, extraction or processing rates, employment levels (modest increase), product transportation levels (moderate increase to currently approved levels) or general environmental management strategies employed at the quarry. Generally, the principal impacts of the Proposal would be the sustained higher levels of extraction and the lengthening of the life of the Quarry. As such, the potential social impacts would generally be similar to those currently experienced by the communities of Hartley, Little Hartley, Lithgow and surrounding areas which overall are comparatively well accepted in the local community. The ongoing direct and indirect employment provided by the quarry would contribute to underpinning maintenance of social values both locally and regionally.

The Proposal would also contribute to meeting the goals of the Lithgow Council's *Our Place…Our Future Community Strategic Plan 2013-2026* by assisting to strengthen the economy of the local area and providing a local source for the raw materials required for the further develop the built environment.

As noted in Section 4.15.3, it is acknowledged that the Proposal could have some adverse impacts associated with reduced amenity ("lifestyle") of the local setting associated with possible emissions, increased visibility and product transportation through the Blue Mountains. These concerns are illustrated by the feedback provided by local community groups when consulted by the Applicant (see Section 3.2.2.5.1). Each area of potential impact is considered as follows.

- Emissions and other physical impacts of the Proposal.

  Notably, the proposed extension would not change the method or scale of operations at the Stage 2 Site significantly, with existing operations either well accepted or even unknown to adjoining land owners and the local community. The results of air and noise modelling emphasise the very limited impact the Proposal would have, with other assessment of impacts on water resources, local biodiversity and heritage demonstrating minimal and acceptable levels of impact.

  On the basis of the above, the likely impact on amenity as a consequence of Stage 2 Site emissions and other physical impacts would be very minor.

- Increased visibility and impacts on regional amenity and tourism.

  The Stage 2 Site is currently visible from several regionally significant lookouts.

  From Hassans Walls within the Lithgow LGA, modifications to the design and sequence of the extraction area would ensure that the view of the Stage 2 Site does not change significantly over the life of the Proposal (see **Figure 4.25** and **4.27**). From Mount York, the area of visible extraction activities would increase, however, the exposed area would be reduced as far as practicable as a result of modifications to the design and sequence of the extraction area (see **Figure 4.26** and **4.27**). In both cases, additional mitigation measures such as application of a bituminous coat and progressive rehabilitation would further reduce the visible intrusion of the Stage 2 Site from these lookouts.

  Acknowledging that the Stage 2 Site is currently visible from these locations, it is assessed that the changes to the visual outlook from these and other lookouts would not be so significant as to create a major change to the amenity of these points and of the region more generally. Specifically, it is considered highly unlikely that the small changes to visibility would result in discouragement of visitors to these locations or to the wider Lithgow and Blue Mountains areas more generally. As a consequence, any small modifications to regional amenity would not be so significant as to impact on local tourism and affect any social changes as a result.

- Increased visibility and impacts on landowner amenity.

  The Stage 2 Site is currently visible from a number of residential vantage and other publicly accessible vantage points (see Section 4.4.2.3). Sections 4.4.3 to 4.4.5 review the likely changes to visual amenity, proposed design and management measures to be implemented to reduce or mitigate impacts and residual visual impacts of the Proposal.

  The residual visual impacts from vantage points to the northwest (Jenolan Caves Road and McKanes Falls Road) would be gradually reduced as the material currently maintained within the Yorkeys Creek stockpile area is sold and removed from the Stage 2 Site. In the interim, the Applicant has committed to undertaking various visual mitigation trials described in Section 4.4.4.3.

  The residual impacts from vantage points to the north, northeast and east of the Stage 2 Site (Great Western Highway, Bells Line of Road, Blackmans Creek Road, Hartley and Little Hartley) would be effectively managed through the measures to be implemented to reduce the impacts on visual amenity at Hassans Walls and Mt York.

  To the south of the Stage 2 Site (Coxs River Road and Kanimbla) the proposed extraction area and overburden emplacement extension would become more visible following the removal of the Southern Ridge (see **Figure 4.27**). The impact would be partially mitigated given the significant distance between the various private vantage points and the Stage 2 Site (6km). Progressive rehabilitation would also reduce the impact as over a 6km distance, revegetation of the completed overburden emplacement and extraction area benches would significantly reduce the visibility of these.

- Social impact of road transport through the Blue Mountains.

  On the basis that the heavy vehicle traffic generated by the Proposal represents only a small proportion of heavy vehicle traffic through the Blue Mountains and the enforcement of high vehicle and driver performance standards, the Proposal would have an imperceptible impact on the traffic environment of the Great Western Highway. On this basis, it is assessed that there would not be any changes to the amenity of those communities located adjacent to the highway and certainly no impact on the businesses operated.

4.15.5.4 Conclusion

Overall, the Proposal has, to the extent feasible, been designed to minimise the social and economic cost on adjoining land owners, local and regional communities. The Proposal provides for the removal, processing and despatch of products important for the continued growth and prosperity of NSW (see Section 2.2). The Proposal would be significant in maintaining and generating local employment opportunities and continue to provide stimulus to the economy of the Lithgow LGA.

Through an effective consultation program and planning process, the potential socio-economic impacts of the Proposal are well understood and this has allowed the Applicant to design the proposed extension in such a way as to reduce the residual impacts on the local environment and amenity as far as reasonably possible.

The Applicant contends that any adverse socio-economic or environmental impacts, both actual and perceived, would be more than adequately countered by the positive effect that the Proposal would have on the community and economy in the vicinity of the Stage 2 Site and the wider area as it would:

- provide ongoing employment opportunities and contribute to the continued economic activity of the Lithgow LGA;
- contribute towards the supply of aggregate, sand and road building materials important to both regional and NSW construction industries and infrastructure projects;
- contribute towards LCC achieving the objectives of *Our Place…Our Future Community Strategic Plan 2013-2026* by assisting to strengthen the economy of the local area and providing a local source for the raw materials required for the further develop the built environment;
- satisfy ecologically sustainable development principles (refer to Section 6.2.2); and
- have manageable impacts on the biophysical environment and regional amenity values.

This page has intentionally been left blank