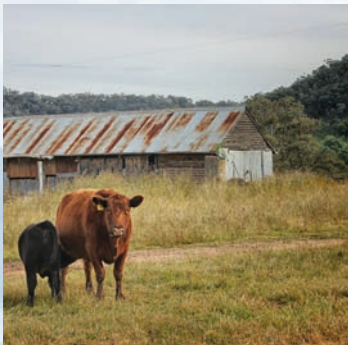


BYLONG COAL PROJECT

Environmental Impact Statement

September 2015

Main Report



EIS Statement

Submission of Environmental Impact Statement (EIS)

Under Section 78A(8A) of the *Environmental Planning and Assessment Act 1979*

EIS Prepared by

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In Respect Of

Bylong Coal Project

Proponent Name

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Land to be Developed

See **Appendix A** of this EIS.

Proposed Development

Development and operation of the Bylong Coal Project and associated activities as outlined in **Section 3** of this EIS.

EIS

An EIS for the Project is attached.

Certification

I certify that I have read and am aware of the terms of the Expert Witness Code of the Land & Environment Court of NSW.

I further certify that I have prepared the contents of this EIS, and to the best of my knowledge:

- It is in accordance with Section 78A(8A) of the *Environmental Planning and Assessment Act 1979*;
- Meets the form and content requirements under Clauses 6 and 7 of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*;
- It contains all available information that is relevant to this EIS for the activity to which it relates; and
- The information contained in this EIS is neither false nor misleading.

Signature



Name

James Bailey

Date

1 September 2015

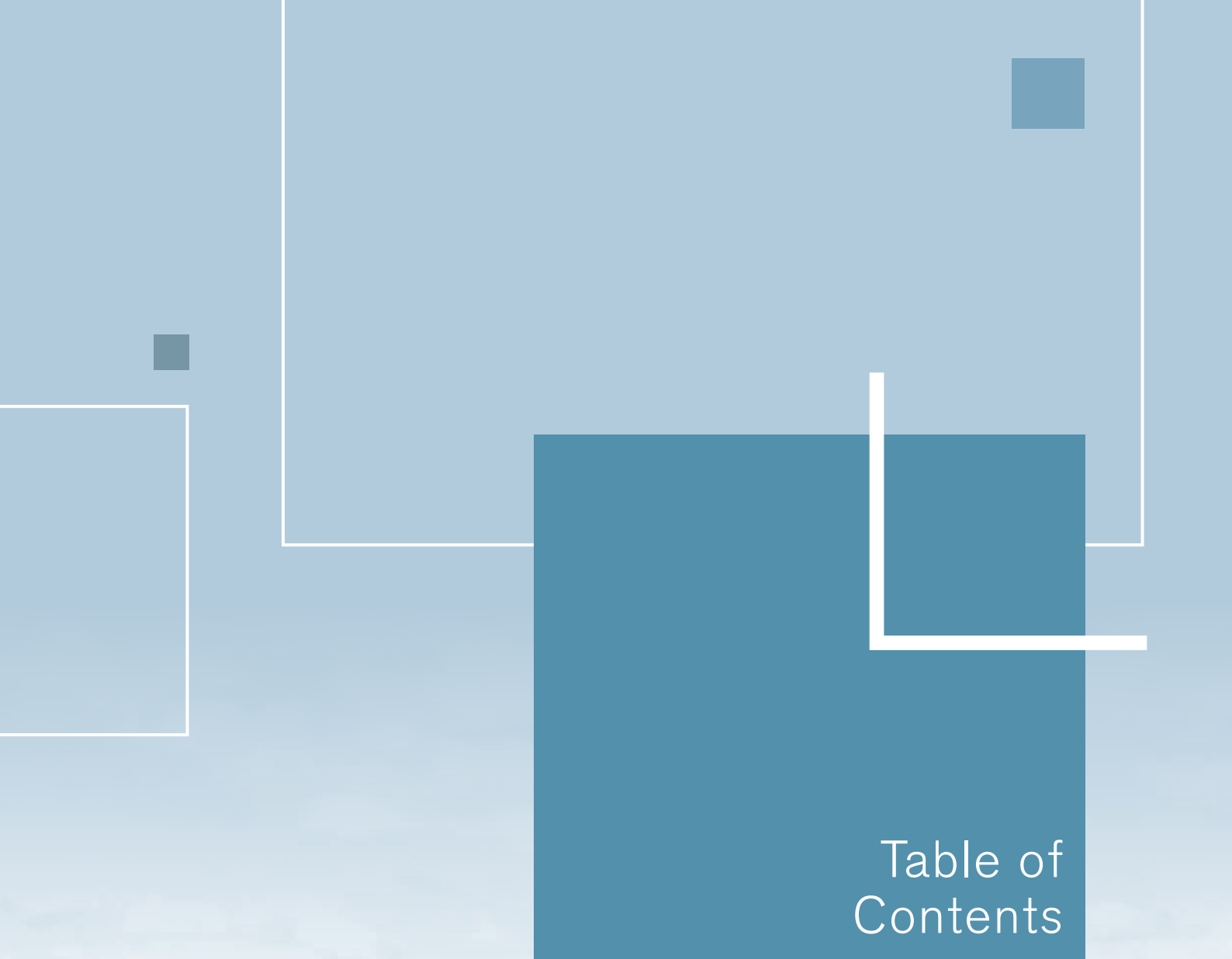


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Appendix N	Groundwater Peer Review	Appendix AE	Economic Impact Assessment
Appendix O	Air Quality and Greenhouse Gas Impact Assessment	Appendix AF	Economic Peer Review
Appendix P	Air Quality Peer Review	Appendix AG	Contamination Impact Assessment
Appendix Q	Noise and Blasting Impact Assessment		



1

Introduction

Introduction

This section describes the background and context of the Project, introduces the proponent and outlines the purpose and structure of this Environmental Impact Statement (EIS).

1.1 BACKGROUND

Korea Electric Power Corporation (KEPCO Korea) is the largest publically listed electricity utility company in Asia (Forbes, 2015) being responsible for the generation of 85% of South Korea's electricity for its industrial, commercial, residential, educational and agricultural customers. KEPCO Korea was initially founded with the overall objective to develop the electric power supply in Korea to meet its increasing electricity supply needs and to contribute to the Korean national economy.

In 2014, KEPCO Korea's total installed capacity was approximately 93,000 Megawatt (MW) and total electricity generation was around 443,000 Gigawatt hours (GWh). Coal and nuclear power are the dominant sources of power in Korea representing 29% and 22% of the total installed capacity and 46% and 35% of the total electricity generation, respectively.

In 2014, approximately 5% of KEPCO Korea's generation capacity was from renewable energy sources (KEPCO Korea, 2014). While KEPCO Korea is committed to further developing renewable energy technologies, high quality thermal coal is anticipated to remain a dominant source of energy over the next several decades whilst these alternative technologies are developed. KEPCO Korea's commitment to best practice environmental management is demonstrated by its Environmental Management System certified to ISO 14001.

South Korea is the fourth largest importer of coal in the world, following China, Japan and India. At present, South Korea imports 97% of its energy sources from abroad, of which 70% of coal imports and 100% of uranium imports are used for power generation. Australia, Indonesia and Russia supply the majority of South Korea's coal imports. In 2014, KEPCO Korea imported 80 Million tonnes (Mt) of thermal coal with 27 Mt of this coming from Australia.

Coal consumption in South Korea increased by around 55% between 2005 and 2012. This increase in demand occurred at a time of an unprecedented world demand for carbon based energy (i.e. with demand surpassing supply), which resulted in elevated fuel prices. This experience has highlighted the need for KEPCO Korea to implement strategic future directions to limit the risk and liabilities associated with maintaining a continuous competitive supply of fuel.

KEPCO Korea's need for vertical integration and being involved in resource development is vital in it achieving a complete value chain. Therefore, KEPCO Korea is aiming to secure stable long term high quality fuel supplies by purchasing overseas resources, mines and resource development companies.

By developing overseas natural resources, KEPCO Korea has the ability to enhance competitiveness and better manage the impact of sudden and unexpected fluctuations in global fuel prices. In order to maintain a stable project pipeline, Australia has been identified as a favourable environment within which to pursue its resource development strategy.

In December 2010, KEPCO Bylong Australia Pty Ltd (KEPCO) (a wholly owned subsidiary of KEPCO Korea) acquired Authorisation (A) 287 and A342 (the Authorisations). The purchase of these Authorisations and their transfer to KEPCO along with the minority shares held in Cockatoo Coal Limited and Yancoal's Moolarben Coal Mine is consistent with KEPCO Korea's overall business strategy to secure critical coal resources. Access to foreign coal resources such as those within the Authorisations will reduce KEPCO Korea's exposure to resource scarcity issues and assist in ensuring energy security for South Korea as a whole.

Since acquiring the Authorisations, KEPCO has conducted extensive exploration and mine planning work to identify the coal resources within the Authorisations and to determine the most environmentally and socially responsible and economically viable mine plan to recover these known coal resources.

In August 2014, KEPCO commissioned WorleyParsons Services Pty Ltd (WorleyParsons) to manage the exploration activities, mine feasibility study planning, environmental approvals and ongoing environmental monitoring for the Bylong Coal Project (the Project).

The preferred Project mine plan involves the construction and operation of an open cut and underground mining operation to recover approximately 124 Mt of Run of Mine (ROM) coal to produce thermal coal products for export predominantly to Korea over a period of approximately 25 years. The Project is anticipated to require up to approximately 800 people during construction, 470 people during peak operations, with an average of approximately 290 people during operations.

The Project is located wholly within A287 and A342 which are located within the Mid-Western Regional Council (MWRC) Local Government Area (LGA). The closest regional centre is Mudgee, located approximately 55 kilometres (km) south-west of the Project Boundary. The Project is approximately 230 km by rail from the Port of Newcastle. **Figure 1** illustrates the locality of the Project within New South Wales (NSW). **Figure 2** shows the regional locality of the Project in relation to the town centres, mining authorities, major transport routes, reserves and the Study Area for this EIS. **Figure 3** presents the key features within A287 and A342.

1.2 PROPONENT

The proponent for the Project is KEPCO Bylong Australia Pty Ltd, a subsidiary of Korea Electric Power Corporation. Contact details are as follows:

*Suite 1301, 141 Walker Street
NORTH SYDNEY NSW 2060*

Phone: 02 8904 9508

www.kepcoco.kr/eng

www.bylongproject.com.au

1.3 DOCUMENT PURPOSE

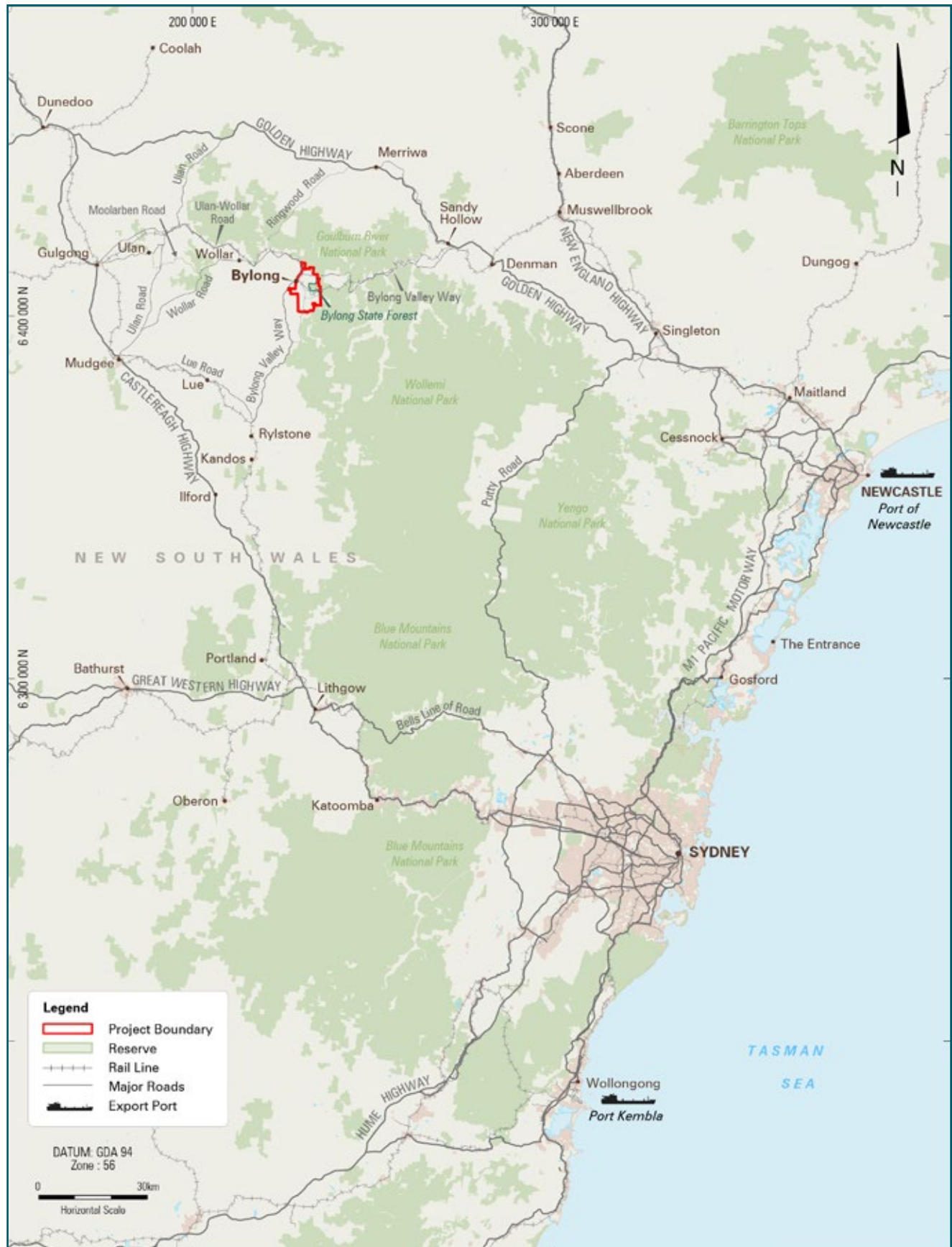
KEPCO seeks a development consent under Division 4.1 of Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to enable the development of a greenfield open cut and underground coal mining operation.

A request for Secretary's Environmental Assessment Requirements (SEARs), supported by a Background Document was made to the Department of Planning and Environment (DP&E) on 17 January 2014, in accordance with clause 3 of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation). SEARs were issued by DP&E on 23 June 2014 (incorporating the Gateway Certificate Recommendations) and were subsequently modified on 11 November 2014.

This EIS has been prepared by Hansen Bailey Environmental Consultants (Hansen Bailey) on behalf of WorleyParsons and its client KEPCO, to support the application for development consent. Under section 78A(8A) of the EP&A Act, a State Significant Development (SSD) application must be accompanied by an EIS. This EIS has been prepared in accordance with the form and content requirements prescribed by clauses 6 and 7 of Schedule 2 of the EP&A Regulation. The Project Boundary to which this EIS applies is illustrated in **Figure 3**. The schedule of land to which this EIS applies is provided in **Appendix A**.

This EIS for the Project has been prepared in accordance with the SEARs. A table listing the SEARs and where they have been addressed is included in **Section 5.4.1** with detailed correspondence provided in **Appendix B**. This EIS also supports an application to the Commonwealth Department of the Environment (DoE) for approval under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

FIGURE 1 Locality Plan



This EIS includes a consideration of the relevant issues raised during the extensive stakeholder engagement process undertaken for the Project. It also addresses the social, economic and environmental impacts of the Project to enable the appropriate delegate of the Minister for Planning to determine the SSD application. A summary of stakeholder issues that were raised in relation to the Project and where these have been addressed within this EIS is presented in **Section 5.4**.

1.4 DOCUMENT STRUCTURE

This EIS consists of seven volumes and a separate Executive Summary document. This volume (Volume 1) includes the main EIS Report prepared by Hansen Bailey which presents the existing environment, Project description, a summary of associated environmental, social and economic impacts and the mitigation and management measures proposed for each. Volume 1 is structured as follows:

- **Section 1** (this section) describes the background and context of the Project, introduces the proponent and outlines the purpose and structure of this EIS;
- **Section 2** provides information about the existing natural environmental setting, including land use and environmental management in place;
- **Section 3** provides a detailed description of the Project and the various alternatives that were considered;
- **Section 4** outlines the regulatory framework relevant to the Project;
- **Section 5** describes the stakeholder engagement program completed to date and discusses the issues raised. Specifically, this section lists the SEARs and identifies where each matter is addressed within this EIS;
- **Section 6** summarises the contemporary environmental risk assessment conducted for the Project, which ranks all identified environmental and social issues to assist in directing the focus of this EIS;
- **Section 7** assesses the potential environmental and social impacts of the Project and details the proposed management and mitigation measures;

- **Section 8** presents a summary of the management, mitigation and monitoring commitments;
- **Section 9** provides a detailed Project justification and conclusion;
- **Section 10** defines the abbreviations used throughout this EIS;
- **Section 11** provides a list of all materials referenced in this EIS; and
- **Section 12** presents the study team who were involved in the compilation of this EIS.

Volumes 2 to 7 contain the schedule of land to which this EIS applies, regulatory correspondence, indicative detailed design drawings, geology report, mine plan justification report, stakeholder engagement summary and revised risk assessment. In addition, they include the specialist technical impact assessments in full, which support the main volume of this EIS.

The hard copy version of this EIS does not contain various annexures to a few of the Appendices. These annexures are reproduced in full in the digital version of the EIS which is available on the DP&E website and the USB on the inside cover of the separate Executive Summary hard copy document. These annexures are able to be made available as a hard copy upon request.

FIGURE 2 Regional Locality

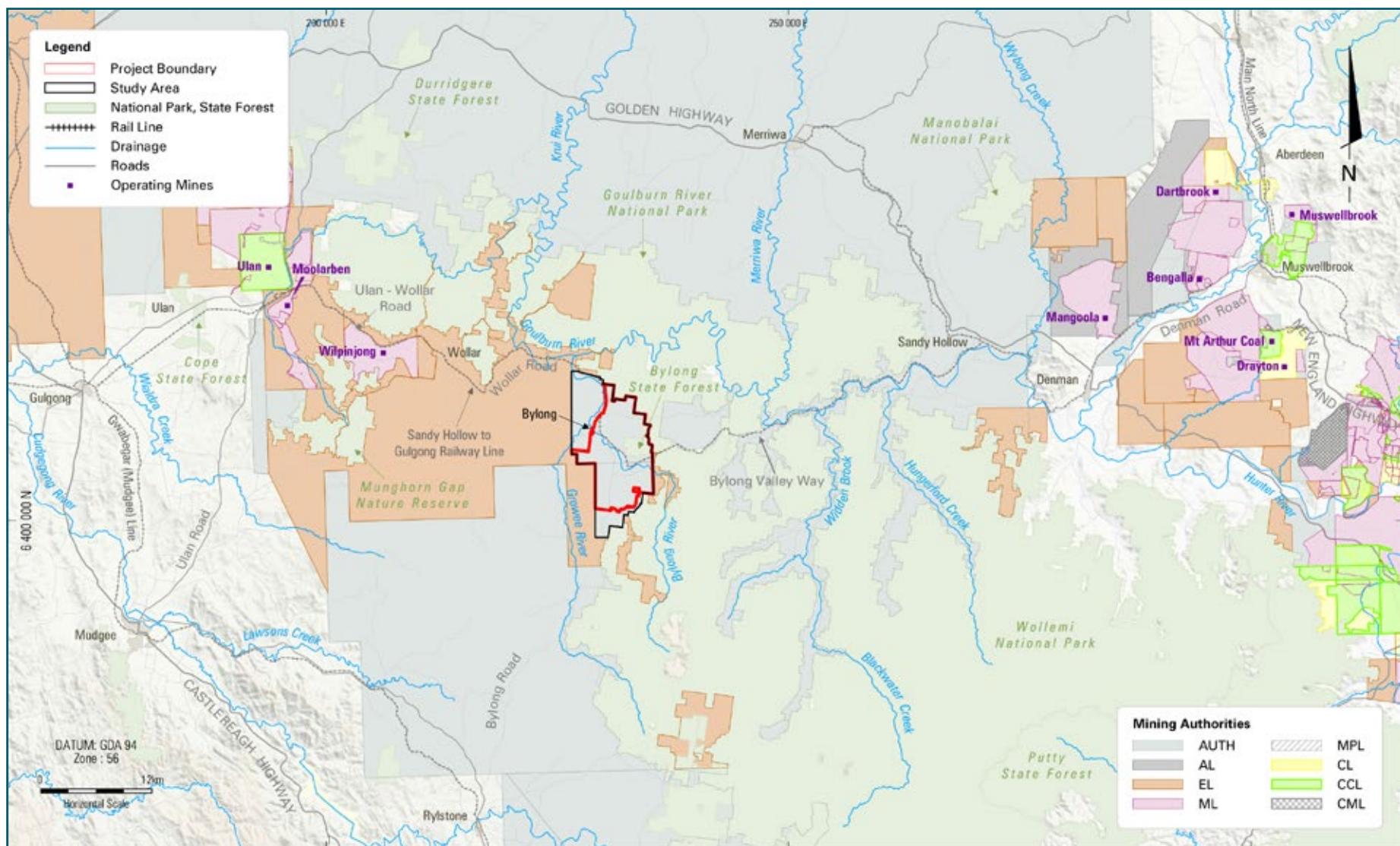
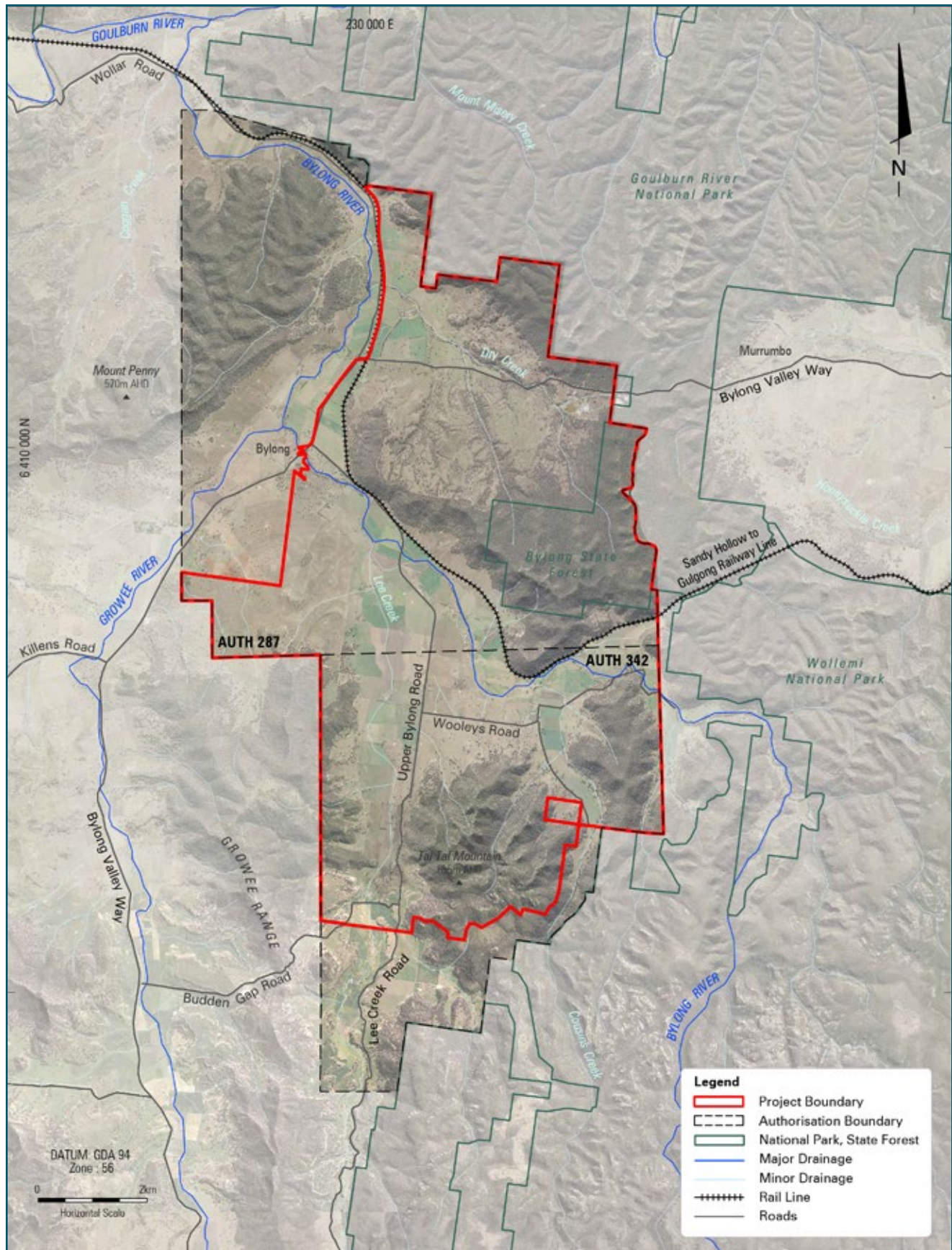


FIGURE 3 Authorisation Boundaries



2

Existing Environment

Existing Environment

This section provides an overview of the regional environmental setting, topography, catchments, climate and geology within and surrounding the Project Boundary. The ownership and use of land relevant to the Project is also discussed.

2.1 REGIONAL SETTING

The Project is located within the Bylong Valley in the eastern portion of the MWRC LGA. The MWRC LGA is located at the eastern extent of the Central West region, adjacent to the western boundary of the Upper Hunter region of NSW (see **Figure 4**). The dominant land use within the MWRC LGA is agriculture. Native vegetation and reserves cover the majority of the remaining areas of land within the MWRC LGA.

The closest settlement to the Project is the Bylong Village, which is located to the north-west of the Project Boundary. Mudgee is located approximately 55 km to the south-west (or 95 km by road), whilst Denman is approximately 53 km (or 72 km by road) to the east of the Project Boundary. The smaller settlements of Kandos and Rylstone are located 38 km and 44 km (or 52 km and 50 km by road) (respectively) to the south of the Project Boundary.

The Bylong Valley (see **Figure 5**) consists of a small, rural community of approximately 100 residents. Bylong Village is the focus of community activity in the Bylong Valley and has a small general store, a community hall, community sporting grounds, St Stephen's Anglican Church and the Bylong Rural Fire Service Station.

There are three houses in the Bylong Village. As of June 2015, the Bylong Village had a residential population of seven persons. The Bylong Upper Public School (BUPS) is a primary school located on Upper Bylong Road approximately 5 km from the Bylong Village.

The BUPS was placed into recess in February 2015 by the NSW Department of Education (DEd) (formerly Department of Education and Communities) due to a gradual decline in enrolments in recent years and there being no enrolments for that year.

Ridges and escarpments surrounding the Project Boundary form a narrow and relatively isolated valley around the Bylong River floodplain. Rural residences within the Bylong Valley are generally well spread out, reflecting the larger land holdings. The residences are typically located low in the valleys along minor roads. Residences within the Bylong Valley are typically relatively isolated from one another.

The main watercourse within the Bylong Valley is the Bylong River, which is ephemeral in nature and confluences with the Goulburn River approximately 4 km to the north-west of the Project Boundary. The Goulburn River subsequently flows to the east where it joins the Hunter River near the town of Denman (see **Figure 2**).

The Bylong Valley Way runs from east to west through the northern portion of the Project Boundary and currently provides the main road access into the Bylong Valley. The Sandy Hollow to Gulgong Railway Line also traverses the northern portion of the Project Boundary and follows the escarpment to the east (see **Figure 5**).

The Bylong State Forest is located within the eastern portion of the Project Boundary. The Bylong State Forest adjoins the more extensive Goulburn River National Park (north-east of the Project Boundary) and the Wollemi National Park in the east.

FIGURE 4 Regional Setting

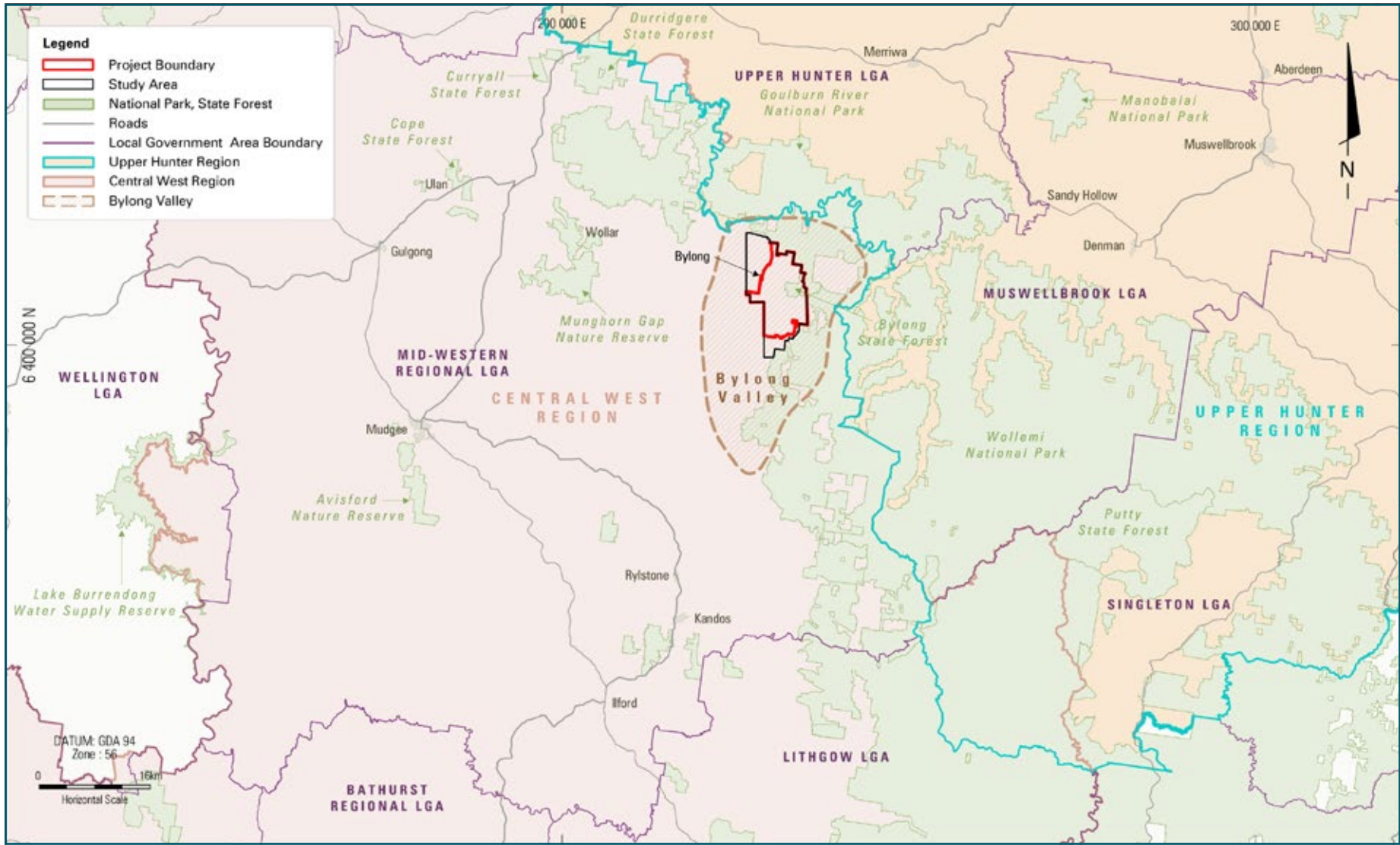
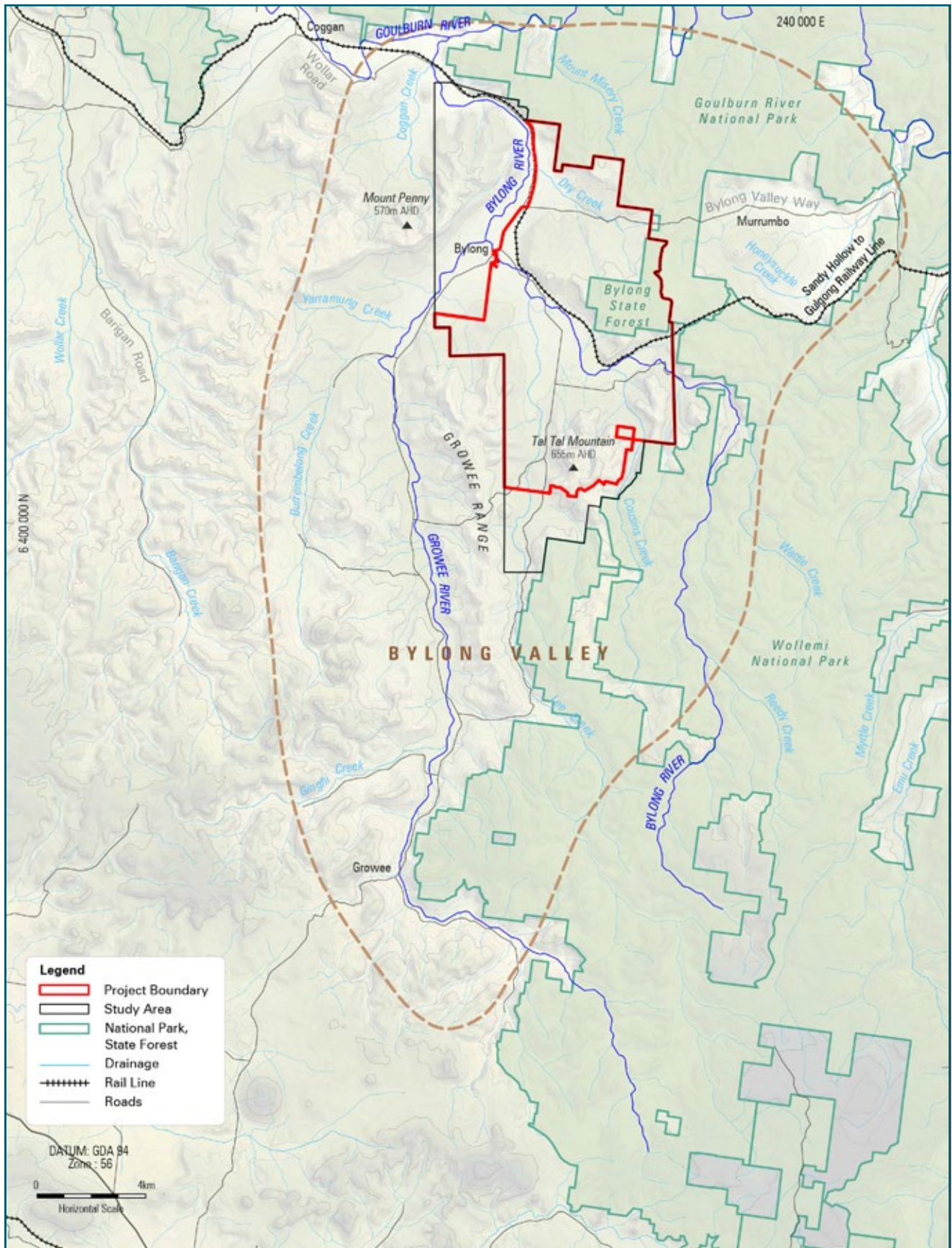


FIGURE 5 Bylong Valley



2.2 TOPOGRAPHY AND NATURAL FEATURES

The topography within the Project Boundary fluctuates greatly between the valley floors (approximately Reduced Level (RL) 250 m Australian Height Datum (AHD)) up to the escarpments and steeper slopes on the eastern margins (approximately RL 430 m AHD). The Bylong Valley is bisected by two broad valleys associated with each of the Bylong River and Growee River which have each been cleared for agricultural land uses.

Tal Tal Mountain (655 m AHD) is located within the south-eastern portion of the Project Boundary, while Mount Penny (570 m AHD) is located to the north of the Project Boundary. The western edge of the Project Boundary is bounded by the Growee Ranges.

The topography and drainage of the Project Boundary is shown in **Figure 6**.

2.3 CATCHMENTS

The Project is located within the catchment of the Bylong River, an ephemeral tributary of the Goulburn River, which in turn is a tributary of the Hunter River. The Goulburn River is located approximately 4 km to the north-west, where it flows from the west to the east into the Hunter River. The drainage network in the area is shown in **Figure 7**. The Project also occurs within the catchment managed by the Hunter Local Land Services (HLLS) (formerly Hunter-Central Rivers Catchment Management Authority) and the Sydney Basin Bioregion.

The Bylong River enters the south-eastern portion of the Project Boundary travelling northward before joining the Goulburn River. Several named creeks and rivers feed the catchment of the Bylong River relevant to the Project Boundary. These are shown on **Figure 7** and include:

- Wattle Creek;
- Cousins Creek;
- Lee Creek;
- Growee River;
- Dry Creek; and
- Coggan Creek.

The primary areas of disturbance for the Project, including mine infrastructure and open cut mining areas are located on elevated land adjacent to Lee Creek and the Bylong River. Parts of the underground mining operations are proposed to occur in sections of the Dry Creek catchment. The remaining tributaries are not affected by the Project.

The headwaters of the Bylong River and Dry Creek catchments are typically steep and well vegetated and include areas of State Forest, such as the Nullo Mountain State Forest and the Bylong State Forest. In the lower portions of the catchment, extensive vegetation clearing has occurred for agricultural use, particularly in alluvial areas adjacent to the river channel, which has resulted in erosion and scouring in some locations.

2.4 LAND USE

The Bylong Valley has a long history of agricultural land use, including grazing, cropping (dryland and irrigation) and horse breeding. The majority of the Project Boundary contains cleared agricultural land with native vegetation constituting the remaining area (predominately within the Bylong State Forest and other portions of Crown Land). The Goulburn River National Park and the Wollemi National Park border the eastern extremities of the Project Boundary.

KEPCO owns approximately 7,547 hectares (ha) of land within and surrounding the Project Boundary. The predominant existing land uses within and surrounding the Project Boundary are illustrated in **Figure 8**. The land zoning under the *Mid-Western Regional Local Environmental Plan 2012* (LEP) within the Project Boundary is discussed in **Section 4.2.1**.

2.4.1 Coal Mining

While there are no approved coal mines within 20 km of the Project, the MWRC LGA supports a number of coal mining related developments, which are shown on **Figure 2**.

Mt Penny Project

The Mt Penny Project was previously proposed in the Coggan Valley to the north-west of the Bylong Authorisations. The Mt Penny Project was proposed as an open cut mining operation extracting coal at a rate of approximately 5 Million tonnes per annum (Mtpa) of ROM coal. This application has since been withdrawn and the related Exploration Licence cancelled.

The Mt Penny Project is not considered to be an existing or proposed future development and has not been considered in the cumulative assessments completed for this EIS.

FIGURE 6 Topography and Drainage

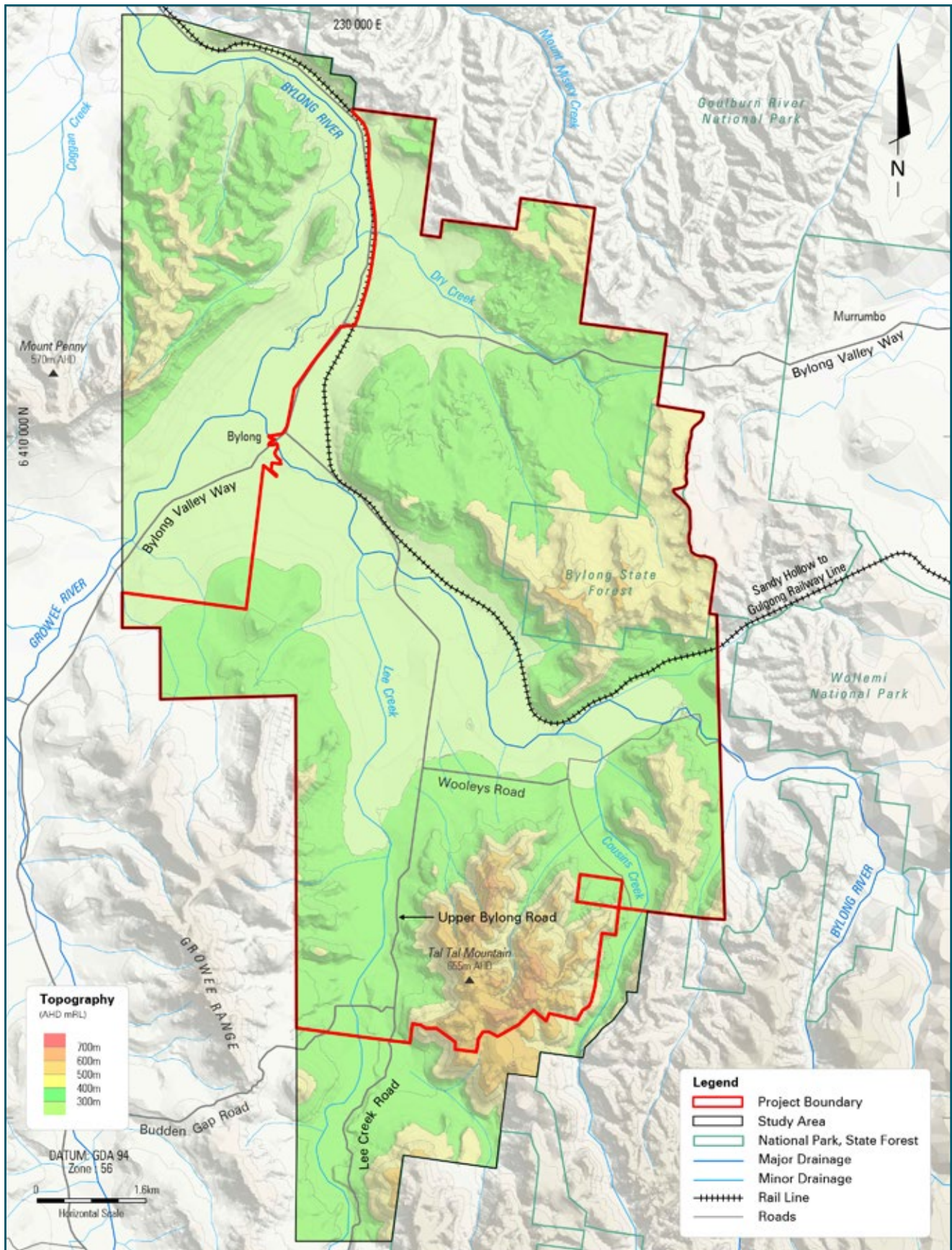
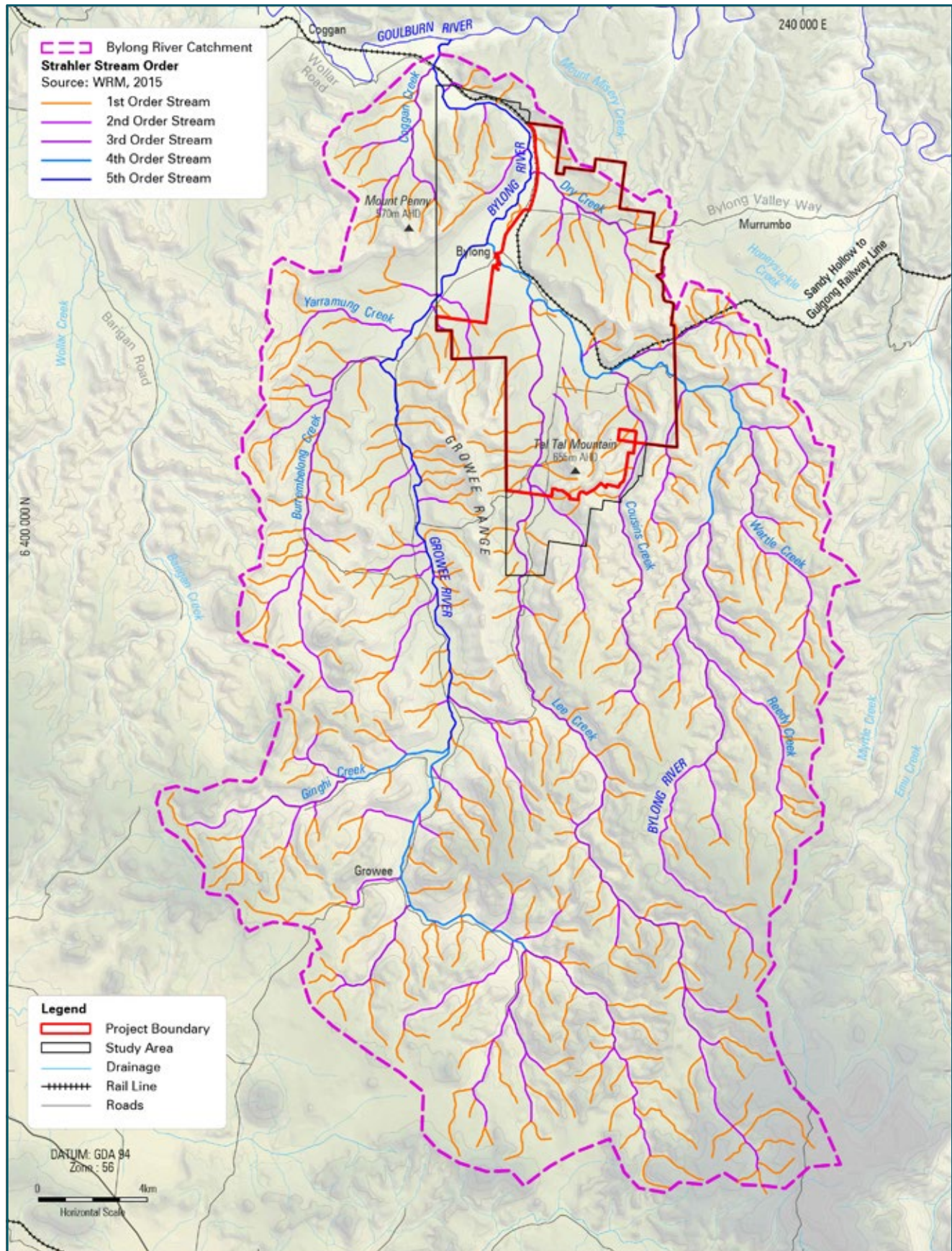


FIGURE 7 Catchments and Drainage

Wilpinjong Coal Mine

Wilpinjong Coal Mine is located approximately 24 km to the north-west of the Project. The Wilpinjong Coal Mine is an open cut coal mine with approvals to extract ROM coal at a rate of up to 16 Mtpa up until February 2027. As reported on the Peabody Energy website (accessed May 2015), Wilpinjong Coal Mine currently employs approximately 550 people. It is understood that the Wilpinjong Coal Mine is currently preparing an EIS to support an application for a new development consent for an extension to the mine life and its coal extraction footprint.

Ulan Coal Mine

Ulan Coal Mine is located approximately 40 km north-west of the Project. Ulan Coal Mine is a combined open cut and underground coal mine operation with approval to extract ROM coal at a rate of up to 20 Mtpa up until August 2031. As reported on the Ulan Coal Mines Limited website (accessed May 2015), Ulan Coal Mine currently employs approximately 931 people. It is understood that Ulan Coal Mines Limited is currently preparing the response to submissions on the EIS for a Modification of the mine supporting an extension of the life of the underground mine by approximately two years and associated minor changes to surface infrastructure.

Moolarben Coal Project

Moolarben Coal Mine is located 36 km north-west of the Project. Moolarben Coal Mine is a combined open cut and underground coal mine operation with approval to extract ROM coal at a rate of up to 17 Mtpa up until December 2038. As reported on the Yancoal Australia website (accessed May 2015), Moolarben Coal Mine currently employs approximately 450 people. It is understood that Moolarben Coal Mine is currently preparing the response to submissions on the EIS for two Modifications of the mine to support minor surface infrastructure changes and haul road realignments.

Other

A small rock quarry is currently in operation within the north-eastern portion of A287 which is proposed to continue operations during the life of the Project (see **Figure 8**).

The Bowden Silver Project owned by Kingsgate Consolidated Limited is located approximately 35 km south-west of the Project Boundary.

A number of wind farm projects, including Uungula Wind Farm, Liverpool Range Wind Farm and Crudline Ridge Wind Farm, are also located within the broader vicinity of the Project in the MWRC LGA.

Summary

Due to the distant location of the above coal mines and other development from the activities proposed for the Project, it is unlikely that cumulative impacts will occur.

Each environmental assessment undertaken for this EIS has considered the above developments and commented on potential for cumulative impacts.

2.4.2 Agriculture

Grazing and Cropping

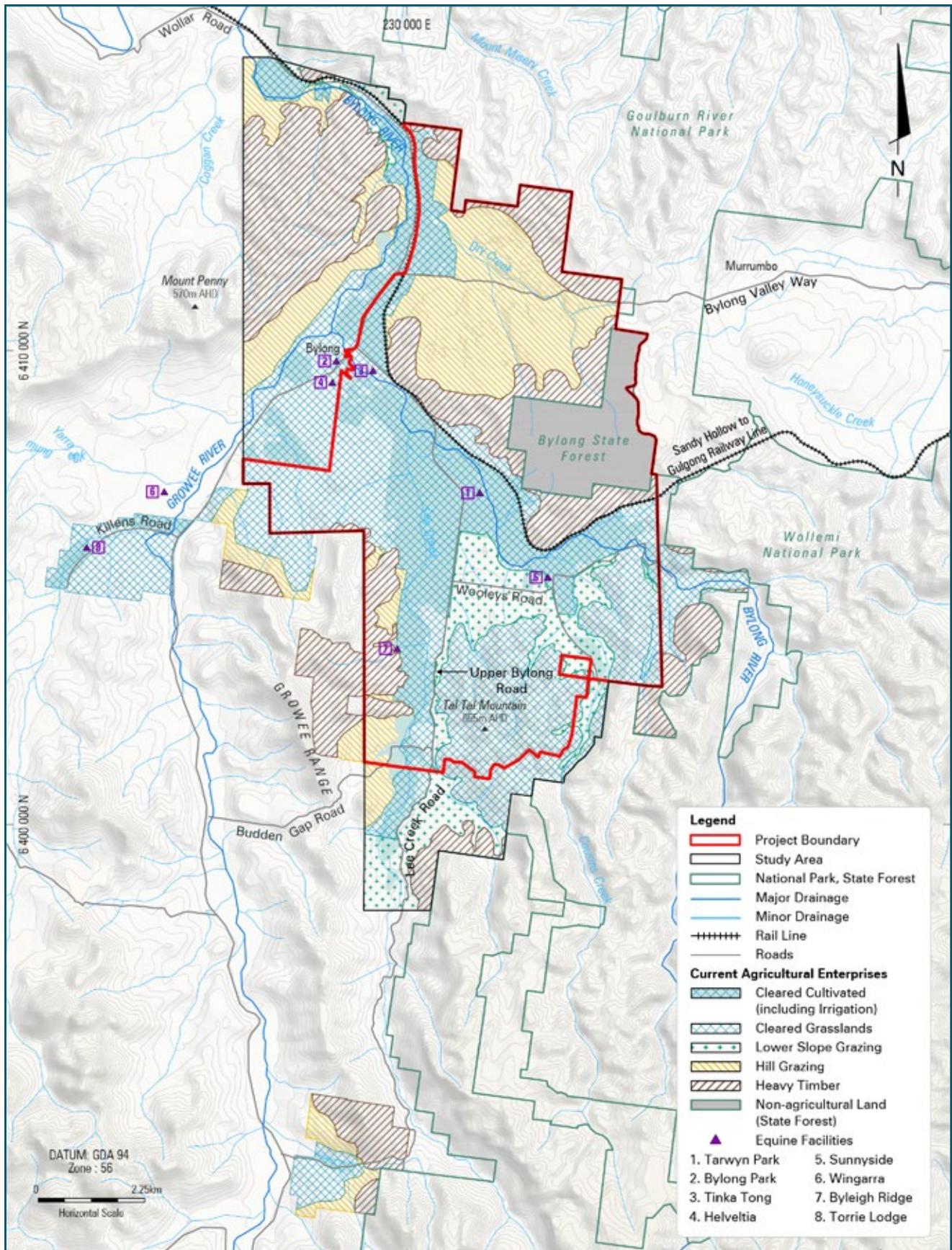
Agriculture has played an important role in the area since first inhabited by Europeans in the 1820s (Lawson, 1822). This has led to the valley floors of the catchments (i.e. Bylong River, Growee River and Dry Creek) being predominantly cleared and now largely comprised of pasture improved grasslands.

The Bylong River runs through the Project Boundary and plays an important role in the region's agricultural enterprises. Cropping within the Bylong Valley is common in the vicinity of the Bylong River floodplain which supports the production of lucerne, rye prairie and English grasses.

The predominant agricultural enterprise within the Study Area is beef cattle grazing supported by fodder cropping (oats, lucerne, millet and forage sorghum) and improved exotic pastures on the better quality land. This typically reflects the enterprises found in the northern end of the Bylong Valley (where the Project is located), which is generally representative of cattle breeding with a lesser emphasis on lucerne hay production and fodder cropping.

Figure 9 presents the current agricultural enterprises in the vicinity of the Project.

FIGURE 9 Current Agricultural Enterprises



Equine and Viticulture

The Upper Hunter Strategic Regional Land Use Plan (SRLUP) (DP&I, 2012) identifies areas of Viticulture Critical Industry Cluster (CIC) and Equine CIC across the Upper Hunter region (see **Figure 10**). In January 2014, an amendment to the *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007* (SEPP Mining) included some changes to the mapping resulting from the NSW Government's verification of CIC. The final mapping identifies approximately 254,900 ha of Equine CIC within the Upper Hunter region. The final mapping illustrates approximately 1,933 ha of Equine CIC located within the Project Boundary. There is a further approximately 467 ha of mapped Equine CIC located immediately adjacent the Project Boundary on land owned by KEPCO. These areas account for only approximately 0.94% of Equine CIC within the Upper Hunter Region (see **Figure 11**).

The mapped Equine CIC within and immediately adjoining the Project Boundary is located on the south-western extremity of the mapped Equine CIC within the Upper Hunter region. The Upper Hunter SRLUP identifies that the relevant thoroughbred horse breeding industry is focused around Scone, which is one of the major horse breeding areas in the world with over 70 studs in this specific concentrated area.

The mapped Equine CIC located in the Bylong Valley is an isolated pocket located at the south-western extremity of the mapped Equine CIC, approximately 1.5 hours' drive from the equine centre of Scone. In total, three properties in the vicinity of the Project Boundary fall within the mapped Equine CIC. It should be noted that this mapping largely reflects historical uses of this land and there are no registered thoroughbred horses on any of these three properties. **Figure 10** illustrates the isolated location of the mapped Equine CIC within the Study Area in relation to the key equine region at Scone. This figure illustrates that there are no thoroughbred horse breeding studs proximate to the Project.

There is no mapped Viticulture CIC within or in the vicinity of the Project Boundary.

2.4.3 Rural and Residential Developments

The village of Bylong is located to the north-west of the Project Boundary within the Bylong Valley. The Bylong Village is situated an approximate 95 km drive from Mudgee via Bylong Valley Way and Lue Road and around 97 km from Muswellbrook via Bylong Valley Way and the Golden Highway. The smaller settlements of Kandos and Rylstone are located approximately 52 km and 59 km (respectively) to the south of Bylong Village via the Bylong Valley Way.

There are no known residential or rural residential subdivisions proposed within or immediately surrounding the Project Boundary.

2.4.4 National Parks and State Forests

Wollemi National Park is located immediately east and south-east of the Project Boundary (see **Figure 8**). Wollemi National Park consists of over 488,000 ha and was established in 1979. The area comprises a range of vegetation types from open eucalypt forests, woodlands, rainforests and perched swamps as well as Aboriginal Heritage sites and geological features including sandstone escarpments and canyons and pagoda rock formations. Wollemi National Park contains camping grounds, and walking tracks and trails.

The Goulburn River National Park is located immediately to the north-east of the Project Boundary (**Figure 8**). Goulburn River National Park is located along with Goulburn River, consisting of over 70,000 ha and was established in 1983. The area comprises native forests, the Goulburn River and Aboriginal Heritage sites. The Goulburn River National Park contains camping grounds, walking tracks and trails and recreational areas including swimming holes.

The Bylong State Forest is located in the eastern portion of the Project Boundary, and links to the more extensive Goulburn River National Park and Wollemi National Park. Bylong State Forest is a hardwood forest and includes approximately 652 ha of forest and woodland communities. The forestry land within Bylong State Forest is slated for timber harvesting, though the area is not included in the 2014-2015 NSW Forestry Corporation harvesting program. The Bylong State Forest predominately comprises native vegetation and still retains significant values for native flora and fauna and Aboriginal heritage. The residual area of land comprises forest and woodland which has largely remained intact due to inaccessibility resulting from the steep terrain.

FIGURE 10 Upper Hunter – SRLUP Mapped Equine CIC

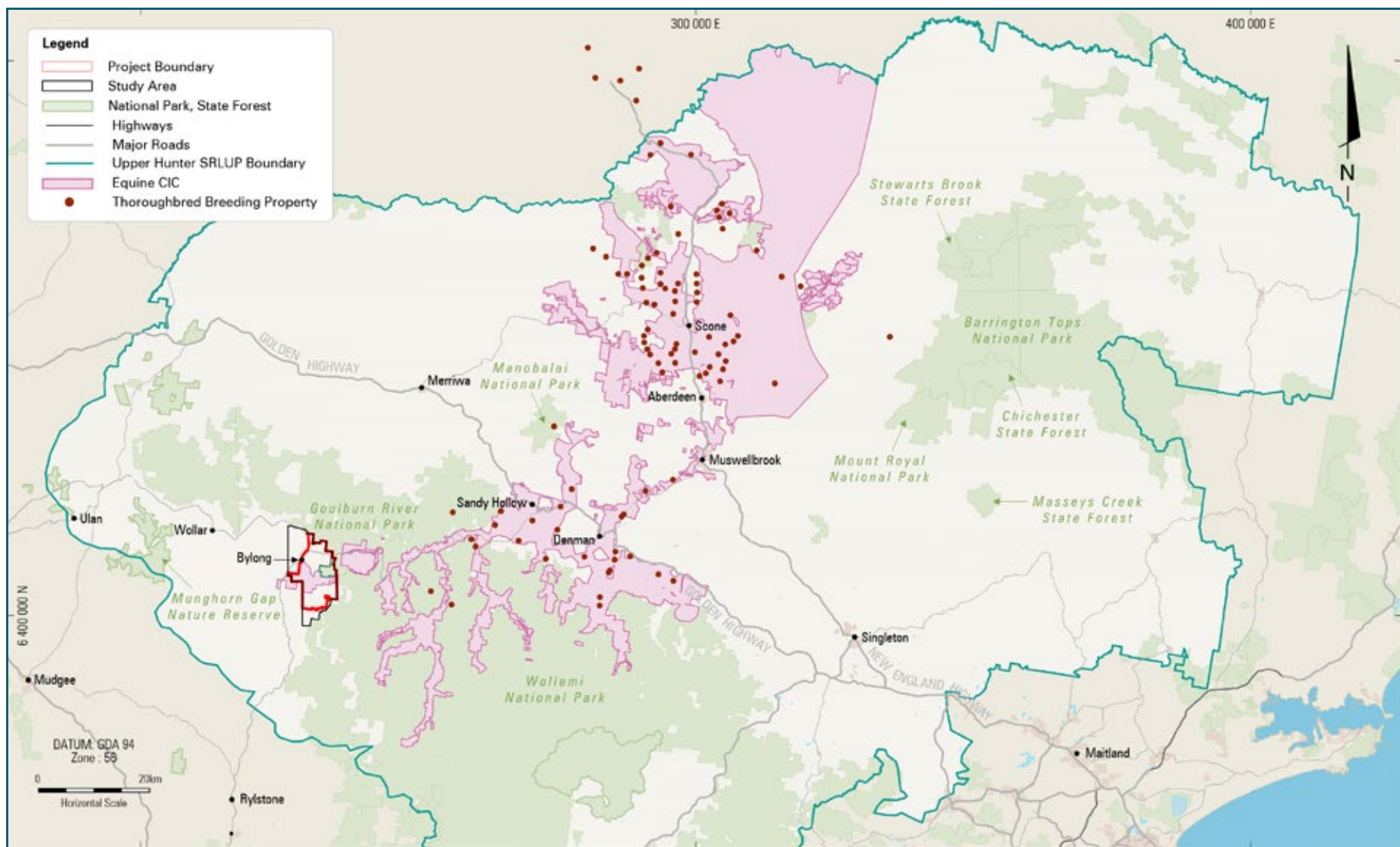
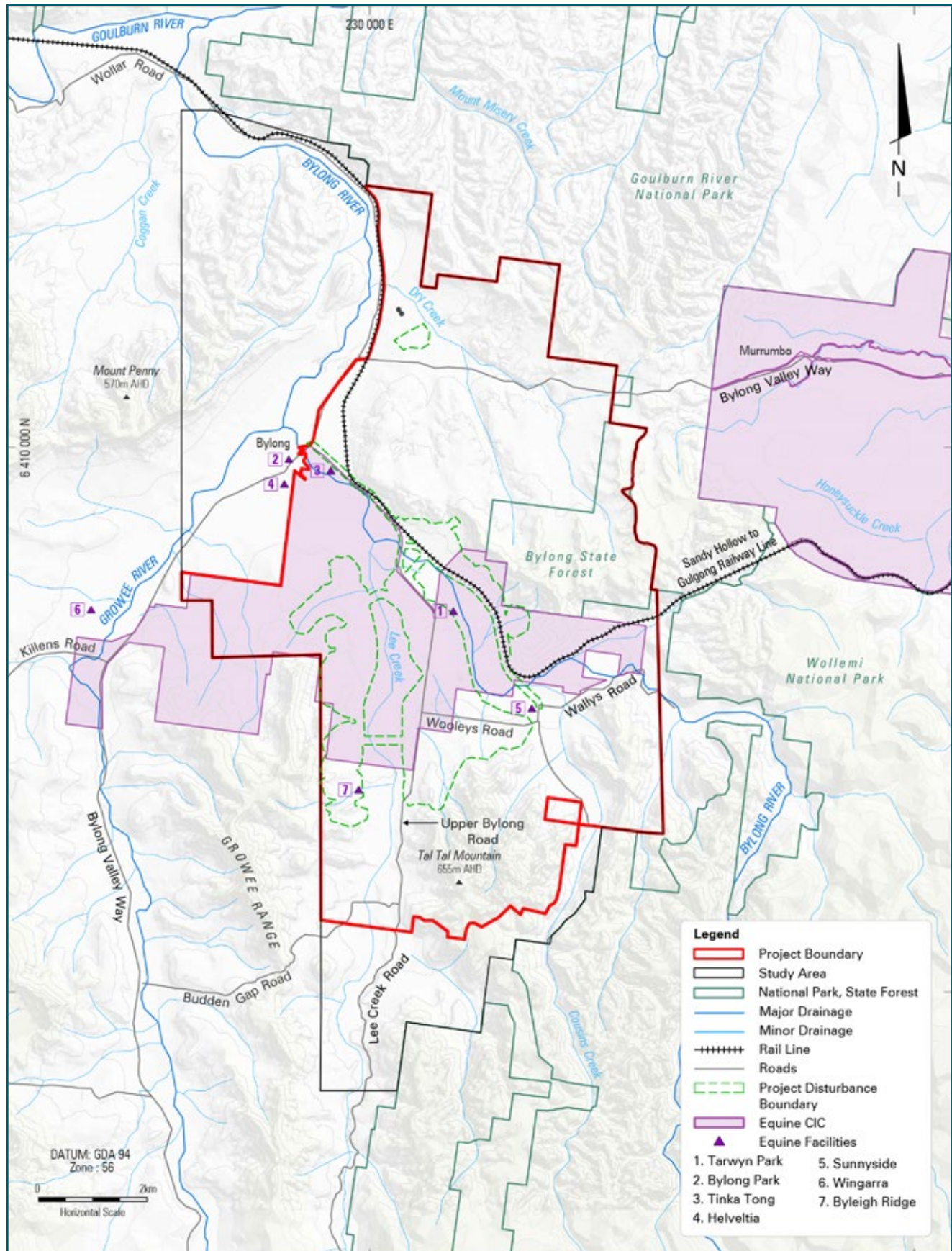


FIGURE 11 Equine CIC Within the Project Locality

2.5 LAND OWNERSHIP

Land ownership within and surrounding the Project Boundary is identified on **Figure 12a** and **Figure 12b** and listed in **Table 1**. KEPCO currently owns approximately 7,547 ha of land within and surrounding the Project Boundary. KEPCO employs an onsite Farm Manager to manage agricultural activities and its land holdings.

The Project Boundary covers an area of approximately 6,958 ha. KEPCO holds approximately 5,425 ha of freehold land or approximately 78% of the land within the Project Boundary.

The remaining 21% of land within the Project Boundary is made up of Crown Land, State Forest and freehold land under private ownership. There are 23 parcels of Crown Land located in the north, south and south-west of the Project Boundary. The Goulburn River and Wollemi National Parks are located immediately adjacent to the eastern extent of the Project Boundary.

TABLE 1 Landownership

BLOCK ID	OWNER	RECEIVER
344 - 346, 359 - 361, 365 - 367, 370 - 373	KEPCO Bylong Australia Pty Ltd	K1 - K30
1 - 40, 172	Justin Kennedy Lewis Pty Limited	4, 5
41	NA Fieldsend	41A, 41B
42	PJ & LJ Kelleher	42
43	W Zappa	43
44	WD & PAS Evans	44
45 - 51	Suntala Pty Ltd	47, 49, 50
52, 173 - 180	Geble Pty Limited	
53 - 55	RF & BW Murdoch	53
56, 57, 264	Locaway Pty Ltd	56, 57A, 57B, 57C
58	J Mead	58
59 - 60	Jarvet Pty Limited	60
61	Anglican Church Property Trust Diocese of Bathurst	61A, 61B
62	Bylong Hall Committee Incorporated	62
63	TA Rixon	63
65	JB Watson	65
66	D George	
67	Integral Energy Australia	
68 - 71	RNK Wright	68, 69
138 - 141	JD & VK & AJ & LF & MG & NJ & K Brown & AN Bonarius	141
142	Minister for Education and Training	142A, 142B
145 - 150	PA Frost & CD Shaw	146
151 - 160	PR Grieve	151, 158
161, 162, 163, 262, 263	JB Watson & JA Nancarrow	161, 162
162A, 163A, 164 - 171, 197 - 199, 347 - 352, 354, 356 - 358, 362, 364, 368 - 369, 374 - 376	J Garling & D & P & R Loneragan	165, 168, 348, 350
181, 265 - 269	Icelink Pty Ltd	181A, 181B, 181C, 181D
195 - 196, 223 - 229, 277, 289 - 290	Timnath Pty Ltd	225, 226
204 - 212	Bruce Walter Edward Kerney	
213, 215 - 217	Peabody Pastoral Holdings Pty Ltd	
214	HCH White	
218 - 219	Mt Penny Properties Pty Ltd	
220 - 222	AL Dunn	
230 - 245	Ian Ross & Kay Carol Tindale	242
246 - 255, 299 - 312, 315	Braithwaites Pastoral Co Pty Ltd	
256 - 261, 316 - 318, 320 - 323, 363	LL Braithwaite	317
275	Tasamboka Pty Ltd	
276	Bongalong Pty Ltd	
278 - 288, 291 - 298	Iwi Cattle Co Pty Ltd	292
313 - 314, 325 - 330	JL Taylor	
319, 353, 355	Crown	
324, 331 - 343	RN & PL Grieve	

FIGURE 12a Landownership

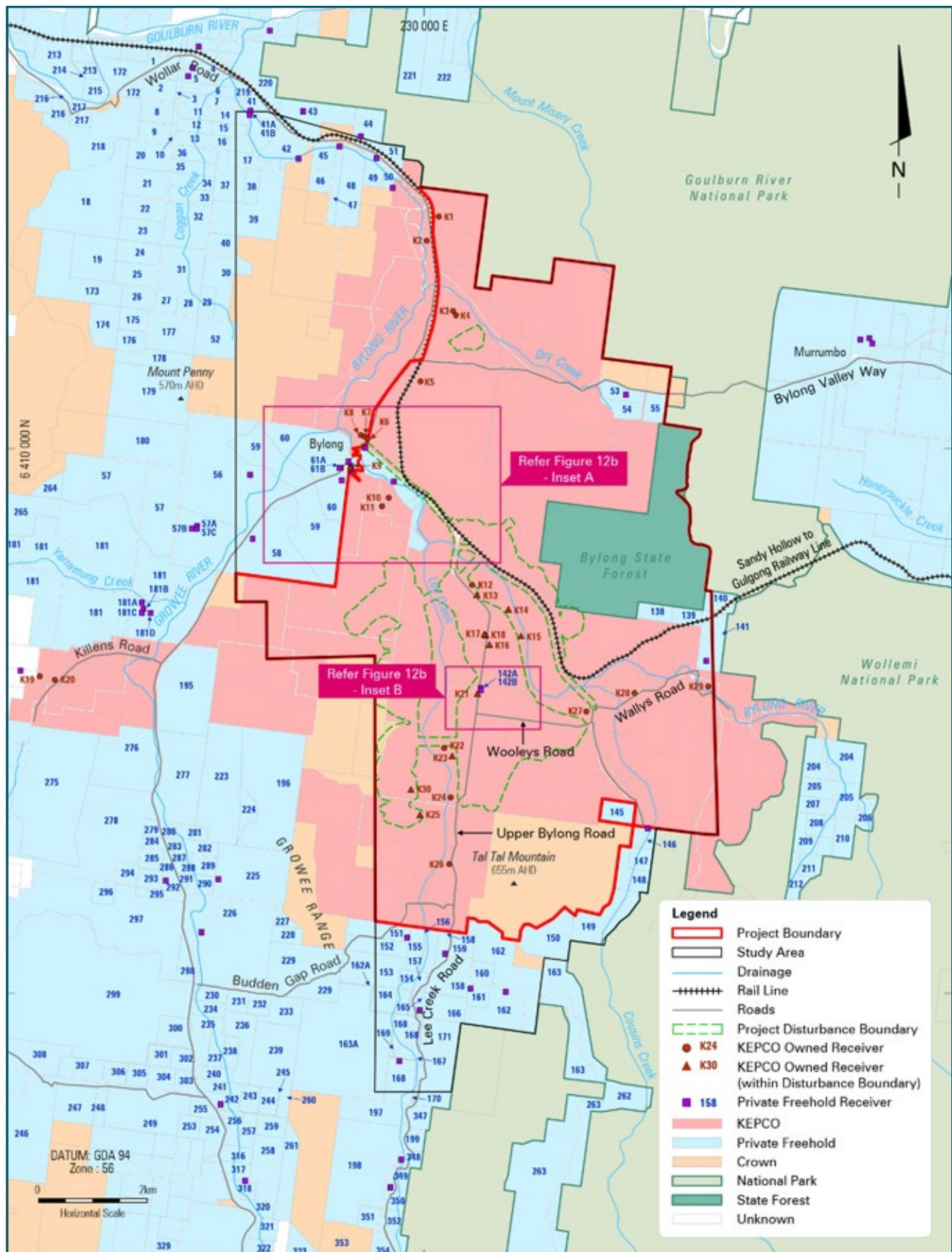
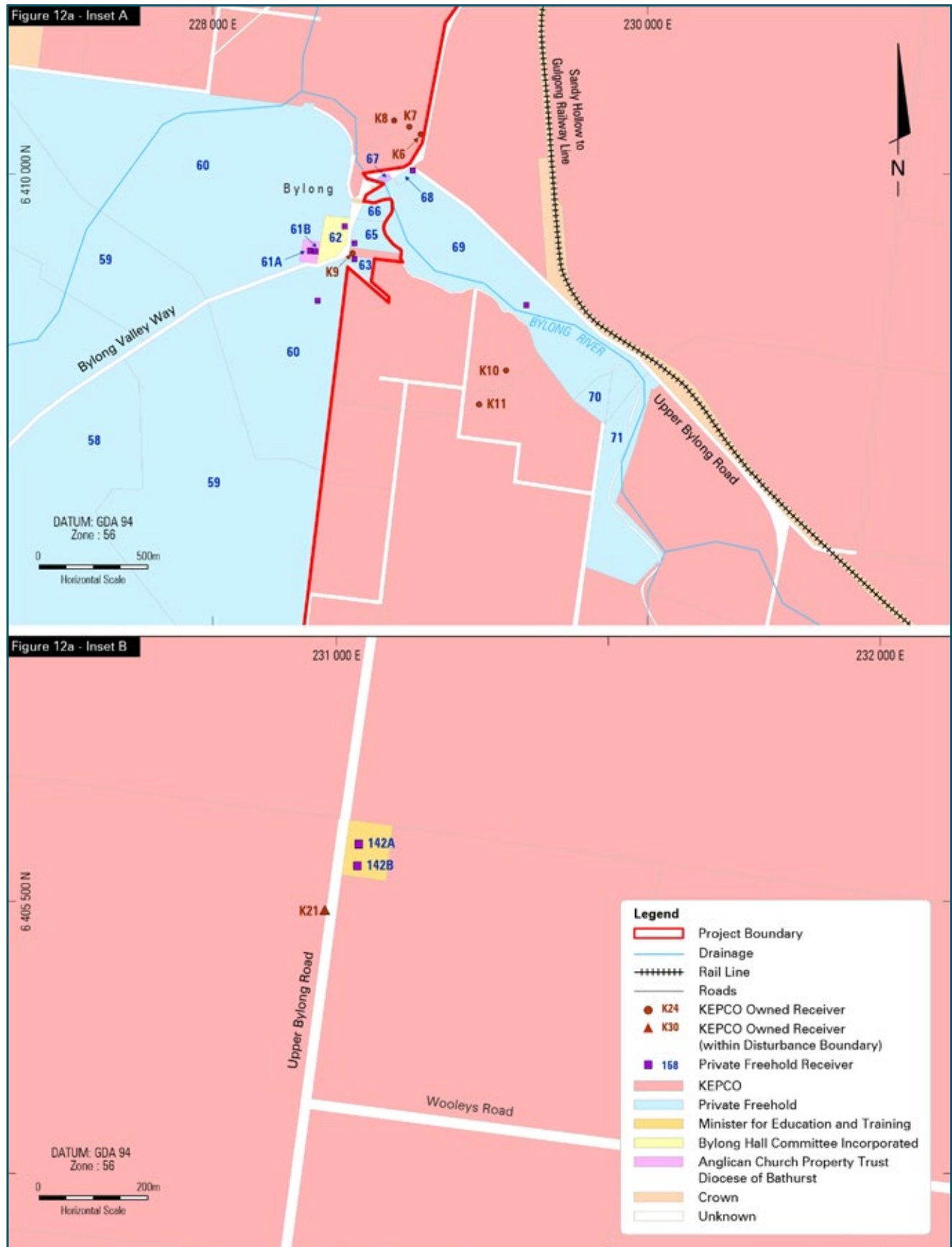


FIGURE 12b Landownership (Inset)



2.6 CLIMATE

The Bylong region experiences a warm temperate climate, characterised by warm, wet summers and cool, dry winters. In the winter months, high pressure systems alternate with cold fronts, combining to produce cool, dry conditions. Frosts and fog are prevalent in the cooler, drier months from mid-autumn to late spring. The warm wet conditions during the summer months are produced by synoptic high pressure systems over the Great Australian Bight. Synoptic low pressure systems occur intermittently during summer, resulting in periods of heavy rain and thunderstorms.

Climate data has been collected from two meteorological stations located either within or in proximity to the Project. The closest station is KEPCO's Bylong Automated Weather Station (AWS) (Bylong AWS), located within the Project Boundary (as discussed in **Section 2.8**). This station has been operational since 2011. The climate data discussed in the following sections has been sourced from the Bureau of Meteorology (BoM) Nullo Mountain AWS (BoM Station Number 62100), located approximately 20 km south-east of the Project. The Nullo Mountain AWS has been operational since 1998 thus providing longer term climatic information for the region. Several other BoM meteorological stations (Wollar, Kerrabee, Bylong (Heatherbrae) and Jerrys Plains) have also been interrogated to assist in the preparation of this EIS.

A description of the locations and recording periods of each meteorological data set utilised in this EIS is provided in **Table 2**. **Table 3** and **Table 4** provide a summary of climatic conditions in the vicinity of the Project, with key parameters discussed further in **Section 2.6.1** to **Section 2.6.5**.

2.6.1 Temperature

Monthly average minimum and maximum daily temperatures are shown in **Table 3**. These temperatures are typical of a temperate climate, with warmer summer months during December, January and February and cooler winter months in June, July and August. The monthly average minimum and average maximum daily temperatures at the Nullo Mountain AWS are 8.0°C and 16.6°C, respectively.

Moderate temperature inversions occur more than 30% of the time during the winter months. Due to the local topography, cold air drainage tends to flow downhill from the southern elevated areas to the north towards the Bylong Village.

TABLE 2 Meteorological Stations

Name	Location	Parameters Reported	Period of Record
Bylong AWS	Within the Project Boundary	Rainfall	2011 to current
Wollar (BoM Station No. 62032)	3 km west-north-west of the Project Boundary	Rainfall	2011 to current
Nullo Mountain AWS (BoM Station No. 62100)	20 km south-east of the Project Boundary	Rainfall, temperature, wind speed, humidity	1998 to current
Kerrabee (Murrumbo) (BoM Station No. 62046)	12 km east of the Project Boundary	Rainfall	1951 to current
Bylong (Heatherbrae) (BoM Station No. 62080)	12 km north of the Project Boundary	Rainfall	1968 to 2008
Jerrys Plains Post Office (BoM Station No. 61086)	68 km east of the Project Boundary	Rainfall, temperature, humidity, evaporation	1884 to current

2.6.2 Relative Humidity

Table 3 provides relative humidity values based on average measurements collected daily at 9:00 am and 3:00 pm at the Nullo Mountain AWS. In regard to average daily variations, relative humidity is approximately 24% higher in the morning in comparison to the afternoon. This is a result of the relatively low annual rainfall at the site and the drying effect of the sun as the day progresses. The highest monthly average relative humidity value was recorded in June for both morning and afternoon values (91% and 78%, respectively).

2.6.3 Rainfall

Table 4 provides a summary of the long term average rainfall, evaporation and number of rain days recorded at the BoM meteorological stations. Rainfall data collected at the meteorological stations indicates that the Bylong region experiences higher rainfall over the summer months than the winter months. The longer term monthly average rainfall varies from 37.8 millimetres (mm) in August to 76.2 mm in January.

The highest mean monthly rainfall recorded at the Bylong (Heatherbrae) AWS was 246 mm in June 2007, and the lowest mean monthly rainfall was 0 mm recorded across most months over several years. The mean annual rainfall for the Bylong (Heatherbrae) AWS is approximately 630 mm.

TABLE 3 Meteorological Data Summary – Temperature and Humidity

Month	Mean Daily Temperature (°C) ¹		Mean Humidity (%) ²	
	Min	Max	9:00 am	3:00 pm
January	13.5	24.0	75	56
February	13.2	22.6	82	64
March	11.3	20.0	83	64
April	8.4	16.7	78	62
May	5.7	12.9	81	68
June	3.4	9.6	85	74
July	2.5	9.1	84	71
August	3.1	10.9	76	60
September	5.6	14.3	72	56
October	7.8	17.3	70	54
November	10.1	19.9	73	58
December	11.6	22.1	73	56
Mean	8.0	16.6	78	62

Source: ¹ Nullo Mountain BoM Station (1998-2015)

² Nullo Mountain BoM Station (1991-2010)

2.6.4 Evaporation

Table 4 provides data from the Jerrys Plains BoM meteorological station which was used to assess representative evaporative trends, typical of the Bylong region. Summer months are shown to experience higher daily evaporation in direct correlation with increased temperature.

Evaporation is generally greater than annual precipitation, with mean monthly pan evaporation rates varying seasonally from 220 mm during January to 60 mm during June, with a monthly mean evaporation of 136.8 mm.

2.6.5 Wind Speed and Direction

Wind direction is typically from the east-south-east during summer and autumn, and prevails from the west and north-west during winter and spring. Average annual wind speeds were found to be 1.9 metres per second (m/s). Calm conditions (less than or equal to 0.5 m/s) were found to occur for approximately 31% of the time. Moderate winds (characterised as between 0.5 and 6 m/s) were found to occur 65% of the time, and strong winds (>6 m/s) occur only 4% of the year. Wind speed and direction are discussed in detail in the Air Quality and Greenhouse Gas Impact Assessment (see **Section 7.7**).

TABLE 4 Meteorological Data Summary – Rainfall and Evaporation

Month	Mean Rainfall (mm)						Mean Rain Days	Mean Evaporation (mm)
	Wollar ¹	Nullo Mountain ²	Kerrabee (Murrumbo) ³	Bylong (Heatherbrae) ⁴	Bylong AWS ⁵	Jerrys Plains ⁶		
January	66.7	96.3	86.4	76.2	34.1	77.1	7.7	220
February	63.1	104.9	73.7	72.1	79.7	73.1	8.2	170
March	52.2	85.8	53.0	49.1	88.2	59.7	8.1	155
April	38.9	61.6	35.0	34.9	20.1	44.0	5.6	120
May	37.7	58.4	43.0	39.1	25.6	40.7	6.1	90
June	44.0	77.5	36.9	42.6	38.0	48.1	8.7	60
July	42.6	62.0	38.1	39.4	33.1	43.4	7.8	71
August	41.2	57.2	43.4	37.8	11.8	36.1	6.5	81
September	40.6	65.6	39.2	41.3	27.1	41.7	6.7	111
October	51.2	71.0	56.3	61.9	10.3	51.9	7.5	164
November	55.7	104.2	59.7	57.4	14.1	61.9	9.0	195
December	59.6	90.6	71.2	69.6	39.3	67.5	7.8	205
Mean Annual	593.5	935.1	635.9	621.2	421.4	645.2	89.7	1,642

Source: ¹ Wollar BoM Station (2011-2015)

² Nullo Mountain BoM Station (1998-2015)

³ Kerrabee (Murrumbo) BoM Station (1951-2015)

⁴ Bylong (Heatherbrae) BoM Station (1968-2008)

⁵ Bylong AWS (2011-2015)

⁶ Jerrys Plains BoM Station (1884-2014)

2.7 GEOLOGY

KEPCO has completed an extensive exploration program to determine the extent and qualities of the coal resources within the Authorisations. This exploration program has collected site specific information to develop a refined geological model for the Authorisations. A Geology Report has been prepared to outline the exploration works completed and to discuss the geological features present within the Authorisations. The Geology Report is presented within **Appendix C**.

2.7.1 Exploration

Under the previous owners, 59 cored and open holes were drilled within the A287 and A342. Since KEPCO's acquisition of A287 and A342 in 2010, a thorough exploration program has been undertaken to further define and understand the coal resource within these Authorisations. These exploration activities have been undertaken to supplement the previous drilling, consisting of:

- Desktop studies of previous exploration work completed within the Authorisations;
- 2D and 3D seismic surveys;
- Aerial surveys, including LiDAR;
- Preliminary mining subsidence study;
- Geotechnical testing;
- Alluvial sediment testing;
- Drilling (large diameter, cored, partially cored and open holes);
- Coal quality tests (including proximate and ultimate analyses, materials handling testing and washability testing); and
- Preliminary hydrogeological studies (including the installation of 94 groundwater monitoring bores).

A total of 525 boreholes have been completed by KEPCO throughout A287 and A342 as at 27 July 2014. This correlates to a total of 241 rotary boreholes and 284 cored or partly cored boreholes. Drilling has also included 18 large diameter boreholes to obtain samples for materials handling and washability testing. Exploration borehole locations are illustrated on **Figure 13**. The coal resource for the Project has been defined and reported in accordance with Australasian Joint Ore Reserves Committee (JORC) requirements.

2.7.2 Stratigraphy

The Project is located within the north-eastern area of the Western Coalfields, which are part of the Sydney Basin. Within this area, a top layer of alluvium sedimentary soil (of Triassic age) overlays the hard Permian bedrock.

Local hingelines and geomorphic processes within the region have shaped the topography of the Bylong area over geological time, allowing the creation of sandstone escarpments and plateaus, as well as basalt-capped hills. The unconsolidated sediments within the low lying valleys of the Bylong Valley are comprised of an upper clay layer, shale conglomerates, sandstones and silty material, and a basal layer containing gravelly sand and gravel.

A history of igneous activity within the Bylong Valley is also evident, with examples of both extrusive and intrusive rock formations (e.g. basalt flows and diatremes, plugs, dolerite dykes and sills) scattered across the region and found in both A287 and A342.

Recent geological investigations of the Bylong Valley have been completed as part of the Pre-Feasibility and Feasibility Studies for the Project. The Feasibility Study recognised six coal seams within the local Permian strata of the NSW Western Coalfields, however the last two in the stratigraphic sequence (namely the Ulan and Coggan seams) are the primary seams of economic interest (see **Section 2.7.3**). Some small quantities of coal from the thin overlying Goulburn and Glen Davis coal seams is also known to occur within the open cut mining areas which will also be recovered during mining and report to the CHPP.

An indicative Stratigraphic Column of the strata within the Project Boundary is shown in **Figure 14**. The stratigraphy of the area generally includes:

- Triassic Conglomeratic Sandstones;
- Permian Illawarra Coal Measures (including formations: Farmers Creek, State Mine Creek, Goulburn, Glen Davis, Ulan and Coggan seams); and
- Late Permian Shoalhaven Group.

The Late Permian Shoalhaven Group forms the sedimentary basement, consisting primarily of mudstone, minor conglomeratic bands and sandstone. The formation outcrops along the lower slopes of the Growee River and in the upper reaches of Lee Creek, in the southern and western portions of the Project Boundary.

The Permian Illawarra Coal Measures overlie the Shoalhaven Group and contain the economic coal seams within the Project Boundary. The dominant lithologies include mudstone, laminated siltstone, fine to medium-grained quartz-lithic sandstone, lenses of polymictic conglomerate, coal, carbonaceous mudstone and tuff. The thickness of sandstone varies across the site from 100 m to 200 m in the Project Boundary, thickening towards the east into the Sydney Basin. The coal measures dip approximately 2° (degrees) to the east.

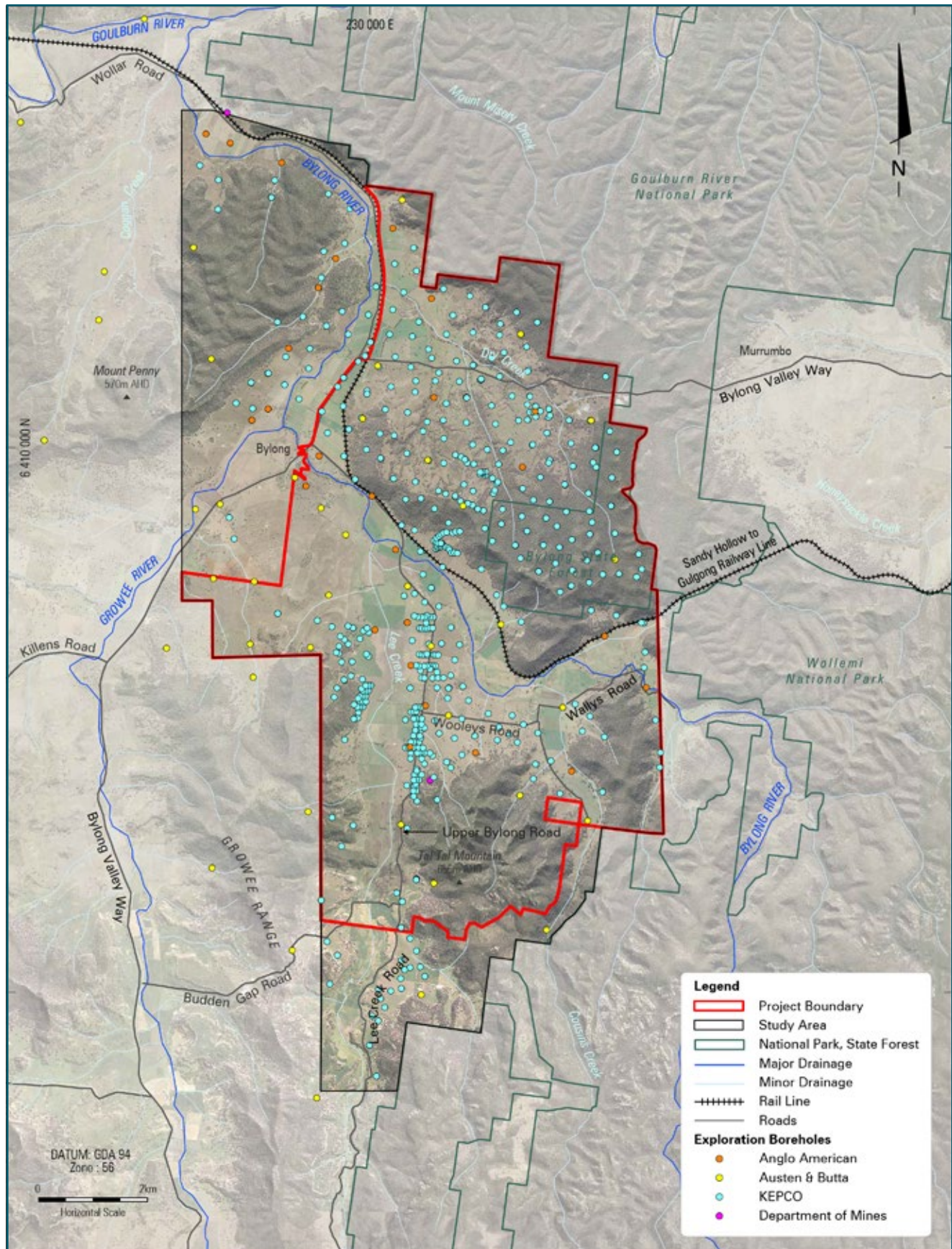
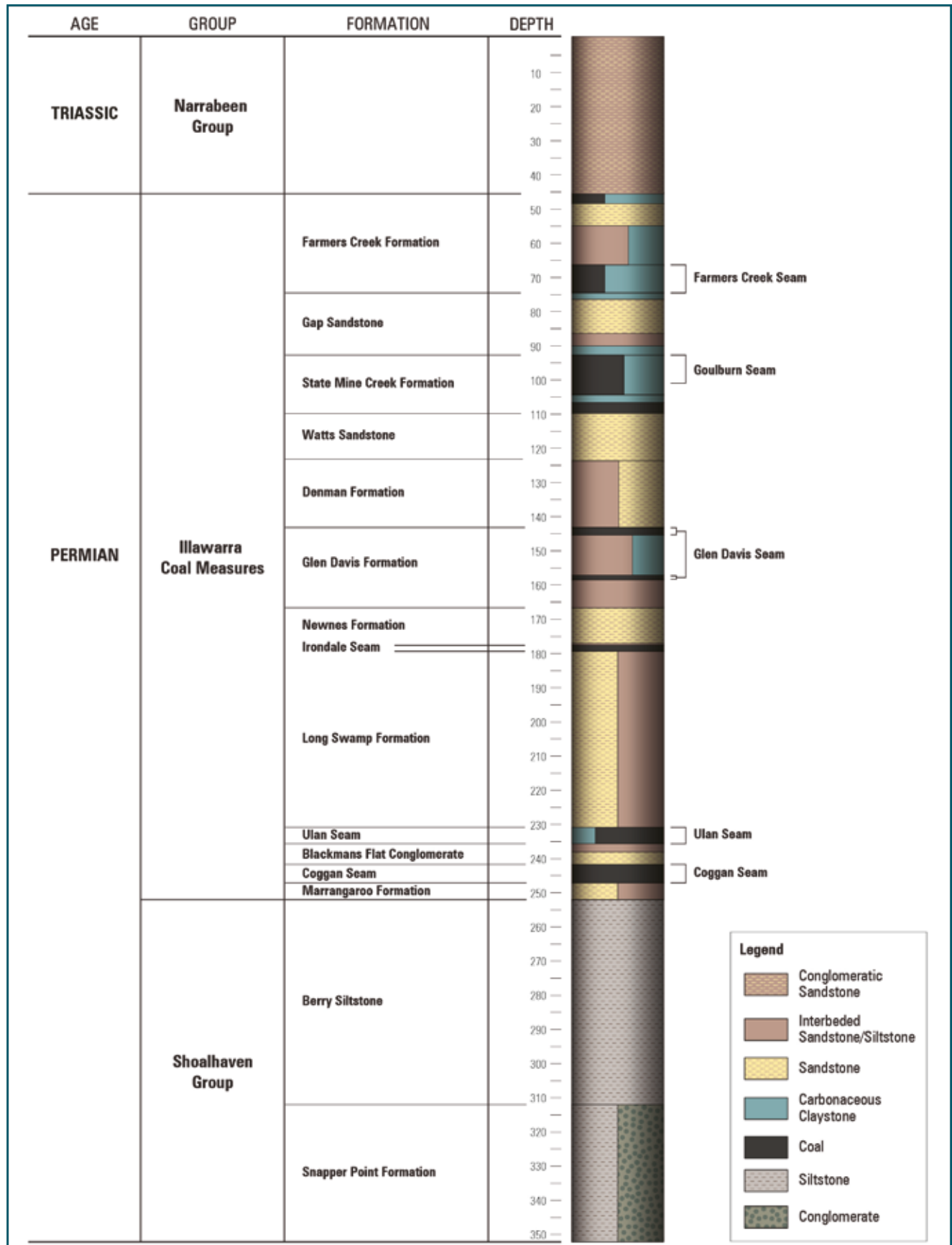
FIGURE 13 Exploration Boreholes

FIGURE 14 Indicative Stratigraphic Column



The Coggan Seam consists predominantly of dull coal with minor bright bands and average ash content ranging from 9 to 30%. The depth to the Coggan Seam varies across the Authorisations from the land surface to a depth of 360 m, largely due to the irregular nature of the topography. In the valleys around Lee Creek and the Bylong River, the depth to the Coggan Seam is less than 60 m with the average coal seam exceeding 3 m in thickness. The Coggan Seam varies from 2 m on the western margin of the Authorisations to around 5 m near the eastern boundary.

Overlying the Illawarra Coal Measures is a Triassic sequence consisting of the Narrabeen Group.

Igneous intrusions and volcanic flows have been intersected within the Project Boundary. The largest igneous intrusion in the area is the Coggan Sill, which is located in the western portion of the Project Boundary (see **Section 2.7.4**).

2.7.3 Target Coal Resource

The main target coal resource for the Project is the Coggan Seam which will be intercepted by open cut and underground mining operations. The overlying Goulburn Seam, Glen Davis Seam and Ulan Seam will also be intercepted and recovered by open cut mining methods within the Eastern and Western Open Cut Mining Areas. The coal seams dip to the north-east, with the Open Cut Mining Areas proposed in the south-western portions where the resource exists closer to the surface (from 20 m to 90 m). Underground mining areas are proposed to be extracted in the eastern areas, where topography provides a greater depth of cover and the seam occurs between 100 m and 350 m.

The Project has an identified mineable ROM coal resource of approximately 124 Mt for the initial 23 years of active mining. Further coal resources have been identified within the Project Boundary and will be the subject of future exploration and economic feasibility studies. The overburden to coal stripping ratio for the open cut mining areas is on average 4.6 bank cubic metres (bcm) /ROM coal tonnes.

The Coggan Seam and Ulan Seam to be extracted for the Project are anticipated to produce two product types, as follows:

- 16% ash (As Received Basis (arb)); and
- 22% ash (arb).

2.7.4 Structural Geology

A number of geological features have been identified though review of previous interpretations from former tenement holders, regional mapping, aeromagnetic survey, 2D/3D seismic, field mapping, and boreholes. The key geological constraints identified within the Study Area are demonstrated in **Figure 15** and further discussed below.

Faults

Within the Study Area, normal and reverse minor faulting has been identified through either interception of fault planes in boreholes or from the processing and interpretation of 2D/3D seismic and acoustic scanner analysis. Faulting is expected to be associated with the folding deformation zones as defined below.

Folds, Joints and Sills

A number of sub parallel anticline and synclinal structures have been interpreted from a combination of 2D and 3D seismic data as well as an extensive borehole data set. The identified folding runs north to south with displacements of between 3 m and 12 m over a 100 m zone. The coal measures appear to be continuous however associated faulting (less than seam displacement) is expected. A zone of deformation up to 50 m from the apex of the fold has been identified from drilling and seismic data. The deformation zone is defined by increased jointing or faulting (<5 m) typically sub-parallel to the dominant feature.

It is interpreted that even major structures are unlikely to provide a significant transient pathway to groundwater movement and discharge.

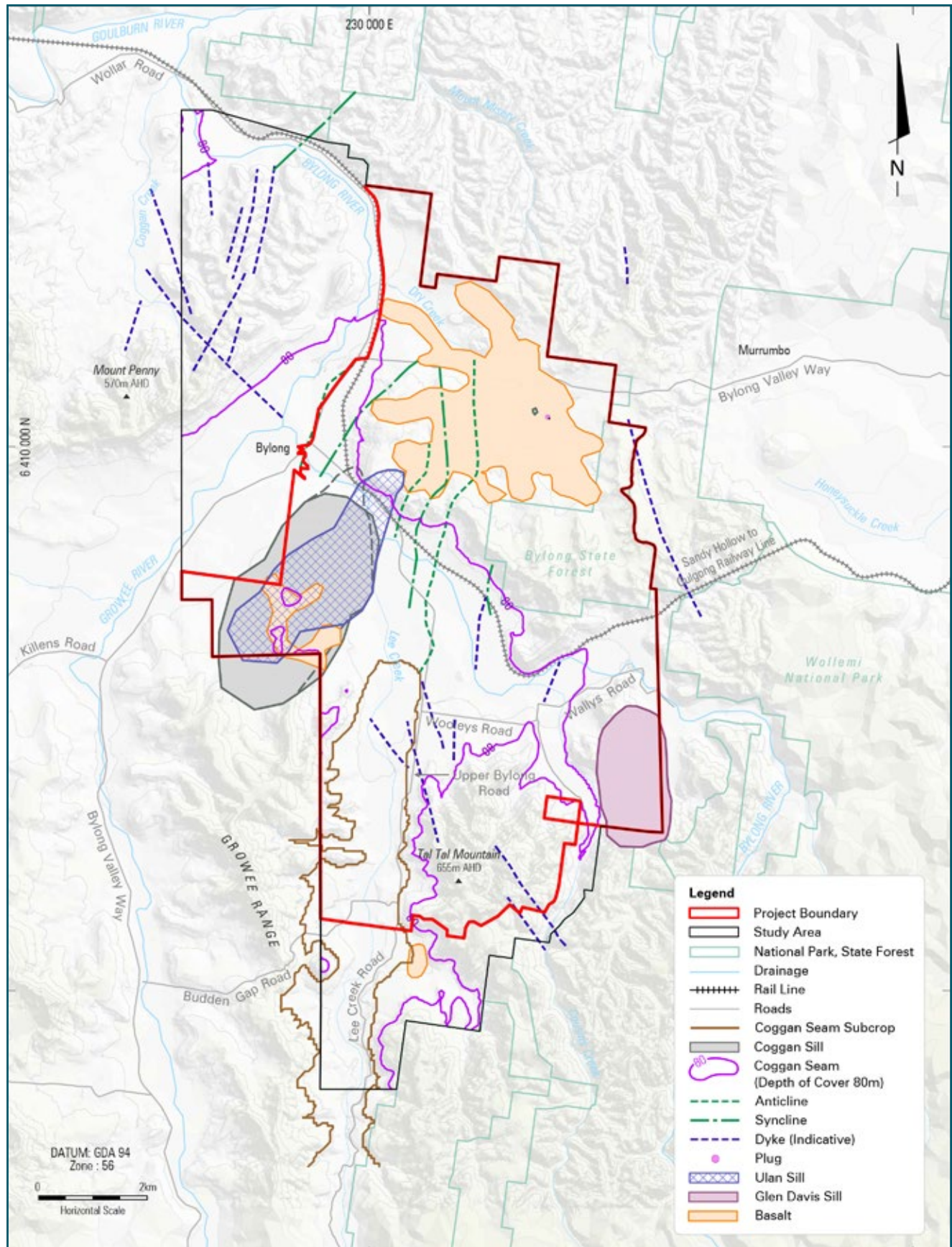
Intruded post deposition, the sills have partially replaced the coal measures. The Coggan, Glen Davies and the Ulan Sills are irregular in nature, and should not be considered continuous features (vertically or horizontally) however they are connected in places. They are typically solid with little jointing evident, unlike the basalt cover.

Emplacement of the sills has also resulted in a heat affected zone which is typically less than 1 m directly from the intrusion itself. The heat affected coal appears sooty black, becomes brittle and can be more porous.

Dykes

Dykes identified in the area through field mapping in the 1980s by Austen & Butta were basalt, ranging from 1 to 2 m in thickness. The dykes are trending from north-west to north with the average orientation being north north-west. One dyke was measured trending north-east and dipping 80° in outcrop.

FIGURE 15 Key Geological Features



2.8 ENVIRONMENTAL MANAGEMENT

KEPCO has progressively developed and operated an Environmental Monitoring Program (EMP) for the purposes of ensuring sufficient background monitoring data to support various technical studies completed as part of this EIS. A summary of the various components of the EMP is provided in **Table 5**. The EMP has been regularly reviewed and enhanced as access has been gained to privately owned properties and appropriate monitoring equipment installed.

The EMP is shown on **Figure 16** and **Figure 17** and has involved the collection of background monitoring data for a range of environmental parameters, including:

- Meteorological;
- Air Quality (depositional dust, particulate matter (PM) of 10 micrometres or less (PM₁₀) and particulate matter of 2.5 micrometres or less (PM_{2.5}));
- Background noise;
- Surface Water (quality and quantity); and
- Groundwater (levels and quality).

TABLE 5 Environmental Monitoring Program

Aspect	Mechanism	Monitoring Location	Parameters Monitored
Meteorological	Meteorological Station	▪ Property adjacent to the site office (Bylong AWS)	▪ Rainfall ▪ Temperature ▪ Relative Humidity ▪ Solar Radiation ▪ Wind speed, direction and deviation of wind direction
Air Quality – Depositional Dust	Depositional Dust Gauges	Five locations: ▪ Redbank Cottage (DDG1) ▪ BUPS (DDG2) ▪ Wingarra (DDG3) ▪ Bylong Village (DDG4) ▪ North of Authorisation (DDG5)	Monthly dust deposition rates (g/m ² /month)
Air Quality – Suspended Particulates	Tapered Element Oscillating Microbalance (TEOM)	▪ Project Site Office (TEOM)	Continuous PM ₁₀ and PM _{2.5} (µg/m ³)
Noise	Unattended Noise Loggers and Attended Noise Monitoring Surveys	Five locations: ▪ Bylong Station (BG01) ▪ Bylong Village (BG02) ▪ Wingarra (BG03) ▪ Harley Hill (BG04) ▪ Redbank Cottage (BG05)	▪ The unattended noise loggers were set to record A-weighted noise levels every 15 minutes ▪ The attended noise measurements recorded LA_{eq}, LA₁, LA₁₀, and LA₉₀
Surface Water	Sample Collection	▪ Nine surface monitoring locations (SW1-SW9)	▪ In situ measurement of pH, EC, Oxidation-Reduction Potential (ORP), Dissolved Oxygen (DO), turbidity and temperature ▪ Lab analysis pH, EC, DO, Cations, Anions, NOx, Total P, NH3 and metals
	Automated Loggers	▪ Three locations are continuously monitored using Doppler velocity meters and telemetry transfer of data	Water levels and flow rates
Groundwater	Sample Collection, Vibrating Wire Piezometers and Automated Loggers	▪ 94 monitoring locations (with 137 observation points) located within the alluvium (43), shallow hardrock (20) and deep hardrock aquifers (22) and vibrating wire piezometers into various strata depths (9)	Water quality, depth and pressures

FIGURE 16 Environmental Monitoring Program (Air Quality & Noise)

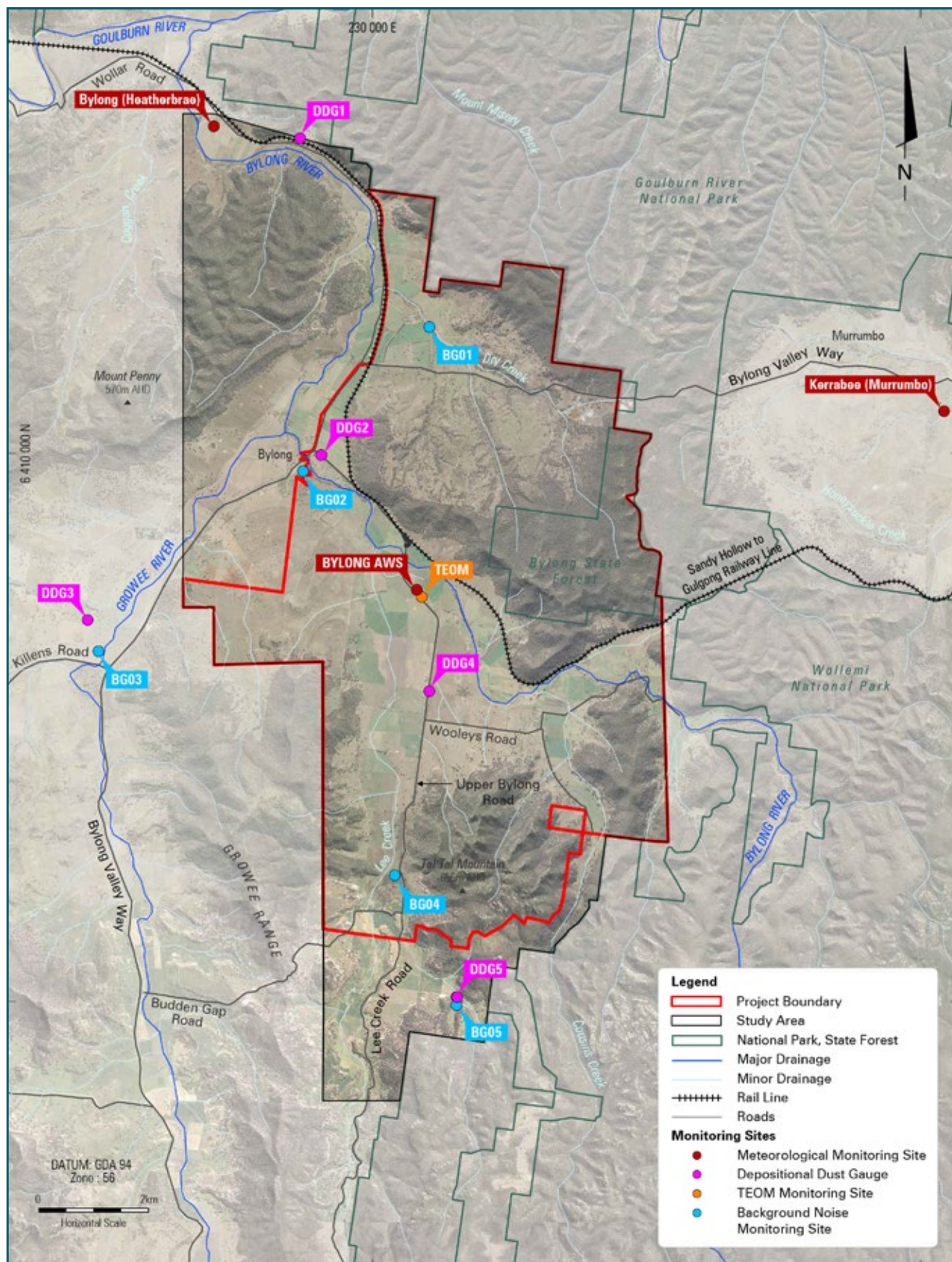
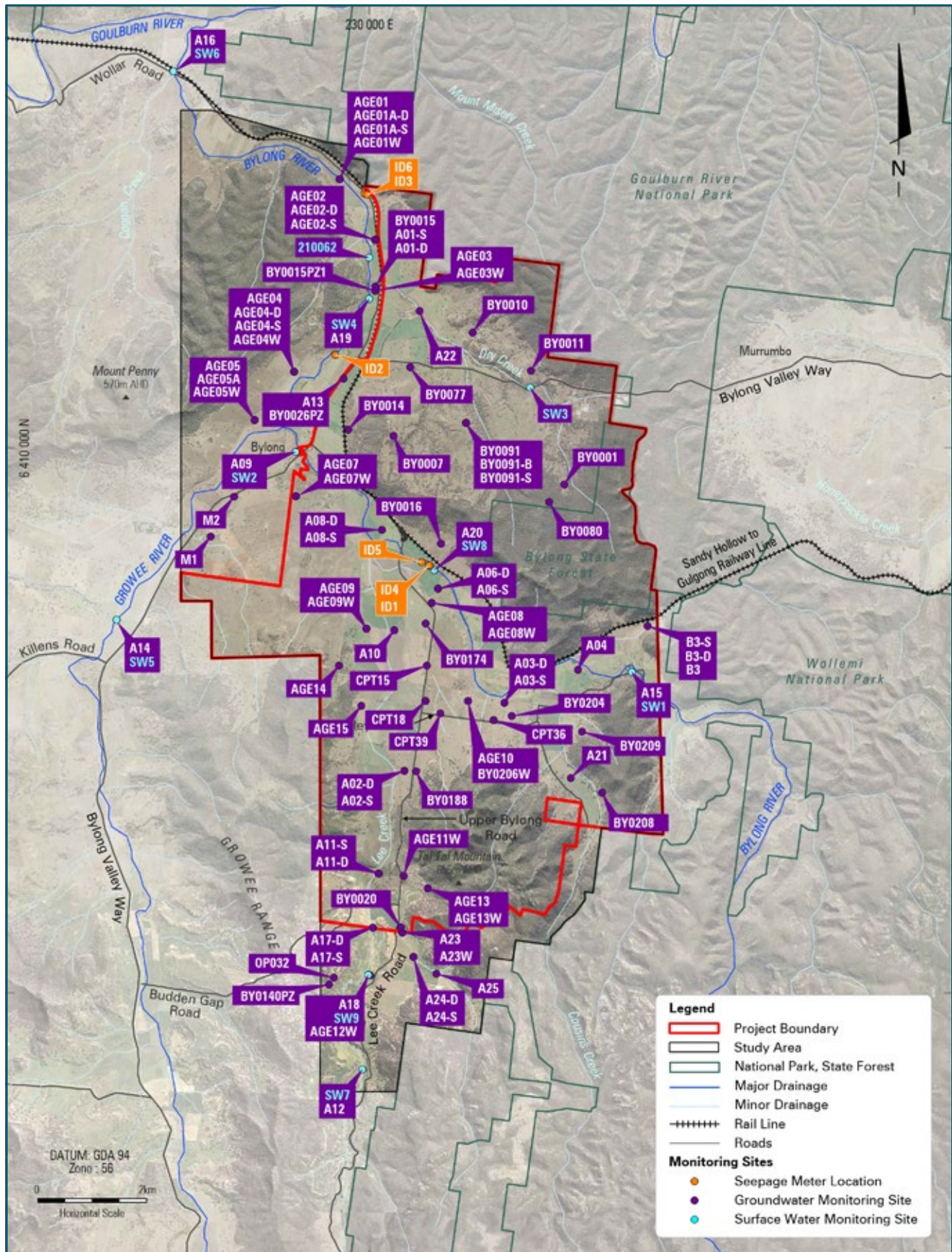
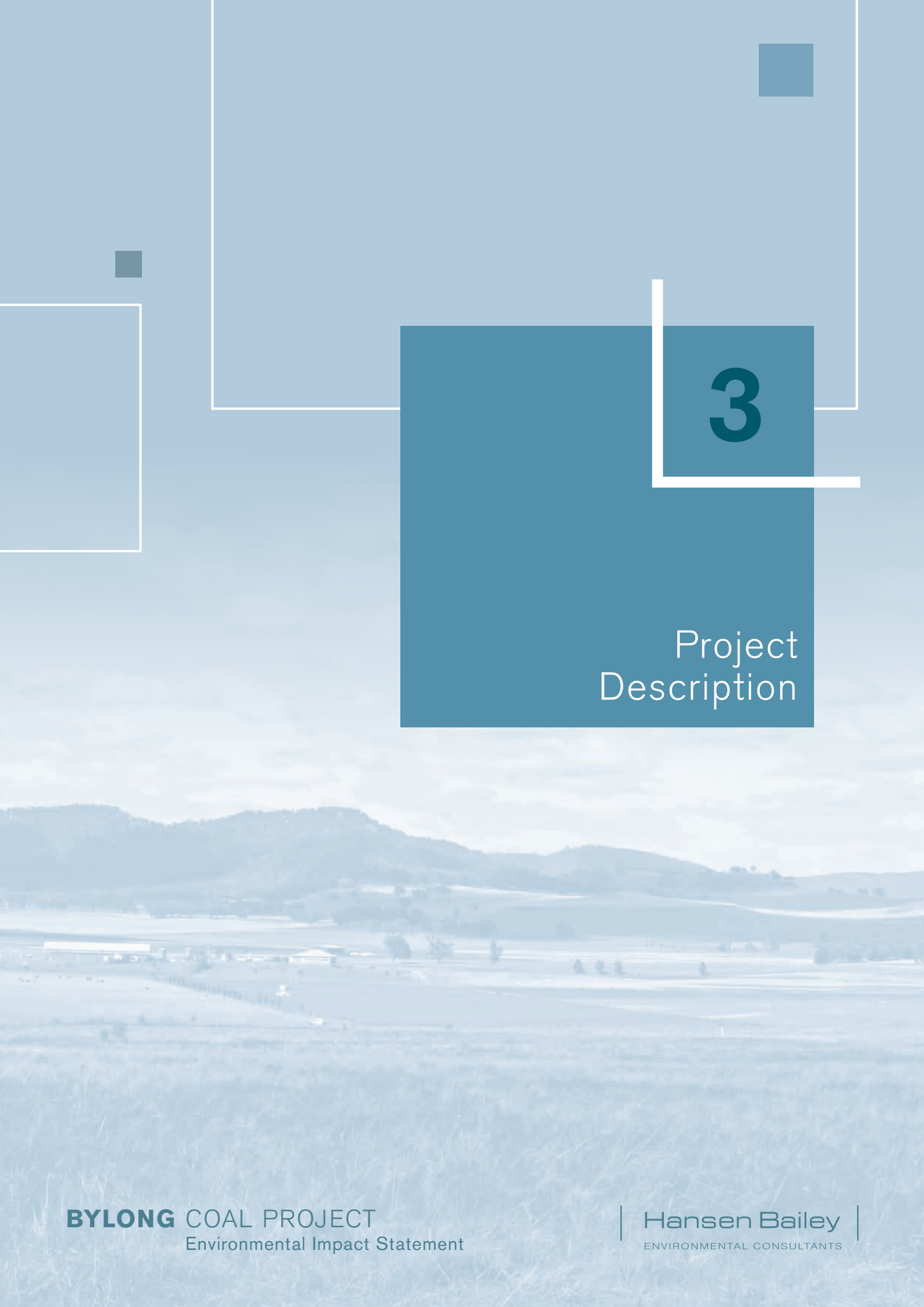


FIGURE 17 Environmental Monitoring Program (Water)





3

Project Description

Project Description

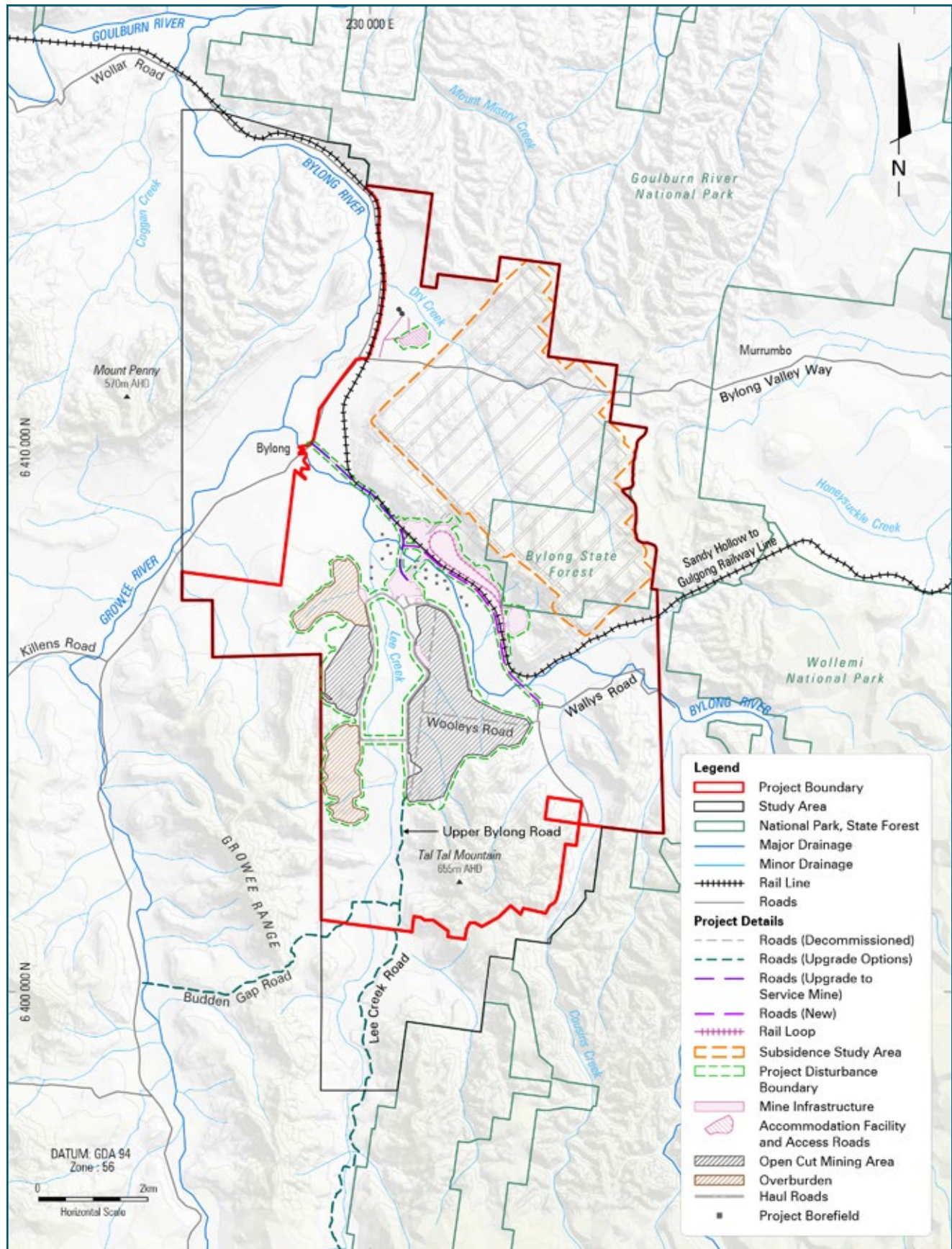
This section provides a detailed description of the Project, including the staging, indicative construction program, conceptual open cut and underground mine plans, equipment, site infrastructure requirements and employment. It then provides a discussion over the key alternatives considered during the development of the Project description.

3.1 OVERVIEW

The Project life is anticipated to be approximately 25 years, comprising a two year construction period and a 23 year operational period, with underground mining operations indicatively commencing in Project Year (PY) 7. Various rehabilitation and decommissioning activities will be undertaken during both the course of, and following the approximate 25 years of the Project. It is noted that further mineable coal resources exist within both A287 and A342 for potential future extraction.

The Project is to be developed on land within the Project Boundary as illustrated on **Figure 18** and land listed in **Appendix A**. Key features of the Project are also conceptually shown on **Figure 18** and include:

- The initial development of two open cut mining areas with associated haul roads and Overburden Emplacement Areas (OEAs), utilising a mining fleet of excavators and trucks and supporting ancillary equipment;
- The two open cut mining areas will be developed with coal extraction and related activities operating 24 hours a day, 7 days a week over an approximate 10 year period and will ultimately provide for the storage of coal processing reject materials from the longer term underground mining activities;
- Construction and operation of administration, workshop, bathhouse, explosives magazine and other open cut mining related facilities;
- Construction and operation of an underground coal mine operating 24 hours a day, 7 days a week for an approximate 20 year period, commencing mining in around PY 7 of the Project;
- A combined maximum extraction rate of up to 6.5 Mtpa ROM coal;
- A workforce of up to approximately 800 during the initial construction phase and a peak of 470 full-time equivalent operations employees at full production;
- Underground mining operations utilising longwall mining techniques with primary access provided via drifts constructed adjacent to the rail loop and Coal Handling and Preparation Plant (CHPP);
- The construction and operation of facilities to support underground mining operations including personnel and materials access to the underground mining area, ventilation shafts, workshop, offices and employee amenities, fuel and gas management facilities;
- Construction and operation of a CHPP with a designed throughput of approximately 6 Mtpa of ROM coal, with capacity for peak fluctuations beyond this;
- The dewatering of fine reject materials through belt press filters (or other similar dewatering technology) within the CHPP and the co-disposal of dewatered fine and coarse reject materials within OEAs and final open cut voids (avoiding the need for a tailings dam);

FIGURE 18 Conceptual Project Layout

- Construction and operation of a rail loop and associated rail load out facility and connection to the Sandy Hollow to Gulgong Railway Line to facilitate the transport of product coal;
- The construction and operation of surface and groundwater management and water reticulation infrastructure including diversion drains, dams (clean, dirty and raw water), borefield, pipelines, pumping stations and other required infrastructure;
- The installation of communications and electricity reticulation infrastructure;
- Construction and operation of a Workforce Accommodation Facility (WAF) and associated access road from the Bylong Valley Way;
- The upgrade of Upper Bylong Road and the construction and operation of a Mine Access Road to provide access to the site facilities;
- Relocation of sections of some existing public roads to enable alternate access routes for private landholders surrounding the Project; and
- Infilling of mining voids, progressive rehabilitation of disturbed areas, decommissioning of Project infrastructure and rehabilitation of the land progressively following mining operations.

The Project will require approximately 1,160 ha of surface disturbance, which will generally be undertaken within the Project Disturbance Boundary as illustrated in **Figure 18**. The Project Disturbance Boundary comprises the area to accommodate the key surface components of the Project with provision for minor adjustments during final design and development. The disturbance areas will be progressively rehabilitated as areas become practically available and where feasible, will be reinstated to its pre-mining land use.

Subsidence related impacts associated with the Underground Extraction Area (as illustrated in **Figure 18**) will also result in influences to the surface, with the majority of material impacts occurring within the Subsidence Study Area (as discussed in **Section 7.1**). The Subsidence Study Area comprises the surface area within the predicted limit of vertical subsidence, determined by the maximum extent of the 26.5 degree angle of draw from longwall extraction and the predicted 20 mm subsidence contour. The Subsidence Study Area covers an area of approximately 1,714 ha.

In addition to the nominated Project Disturbance Boundary and Subsidence Study Area, other minor disturbance associated with ancillary works for the Project may also be required to occur within the Project Boundary.

For example disturbances associated with firebreaks, water diversion structures, minor contour banks, pipelines and associated tracks, power supply infrastructure, fences, sediment and erosion control structures, access to facilitate the remediation of surface subsidence cracks, installation of monitoring equipment and other similar development. This disturbance will be the subject of assessment in accordance with a Land Disturbance Protocol process as described in **Section 7.2**.

3.2 INDICATIVE PROJECT SCHEDULE

An indicative schedule for the construction, operational and decommissioning phases of the Project is presented in **Table 6**.

This EIS refers to PYs, rather than calendar years, with PY 1 being the first year of construction activities. It should be noted that the indicative Project schedules are subject to continual revision based on changing mining and marketing conditions and as such the forecast timing may vary. The indicative Project schedule presented in this EIS is also subject to the necessary regulatory approvals being obtained by 2016.

3.2.1 Construction Phases

There are two construction phases proposed for the Project:

- **Construction Phase 1** – involves the construction of the surface facilities (including the temporary and open cut Mine Infrastructure Areas (MIAs), CHPP, rail loop, water and power reticulation and the development of the open cut mining areas. Phase 1 construction activities are scheduled to commence in the second half of PY 1 and continue through to the middle of PY 3 for a duration of up to approximately 26 months; and
- **Construction Phase 2** – a second, smaller construction phase involving the development works for the underground mine. Phase 2 construction activities will commence at the end of PY 4 and continue until PY 6 for a total duration of approximately 24 months. This phase of construction will generally involve the engagement of a specialist underground mine development team.

During the initial months of construction, a Temporary MIA will be erected at the site of the proposed Underground MIA to accommodate office employees during the term of the phase 1 activities.

TABLE 6 Indicative Project Schedule

ACTIVITY	Project Year																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Open Cut Construction																									
CHPP Construction																									
Underground Construction																									
CHPP Operations																									
Open Cut Operations																									
Underground Operations																									

Note: Shading in PYs 11 and 12 denotes decommissioning of open cut operations

Construction activities, with the exception of excessively noisy activities (or activities generating significant impulsive noise), will be conducted up to 24 hours per day, seven days a week. The proposed construction hours for the activities generating substantial impulsive noise will be 7:00 am to 6:00 pm Monday to Friday and 8:00 am to 1:00 pm on Saturdays. Construction activities will be facilitated by a workforce of approximately 800 full-time equivalent employees during peak periods.

The indicative construction schedule for the phase 1 construction activities is outlined in **Table 7**.

3.2.2 Operations Phase

The operations phase includes open cut and underground mining activities. The proposed indicative phasing is described below:

- Open cut operations will commence following phase 1 construction activities (within which initial clearing and grubbing activities will be completed) in PY 3 and continue until approximately PY 12 and will include decommissioning activities during PY 11 and PY 12, inclusive;
- Continuous miner development works associated with the initial longwall panel will commence in approximately PY 7;
- Longwall mining operations will commence in approximately PY 9 and continue until PY 25, inclusive; and
- From PY 7 to PY 10, both open cut and underground mining activities will operate concurrently. This is referred to as the "dual operations" phase.

3.2.3 Decommissioning Phase

Progressive rehabilitation of the open cut will be undertaken throughout the operations phase. However the decommissioning of open cut mining operations will occur in approximately PY 11 and PY 12.

Decommissioning of underground operations will occur from approximately PY 25 with the cessation of underground mining activities. The final capping and rehabilitation of the open cut mining areas will also occur at this time, in the event that no further extensions to mine life are sought.

3.3 CONCEPTUAL MINE PLAN

The Project seeks to recover approximately 124 Mt of ROM coal within a period of approximately 23 years of active mining to produce approximately 90 Mt of two key thermal product coal types.

During the mine planning process, it was identified that the majority of the coal resource within the Authorisations would be most suited to recovery utilising underground mining methods. This is a result of the topographic relief, local geology, current land uses and environmental constraints within the Project Boundary.

However, primarily due to Project viability considerations, two open cut mining areas are proposed for the efficient recovery of identified marketable seams within the coal resources as part of the Project.

TABLE 7 Indicative Phase 1 Construction Schedule

CONSTRUCTION ACTIVITY	Project Month																									
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Mobilisation																										
Mobilisation to the site																										
General Works																										
Site Compound and Workforce Accommodation Facility																										
Erosion and Sediment Control																										
Construct Access Roads																										
Coal Handling and Preparation Plant																										
Civil Works																										
Coal Preparation Plant																										
ROM and Product Coal Stockpiles																										
Coal Handling Infrastructure																										
Overland Conveyor																										
Rail Loop																										
Civil and Track Work																										
Signalling																										
Open Cut MIA																										
Civil Works																										
Buildings and Other Facilities																										
Dams and Drains																										
Dams and Drains																										
Road Works																										
Internal Haul Roads																										
Upper Bylong Road																										
Utilities																										
Main Water																										
Main Cable																										
Communications																										
Electrical																										
High Voltage Electrical Power Supply																										
Commissioning																										
Commissioning and First Coal																										

The recovery of coal from the two open cut mining areas during the initial eight years of mining operations is pivotal in securing the economic viability of the Project. This valuable coal resource is located at shallow depths of cover ranging from 20 m to 90 m and subsequently cannot be extracted safely and effectively by underground mining methods.

Further, the development of the two open cut mining areas will provide a suitable receptacle for the emplacement of coarse and fine reject materials throughout the life of the proposed mining operations avoiding the need for the construction of a large tailings dam and coarse reject emplacement area.

3.3.1 Open Cut Mining

Resource

The Project proposes the recovery of approximately 33 Mt of ROM coal utilising open cut mining methods. The targeted economic coal seams within the coal resource are primarily the Ulan and Coggan Seams. Some small quantities of coal will be extracted from the overlying coal seams such as the Goulburn and Glen Davis coal seams that exist within the proposed open cut mining areas.

Initial conceptual plans to mine the significant coal resource from seven open cut mining areas were rejected by KEPCO to minimise impacts to Strategic Agricultural Land (SAL) and to mitigate other environmental and social impacts (i.e. a reduction from seven open cut mining areas to the two as proposed). This major concession to the mine plan is discussed further in **Section 3.17**.

Pre-Stripping Activities

Prior to any surface disturbance activities commencing, pre-clearance surveys will be completed to identify any habitat features present and any suitable soils and other materials (bush rock, habitat/stag trees, etc.) that are able to be recovered for use in future rehabilitation activities. **Section 7.2** provides a description of the process which will be followed where any habitat trees or other suitable habitat features are present within the area to be cleared.

Suitable soils and other materials will be recovered from all areas that are proposed to be disturbed (such as areas proposed for infrastructure, OEAs and open cut mining areas).

All soil and other materials recovered will either be directly placed on areas to be rehabilitated or will be strategically stockpiled in dedicated areas, to particular specifications depending on soil type and the estimated time of use in rehabilitation. Indicative soil stockpile locations are provided on the staged mine plans presented below.

Further details regarding the management of soil to be recovered within the Project Disturbance Boundary are provided in **Section 7.14**.

Mining Method

The coal resource within the open cut mining areas occurs at relatively shallow depths (i.e. between 20 m to 90 m depth of cover) and cannot be safely and effectively extracted by underground mining techniques. The natural stratigraphic positioning and sequencing of the Ulan Seam and the Coggan Seam and their relatively shallow depths of cover within these areas, warrants the use of open cut mining methods.

The Project will utilise contemporary open cut excavator mining techniques supported by trucks and other ancillary mining equipment to develop the two open cut mining areas.

Once the soil resources and other materials have been recovered from the initial mining area, a box cut will be developed by removing overburden materials with an excavator and truck fleet to uncover the coal resource.

The initial development of the box cut and other early operations is likely to commence in the construction phase in approximately PY 2 in readiness for the commencement of open cut coal extraction in approximately PY 3.

Due to geological interburden formations, some areas will require the controlled use of explosives to fracture the rock materials to facilitate its safe and efficient removal. Extracted overburden materials will initially be emplaced within the OEAs adjacent to the open cut mining areas as shown on **Figure 18**. Once the open cut mining areas are developed sufficiently, overburden materials will be utilised to backfill previously mined areas.

As the overburden material is progressively removed to uncover the coal resource, a fleet of excavators and trucks will be utilised to extract the ROM coal and deliver this to the ROM pad prior to it being delivered to the CHPP for processing (as discussed in **Section 3.5**). Some of the coal resource within the open cut mining areas will require blasting through controlled use of explosives to fragment the insitu material prior to extraction, while other coal will require selective ripping and preparation utilising a dozer prior to excavation and loading. This selective management will improve the efficiency of operations and enable the reduction of dilution materials from the ROM coal prior to loading.

Mine Plan Layout and Sequencing

Figure 19 to Figure 22 illustrate the conceptual indicative sequence for open cut mining operations for PYs 3, 5, 7 and 9 within the two open cut mining areas; the Eastern Open Cut Mining Area (Eastern Open Cut) and Western Open Cut Mining Area (Western Open Cut). These years have been selected for modelling purposes as they represent a combination of mining scenarios closest to neighbouring private receivers and at the greatest intensities of mining.

Mine plan optimisation studies incorporating environmental and social considerations have indicated that the preferred mining sequence within the Eastern Open Cut entails the commencement of operations as a box cut in the northern portion of the mining area and progressing operations southwards. Within the central parts of the Eastern Open Cut, mining operations will generally develop from west to east, with the most southern extent being mined from north to south. Mining operations will progress with designed laid back advancing faces that will initially extract overburden to uncover the coal. As coal resources are progressively recovered within the open cut mining areas, overburden material will be emplaced behind mining operations and shaped to enable progressive rehabilitation activities. The mining sequence described above is subject to any changes that may be required due to operational constraints.

Overburden extracted from the Eastern Open Cut will initially be placed within the two OEAs external to the mining areas (North Western OEA and South Western OEA) until the mining area is suitably developed to enable progressive backfilling behind mining operations.

The south-eastern portion of the Eastern Open Cut will remain as an open void at the completion of open cut mining operations. This void area will remain open for the controlled emplacement of coarse and fine reject materials generated during the longer term underground mining operations. The reject materials within this area will be capped and rehabilitated at the end of the mine life, so that no final void remains at the completion of the Project. Overburden material which has been emplaced and temporarily rehabilitated during the operations within the Eastern Open Cut will be rehandled, placed, compacted and shaped to cover the reject materials to generate the final landform.

In parallel with the commencement of mining operations in the Eastern Open Cut, extraction will also commence within the Western Open Cut via a box cut in the northern end of the mining area. Operations within the Western Open Cut will advance from the north to south, generally using east to west orientated benches. Overburden material extracted from this mining area will initially be placed within the North Western OEA and South Western OEA until the mining void is suitably developed to enable progressive backfilling.

Once operations within the Eastern Open Cut and Western Open Cut are progressed and the OEAs have been shaped, the soil resources collected in advance of mining will be directly placed onto the shaped OEAs to facilitate the progressive rehabilitation process.

The Open Cut Mining Areas and OEAs are located on land predominantly owned by KEPCO. The BUPs is located within the Eastern Open Cut Mining Area. Public roads (as discussed in **Section 3.13**) and various Crown Land also occurs within the open cut mining areas for which appropriate access will be sought. No open cut mining operations are proposed on any privately owned land.

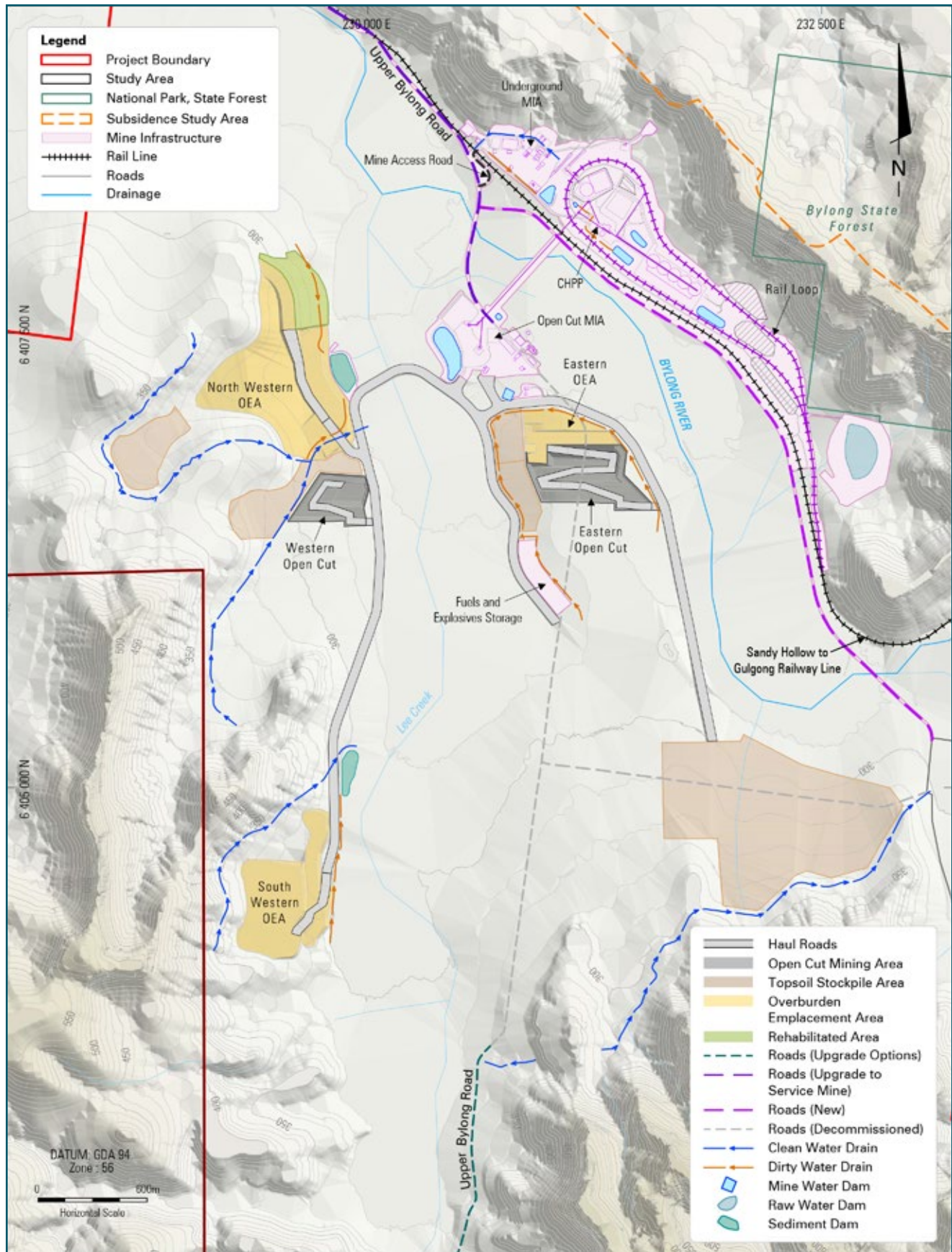
FIGURE 19 Conceptual Open Cut Mine Plan Year 3

FIGURE 20 Conceptual Open Cut Mine Plan Year 5

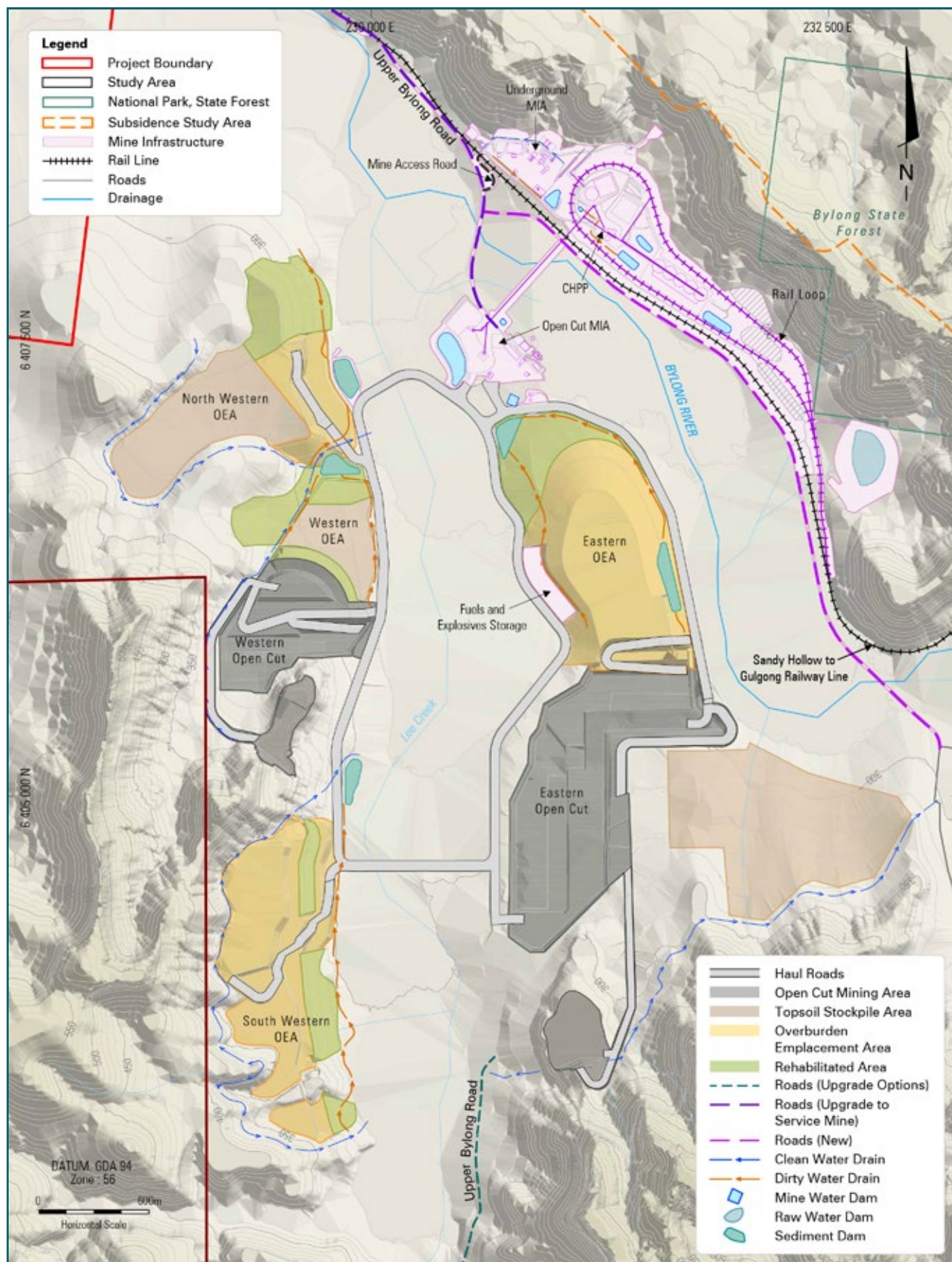


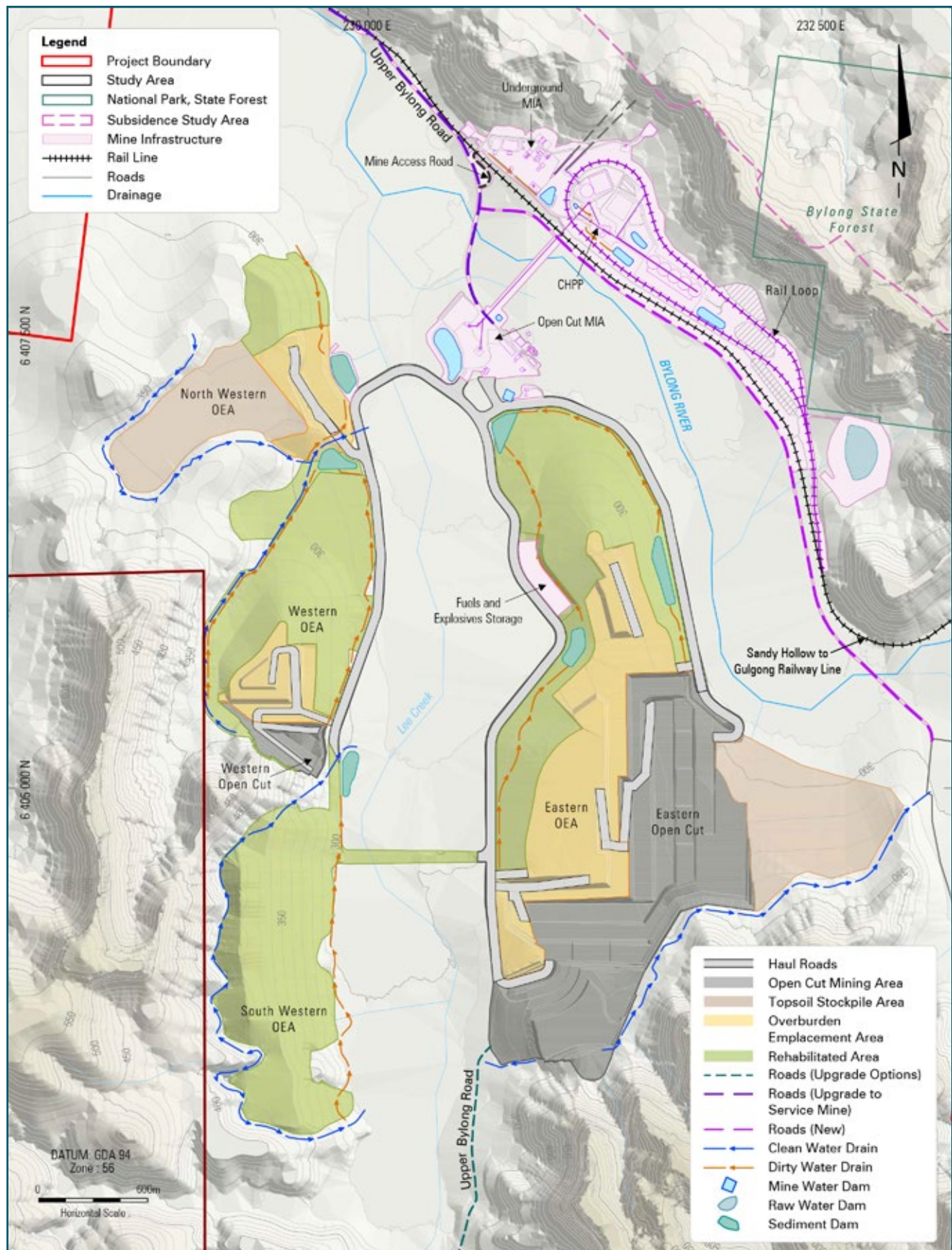
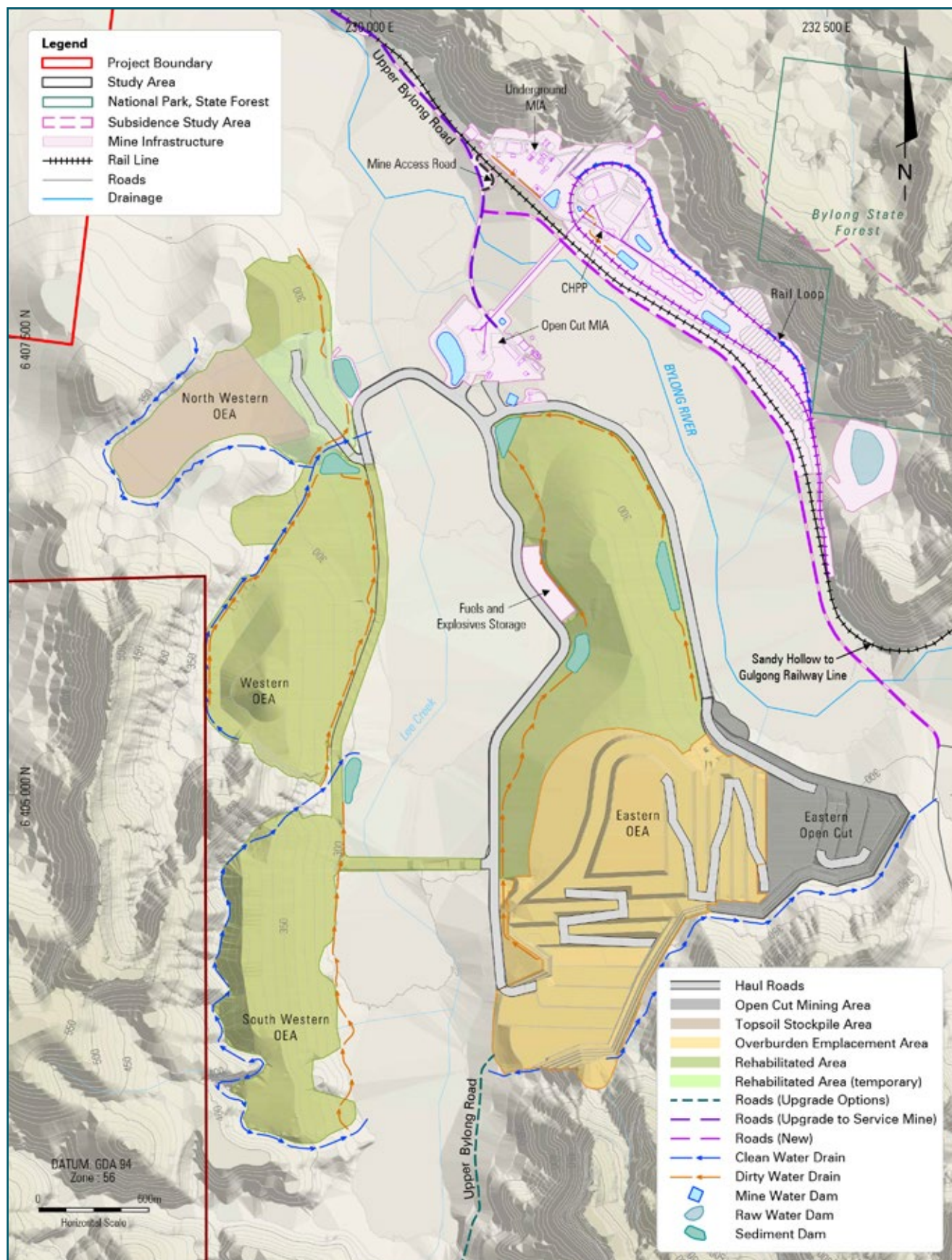
FIGURE 21 Conceptual Open Cut Mine Plan Year 7

FIGURE 22 Conceptual Open Cut Mine Plan Year 9



Indicative Production Schedule

An indicative open cut mining production schedule for PYs 3, 5, 7 and 9 is provided in **Table 8**. Coal production for the open cut mining operations is estimated to commence in PY 3 at approximately 4.0 Mtpa ROM coal and will increase to approximately 5.5 Mtpa ROM coal by PY 5.

A total of approximately 33 Mt ROM coal is proposed to be extracted from the open cut mine, which will require the removal of approximately 152 Million bank cubic metres (Mbcm) of prime overburden material over the approximate 8 years of operations.

The combined coal extraction (open cut and underground mining operations) for the Project will be up to 6.5 Mtpa ROM coal.

Blasting

Within the open cut mining areas, the hard rock overburden material that is to be encountered will require blasting via the controlled use of explosives to achieve suitable fracturing and fragmentation to enable efficient and safe removal by the fleet of excavators and trucks. Certain thicker sections of the coal resource within the open cut areas will also require blasting to improve the efficiency of extraction and loading operations.

Mine planning has predicted an average of two blast events per week over any one year, with up to six blast events per week at maximum annual production. Blasting will be undertaken between 7:00 am to 5:00 pm Monday to Saturday. No blasting will occur on Sundays and public holidays except under special circumstances with prior approval from the relevant regulator.

Materials required for the blasting activities will be stored in a facility located within the western side of the Eastern Open Cut, which has been appropriately designed to meet regulatory spacing requirements.

This facility provides an area for the blasting contractor to store high explosives and detonators with a separate ammonium nitrate storage and reloading facility that has security fencing, access roads, earth bunds and connection to the site wide electrical and communications networks. Storage and handling of explosives and other related materials will be undertaken in compliance with *AS2187.2-2006 – Explosives – Storage, Transport and Use. Part 2: Use of Explosives* (or its latest version). The management of hazardous materials is discussed further in **Section 7.24**.

At various times throughout the open cut mining operations, public roads within 500 m of blasting activities, including Upper Bylong Road Realignment; Wallys Road (name denoted to the most eastern section of Wooleys Road); and Lee Creek Road, will need to be temporarily closed. These road closures will be in accordance with a Traffic Control Plan to be approved by the MWRC.

Blasting activities will be designed and undertaken in order to manage any potential impacts upon buildings, sensitive surface features and structures (including heritage items) within and surrounding the proposed open cut mining areas. Neighbouring the southern boundary of the proposed Eastern Open Cut is a series of rock structures and landforms. Specific consideration of the blasting methodology will be undertaken to mitigate the impacts to these identified features.

TABLE 8 Indicative Open Cut Mining Production Schedule

Project Year	Indicative Year	Overburden (Mbcm)	ROM Coal (Mt)	Product Coal (Mt)	Coarse & Fine Rejects (Mlcm)
3	2018	17.1	4.0	2.4	0.9
5	2020	27.7	5.5	4.3	0.7
7	2022	29.7	5.0	4.5*	0.6*
9	2024	24.6	2.9	4.5*	1.2*
Total for Open Cut Years	2018 to 2025	152.0	33.0	31.0*	6.0*

Mlcm – Million loose cubic metres

* For PY 7 and 9, both open cut and underground mining are occurring. Therefore the product coal and rejects generated is presented from both mining operations.

Blasting activities will also occur during construction stages of the Project. Construction activities for the installation of surface facilities (such as the rail loop) will involve a substantial amount of bulk earthworks to develop the appropriate working areas.

Dependant on geological formations within the designated construction areas, blasting will be required to achieve suitable fracturing and fragmentation to enable efficient and safe removal by an excavator and truck fleet.

A detailed Noise and Blasting Impact Assessment has been prepared for the Project, which includes the relevant assessment of blasting related impacts. A summary of the assessed impacts and proposed management measures is provided in **Section 7.10**.

Final Landform Establishment and Rehabilitation

The Project will require two OEAs external to the open cut mining areas:

- The North Western OEA located to the north-west of the Western Open Cut; and
- The South Western OEA located to the west of the Eastern Open Cut and south of the Western Open Cut.

These two OEAs external to the mining areas will be developed in the initial years of open cut mining operations. The North Western OEA will be developed to a final landform height of approximately RL 395 m. The South Western OEA will be developed to a final landform height of approximately RL 390 m.

Once the mining areas have been sufficiently developed, overburden will be placed within the void remaining behind previously mined areas (see **Figure 19** to **Figure 22**).

The Eastern OEA will be progressively developed within the mined area of the Eastern Open Cut to approximately RL 360 m. The Western OEA will be developed within the mined area of the Western Open Cut to approximately RL 360 m.

The OEAs (internal and external to the open cut mining areas) have specifically been designed to:

- Minimise disturbance to sensitive surface features;
- Blend into the natural topography (slopes of generally less than 10 degrees);

- Achieve land and soil capability class 4 characteristics, although some areas will also be specifically developed to achieve class 3 characteristics (as discussed in **Section 7.15**); and
- Minimise visual impacts to neighbouring receivers.

Rehabilitation of the contoured OEAs will occur progressively throughout the mining operations, generally as illustrated in **Figure 19** to **Figure 22**, to achieve the objectives and program of rehabilitation works described in **Section 7.15**.

Final Landform and Land Use

At the completion of open cut mining operations in approximately PY 10, an open void area will remain in the south-eastern portion of the Eastern Open Cut. This void area will remain open for the storage of coarse and fine reject materials generated from the processing of ROM coal associated with underground mining operations. Initially, the void will comprise an area of approximately 155 ha and have a maximum depth of 90 m below the natural ground surface.

The void will have a nominal capacity of approximately 19 Mbcm, which will be sufficient to accommodate the coarse and fine reject materials for the longer term underground mining operations.

In the event that future approvals are not sought to continue mining at the end of PY 25, overburden from the neighbouring OEAs will be used to cover the coarse and fine reject materials and facilitate rehabilitation to achieve the final landform as conceptually illustrated in **Figure 23**. A cross section of the void remaining at the completion of open cut mining operations and the eventual final landform following underground mining operations is shown in **Figure 24**.

Progressive rehabilitation of the site will be appropriately focused towards establishing a safe and stable final landform that integrates into the neighbouring natural environment and where practical return the land to its pre-mining land use post-mining. Post-mining land use objectives are further discussed in **Section 7.15**.

Final landform and land use design alternatives considered in the development of the mine plan are provided in **Section 3.17**.

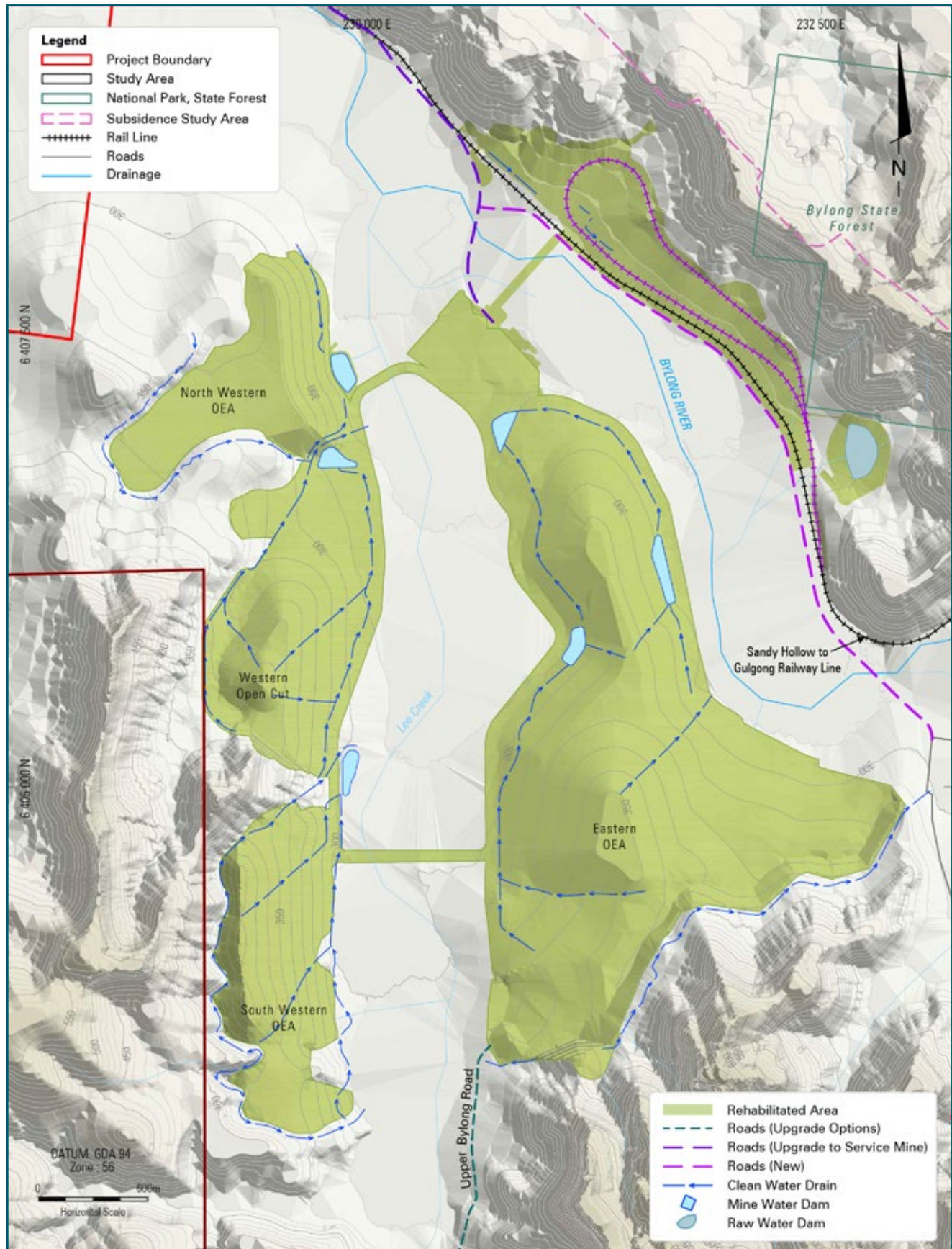
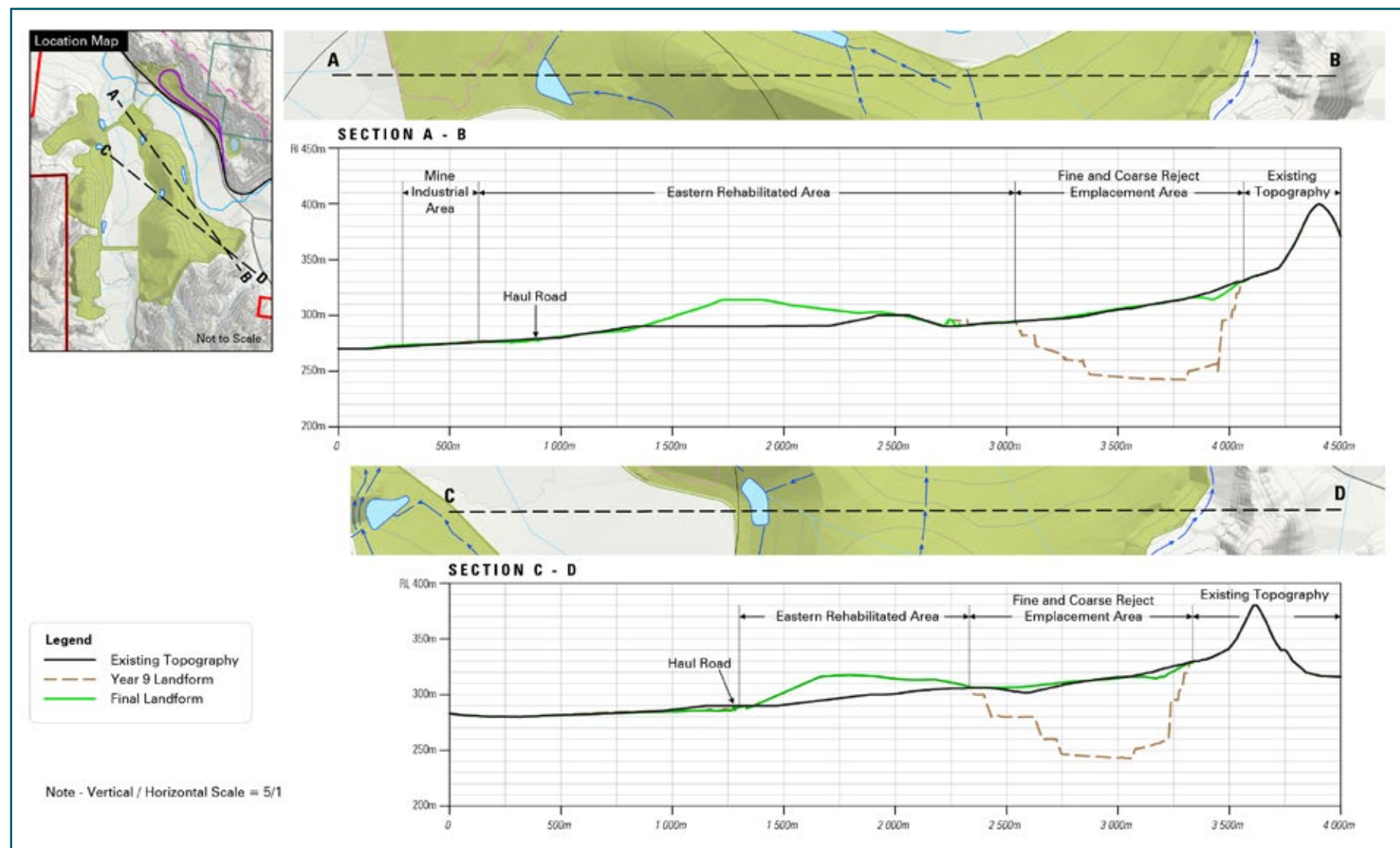
FIGURE 23 Conceptual Final Landform

FIGURE 24 Conceptual Staged Final Landform Cross Sections



3.3.2 Underground Mining

Resource

The Project will target the recovery of approximately 91 Mt of ROM coal from the Coggan Seam by underground longwall mining methods. The interburden between the overlying Ulan Seam and the Coggan Seam is of varied thickness and strength. Accordingly, a suitable Ulan Seam working section is not able to be safely extracted concurrently with the Coggan Seam and does not form part of this proposal.

Due to current legislated constraints and social and environmental considerations, KEPCO has intentionally excluded substantial underground coal resources from its mine plan. This has resulted in the avoidance and/or minimisation of potential impacts to surface features such as significant cliff lines and rock structures. This is discussed further in **Section 3.17**.

There are very material additional coal resources within A287 and A342 that could (subject to the relevant planning approvals) extend the life of the Project well beyond the 23 year production life depending on the findings of future planned exploration activities and demand for thermal coal.

Mining Method

The proposed Underground Extraction Area is located where the geology and natural formation of the Coggan Seam allows for the safe and efficient recovery of coal utilising proven underground mining methods.

The mine plan adopts a contemporary longwall mining operation supported by underground infrastructure, development machinery for roadway formation, and an integrated longwall mining system that includes hydraulic roof supports and a shearer. In the case of longwall mining, blocks of coal (or panels) are delineated by developing a series of parallel roadways (or tunnels which are also referred to as 'headings') within the coal seam.

Once the headings delineating the panel are developed, a longwall mining system is installed which progressively extracts the panel as the longwall system retreats. The coal seam roof in the immediate longwall operating area is supported by a series of advancing hydraulic supports to primarily protect the workers at the longwall mining face and the extraction equipment.

The extracted coal is removed via an integrated conveyor system, which runs along the operating face of the panel being extracted, then down one side of the panel to the main roadways leading out of the mine.

The roadways are also used for equipment and personnel access and to draw fresh air into the mine to ventilate the mine workings and to remove generated dust from the working areas. The roadways are developed using continuous miner equipment. These headings are either permanent roadways for access and services throughout the mine life or temporary roadways for access to each longwall panel. **Figure 25** provides a schematic showing the above processes associated with longwall mining.

Mine Plan Layout and Sequencing

The Underground Extraction Area occurs below the elevated terrain within the north-eastern portion of the Project Boundary (see **Figure 26**). The Underground Extraction Area has been positioned to avoid site significant rock structures, landforms and cliff lines where possible to ensure that impacts to these features are minimised.

Two decline drifts will be constructed from the surface to the north-west of the CHPP and rail loop and will provide access to the proposed workings within the Coggan Seam. One drift will provide ongoing access to the underground mining operations for materials, ventilation and employees. The second drift will provide ongoing access for coal delivery purposes and secondary means of egress. Key drivers for locating the decline drifts in the vicinity of the CHPP and rail loop include its positioning within the central portion of the Underground Extraction Area and its proximity to relatively flat ground between the rail loop and the main headings within the Underground Extraction Area. The surface topography to the north-east of the rail loop will also be acceptable for the establishment of the ventilation shaft and various boreholes for mine services.

At the pit bottom (as illustrated on **Figure 26**), various roadways that transition between the two drifts and the main headings of the Underground Extraction Area will be developed. The pit bottom will accommodate (at least) the following key features:

- Conveyor transfers from the trunk belt to the drift belt;
- Trunk belt drive, loop take-up, control systems and electrical gear;
- Main pit transformers;
- Main pit ventilation set up (including ventilation shaft);
- Boreholes for the delivery of stone dust, ballast, and concrete;
- Crib facilities; and
- Service bays to enable personnel to conduct minor servicing and repair activities.

As illustrated on **Figure 26**, the permanent main headings are proposed to be developed in a south-east to north-west direction to generally align with the elevated topography leading up from the valley areas. The purpose of this alignment is to ensure that the visible surface cliffs and steep topography within proximity remain outside of the area affected by material subsidence effects.

Development of the permanent main headings will commence within the central portion of the south-western extent of the Underground Extraction Area in approximately PY 5. The initial development of the main headings will be constructed utilising continuous miners and will provide permanent roadways for employee access, ventilation and mining services throughout the life of the underground mining activities. The development works for the main headings are designed to facilitate their use for 'life of mine' and are engineered to have no material measurable (i.e. <20 mm) surface subsidence.

During the initial development of the main headings, a ventilation network will be installed to the relevant mine safety standards. Associated with this ventilation network, a ventilation shaft compound is proposed on the north-eastern side of the rail loop as discussed further in **Section 3.6.2**.

The conceptual longwall panel design generally follows the easterly dip of the geology within the Underground Extraction Area, with each longwall panel to be extracted from the north-east to the south-west towards the permanent main headings. The longwall panels within the south-eastern portion of the Underground Extraction Area are designed with a nominal width of approximately 304 m, whilst the panels in the north-western portion are designed with a nominal width of approximately 344 m as illustrated in **Figure 26**.

Significant mining risk mitigation design including monitoring and management of subsidence has been incorporated into both the 304 m and 344 m wide longwall faces. Consideration to environmental impacts from subsidence effects, minimising cost and economically determining efficient resource recovery were key considerations in the control of both environmental and mining risk. Notwithstanding these design considerations, the monitoring and management of subsidence effects observed during mining will be used to verify the subsidence prediction model.

The proposed coal extraction height varies with the changes in geology and seam thickness throughout the Underground Extraction Area. The Coggan Seam has been identified to be suitable for extraction in thicknesses between approximately 3.4 m and 5.8 m. The design specification for the longwall mining equipment is proposed to provide working heights between approximately 3.4 m and 5.0 m.

Longwall panel extraction will commence following the development of the headings of the first longwall panel (i.e. approximately PY 9). Longwall operations will commence in the central portion of the Underground Extraction Area with subsequent panels progressing towards the south-east. Following completion of the initial south-eastern longwall panels, the longwall mining equipment will move to the central area to continue mining the longwall panels to the north-west of the initial longwall panel (see **Figure 26**).

To manage any potential spontaneous combustion risk, the completion of each longwall panel extraction will require each individual panel to be sealed off. Where it is safe and practical, mining related infrastructure such as electrical cables, belt conveyors and water pipelines will be removed from the mining area prior to the panels being sealed off.

Some blasting activities will be required during the underground mining operations in the instance where any unexpected rock intrusions in the coal seam are encountered. It is the intention that during the underground mining years, extensive amounts of explosive materials or precursors will not need to be stored onsite and that any required explosive materials will be delivered to the site on an as needed basis by an authorised and licensed provider. The explosives facility developed for the open cut mining operations may be utilised to store limited amounts of explosives material for the underground mining operations.

The vast majority of underground mining activities are to occur under KEPCO owned land. Some underground mining however is proposed under the Bylong State Forest and a section of the Bylong Valley Way in the northern portion of the Underground Extraction Area. Underground mining is also proposed below sections of a privately owned property in the south-eastern portion of the Underground Extraction Area and a privately owned quarry in the north-eastern portion of the Project Boundary.

No underground mining is proposed under any privately owned residences. Subsidence Management Plans will be developed as part of an Extraction Plan in consultation with the landowners of these properties, prior to commencing mining of a longwall panel(s) which has the potential to impact any privately owned infrastructure.

FIGURE 25 Longwall Mining Schematic

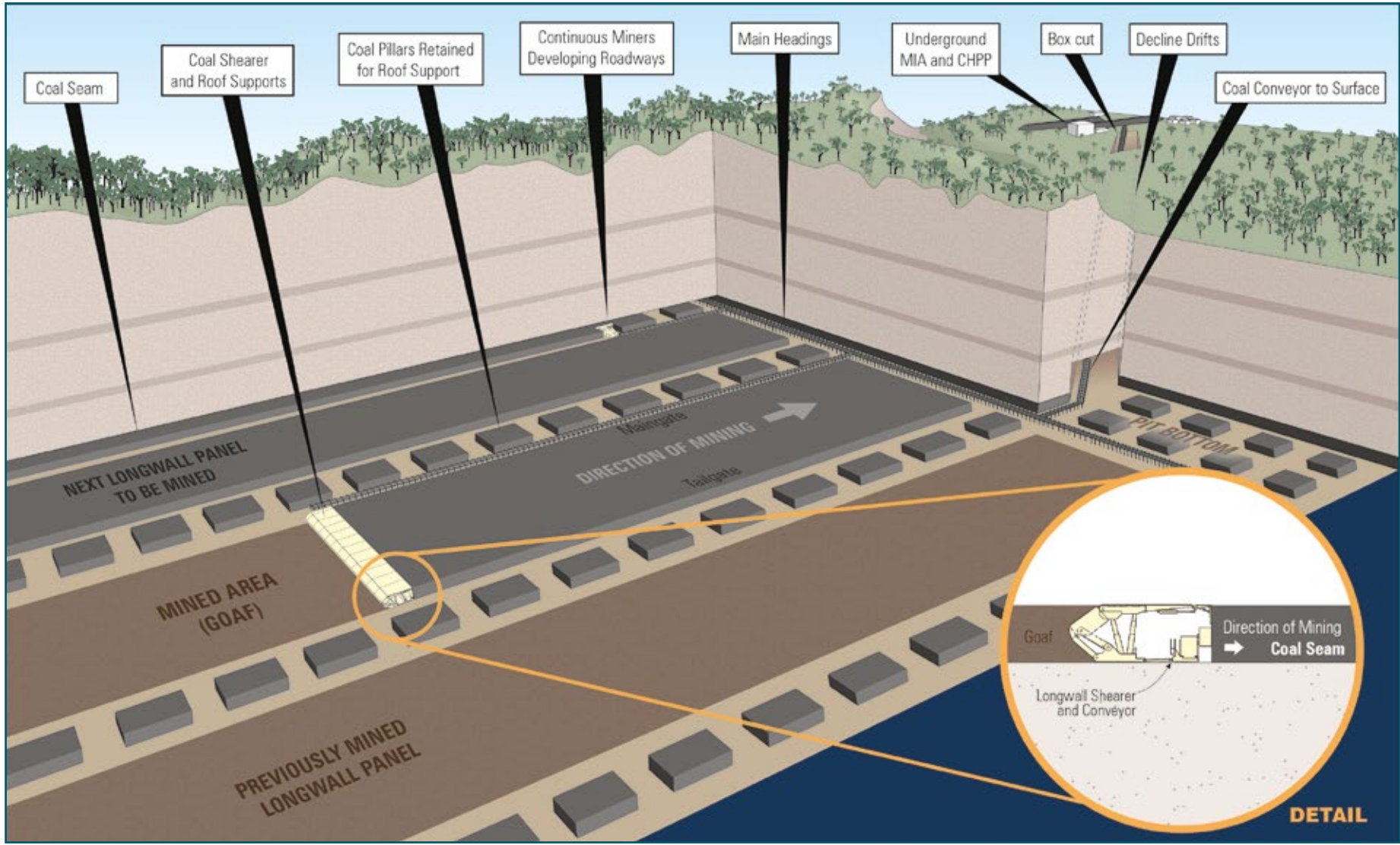
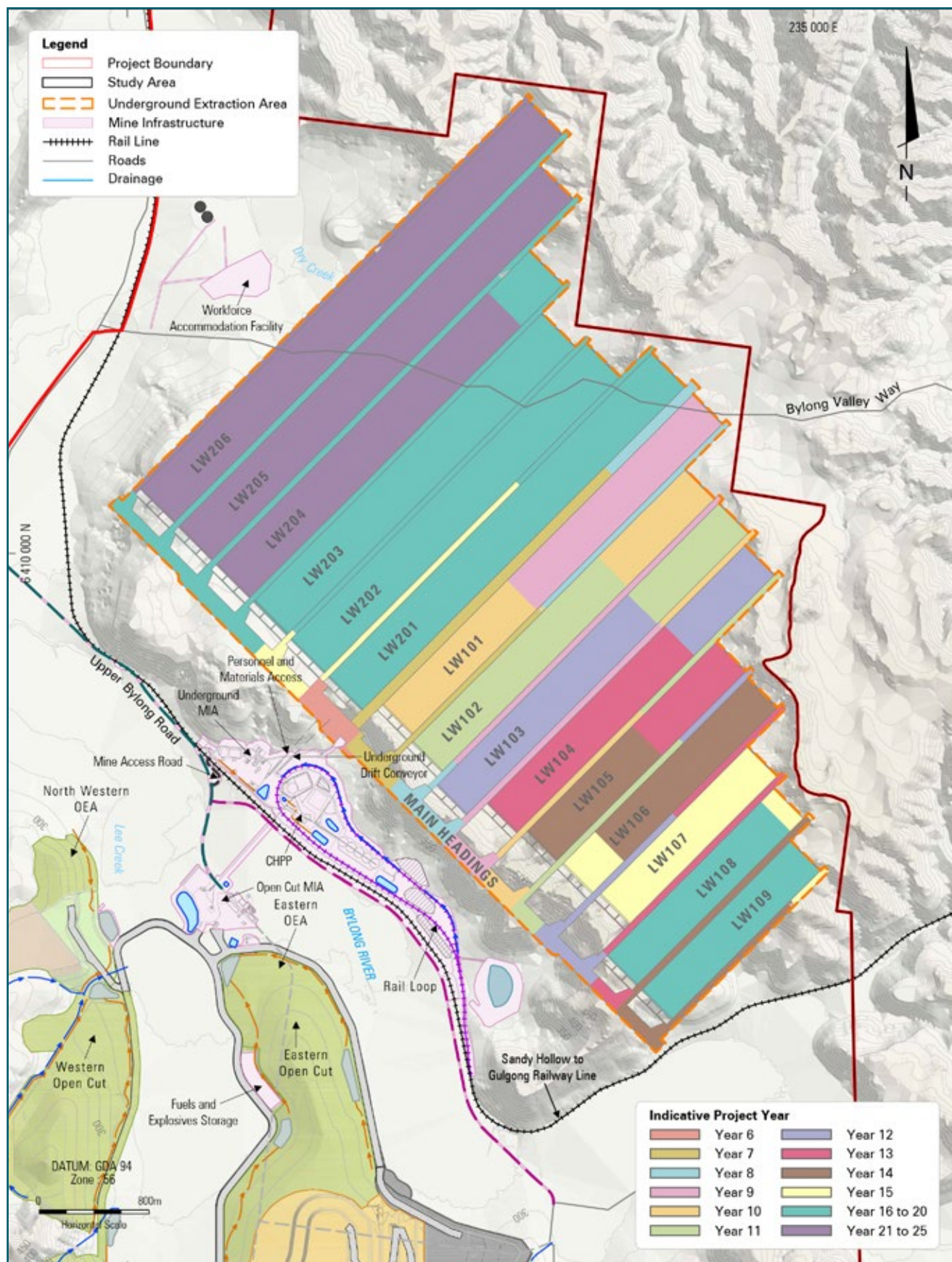


FIGURE 26 Conceptual Underground Mine Plan



Indicative Production Schedule

An indicative underground mining production schedule for PYs 7, 9, 12, 16, 18, 21 and 25 is provided in **Table 9**.

Subsidence and Remediation

The progression of coal extraction by longwall mining techniques will result in the formation of a cavity or 'goaf' (see **Figure 25**). Integrated hydraulic roof supports are designed to progressively move forward providing a stable roof area to primarily protect the workers at the face and to control goaf formation across the width of the longwall panel. The controlled goaf formation influences subsidence behaviour within the individual longwall panel. As mining advances through the coal seam, a goaf is formed as the unsupported immediate roof eventually collapses under the weight of the overlying strata (cave zone).

The collapse of the material overlying the goaf will cause physical ground movements. This will include measured vertical subsidence, horizontal displacement, tilt, curvature and strain immediately above and surrounding the longwall panel. This influences changes to rock mass and surface relief. This can be in the form of tensile and shear failure of the immediate rock mass, including at times shear and localised buckling of the strata.

Subsidence related surface impacts such as surface cracking and deformations in the landform may potentially affect safety and access or result in environmental impacts (such as increased erosion) (as discussed in **Section 7.1**).

Monitoring of subsidence related surface impacts will be undertaken during and following the extraction of each longwall panel to identify impacts which require remediation and to validate subsidence predictions. Remediation techniques will include infilling of surface cracks with soil or other suitable materials, or by locally regrading and compacting the surface. In some cases, erosion protection measures may be needed, such as the regrading and planting of vegetation in order to stabilise the slopes created within subsided areas.

A detailed Subsidence Impact Assessment has been prepared for the Project. A summary of the assessed impacts and further details in relation to the management measures is provided in **Section 7.1**.

Goaf Management

Due to the minimal interburden thickness between the Ulan and the Coggan Seams, the cave zone resulting from longwall mining may extend throughout sections of the Ulan Seam. This will potentially result in fractured coal from the Ulan Seam to enter the longwall panel goaf. As discussed in **Section 7.20**, both the Ulan and Coggan Seams have a moderate to high propensity for spontaneous combustion when exposed to oxidising conditions, however do not meet thermal runaway and therefore can be managed appropriately. A specific strategy for the management of spontaneous combustion in the Underground Extraction Area is discussed further in **Section 7.20**.

TABLE 9 Indicative Underground Mining Production Schedule

Project Year	Indicative Year	ROM Coal (Mt)	Product Coal (Mt)	Rejects (Mlcm)
7	2022	0.5	4.5*	0.7*
9	2024	3.7	4.4*	0.8*
12	2027	6.0	4.5	0.8
16	2031	5.6	4.9	0.5
18	2033	6.3	3.6	0.8
21	2036	5.3	3.2	0.7
25	2040	6.0	4.1	0.8
Total for Underground Mine	2022 to 2040	91.0	90.0[^]	14.0[^]

* For PYs 7 and 9, both open cut and underground mining are occurring. Therefore the product coal and rejects generated is presented from both mining operations.

[^] Represents product coal and rejects generated from both open cut and underground mining operations during life of Project.

3.4 INDICATIVE EQUIPMENT FLEET

3.4.1 Open Cut Mining Equipment

An indicative equipment fleet (subject to supply by a mining contractor to be engaged in the future) for open cut mining operations at peak production for the Project is shown in **Table 10**. Ancillary equipment will also be required, including (but not limited to) lighting plants, generators, water pumps, mobile cranes, delivery trucks and light vehicles.

TABLE 10 Indicative Open Cut Equipment

Equipment	Number*
550 t Hydraulic Excavators	2
250 t Hydraulic Excavators	3
Front End Loaders	3
220 t Haul Trucks	10
180 t Haul Trucks – Coal	5
180 t Haul Trucks – Combi-body	11
D11 Dozers	10
Graders	3
150 t Water Carts	2
Blast Hole Drill	3
Fuel and Lube Trucks	2

*Includes coal and reject materials handling equipment fleet

3.4.2 Underground Mining Equipment

Indicative equipment for underground mining operations at peak production for the Project is provided in **Table 11**. Other ancillary equipment will also be required for the underground mining operations for the Project including (but not limited to) lighting plants, generators, water pumps, mobile cranes, delivery trucks and light vehicles.

TABLE 11 Indicative Underground Equipment

Equipment	Number
Continuous Miner	3
Longwall Miner	1
Ancillary fans	4
Conveyor systems	5
Electrical power system	1
Communication system	1
Gas monitoring system	1

3.5 COAL HANDLING, PROCESSING AND TRANSPORT

The CHPP and associated facilities will enable the handling and processing of up to approximately 6 Mtpa of ROM coal (with capacity for peak fluctuations beyond this) using a single module conventional dense-medium cyclone and spiral process. The CHPP and associated facilities are proposed to be located within the rail loop at the foothills of the natural escarpment to the north-east of the Sandy Hollow to Gulgong Railway Line (see **Figure 18**).

The conceptual design of the CHPP comprises a system of conveyors, dense medium cyclones, centrifuges, pumps, fans, feeders, breakers, valves, gates, mixers, sizers, screen, storage tanks, sample stations, belt press filters (or similar mechanical dewatering components) and bins.

The Coal Preparation Plant (CPP) (a component of the CHPP) will be enclosed by cladding from the roof to the top of the ground floor to manage noise impacts to near neighbours. The surge bin will have cladding on external walls with exception of one wall which will remain open for the tertiary sizer to be rolled out for maintenance. Cladding will also be installed on the south-western walls of the product skyline conveyor to manage noise impacts to near neighbours. Night lighting will be provided on the exterior of the CPP halfway up the walls, pointing down towards the ground to provide safe access in the immediate vicinity.

The following sections describe the coal preparation, processing and transport phases as coal passes through the various components of the CHPP.

3.5.1 ROM Coal Handling and Processing

ROM coal from the open cut mining areas will be trucked to the ROM pad at the northern end of the Eastern Open Cut. At that point, it will either be unloaded to a stockpile for future reclaim by front end loader or directly placed on the open cut sizing and conveying system to the CPP.

The conceptual design includes an approximate 3 m wide feeder breaker which will be utilised to achieve a primary size reduction to approximately 350 mm at rates of up to 1,200 tonnes per hour (tph). Once the ROM coal has been sized by the feeder breaker, it will be delivered to an adjacent raw coal twin roll sizer (or equivalent) where the top size of coal will be reduced to approximately 150 mm prior to being delivered to the raw coal surge bin via the overland conveyor, which conceptually has an approximate capacity of 800 t.

ROM coal from the Underground Extraction Area will be delivered by way of a conveyor drift at a rate of up to approximately 4,500 tph into a sizing station with a pick and scroll type sizer for reduction down to approximately 200 mm. This sized coal will then be delivered to an underground ROM coal stockpile at the western side of the CHPP, with a nominal capacity of approximately 150,000 t (primary 40,000 t and secondary stockpile 110,000 t). Underground ROM coal will generally be reclaimed to a reclaim tunnel below the stockpile and fed via conveyor to the raw coal surge bin. A dozer will operate to reclaim any coal that is located on the secondary stockpiles.

The raw coal surge bin will be located adjacent to the CPP and will contain a twin roll tertiary sizer (or equivalent) at the top of the bin which sizes coal down to a top size of approximately 50 mm prior to it entering the bin. Two vibrating feeders (or equivalent) will be installed at the surge bin outlet: one that feeds the CPP; and the second which enables suitable ROM coal to bypass the washing process.

The targeted coal seams within the open cut mining areas have quantities of coal suitable for bypass. This will allow simple crushing and direct product stockpiling for train loading and no refuse material disposal. For non-bypass coal, the CHPP will wash the ROM coal at a nominal rate of 850 tph using a conventional dense-medium cyclone and spiral process (or equivalent coal washing process).

Given the ROM coal is expected to have variable washability characteristics and relatively high specified ash content, a proposed two-stage coal cleaning circuit will provide superior separation efficiency and operational flexibility.

The proposed dense-medium cyclones will clean the coarser fractions and coal spirals for the fine-size fractions. The fine coal will be thoroughly deslimed as part of this process thereby reducing the ash and moisture content of the final product. Following washing and sizing, two types of coal product are targeted: 16% ash (as received basis (arb)) and 22% ash (arb). The product coal generated will be largely dependent upon the ROM coal processed and the market conditions and demands at the time.

3.5.2 Product Coal Handling

It is proposed that product coal processed through the CPP will be directed onto an overhead skyline conveyor with belt ploughs that will divert coal to the five discrete stockpile zones. To minimise dust emissions from the bypass coal, the first two stockpile zones have been allocated for this product. Telescoping chutes will be installed for these discharge points. The product coal stockpile has been designed with a nominal capacity of 200,000 t stockpiled to approximately 25 m in height. An additional area adjacent to the product coal stockpile provides an additional push-out capacity of approximately 300,000 t when pushed out to a nominal 10 m height.

The conceptual design includes coal stockpile areas that are centred over a concrete arch tunnel with a conveyor facility providing a reclaim capacity of approximately 4,500 tph running the length of the coal stockpile. Coal valves are proposed to be located below each of the five stockpile zones to facilitate the blending of coal upon reclaim. Product coal will be pushed into the coal valves onto the tunnel conveyor for loading onto trains using a dozer. Typically, two dozers may be required for the operation of the reclaim system, particularly when the additional push-out stockpiles are in use. The tunnel conveyor feeds product coal into a train loading bin located over the rail loop adjacent to the CHPP.

3.5.3 Rail Loop and Train Loading

The Project will require the construction of a rail loop that will accommodate trains to be loaded with product coal and will connect with the Sandy Hollow to Gulgong Railway Line. The Sandy Hollow to Gulgong Railway Line connects with the Main Northern Railway Line at Muswellbrook, where it continues down to the Port of Newcastle.



Example of Coal Train Travelling on the Sandy Hollow to Gulgong Railway Line

The rail loop has been designed to accommodate up to two trains and will facilitate in meeting the rail providers required turnaround time for trains to be loaded with product coal and travel from the site. The rail loop will be approximately 5.1 km in length. Signalling, switching equipment, turnouts, bridge and culvert structures, and road crossing protection will also be constructed in line with the relevant guidelines and standards as specified by the Australian Rail Track Corporation (ARTC).

The train loading station will have a two batch weigh or volumetric system with an approximate 300 t surge bin and approximate 50 t weigh bin. The train loading system will have a nominal capacity for loading trains at a rate up to approximately 5,000 tph. The system allows for the train to remain in motion while being loaded. Product coal will then be transported from site via rail to the Port of Newcastle for export.

Whilst train movements will vary depending on factors such as production, sales and availability in the transport chain, the Project is estimated to require an annual average of two return train movements per day, with a peak of ten return train movements per day to transport the product coal from the site at any one time.

3.5.4 Rejects Management

All coal rejects processed through the CHPP will be mechanically dewatered. Fine reject materials will be recovered by a conventional thickener. The thickened material will be dewatered using a mechanical dewatering system (e.g. belt press filters). This waste stream will be combined with the coarse reject, mechanically dried and handled as a solid by-product.

The combined coarse and fine reject material will be transported via the overland reject conveyor system (at a rate of up to 560 tph) to an approximate 500 t capacity reject bin located on the northern extent of the Eastern Open Cut Mining Area.

The reject bin will also include an extended feed and tripper section to transfer filter cake to an emergency stockpile, in the unforeseen circumstance that haul trucks are unable to load the rejects or it is out of service for maintenance. The reject bin will be configured to load haul trucks with reject materials which will then be transported to the OEAs and open cut mining areas for co-disposal with overburden.

Rejects will be co-disposed with the overburden material to infill the mined area and establish the final landform. The geotechnical integrity of the co-disposal areas will be assessed during establishment to ensure the ongoing stability of the final landform.

At the completion of open cut mining operations, a void will remain within the south-eastern area of the Eastern Open Cut (see **Figure 22**). Reject materials from the processing of coal extracted via the longer term underground operations will be emplaced within this area and will effectively fill the void to create the final landform. No void will remain at the end of the Project.

All areas where reject material has been emplaced will be capped and rehabilitated to a suitable final landform which will aim to integrate with the surrounding landscape and return this land to a predominantly agricultural land use.

3.6 MINE INFRASTRUCTURE AREAS

The Project will require the construction of various items of surface infrastructure to support the open cut and underground mining operations. This includes the Open Cut and Underground MIAs (see **Figure 27**). Conceptual design drawings for relevant structures as required under Schedule 1 of the EP&A Regulation are provided in **Appendix D**.

3.6.1 Open Cut Mine Infrastructure Area

The Open Cut MIA will contain (at least) the following supporting infrastructure:

- Internal mine access roads, bus set down area and light vehicle parking;
- Administration and bathhouse facilities;
- Water treatment and reticulation systems;
- Lighting facilities;
- Igloo style mine workshop (up to four bays) and store;
- Tyre change bay and storage areas;
- Hardstand areas;
- Heavy and light vehicle washdown facilities;
- Fuel and lubrication station and refuel facility;
- Compressor facility;
- Associated water management infrastructure; and
- Associated power and communications infrastructure.

Since open cut mining is proposed to be completed by approximately PY 10, the open cut mine infrastructure will be temporary in nature and thus built to a lighter specification than that of typical, more permanent facilities. A description of the Open Cut MIA supporting infrastructure is provided below and illustrated in **Figure 28**. This layout of the Open Cut MIA is conceptual in nature as it will ultimately be designed, constructed and operated by a mining services contractor. The components of the Open Cut MIA will however be constructed within the overall footprint illustrated in **Figure 28**.

Conceptual design drawings of the proposed structures within this area are provided in **Appendix D**.

Internal Mine Access Roads and Light Vehicle Parking

Dedicated two-way heavy vehicle haul roads will be established from the open cut mining areas and the relevant mine site facilities. The heavy vehicle haul roads will be constructed from overburden materials and will be utilised throughout the life of the open cut component of the Project. Various light vehicle access roads will also be constructed within the mine site facilities to allow safe separation between heavy and light vehicles.

The following indicative car parking facilities will be constructed:

- A visitors and administration car park comprising of approximately 60 car spaces at the Open Cut MIA, including provision for disabled parking spaces;
- Light vehicle parking bay with approximately 20 car spaces;
- A bus pick up and drop off zone; and
- An emergency vehicle bay.

Administration and Bathhouse Facilities

Given the relatively short duration of the open cut mining operations and to minimise unwarranted costs, it is proposed to utilise the existing homestead building, which is currently approved for use as an office. This building will require some minor upgrades. Prefabricated administration and bathhouse buildings will also be installed to support the employees for the open cut mining operations.

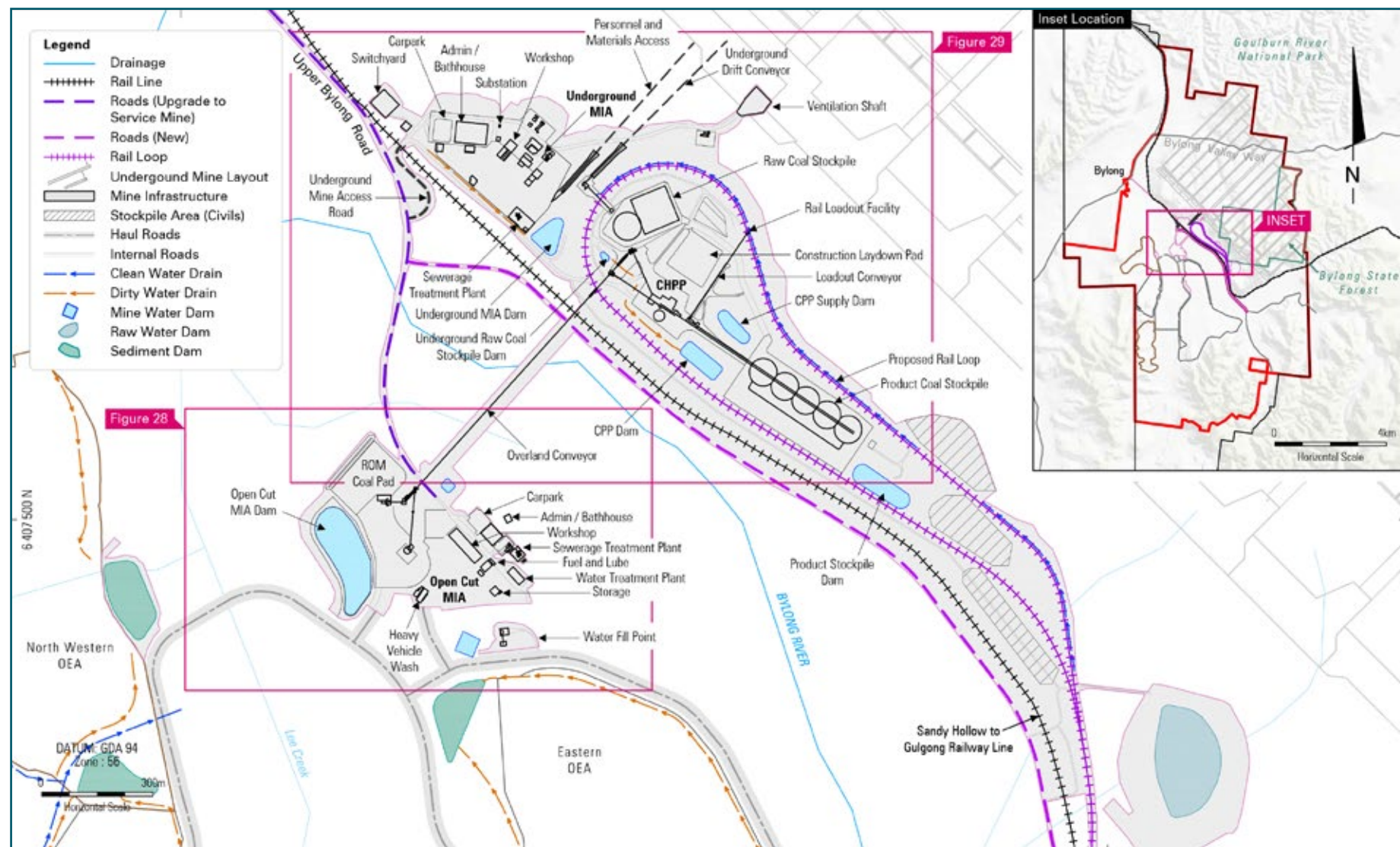
These buildings will accommodate (at least) workstations and offices, including administration and technical services offices, supervisors' office, crew dispatch, training rooms, separate male and female bathhouses with lockers, plant rooms, kitchen and a first aid room.

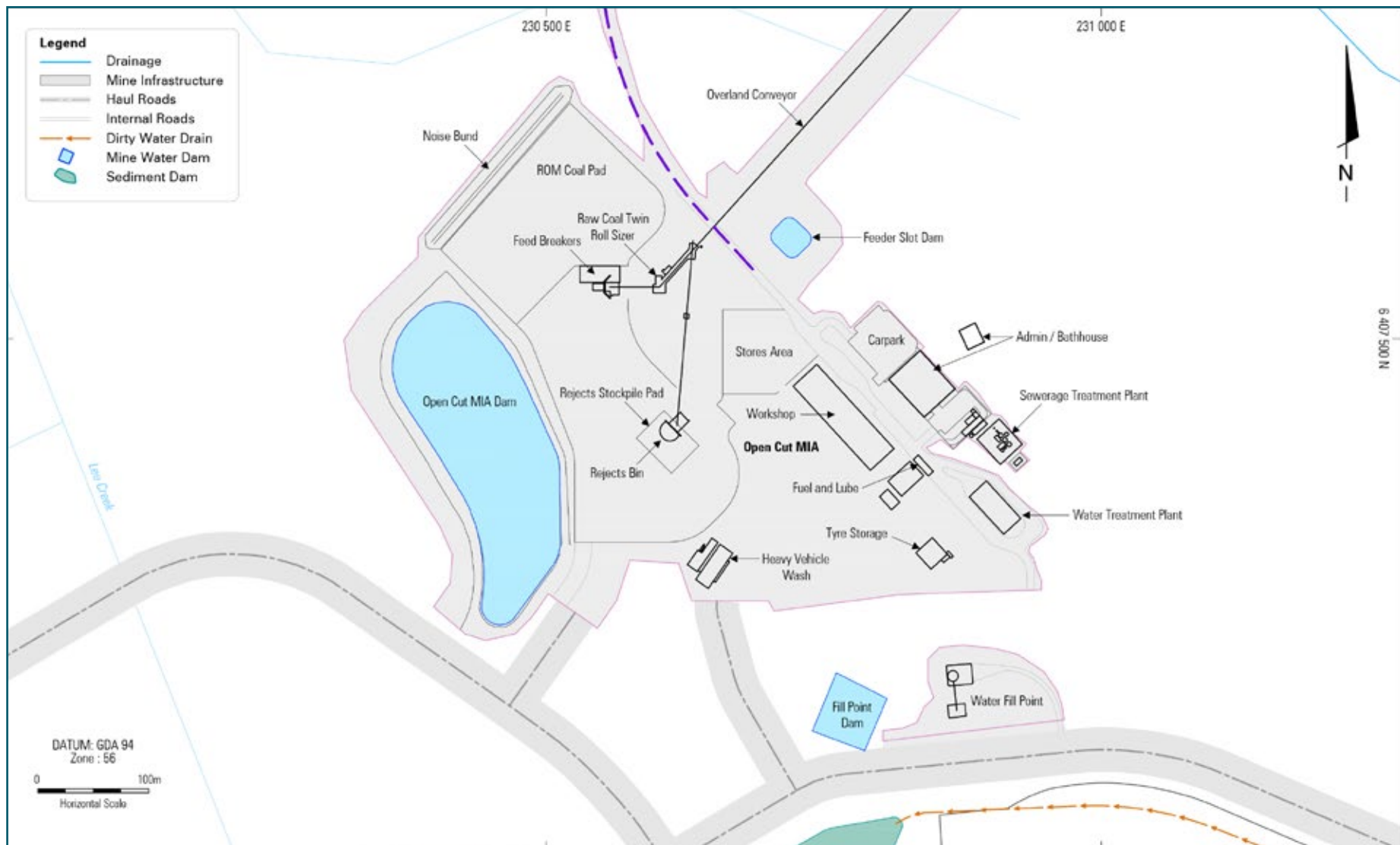
Sewerage Treatment System

Waste water generated by the Project within the Open Cut MIA (e.g. toilets, showers and floor wash-down, excluding workshops) will be treated at an onsite packaged sewerage treatment facility. The sewerage treatment facility will have a capacity of approximately 33 kilolitres per day (kL/day) and will be designed in accordance with the relevant Australian Standards and regulatory requirements.

Section 3.7.6 provides details of the sewage generated onsite and methods for recycling and reuse of the effluent.

FIGURE 27 Conceptual Mine Infrastructure Overview





Water Treatment Plant

Water will be required for use in the facilities that form part of the Open Cut MIA. A water treatment plant with a capacity of treating approximately 15 kL/day for potable uses will be operated within the Open Cut MIA. To ensure sufficient water is available, a series of raw water tanks will be utilised with a capacity of approximately 460,000 L to store suitable quantities of water to facilitate at least two days of use, including emergency fire water supplies.

Lighting Facilities

High mast night lighting will be installed on all buildings within the Open Cut MIA, including workshops, hardstand areas and general buildings. Buildings and hardstand areas will have sufficient lighting to enable 24 hour operation. All light fittings will be directed downwards to minimise light spill and will be compliant with *AS4282 (INT) 1997 – Control of Obtrusive Effects of Outdoor Lighting* (AS4282) (or latest version).

Elevated conveyor gantries will have lighting to provide safe access to, from and within the elevated area. Hinged light stands approximately 3 m above the top of the structure will point down towards the structure and walkway levels. At grade conveyors will not have permanent lighting.

Mine Workshops and Store

A heavy vehicle workshop will be constructed to accommodate maintenance activities required on mobile equipment throughout the life of the open cut mining operations. The workshop will utilise short term industry standard igloo workshops. The workshop will comprise up to four double bays with a concrete floor. The workshop floor area will be bunded and designed to drain to a mine water sump and oily water separator system. The workshop is designed to provide clearance for a tray-up CAT 793 or equivalent sized haul truck.

A store building (also standard igloo structures) will be attached to the workshop constructed with a designated forklift zone, direct access from the layby area for B-Double truck deliveries, and forklift access to the apron slab on the hardstand side of the building for interactions with the workshop.

Tyre Change Bay and Storage Area

The tyre change bay will be located separately from the workshops and associated store areas, for safety reasons. The tyre change bay will be designated for both heavy and medium vehicles. The tyre change bay will be fitted with reticulated air, water and power.

Hardstand Areas

A large, level hardstand area will be constructed adjacent to the heavy vehicle workshop to facilitate access for heavy vehicles to the workshop, heavy vehicle washdown, fuel and lubrication station and the tyre change bay. It will be constructed to provide heavy vehicles with sufficient turning room to manoeuvre into and around the workshop and storage areas. Park up areas for heavy vehicles will also be constructed within the hardstand areas.

Separate light vehicle roads are proposed around the Open Cut MIA to reduce interactions with heavy vehicles.

Vehicle Washdown

Separate vehicle washdown facilities for heavy and light vehicles are proposed to be constructed to avoid unnecessary interactions. The heavy vehicle washdown is likely to be constructed on the western side of the hardstand area.

The light vehicle washdown is proposed to be located adjacent to the dirty vehicle car park in the vicinity of the administration and bathhouse buildings. Runoff from the vehicle wash facilities will be diverted through a sediment trap to capture sediment prior to being fed into an oily water separation unit for treatment and released for reuse within the mine water management system.

Fuel and Lubrication Station

The fuel and lubrication station will be constructed to house and dispense diesel, oils and lubricants that are typically required to fuel vehicles as they leave the workshop. Typical day-to-day operations will be serviced by additional facilities located within the western portion of the Eastern Open Cut Mining Area, adjacent to the explosives storage facility. The Open Cut MIA heavy vehicle fuel and lubrication station will be located adjacent to the workshop on the hardstand area, with the light vehicle refuelling station being located adjacent to the light vehicle access road. The stations will be constructed in accordance with *AS1940 – The Storage and Handling of Flammable and Combustible Liquids* (AS1940) (or latest version).

Indicatively, the station and facility will contain the following above ground storage tanks:

- 95,000 Litre (L) self bunded tank for diesel storage;
- Hydraulic oil storage;
- Coolant storage; and
- Waste oil storage.

An automated electronic tank gauging system will be installed to monitor the level of diesel, oil and coolant in the storage tanks remotely from the site office.

Any contaminated surface runoff from the station and facility will be collected at a common collection point prior to being fed into an oily water separation unit for treatment and released for reuse within the mine water management system.

3.6.2 Other Open Cut Infrastructure

Further to the Open Cut MIA, there will be some mining related infrastructure located within the Open Cut Mining Areas.

Additional to the facilities provided within the Open Cut MIA, the main refuelling facility will be located within the western portion of the Eastern Open Cut Mining Area, adjacent to the explosives storage facility. This facility will be constructed in accordance with AS1940 (or latest version).

Indicatively, the main refuelling facility will contain the following above ground storage tanks:

- 95,000 L self bunded tanks for diesel storage;
- Hydraulic oil storage;
- Coolant storage; and
- Waste oil storage.

An automated electronic tank gauging system will be installed to monitor the level of diesel, oil and coolant in the storage tanks remotely from the site office.

An explosives storage and reload facility will also be constructed adjacent to the haul roads located within the western portion of the Eastern Open Cut Mining Area. This location was nominated as it meets the relevant legislative separation distances. A level pavement will be developed to enable a blasting contractor to develop their own specialist explosives compound. The compound will comprise security fencing, access roads, earth bunds and connection to the site wide electrical and communications networks.

3.6.3 Underground Mine Infrastructure Area

The Underground MIA is proposed to contain (at least) the following main items:

- Internal mine access roads and light vehicle parking;
- A high voltage transmission line and associated power reticulation infrastructure;
- Administration and bathhouse facilities;
- Sewerage treatment systems;
- Lighting facilities;
- Mine workshop and store;
- Hardstand areas;
- Fuel and lubrication station and refuel facility;
- Compressor facility;
- Associated water management infrastructure;
- Associated communications infrastructure;
- Helipad for emergencies;
- Ventilation; and
- Underground inertisation plant.

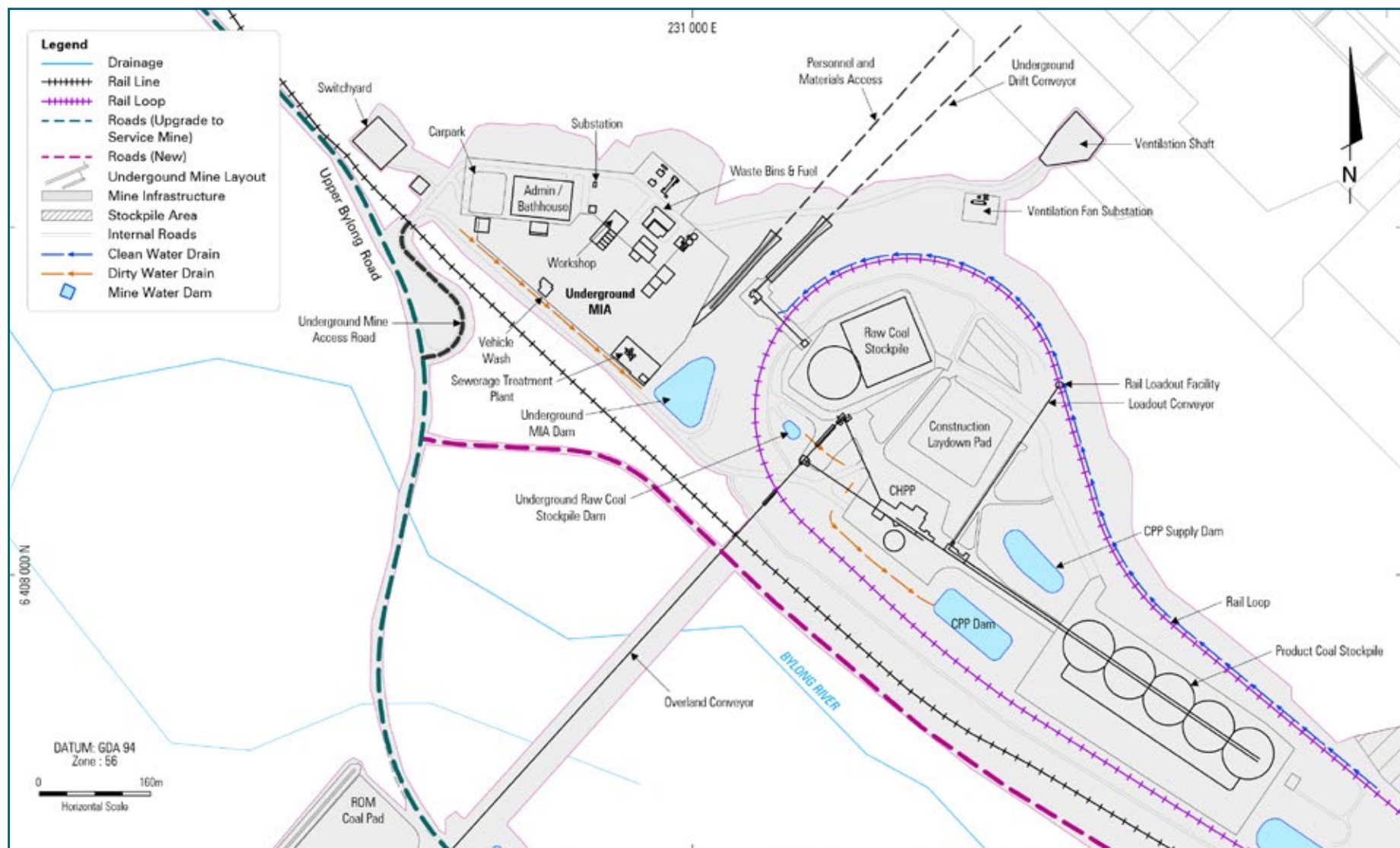
A description of the Underground MIA supporting infrastructure is provided below and illustrated in **Figure 29**. Detailed design drawings of the various structures to be developed are provided in **Appendix D**.

Internal Mine Access Roads and Light Vehicle Parking

The Underground MIA will have a number of internal access roads for light vehicles to travel to and from the underground mining facilities.

In phase 2 of construction, the two drifts (as described in **Section 3.3.2**) will be constructed on the north-eastern fringes of the Underground MIA. An access road from the Underground MIA to the drift entries will be required to facilitate the transport of materials and employees to the underground mine workings.

FIGURE 29 Conceptual Underground Mine Infrastructure Area



The two drifts will extend from the surface to the underground mining area and will be approximately 600 m in length with a width of approximately 6.0 m and around 4.5 m in height. The drifts will lead from the surface to the main headings to be developed into the Coggan Seam. The gradient of the declines will be approximately 1 in 8 which will facilitate vehicles to travel to and from the pit bottom facilities.

An access road will also be required from the Underground MIA to the mine ventilation and borehole facilities to allow for maintenance activities and the transport of materials to the Underground Extraction Area via the boreholes in this area.

The indicative light vehicle parking for the Underground MIA will be consistent with the facilities at the Open Cut MIA and will include:

- A visitors and administration car park comprising approximately 60 car spaces, including disabled parking spaces;
- A bus pick up and drop off parking zone; and
- An emergency vehicle bay.

Administration and Bathhouse Facilities

The administration and bathhouse facilities will consist of a number of prefabricated units. The facilities will comprise a muster area, lamp room, control room, crib room and first aid room with adjacent covered emergency vehicle parking. The administration building will provide offices, workstations, plus associated facilities including meeting rooms, kitchen and store room. The bathhouse will be constructed to accommodate clean and dirty lockers.

The administration and bathhouse is initially to be partially built for use as construction offices and the operational CHPP offices. Prior to the underground mine becoming operational, the offices will be completed and the existing components upgraded and incorporated into the new office facilities.

Sewerage Treatment Systems

An onsite packaged treatment facility will be constructed as a component of the Underground MIA and will be located in the south-eastern portion. The sewerage treatment facility will treat waste water from the facilities in the Underground MIA and CHPP with a capacity of approximately 33 kL/day and will be designed in accordance with the relevant Australian Standards and various regulatory requirements. The effluent from the treatment plant will be pumped back into the mine water management system for reuse.

Section 3.7.6 provides details of the sewage generated onsite and methods for recycling and reuse of the effluent.

Water Treatment Plant

Water will be required for use in the facilities that form part of the Underground MIA and also for use in the underground mining operations. A water treatment plant with a capacity of treating approximately 30 kL/day for potable uses will be operated within the Underground MIA.

To ensure sufficient water is available, a series of water tanks will be utilised to store suitable quantities of water to facilitate at least three days of use. In addition to these storage facilities, raw water tanks with a capacity of approximately 420,000 L will be sited in the north-eastern extent of the Underground MIA. This raw water storage will provide the capacity required for fire water storage purposes.

Water storages for use in the underground mining operations will be located to the east of the water treatment facilities and will comprise tanks with a capacity of approximately 430,000 L.

Mine Workshop and Store

The mine workshop and store facilities within the Underground MIA will be similar to that required for the Open Cut MIA.

The workshop will be steel framed and clad (or equivalent) with four bays and a 20 t overhead crane to assist maintenance activities. The workshop will comprise a concrete floor and suitable for accommodating various pieces of underground mining equipment for maintenance purposes. The workshop floor area will be bunded and designed to drain to a mine water sump and oily water separator system.

A hardstand area will be provided adjacent to the stores to accommodate materials and equipment required for the underground mining operations.

Fuel and Lubrication Station

The fuel and lubrication station will be constructed to house and dispense diesel, oils and lubricants that are required for day to day operations. The fuel and lubrication station and refuel facilities will be constructed with bunding in accordance with AS1940 (or its latest version).

The fuel and lubrication station will also provide for the reclaiming and storage of waste oil and waste coolant resulting from vehicle servicing and repair. Indicatively, the station and facility will contain the following above ground storage tanks:

- Two 75,000 L tanks for diesel storage;
- Hydraulic oil storage;
- Coolant storage; and
- Waste oil storage.

An automated electronic tank gauging system will be installed to monitor the level of diesel, oil and coolant in the storage tanks remotely from the site office.

Any contaminated surface runoff from the station and facility will be collected at a common collection point prior to being fed into an oily water separation unit for treatment and released for reuse within the mine water management system.

Hardstand Areas

Level hardstand areas will be formed in and around the various components of the Underground MIA. The main hardstand areas will be adjacent to the workshop, refuelling facility and administration facilities.

A separate underground laydown area will be constructed adjacent to the employee and materials drift to the underground. It will also accommodate storage sheds to enable the temporary storage of materials and equipment.

Lighting Facilities

Similar to the Open Cut MIA, high mast night lighting will be installed on all buildings within the Underground MIA, including workshops and general buildings. Buildings will have sufficient lighting to enable 24 hour operation. Some lighting will be required along the key access roads to provide safe drive environments.

All light fittings will be directed downwards to minimise light spill and will be compliant with AS4282 (or latest version).

Ventilation

A ventilation shaft and borehole compound will be constructed to the north-east of the rail loop (see **Figure 29**). The ventilation shaft compound will comprise the following shafts/boreholes to the main headings, which will be approximately 90 m below the ground surface:

- The construction of an upcast shaft with a diameter of approximately 6.0 m, with up to three ventilation fans attached;
- A concrete and ballast borehole with a diameter of approximately 0.3 m;
- A stonedust borehole with a diameter of approximately 0.3 m; and
- Other boreholes as is required to support the underground mining operation.

Associated access tracks and various storage areas will also be developed within the ventilation shaft compound.

A mine ventilation fan facility will accommodate up to three centrifugal fans, purposely orientated and coupled with outlet silencers and air flow control dampers to limit noise and vibration impacts. The three ventilation fans will be designed to face approximately north-east to south-west away from privately owned receivers in order to minimise potential noise and vibration impacts.

Underground Inertisation Plant

An underground inertisation plant is proposed to be constructed to provide an onsite source of nitrogen which will be utilised to exclude oxygen from redundant underground workings and/or push any explosive gas mixture deep into the goaf where there are no probable ignition sources. The plant will include pressure, flow and purity controls, an alarm system and associated power reticulation facilities. The availability of this plant will reduce the potential for the outbreak of spontaneous combustion in the underground workings.

3.7 WATER MANAGEMENT

The Project's mine water management system will enable the optimal collection, use, recovery and recycling of water within the Project Boundary. The mine water management system will generally be comprised of:

- Borefield and associated pipelines and access;
- Mine water dams, including:
 - Underground MIA dam;
 - Underground raw coal stockpile dam;
 - CHPP contact dam;
 - Product stockpile dam;
 - CPP supply dam;
 - Open cut MIA dam;
 - Feeder slot dam; and
 - Fill point dam;
- A raw water dam;
- Indicatively eight sediment dams at each of the OEAs and mine disturbance areas;
- Dirty water diversion drains leading runoff water towards sediment dams; and
- Clean water diversion drains.

The various components of the water management system will be connected via a network of pipes and supported by minor infrastructure, which enables the transfer of water according to mine operational requirements.

Figure 30 illustrates the conceptual layout of the water management system. **Section 7.4.1** discusses the conceptual configuration of the various components of the water management system. The general principles for the management of surface water for the Project include:

- Achieve and maintain regulatory compliance;
- Maximise the diversion of clean water flows around the mining operations;
- Seek to protect the environmental values of receiving waters;

- Minimise raw water demands required by maximising the recycling of mine water;
- Avoid the discharge of mine-affected water from the site;
- Ensure safe and efficient dewatering of underground mining operations; and
- Manage sediment affected water within an Erosion and Sediment Control Plan.

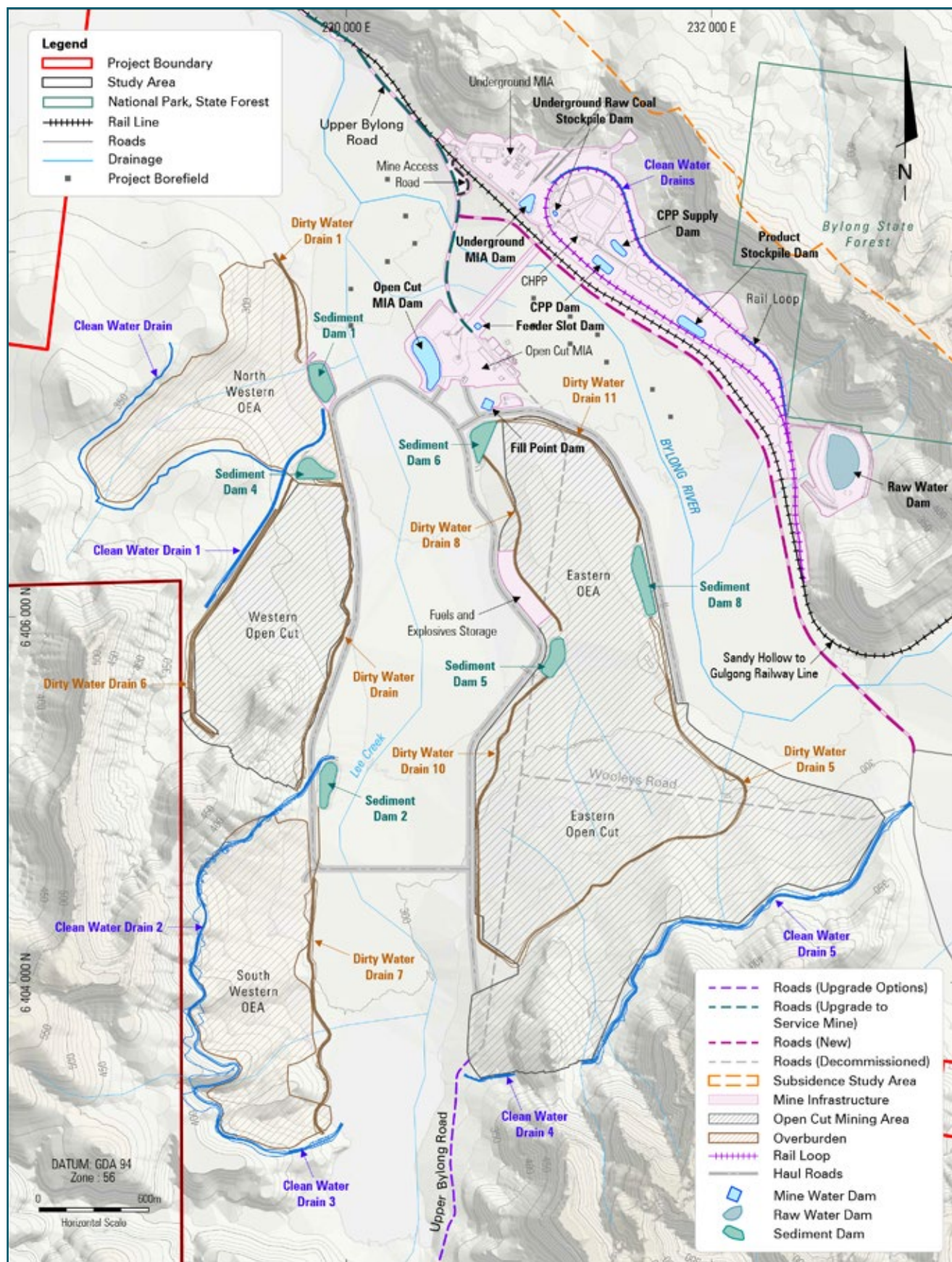
The relevant water access licences (WALs) that are necessary to account for the take of water from the existing environment and its subsequent use in the water management system are described in **Sections 7.4** and **7.6**.

3.7.1 Mine Water Management and Storage

Groundwater seepage and rainfall runoff recovered from mining operations will be diverted or pumped to the mine water dams. This mine water will either be reused for operations (including dust suppression for the open cut mining, surface facilities, processing of coal in the CHPP and within the Underground Extraction Area for longwall and the continuous miner units), or stored for later use.

Surface runoff from industrial areas, which may contain high levels of suspended sediment, detergents, oil and other chemicals, will be captured in storage dams and treated prior to being reused in the mine water management system. Similarly, surface runoff from all site haul roads will be captured utilising a series of diversion drains, bunds and sediment dams and treated prior to being reused in the mine water management system. The mine water management system has been designed with the aim of avoiding the requirement to release mine-affected water into the receiving environment.

FIGURE 30 Conceptual Water Management System Layout



3.7.2 Supplementary Raw Water Supply

A borefield within the Bylong River and Lee Creek alluvial aquifers is proposed to be utilised throughout the life of the Project to supplement the other site water supplies.

Water extracted from the borefield will be delivered to either the Fill Point Dam or Feeder Floor and Reject Dam for use within the wider mine water management system. Prior to the construction of this borefield, the Land Disturbance Protocol process will be completed as described in **Section 7.2**.

The Raw Water Dam will be constructed to collect rainfall runoff from its natural catchment. Water from this dam will be fed directly to the CHPP to supplement water supplies from the wider mine water management system.

3.7.3 Sediment-Laden Water Management and Storage

The mine water dams will be supported by a suite of sediment dams required predominantly at the base of the OEAs and areas where the surface soils have been disturbed. Sediment dams will be designed in accordance with *Managing Urban Stormwater, Soils and Construction* (Landcom, 2004) and *Managing Urban Stormwater, Soils, and Construction, Mines and Quarries* (DECC, 2008). The adopted design standard will not provide full containment of rainfall runoff in periods of rainfall greater than design standard. Accordingly, sediment laden water will overflow from the dams during periods of rainfall greater than the design standard.

Surface water runoff from disturbed, active and rehabilitated areas will be directed to sediment dams for the treatment of sediment prior to either being diverted to the mine water management system for reuse or being released to the local catchment. These sediment dams will be managed in accordance with an Environment Protection Licence (EPL) to be sought for the Project under the *Protection of the Environment Operations Act 1997* (POEO Act).

3.7.4 Clean Water Management and Diversion

Clean water runoff upstream of proposed disturbance activities will be controlled by a series of diversion drains and transferred away from the mining areas, wherever possible. Some limited amounts of clean water that are not able to be captured and diverted away from the disturbance areas will be collected as part of the mine water management system.

The clean water management structures will be developed on a staged basis ahead of proposed mining operations in particular areas.

3.7.5 Supporting Surface Infrastructure

The water storages will be supported by a suite of minor surface infrastructure, including a network of pipes, pumps and access tracks.

Generally pumps will be bank-mounted end-suction, centrifugal self-primed water pumps. If these pumps are not suitable due to dam design, either pontoon mounted submersible pumps or pump station inlet pipes under dam embankment walls will be considered. Each pump station will include a non-return check valve, a gate valve to isolate the pump if required, and a flow meter and a pressure transducer which can be isolated by a ball valve.

Pipes will be surface run high density polyethylene. Pipelines will require air release valves and scour valves, with scour protection. Where pipelines cross clean water catchments, it will be double sleeved or have a system to detect leakage such as flow meters at the beginning and end of the pipeline.

3.7.6 Sewage Treatment

Sewage generated by the Project will be treated at onsite packaged sewerage treatment facilities within the Open Cut MIA and the Underground MIA (see **Section 3.6.1** and **Section 3.6.3**). Based on the anticipated workforce, the WAF is estimated to produce approximately 54 kL/day of sewage. The design of the sewerage facilities will be sized at 33, 33 and 60 kL/day respectively to ensure peaks are appropriately managed.

The effluent from the sewerage treatment facility will be of a suitable standard to be used as irrigation water in accordance with the *Environmental Guideline for the Use of Effluent by Irrigation* (DEC, 2003) or removed from the site for appropriate disposal by a licensed waste contractor.

3.7.7 Potable Water

Potable water required within administration, bathhouse and office facilities will be delivered to the site on an as needs basis to supplement rainwater supply. Potable water will be stored in water tanks located in the vicinity of these buildings and will be managed according to the relevant regulatory requirements. Potable water will be treated onsite with a water treatment plant within the Underground MIA.

3.7.8 Groundwater Inflows

The groundwater inflows from the Permian coal measures into the mining areas will vary throughout the mine life, which is directly related to the design of the mine plan and hydraulic gradients induced by the depressurisation. As open cut and underground mining progresses and enters into a new strip, groundwater inflows will rise, followed by a gradual reduction in inflows. This water source will be pumped into the mine water management system for reuse in operations.

A detailed Groundwater Impact Assessment has been prepared for the Project. An assessment of the groundwater inflows to the mining area and proposed management measures are provided in **Section 7.6**.

3.8 POWER SUPPLY AND RETICULATION

Power for the Project will be sourced from upgraded Endeavour Energy infrastructure from north of the Ilford Transmission Substation to the Project site. KEPCO is in discussion with Endeavour Energy over upgrades to this infrastructure. The required upgrades will be the subject of separate planning approval instruments.

The Project will require the construction of a 66 kV transmission line from the Bylong Zone Substation to the Underground MIA. This transmission line will provide the principal power supply for the mining operations and will be owned and managed by KEPCO.

The indicative alignment of the 66 kV transmission line will cross the Bylong Valley Way and travel generally adjacent to the upgraded Upper Bylong Road to the Underground MIA (see **Figure 31**). Subject to review and final design, the alignment of the transmission line will cross the Sandy Hollow to Gulgong Railway Line as conceptually shown in **Figure 31**. Prior to the construction of this transmission line, the Land Disturbance Protocol process will be completed as described in **Section 7.2**.

In addition, various realignments of existing power reticulation infrastructure will be undertaken to accommodate the various components of the Project. The key power reticulation infrastructure that will require realignment as part of the Project will be those currently located within the open cut mining areas. These realignments will be undertaken in accordance with complying development approvals that will be sought from the relevant consent authority under the EP&A Act.

The existing 22 kV distribution line which traverses the Upper Bylong Road falls within the area to be developed as the Eastern Open Cut. This distribution line will be realigned as part of the Project as two branches: one continuing along the realigned portion of Upper Bylong Road and the second being diverted around the western side of the Eastern Open Cut.

The upgrade and extension of an existing 22 kV distribution line owned by Endeavour Energy and located on Bylong Valley Way will be required to supply the WAF (as described in **Section 3.11**). Prior to the construction of this distribution line, the Land Disturbance Protocol process will be completed as described in **Section 7.2**.

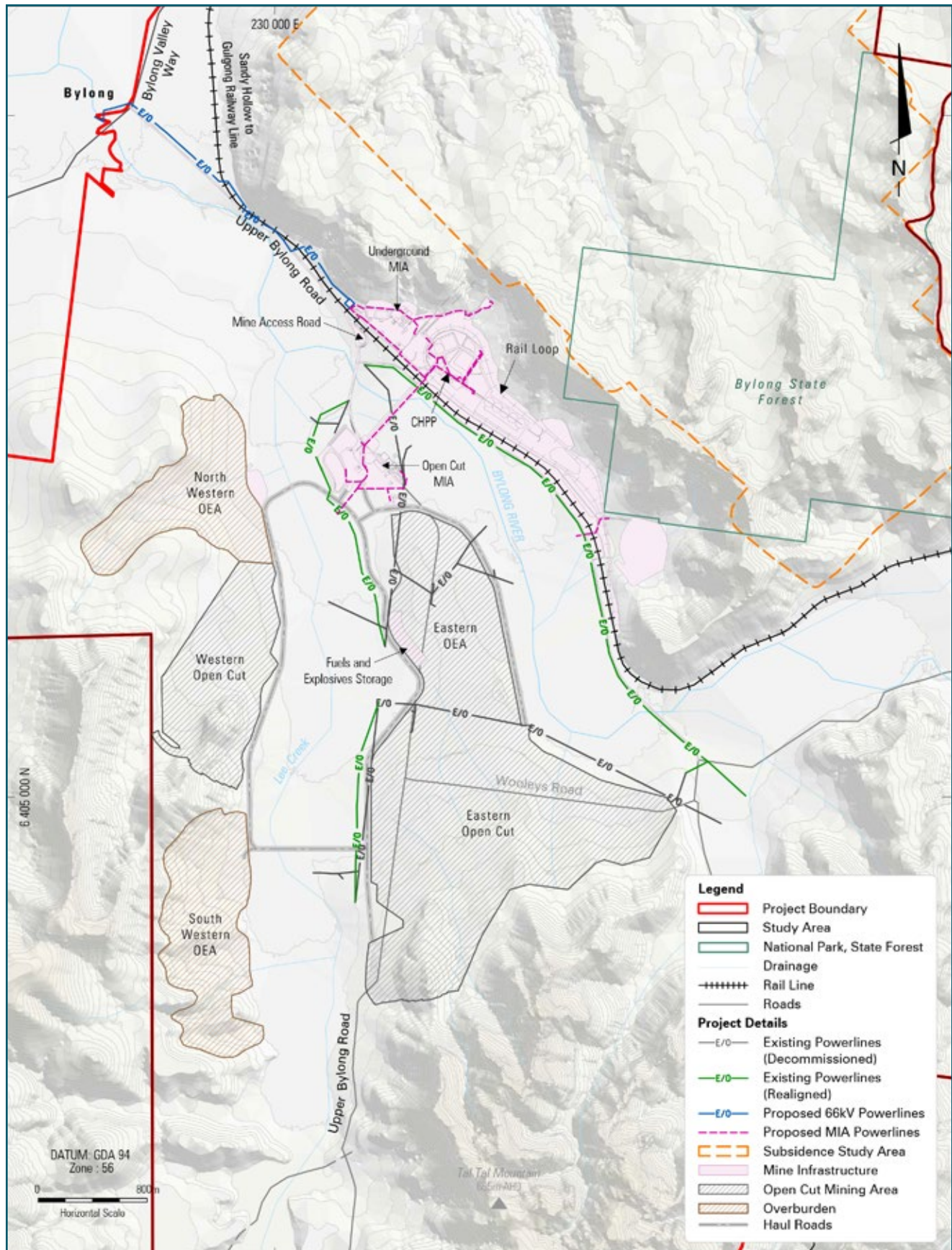
3.9 COMMUNICATIONS

Primary communications onsite will be facilitated via single mode optical fibre cables reticulated from the Open Cut and Underground MIA communications rooms. A Wide Area telecommunications Network connection (WAN) will be provided via a feed from a suitable internet service provider.

Voice communication onsite (up until the entry of the Underground Extraction Area) will be provided via a trunked two-way mobile radio system. Radio base stations will be mounted on trailers and towers to provide full coverage of the site and roads leading to the longwalls.

Wireless data radio communications will be provided within the MIAs via a WiMAX radio system. Vehicles will be fitted with vehicular access points that will provide local Wi-Fi hotspots for accessing the corporate intranet. All access terminals (vehicles and personnel) will be Global Positioning System (GPS) enabled.

All buildings and facilities within the MIAs will be covered by a fire and safety system as per Australian Standards. Selected key buildings and facilities within the MIAs will be covered by a security and closed-circuit television system.

FIGURE 31 Conceptual Onsite Powerlines and Relocations

3.10 WORKFORCE AND OPERATIONAL HOURS

The Project will require the following indicative full-time equivalent (FTE) workforce as illustrated in **Figure 32**:

- 800 people at peak construction phase 1 (PY 2) for the development of the open cut mine and associated infrastructure;
- An annual average workforce of approximately 360 people during PY 3 and PY 12 including approximately 100 people during construction phase 2 for the underground mine (PY 4 – PY 6);
- 470 people during peak dual operations (PY 9); and
- 275 people during underground only operations (PY 13 – PY 25).

The Project workforce will be recruited as a mixture of local hires (i.e. those currently residing within a one hour commute of the Project) and Non-Local Hires (NLHs) (i.e. those sourced from outside the one hour commute zone).

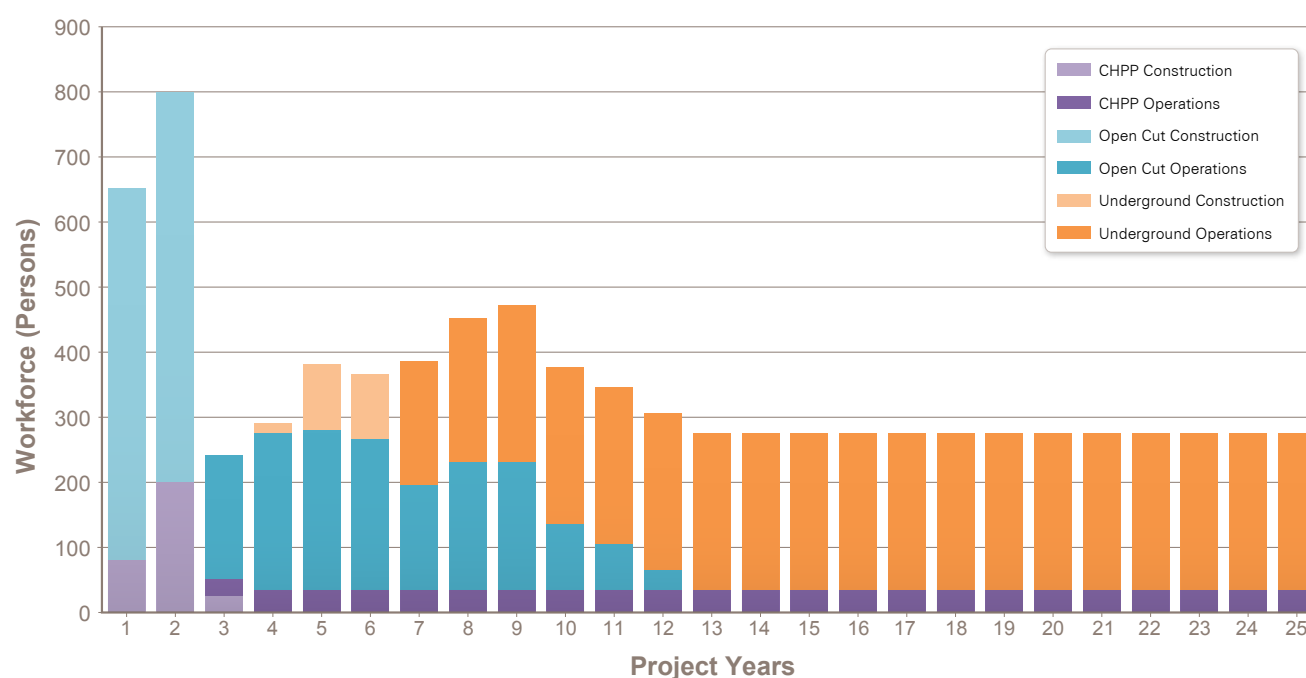
The majority of the workforce associated with both construction phases is expected to be NLHs. Approximately 85% of the operations phase workforce is expected to be NLHs. KEPCO will seek to encourage all NLHs associated with the operations phase to relocate permanently to within a one hour commute of the Project Boundary. The majority (95%) of NLHs associated with the operations phase are anticipated to relocate to the MWRC LGA, with 85% of these people predicted to relocate to Mudgee.

Construction activities will be undertaken 24 hours per day, seven days a week for the duration of the construction phases. The final shift rosters for construction phases 1 and 2 will be at the discretion of the appointed lead contractor. However, it is anticipated that the construction workforce will operate on a seven day rotating roster for the duration of the construction phases.

A number of different shift patterns will operate during the operations phase. The preferred roster will reflect the commute time from Mudgee to the Project, and will be sensitive to Mudgee community values. Managerial, technical and support staff will operate largely on a Monday to Friday roster. As with other mines, the scheduling and determination of rosters and rotations for operations workers will be based on the requirements of the position.

The workforce accommodation strategy for the Project is detailed in **Section 7.21**.

FIGURE 32 Peak Workforce (FTE) by Project Phase



Note: Annual underground operations workforce data was compiled and averaged PY 9 - PY 25

Initial construction activities, coal mining operations and associated activities, including maintenance, deliveries, coal processing and coal transport, for both the open cut and underground mining operations will continue to be undertaken up to 24 hours per day, seven days a week.

Certain high noise generating activities (including major construction activities and blasting), will be undertaken between the hours of 7:00 am to 6:00 pm (Monday to Friday) and 8:00 am to 1:00 pm (on Saturdays) to avoid adverse noise and vibration impacts (see **Section 3.3.1**).

3.11 WORKFORCE ACCOMMODATION FACILITY

In light of the remoteness of the Project from regional town centres (with the township of Mudgee currently being over an hour travel from Bylong), the need for a WAF to accommodate the Project's employees was identified during the initial mine planning process. The WAF is proposed to be constructed within the northern portion of the Project Boundary, north of Bylong Valley Way, near the intersection of Wollar Road (see **Figure 18**).

The WAF will operate from the commencement of construction phase 1 (PY 1) to the completion of construction phase 2 (approximately end of PY 6). The operation of the WAF is required from the commencement of open cut construction in PY 1 for the following reasons:

- The short term nature of the construction phase combined with the size of the construction workforce has the potential to adversely impact the Mudgee housing and short term accommodation market and their social infrastructure in the absence of a WAF;
- To provide the appropriate risk management strategy for ensuring accommodation is available in a timely manner for its workers throughout this critical phase of the Project; and
- To manage the potential risk of the upgrade to Wollar Road not being completed in the timeframe anticipated due to unforeseen delays. The commute time from the Project to Mudgee in the absence of an upgraded Wollar Road (1.25 hrs) is longer than the Project's health and safety requirements to manage fatigue. A maximum one hour daily commute time in each direction is considered acceptable from a health and safety perspective.

KEPCO proposes the use of the WAF to provide a risk management approach for ensuring that a proportion of its workforce and contractors can be accommodated during the initial critical stages of the Project, specifically the construction phases. Having a WAF is essential for the viability of the Project, particularly during the first 6 years for the construction of both open cut and underground components of the Project. It should be noted that the development of a WAF and its onerous operating cost per employee stay will incentivise the proponent to move employees into more permanent accommodation within a safe driving distance as soon as such accommodation options are available.

MWRC has been granted funding as part of the Resources for Regions initiative for the upgrade and sealing of the currently unsealed section of Wollar Road. This road upgrade will reduce the travel time between Mudgee and the Project to within an acceptable travel time. This will result in an improved safety outcome for Project employees travelling between the two destinations.

In the absence of the upgrade of Wollar Road, a WAF would need to be relied upon for the life of the Project. With the upgrade of Wollar Road proposed for completion in 2016, the reliance on a WAF is able to be limited to around the first six years of the Project.

Indicative design layouts and elevations of the WAF which were developed throughout the various stages of the mine planning phases are provided within **Appendix D**. The ultimate detailed design and construction of the WAF will be subject to the contractor commissioned to supply and operate this facility. The construction activities for the WAF (similar to other components of the Project) will be subject to the relevant design and engineering inspections in accordance with the requirements of the National Construction Code.

The indicative design layout of the WAF was developed during the mine planning process with a consideration of the requirements under the MWRCs *Development Control Plan 2013*. The Social Impact Assessment for the Project (as described in **Section 7.21**) demonstrates where each of the specifications under the MWRCs *Development Control Plan 2013* has been addressed within this EIS.

The workforce accommodation strategy assumes that the WAF will be used to accommodate the following Project related workforces:

- Majority of NLHs associated with construction phase 1;
- A small number of NLHs associated with open cut operations as they transition to permanent housing in the Local Area; and
- All NLHs associated with construction phase 2.

The WAF has been designed to address social amenity considerations and assimilate with the Bylong Village. These assumptions have been developed on the basis that MWRC will complete the bitumen seal of Wollar Road before the end of PY 1 of the Project. The WAF is anticipated to operate based on a "motel" style philosophy.

The indicative design layout of the WAF includes (at least) the following key features:

- Single accommodation rooms;
- Communal amenities (including kitchen, dining halls, multi-function pavilion, lounge area, conference room, laundry, first aid facility, courtyard, barbeque pavilions, and sports areas);
- Utilities (including electricity, gas, communications, sewage and water treatment);
- Administration office; and
- Parking.

Standard Accommodation Buildings

Construction of the WAF is anticipated to be completed in the first three to six months of the initial construction phase. During the peak periods of construction, it is likely that approximately 650 beds will be required. This indicatively includes the construction of 300 medium term beds and 350 short term beds.

At cessation of construction phase 1, it is proposed that the 350 short term bed WAF will be decommissioned. The 300 medium term bed WAF will operate until the completion of key underground construction activities in approximately PY 6 of the Project.

The 300 medium term beds will be constructed as single en-suited rooms in one storey transportable type buildings made up of four rooms per building. Each building will be approximately 15 m x 5 m.

The 350 short term beds constructed for phase 1, will be of a lower specification to the medium term bed buildings and will be approximately 15 m x 3.5 m in size. The accommodation buildings will have covered verandas attached and setup with internet and telephone facilities. Each unit will be air conditioned and plumbed to hot water.

Kitchen and Dining Building

A kitchen/dining room building will be constructed to cater for the 300 workers to be accommodated within the medium term facilities. This building will conceptually contain areas for food preparation and cooking, storage, pot washing and dishwashing, a kitchen manager's office, staff facilities, deliveries receiving, dining hall, crib lunch preparation area, bag store and hand wash troughs, cool room, freezer and dry storage areas. A smaller short term diner building will be required for the additional workers residing in the WAF during construction phase 1. The short term dining facility will provide additional seating capacity and will be situated adjacent to and accessible to the medium term dining room to enable the combined use of the main kitchen.

Recreation Facilities

The indicative design layout of the WAF includes various recreational facilities for the residents, including a tavern and beer garden, BBQ pavilion, recreation room, gym and sporting fields. The scale of these facilities will be adjusted according to the size of the medium and short term facilities.

Similarly, laundry facilities will be provided according to the size required for the persons accommodated within the WAF. A laundry building has been included within the conceptual WAF layout and includes areas for the main laundry, cleaners'/chemical store and linen store.

A tavern will be constructed to open onto a landscaped beer garden area. The beer garden will be orientated to provide an outlook over areas of interest where possible (such as sports courts or landscape views). The beer garden will not be located on the western side of the tavern as late afternoon sunlight generally causes this orientation to be the hottest at peak usage times. Toilet amenities will be located adjacent to the tavern and beer garden.

The recreation room will provide a kitchenette, lounge and games areas and open onto a veranda. The final layout and furnishings/finishes of the various recreation areas will aim to provide a relaxing and social atmosphere for construction village residents.

The sporting fields will be developed as multi-use sport courts and will be surrounded by a multi-use fitness track, gazebos, recreation nodes and BBQ areas.

Medical Facility

The WAF will include a first aid facility which will operate for the life of the Project and service the residents of the WAF and any medical requirements for the Project's operations. The medical facility will be located in a highly visible and readily accessible location, potentially adjacent to the administration offices.

The first aid facility conceptually contains a Paramedic's office/consultation room, treatment room, universal access ensuite (accessed from the treatment room), recovery and observation rooms.

Communications and Utilities

The WAF is intended to be self-sufficient with regard to communications infrastructure, recreational facilities and medical services. All appropriate buildings and other facilities within the WAF will be serviced by electricity, communications and sewerage and water treatment infrastructure which will be developed according to the relevant standards and guidelines.

A communications room will be used to house the head-end equipment required to de-code communications signals incoming to the site and to distribute voice and data communications, television and a/v entertainment services throughout the village and construction depot. The building will be positioned near to the village administration office.

The indicative layout of the WAF contains various services to manage water within and around the facility for potable water treatment and reticulation (including firefighting water), sewage reticulation and sewerage treatment facilities and treated waste water disposal.

Various toilet facilities will be provided in the vicinity of the dining and recreational facilities and will contain separate male, female and unisex wheelchair accessible ablutions. A small cleaners' trough and store will be located in the unisex ablution.

WAF Administration Offices

The administration office will be the main "welcome" point to the site for personnel arriving for the first time and returning residents. It will also be the administrative hub for the WAF. The administration building will be positioned close to, or be easily accessible from, the main site entry and adjacent to the main bus shelter.

Car Park, Road Works, Footpaths and Delivery Area

All access roads, sealed car parks and delivery areas will be finished with a two coat seal and all pavements will have a minimum longitudinal grade of 0.5% and a maximum longitudinal grade of 4%. Site roads and car park areas will be designed in accordance with the *Austroads Rural Road Design Guide* and relevant Australian Standards.

Covered walkways and shelters will be provided between the various facilities contained within the WAF. Landscaping and tree planting will also be undertaken within the WAF to provide a scenic landscape for residents. A description of the various visual mitigations proposed to manage the potential visual impacts as a result of the WAF to external viewing locations is provided in **Section 7.17**.

Car parking at the WAF conceptually comprises an approximate 300 car bitumen sealed car park, with a further 150 car gravel car park for overflow capacity. Areas suitable for parking, delivery and pick-up/drop-off points are also proposed.

Access to the WAF will be via an upgraded intersection from Bylong Valley Way into an existing access of a residence located on the Bylong Station property (owned by KEPSCO) (see **Section 3.14.3**). A bus service will operate between the WAF and the mine to reduce additional road traffic generated by the Project.

Maintenance Shed and Compound

The conceptual layout of the WAF provides a maintenance shed for use by management personnel. The maintenance shed will be used to undertake miscellaneous repair works, store tools, equipment and spare parts and will also incorporate a small office for the Maintenance Manager. A secure storage and work compound will likely be established adjacent to the shed.

Recyclable materials will as far as practical be segregated from waste streams for separate collection and reuse. The compound will also be used for managing recyclables prior to their transport off site. An undercover dry area is required for storage of paper and cardboard products. Three phase power outlets are required at this location for paper balers and glass crushers. Undercover breezeways are required for vehicle parking, service-buggy recharging and recycling equipment.

Staging and Decommissioning of WAF

The workforce involved in the construction of the underground mine and associated infrastructure are anticipated to be accommodated within the 300 bed WAF. At the completion of the construction phase 2 activities, the medium term WAF will be decommissioned, infrastructure will be removed and the area will be reshaped and rehabilitated with grasses. However, some of the infrastructure contained within the WAF (i.e. the first aid facility and car parking facilities) will be retained for the ongoing use throughout the life of the Project.

3.12 MINE ACCESS

Access to the Project will generally be via the existing Upper Bylong Road from Bylong Valley Way. Access to the Open Cut MIA will be via the existing Upper Bylong Road with access to the Underground MIA being via an upgrade to the existing road and crossing of the Sandy Hollow to Gulgong Railway Line.

It is anticipated that following the initial construction period and into operations phase that the majority of the Project's employees will reside in Mudgee or within the wider MWRC LGA. Those employees who reside within Mudgee are likely to travel via Wollar Road which is proposed to be upgraded by MWRC with the announcement of it receiving funding from the State Government as part of the Resources for Regions program in March 2015.

3.13 ROAD CLOSURES AND REALIGNMENTS

The southern portion of Upper Bylong Road (i.e. between 2.6 km and 7.7 km to the south of its intersection with Bylong Valley Way) and the majority of Wooleys Road will be closed to the public to facilitate the use of the Open Cut MIA and the mining operations within the Eastern Open Cut (see **Figure 33**).

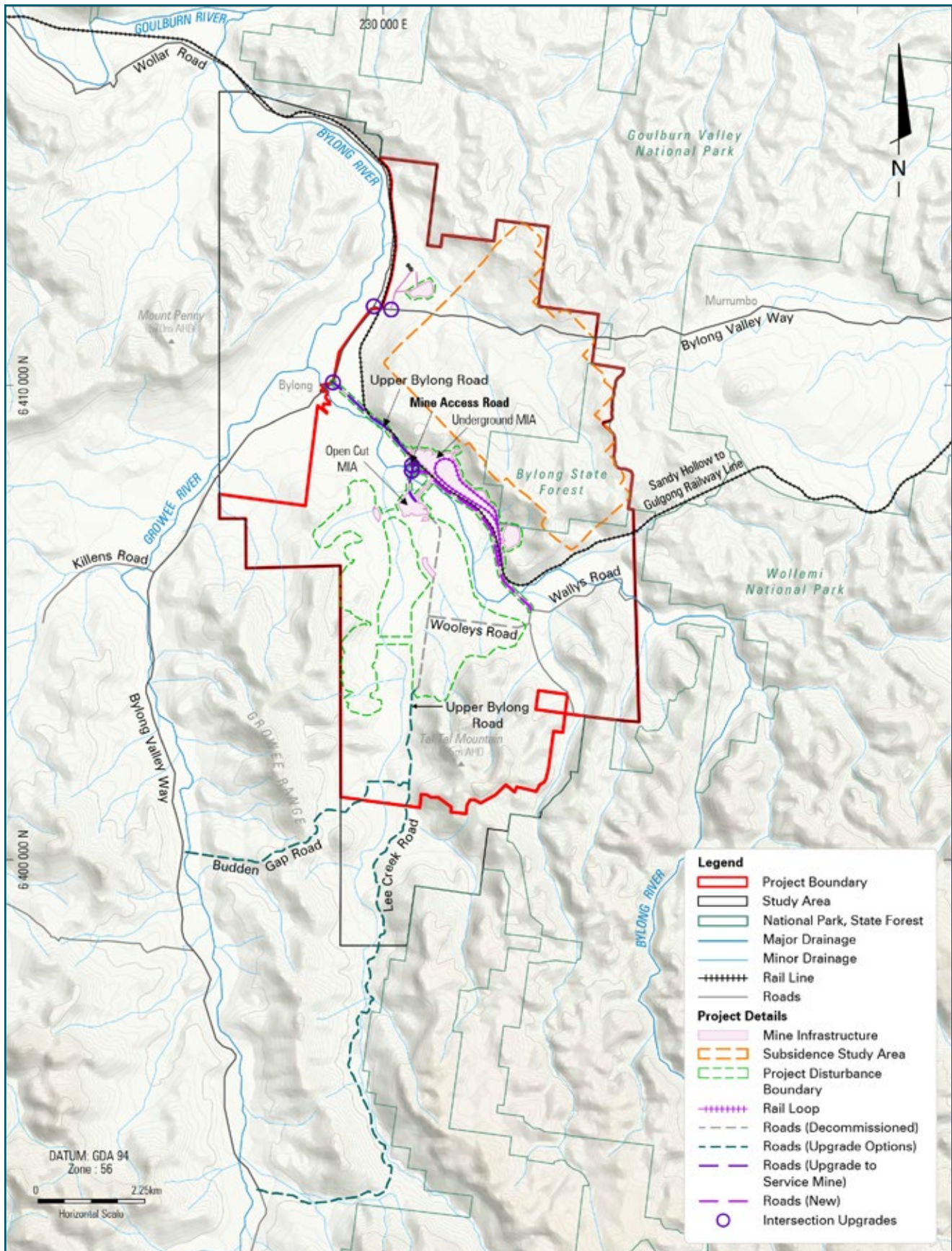
KEPCO will construct a 4.1 km realignment of the Upper Bylong Road to provide a suitable alternate route for private landholders located to the east of the Project that currently utilise Upper Bylong Road and Wooleys Road (to be decommissioned) to access their properties.

The realigned portion of Upper Bylong Road will continue from a Type BA left turn intersection with the existing Upper Bylong Road approximately 2.5 km from the Bylong Valley Way intersection and will be constructed along the southern side of the Sandy Hollow to Gulgong Railway Line to connect with Wallys Road (name denoted to the most eastern section of Wooleys Road) to the east of the Eastern Open Cut (see **Figure 33**).

The realigned portion of Upper Bylong Road will be designed to be a standard gravel road in accordance with *Road Design Guide* (RTA, 2000) for a typical two-lane, two-way rural road with a nominal speed limit of 80 km/h. The existing section of Upper Bylong Road will be closed to the public once the new alignment has been completed.

KEPCO will fund the road works and the realigned portion of road will be designated to MWRC as a public road. The closed section of Upper Bylong Road will be utilised as the main access to the Open Cut MIA.

The proposed realignment of Upper Bylong Road will require approval under section 138 of the *Roads Act 1993* (Roads Act). Additionally, KEPCO will submit a road closure application under Part 4 of the Roads Act. MWRC is the approval authority for these road work applications. Further detail regarding the required road work approvals is provided in **Section 4.4.2**.

FIGURE 33 Local Road Network

3.14 ROAD AND INTERSECTION UPGRADES

3.14.1 Upgrade to Upper Bylong Road and Bylong Valley Way Intersection

An upgrade to the Upper Bylong Road and its intersection with Bylong Valley Way is proposed to ensure it is appropriate to support the additional construction and operational traffic to be generated by the Project (see **Section 7.18**). The upgrade will entail the resealing and widening of the road alignment to meet the Austroad's standards for the vehicles to service the Project.

The Traffic and Transport Impact Assessment prepared for the Project (as discussed in **Section 7.18**) has confirmed that a Type BA intersection will be sufficient for this intersection with the volumes proposed.

The final design of the intersection and upgrade of Upper Bylong Road will be developed in consultation with and to the approval of MWRC, who is the relevant roads' authority for these two local roads.

3.14.2 MIA Access Road Intersections

The section of Upper Bylong Road to be closed will be utilised as the main access road to the Open Cut MIA. A Type BA left turn intersection with the Upper Bylong Road will be constructed with the realignment of Upper Bylong Road, enabling the existing alignment of Upper Bylong Road to be utilised for the mine access road to Open Cut MIA.

The Underground MIA will be accessed via a purpose built road off Upper Bylong Road in the vicinity of the existing crossing of the Sandy Hollow to Gulgong Railway Line (Underground MIA Access Road). The intersection will be on Upper Bylong Road approximately 2.4 km from its Bylong Valley Way intersection and will be constructed to a rural Type CH intersection with dedicated left and right turn lanes which will comfortably accommodate future intersection traffic volumes.

The existing level crossing of the Sandy Hollow to Gulgong Railway Line will be upgraded in conjunction with the construction of the Underground MIA Access Road. The upgrade will be undertaken in consideration of the weight of vehicles required to travel via this level crossing and the outcome of the consultation being undertaken with ARTC to ensure that their design specifications are met.

A temporary level crossing is being negotiated with the ARTC to allow construction haul vehicles to cross the Sandy Hollow to Gulgong Railway Line at the location of the proposed overland conveyor. This temporary construction haul road will allow excess cut material to be hauled (during phase 1 construction) directly across the Sandy Hollow to Gulgong Railway Line easement and the proposed realignment of the Upper Bylong Road. This temporary construction haul road will provide direct access to the OEAs, the Open Cut MIA and ROM coal pad via an at grade haul road across the Bylong River floodplain (on land proposed for the overland conveyor) without requiring the construction vehicles to travel via public roads.

The conceptual design of the Underground MIA Access Road is illustrated in **Figure 34**. The Underground MIA Access Road will be designed in accordance with *Road Design Guide* (RTA, 2000) for a typical two-lane, two-way rural road.

3.14.3 Workforce Accommodation Facility Intersection Upgrade

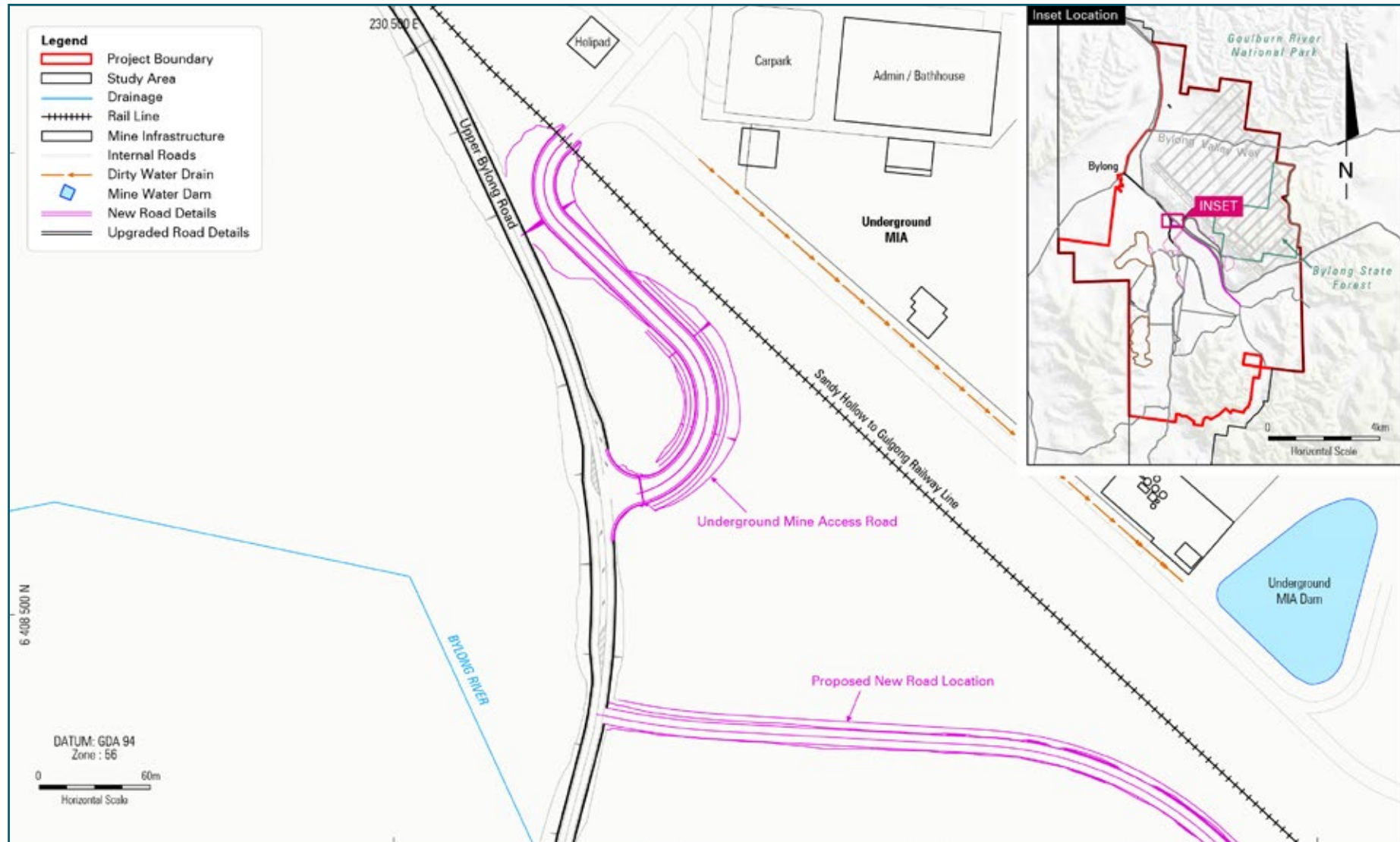
Access to the WAF will be via an upgraded intersection on the Bylong Valley Way into an existing access of a residence located on the Bylong Station property (owned by KEPCO).

The Traffic and Transport Impact Assessment prepared for the Project (see **Section 7.18**) confirms that a Type BA intersection will be suitable for accommodating the traffic generated at this intersection. The final design of the intersection will be developed in consultation with and to the approval of MWRC, who is the relevant roads' authority.

3.14.4 Southern Road Upgrade Alternatives

Two options are being considered in relation to maintaining a reasonable level of access to the Bylong Valley Way for neighbouring landholders positioned along the southern reaches of Upper Bylong Road. These are either the upgrade of:

- Lee Creek Road, which intersects the Bylong Valley Way further to the south of the Project Boundary; or
- Budden Gap Road, which connects Lee Creek Road to the Bylong Valley Way 8 km to the north of the intersection of Lee Creek Road and Bylong Valley Way.



The preferred option will be selected as part of the detailed engineering design phase and in consultation with the MWRC and the local landholders within this area. Further, it is proposed that the works associated with the selected option will be completed under a separate approval to be sought from MWRC under the EP&A Act and at the cost of KEPCO.

In the event that agreements are reached with all three of the relevant landholders (Landowner IDs 151, 161 and 165 as identified on **Figure 12a**) over compensation for the resultant loss in optionality for land access, and MWRC is in agreement that neither of the two road upgrades described above is required, then neither of these upgrades will be progressed.

3.15 DECOMMISSIONING OF EXISTING RURAL INFRASTRUCTURE

Within the Project Disturbance Boundary, there are a number of existing structures, buildings, fences and other infrastructure that will need to be decommissioned prior to open cut mining operations proceeding.

Various buildings within the Project Disturbance Boundary (including items identified with historic heritage significance) will be demolished or removed, including:

- Former Bylong Catholic Church (Landowner ID K17/K18 on **Figure 12**);
- Residences/Landowner IDs K13, K14, K15, K16, K23, K25 and K30 on **Figure 12**;
- Wooden Shed which has been identified as the former Upper Bylong Hall;
- BUPS buildings and adjacent residence (Landowner ID 142A and 142B on **Figure 12**);
- Residence/Landowner ID K21 on **Figure 12** which has been identified as the former Upper Bylong Post Office.

Demolition activities will be undertaken in accordance with *Australian Standard AS 2601-2001: The Demolition of Structures*, or its latest version. The various items that have been identified to have heritage significance will be managed as discussed in **Section 7.12**.

3.16 ENVIRONMENTAL MONITORING NETWORK

As provided in **Section 2.8**, KEPCO operates an environmental monitoring network for the purposes of obtaining relevant background monitoring data for the Project.

KEPCO will continue to operate this network and install additional monitoring sites where required (see **Section 7**), to meet regulatory expectations during construction and operation of the Project that allows for the early identification and appropriate management of environmental risks.

3.17 PROJECT ALTERNATIVES

3.17.1 Introduction

Since the granting of A287 and A342, an extensive exploration program and series of feasibility studies have been conducted in order to determine the most economic and environmentally responsible mining operation to recover the available coal resources. This process has included the consideration of numerous mine plans, operational methods and infrastructure designs and alternatives.

Mine Advice Pty Ltd has prepared a Mine Plan Justification Report which explains the evolution of the mine planning process undertaken and the decisions made by KEPCO to deliver the preferred mine plan for the Project. A copy of the Mine Plan Justification Report is provided in **Appendix E**, with a summary provided in the following sections.

3.17.2 Overview of Mine Planning Process

The preferred alternative for the Project (Option 4 as described below) has been the result of a rigorous process of refinement through the various planning stages from a Concept Study through to a Feasibility Study.

Initial mine plans had up to seven open cut mining areas and several underground mining domains which were progressively refined taking into consideration social, environmental and economic constraints to achieve the preferred mine plan upon which to base the EIS.

The primary objective of the mine planning studies was to develop an approvable mine plan which maximises coal recovery whilst minimising the potential for adverse environmental and social impacts. The various alternatives have also been considered and modified where possible in light of changing stakeholder expectations as experienced by other recent Projects within the NSW planning approvals system.

Each mine planning phase was assessed in terms of key economic criteria set by KEPCO with relevant consideration of all applicable constraints (such as site suitability and the impacts of the development on both the natural and built environment) to the Project at that time. This mine planning process involves the following steps:

- **Exploration Studies** (various since 1984 and are ongoing) have been commissioned to gather the knowledge required on the geology within A287 and A342 in order to complete required mine planning studies;
- **Concept Study** (March 2011) was undertaken to identify conceptual mine plans and understand the potential for the development of a coal mine;
- **Pre-Feasibility Study (PFS)** (July 2012) was undertaken to develop several mine plan options (with up to seven open cut mining areas and various underground mining areas) and determine the most appropriate option to take forward;
- **Option Study** (November 2013) to determine the proposed final Project that incorporated significant changes from the PFS in consideration of Biophysical Strategic Agricultural Land (BSAL), alluvium, CIC and regulatory advice; which resulted in the reduction from seven open cut mining areas to two and the repositioning of a significant amount of proposed surface infrastructure;
- **Feasibility Study** (September 2014) was completed to increase levels of understanding and certainty with selected option and to make further refinements to the Options Study mine plan; and
- **Construction** (target 2016, pending relevant approvals) will involve the execution of the preferred mine plan.

The preferred mine plan incorporates the environmental benefits that have been progressively identified in the process of mine planning from the initial PFS, through to the options study and ultimately in the Feasibility Study.

This has resulted in a reduction in disturbance of CIC and BSAL together with reductions in disturbance of threatened and endangered species and critically endangered ecological communities.

The various mine planning phases conducted to date have been completed over several years. During this time, the planning approval process has changed according to the evolving understanding, perceptions and expectations by community stakeholders and the Government regulators. The mine planning phases have adapted to the evolving requirements as they have occurred over time.

The Gateway Certificate Process was implemented by the NSW Government (in September 2012) during a critical time of the mine planning process (i.e. between completion of the PFS and prior to the commencement of the Feasibility Study). As a result, the Project team was required to take on board the additional environmental constraints (i.e. BSAL and CIC) and has proactively introduced another layer of study phase to not only address the resulting additional constraints that need to be applied to the mine plan, but to quantify the trade off with expected economic benefits.

The Options Study was introduced as an additional step in the mine planning process to supplement the work completed within the PFS. This additional step was considered to be required to ensure the preferred option taken into Feasibility Study was both environmentally acceptable to external stakeholders as well as being economically viable from an investor/owner's point of view.

Further to this, key study milestones have been tabled with relevant government bodies (during briefings with DP&E, Department of Trade and Investment Regional Infrastructure and Services Division of Resources and Energy (DRE), DoE and MWRC) throughout the duration of the mine planning process. This has assisted the Project team to understand and implement relevant changes to the regulator requirements to the mine plans during this time. This approach demonstrates the proactive and iterative mine planning process that has been adopted throughout the development of the Project.

Whilst numerous alternatives and options have been considered throughout the mine planning process, the key options are presented in the following sections.

Option 1 – Do Nothing

The 'do nothing' approach would result in KEPCO suspending its current intentions to invest the significant capital required for the development of this State Significant coal resource.

It would result in the forfeiture of expenditure within the State of NSW associated with the development of the Project. Adopting this option would result in a loss of direct and indirect employment opportunities and other socio-economic benefits in addition to a loss of benefits such as royalties and other payments to both the NSW and Commonwealth Federal Governments.

This alternative fails to maximise coal resource recovery from the area and therefore was not considered to satisfy at least one of the Objects of the EP&A Act, that is, to encourage the proper development of natural resources for the purpose of promoting the social and economic welfare of the community.

Option 2 – Underground Only Operation

Option 2 involved considering the development of an underground only mining operation utilising either bord and pillar and/or longwall methods. Whilst this option would minimise the extent of surface disturbance within the Project Boundary, other constraints were identified.

There are areas within the Project Boundary where the coal resource is too shallow to enable the safe and effective recovery of coal utilising underground mining methods. Hence, this option would sterilise a coal resource that can only be safely and efficiently recovered by open cut mining methods.

For a thermal coal deposit that exists within the Project Boundary, the economics of a stand-alone bord and pillar operation presented limited value and would sterilise large areas of the coal deposit within those areas suitable for recovery by underground mining methods.

Alternatively, a stand-alone longwall operation was considered, but presented limited economic potential. A financial analysis confirmed that an underground only option is not economically feasible under current market conditions or for longer term forecasts for the return to normalised market conditions.

Further, an underground only scenario presents environmental constraints relating to the challenges surrounding the disposal and containment of coarse and fine reject material from the CHPP within an appropriate facility. The underground only option would also sterilise a significant quantity of coal resource that is only suitable for the safe and efficient recovery utilising open cut mining methods.

Option 2 was rejected on economic, resource recovery and environmental grounds.

Option 3 – Open Cut Only Operation

As previously explained in **Section 3.3**, the topography and the resulting depth of the coal resource within the Project Boundary effectively divides the resource into areas that can only be recovered via underground mining methods and areas that can only be recovered by open cut mining methods. The potential to mine the coal resource solely by open cut mining methods has been investigated.

Adopting only the open cut mining method would result in the sterilisation of a significant quantity of coal resource that can only practically be achieved by underground mining methods. Further, and more importantly from a post-mining visual impact, it would result in a significant modification to the landform within the Bylong Valley and in substantial environmental and social impacts to local stakeholders, particularly in relation to amenity impacts.

Recovery of the entire coal resource that is suitable for open cut mining operations would result in significant disturbance to areas of agricultural land, sensitive ecology, items of heritage significance and also potentially result in impacts to water resources due to the immediate vicinity of these coal resources to existing surface water and groundwater resources. Various mine plan options for the open cut mining operations were reviewed and refined in order to minimise to the extent possible, the impacts on the identified sensitive environmental constraints.

Proactive meetings with both the DP&E and DRE were undertaken in the early stages of mine planning to understand perceptions and devise an appropriate strategy to best satisfy the needs of relevant stakeholders.

Option 3 was rejected as it did not adequately satisfy the principles of Ecologically Sustainable Development (ESD), nor did it appropriately address the Objects of section 5 of the EP&A Act. Iterative processes were adopted to ascertain the appropriate balance of open cut mining within the Project Boundary.

The extensive coal sterilisation that would result from adopting this option (i.e. coal most suited to underground mining methods) was not considered to be a sound outcome based on social, economic or environmental grounds.

Option 4 – Open Cut and Underground Mining

The preferred alternative is the Project as it is proposed, which comprises an operation utilising both open cut and underground mining methods for a period of approximately 25 years. The Project includes initial open cut mining operations within two refined areas over a period of around 8 years. An approximate 19 year underground longwall mining operation is proposed to commence in PY 7, with dual operations until PY 10. It is considered that this option will safely maximise the social and economic benefits from the Project whilst minimising impacts on the community and environmental aspects such as, alluvial floodplains, sandstone outcrops and escarpments, surface water and groundwater resources, ecology, heritage items and agricultural lands and soils.

Significant mine planning was undertaken to minimise impacts to BSAL from open cut mining areas and the positioning of OEAs. The identification and avoidance of alluvial lands was prioritised during the early mine planning phase of the Project. Further refinements to the mine plan were made during the preparation of the Feasibility Study which resulted in further reductions in disturbance to BSAL and Equine CIC associated with the OEAs. Mineable coal resources were determined to be preferably left insitu in consideration of the principles of ESD and the *NSW Strategic Regional Land Use Policy* (SRLU Policy) (DP&I, 2012).

Some BSAL (derived from sedimentary material) which is utilised for less intensive 'grazing' purposes only (not highly productive crops or farming) remains within the Eastern Open Cut. There was extensive deliberation about the benefits of extracting the coal resource compared to the current agricultural potential of this area. Extensive discussion and further justification in accordance with relevant guidelines on this issue are provided in the *Bylong Coal Project Gateway Certificate Application Supporting Document* (Hansen Bailey, 2014).

The landform within A287 and A342 is characterised by the occurrence of prominent escarpment type features bordering the lower lying alluvial valleys. Throughout the mine planning process, these escarpment features have been identified as constraints to mining operations. Potential open cut areas have been offset from the steep slope areas and the underground mine plans have been developed in consideration of minimising impacts to most of the prominent cliffs within the region.

The preferred mine plan developed within the Feasibility Study resulted in a substantial setback of the longwall panels to the key cliffs visible to the Bylong Valley in order to minimise the potential for adverse impacts to these features.

Throughout the preparation of this EIS, the scheduling of the open cut mining areas was adjusted in response to the implementation of a noise management strategy to minimise adverse noise emissions on sensitive receivers. This amendment has resulted in improved amenity outcomes for sensitive receivers during open cut mining operations.

Option 4 also presents an opportunity to recover additional coal resources beyond the life of the Project, subject to future feasibility studies and the grant of the relevant approvals. For all of the reasons discussed above, Option 4 is considered to be the best alternative in terms of meeting the principles of ESD and the Objects of the EP&A Act.

3.17.3 Options in Respect of Project Related Infrastructure

A number of alternative locations were considered to accommodate the infrastructure required for the Project. Certain alternatives were rejected on the grounds of economic, environmental and/or social grounds throughout the planning and design phase. A summary of the options considered is provided in the following sections.

Accommodation Facilities

Various options for accommodation for each of the construction and operations' workforces have been considered for the Project. In the early stages of mine planning, a detailed consideration of the potential labour pool within an approximately one hour drive of the Project (considered a safe drive time) determined that the labour force in 2011 seeking full time employment was few.

Experienced mining sector employees presently reside largely outside of the region. In addition to training local workers, some sourcing of employees from outside the area will be required.

Should a WAF not be constructed as part of the Project, this would result in significant additional pressure on local infrastructure and accommodation facilities in the immediate area. This would also significantly increase traffic volumes on key local roads, travel times for workers and hence safety risk for workers and other road users.

A permanent WAF was considered, however initial stakeholder analysis indicated that this may be unfavourable to the local community and MWRC. MWRC has been provided funding as part of the Resources for Regions initiative to upgrade the Wollar Road, which would improve safe travel and travel times between the Project and township of Mudgee, providing a suitable place of residence for the Project's employees and their families.

The demand for the WAF will generally be highest during the early years of the Project life for construction activities and as a short term option for operations staff relocating to the area during the initial years of open cut mining operations. Once Wollar Road is upgraded and the construction activities for the Project are completed (approximately end of PY 6), it is proposed that the WAF will no longer be required. KEPCO intends to encourage the longer term employees to relocate their families to reside within the local community to ensure that the WAF is not required during the later years of the Project.

The location of the WAF was originally proposed further to the west. Following the completion of mapping of areas of BSAL within the Project Boundary, the proposed locality has been moved further east to avoid interfering with an area identified as BSAL. Further, it has been located on and around existing farm access infrastructure to reduce disturbance impacts.

Consideration was also given to ensuring the WAF was located within acceptable amenity levels for noise and dust, as well as being largely remote from private residences (including the township of Bylong).

Rail Loop

Due to the Project being remote from other mining projects within the region and the Sandy Hollow to Gulgong Railway line being proximal to the Project, it was deemed that a stand alone rail loop or rail loadout facility will be required.

Various engineering and cost preferred locations were proposed for the rail loop, including on private land and within the alluvial floodplain. The final location was determined in consideration of avoidance of the above.

Additionally, the CHPP and its associated facilities have been proposed to be constructed within the rail loop with an aim to minimise disturbance to native vegetation, BSAL and agricultural land more generally.

Refinements to the rail loop were determined throughout the Feasibility Study to minimise the extent of cut and fill earthworks that are required for this piece of infrastructure. The Feasibility Study design of the rail loop has reduced its disturbance footprint.

66 kV Transmission Line

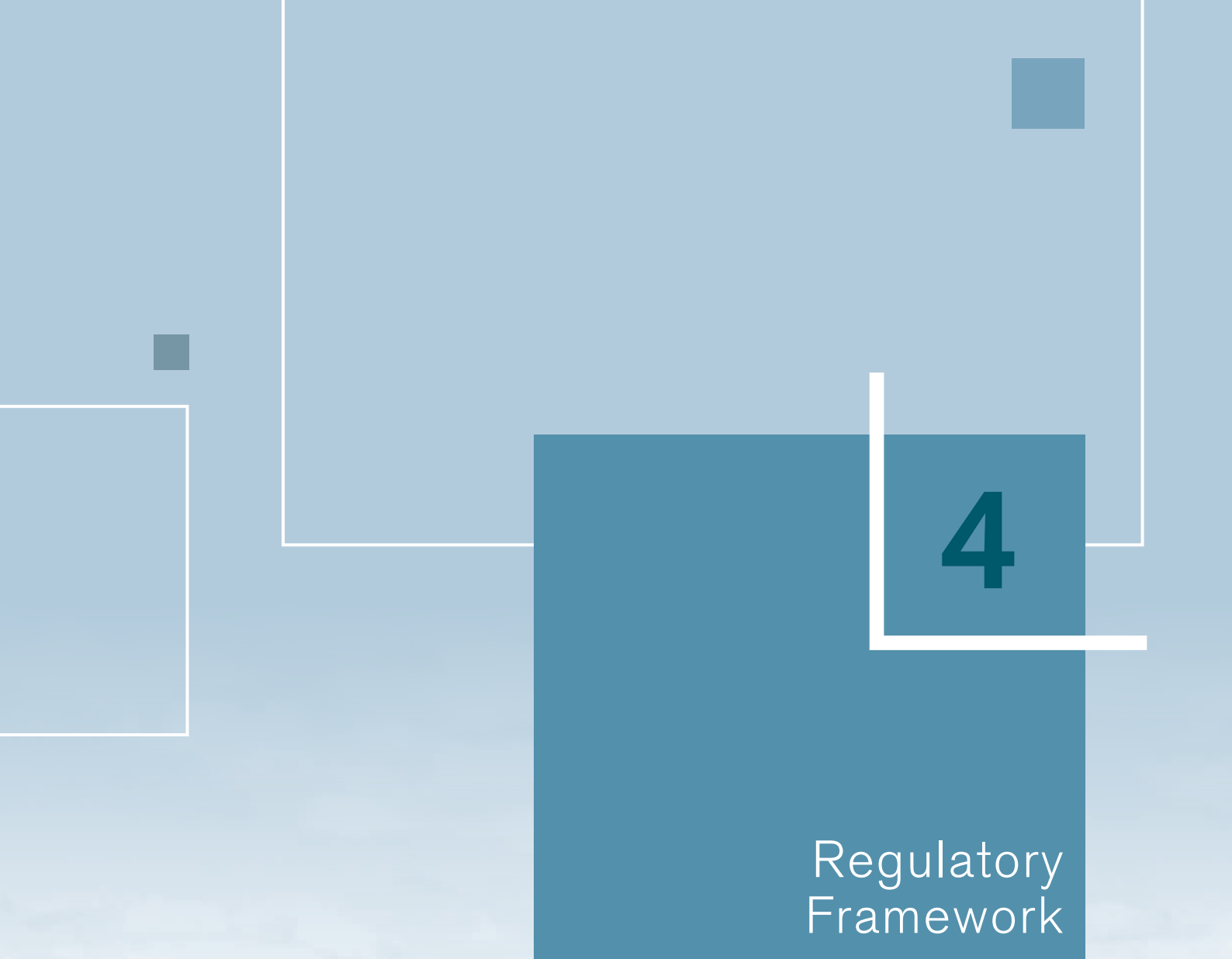
The conceptual alignment of the proposed 66 kV transmission line between the Bylong sub-station and the Underground MIA has been refined to minimise impacts to neighbouring agricultural enterprises. The conceptual alignment has been identified within the vicinity of public road easements and on land owned by KEPCO.

Compared to other alternative locations, the preferred alignment minimises impacts on land conforming to Equine CIC and will also reduce fragmentation impacts to existing agricultural enterprises, external to the Project Boundary.

Overland Conveyor Embankment

The design for the overland conveyor developed as part of the Feasibility Study included an embankment extending across the western portion of the Bylong River floodplain as the most economic option.

During the preliminary flood modelling completed as part of the Surface Water and Flooding Impact Assessment (WRM, 2015), the embankment for the overland conveyor was identified to hold back a significant quantity of flood water and potentially result in significant erosional impacts to the drainage line. The flood modelling considered a number of embankment lengths to determine a length which minimised significant flooding impacts. The overland conveyor is now proposed to be constructed with a shorter embankment across the floodplain in order to reduce the potentially significant flooding impacts to the drainage channel. The final detailed design of the overland conveyor will consider the need for the reduced embankment length and enable the conveyor to be elevated across the floodplain (i.e. on posts or other similar structure).



4

Regulatory Framework

Regulatory Framework

This section describes the environmental and planning regulatory framework applicable to the Project and considers both NSW and Commonwealth legislation. A flowchart illustrating the planning assessment and consultation process relevant to the Project is presented in **Figure 35**.

4.1 OVERVIEW OF REQUIRED APPROVALS

The principal approval that is required for the Project is a development consent under the EP&A Act. The Project is declared to be SSD under clause 5 of Schedule 1 of the *State Environmental Planning Policy (State and Regional Development) 2011* (SSD SEPP) as the Project is for the purpose of coal mining and has a capital investment value of more than \$30 Million. The approvals regime for SSD occurs under Division 4.1 of Part 4 of the EP&A Act. The subordinate legislation and environmental planning instruments relevant to the Project are described in **Section 4.2**.

Section 89J of the EP&A Act lists the authorisations that are not required for SSD that is authorised by development consent under Division 4.1 of Part 4 (see **Section 4.3**). In addition, section 89K of the EP&A Act lists a number of authorisations that cannot be refused if they are necessary for carrying out SSD that is authorised by development consent under Division 4.1 of Part 4 (see **Section 4.4**).

There are other licences and approvals under NSW legislation which will be required for the Project, including an approval under the Commonwealth EPBC Act. **Table 12** provides a summary of all anticipated approvals needed to enable the construction and operation of the Project.

The approvals listed within **Table 12** are not required prior to the determination of the Project's Development Application. Some of these approvals will be required prior to commencement of construction activities, whilst others may only be required at various stages throughout construction and operation of the Project.

4.2 DEVELOPMENT CONSENT UNDER EP&A ACT

This section considers the requirement for development consent under the EP&A Act and the application, assessment and determination process for the Project by reference to the relevant sections of the EP&A Act and the applicable subordinate legislation and environmental planning instruments.

4.2.1 Permissibility and Development Consent and Zoning

Section 89E(3) of the EP&A Act provides that "*Development Consent may be granted despite the development being partly prohibited by an environmental planning instrument*". Clause 5 of the SEPP Mining states that if there is an inconsistency with any other Environmental Planning Instrument (EPI), the provisions of the SEPP Mining prevail to the extent of the inconsistency.

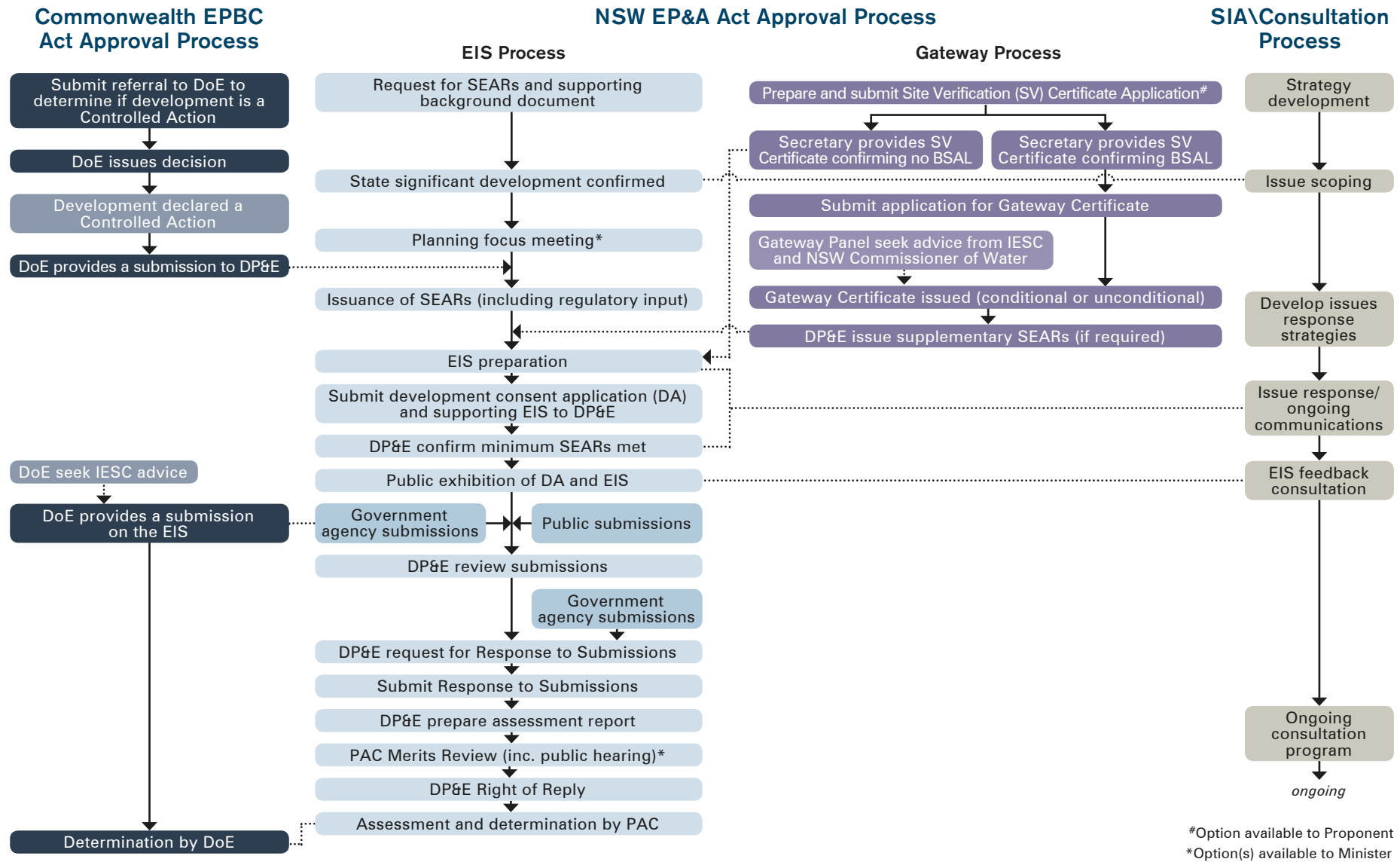
FIGURE 35 EIS Process and Stakeholder Engagement Program

TABLE 12 Licences and Approvals Required for the Project

Approval	Legislation	Authority	Comments
Development Consent under Part 4 of the EP&A Act	Section 89E of EP&A Act	Minister for Planning	The Minister has delegated his functions as the consent authority to the PAC. This is the main approval, which will include requirements for Environmental Management Plans, Monitoring Programs and other subsidiary approvals.
Gateway Certificate	SEPP Mining and SRLU Policy.	Mining and Petroleum Gateway Panel	A Gateway Certificate was issued for the Project on 15 April 2014.
Construction Certificate	Division 1 of Part 4A of EP&A Act	MWRC	Will be obtained as required.
Building Certificate	Section 149A of EP&A Act	MWRC	Will be obtained as required.
Consent to carry out a work in, on or over a public road	Section 138 of Roads Act	MWRC	Section 89K of the EP&A Act provides that this authorisation cannot be refused and must be substantially consistent with the development consent.
Approval for works over Crown Land	<i>Crown Lands Act 1989</i>	Division of Crown Lands	Will be obtained as required.
Environment Protection Licence	Section 48 of POEO Act	Office of Environment and Heritage	Section 89K of the EP&A Act provides that this authorisation cannot be refused and must be substantially consistent with the development consent.
Forestry Occupation Permit for Non-forestry Uses	Section 60 of <i>Forestry Act 2012</i>	Forestry Corporation of NSW	Will be obtained as required.
Radiation Management Licences	Section 6 of <i>Radiation Control Act 1990</i>	Office of Environment and Heritage	Will be obtained as required.
Mining Lease(s)	Section 63 of <i>Mining Act 1992</i>	Minister for Resources & Energy	Under section 89K of the EP&A Act, a Mining Lease cannot be refused and must be substantially consistent with the development consent. It is anticipated that the Mining Lease(s) will require the preparation of a Mining Operations Plan (MOP). Additionally for the underground mining operations, an Extraction Plan will be required.
Aquifer Interference Approval	Section 91 of <i>Water Management Act 2000</i>	NSW Office of Water	Will be obtained as required.
WAL(s)	Parts 2 of Chapter 3 of <i>Water Management Act 2000</i>	NSW Office of Water	Will be obtained as required. Requirements are set out in Table 13 .
Bore Licence(s)	Part 5 of <i>Water Act 1912</i>	NSW Office of Water	Will be obtained as required.
Notification of Schedule 11 Hazardous Chemicals	Division 3, Part 7.1 of <i>Work Health and Safety Regulation 2011</i>	WorkCover	Notification of Dangerous Goods Stored on Premises. Will be provided when required.
Notification of High Risk Activities	Clause 33 of <i>Work Health and Safety (Mines) Regulation 2014</i>	NSW Trade and Investment Mine Safety	Will be provided when required. The development of emplacement areas is listed in Schedule 3 of <i>Work Health and Safety (Mines) Regulation 2014</i> as a high risk activity requiring notification.
Approval to Exhume Remains	Clause 70 of the <i>Public Health Regulation 2012</i>	NSW Health	Will be obtained as required.
Approval for the taking of a Controlled Action	Section 133 of EPBC Act	DoE	DoE has accredited the assessment process under Division 4.1 of Part 4 of the EP&A Act. Specific Environmental Assessment Requirements provided on 31 March 2014.

The Project is located entirely within the MWRC LGA. **Figure 36** illustrates the land zoning within the Project Boundary, which is primarily zoned as RU1 (Primary Production), with the exception of the Sandy Hollow to Gulgong Railway Line, which is zoned as SP2 (Infrastructure). The Land Use Table in the Mid-Western Regional LEP provides that open cut mining is permissible with development consent on land zoned as RU1. Some components of the Project will also be undertaken on land zoned as SP2. The Mid-Western Regional LEP prohibits mining on land zoned as SP2.

Under the Mid-Western Regional LEP, extensive agriculture, roads and water systems are permissible without development consent in Zone SP2. Clause 7(1)(b) of the SEPP Mining states that mining is permitted with development consent on any land where agriculture or industry can be carried out. The term “agriculture” is defined within the Mid-Western Regional LEP and the SEPP Mining to mean, amongst other things “extensive agriculture”.

In addition, clause 7(1)(a) of the SEPP Mining provides that underground mining is permissible with development consent on any land. Further, clause 7(1)(d) of the SEPP Mining provides that facilities for the processing or transportation of minerals are permissible with development consent on any land on which mining may be carried out, provided that the minerals were mined from that land or the adjoining land.

Therefore, the components of the Project are permissible with development consent under the EP&A Act on the land on which they are proposed to be carried out.

4.2.2 Approval of SSD

The Project is declared to be SSD by application of:

- Section 89C which states that a State Environmental Planning Policy (SEPP) may declare any development or class of development to be SSD;
- Clause 8 of *State Environmental Planning Policy (State and Regional Development) 2011* (SRD SEPP) which provides that development specified in Schedule 1 or 2 of the SRD SEPP is declared to be SSD; and
- Clause 5 of Schedule 1 of the SRD SEPP which lists development for the purposes of coal mining and mining with a capital investment value of more than \$30 Million is SSD.

The planning approval pathway for SSD is set out in Division 4.1 of Part 4 of the EP&A Act, the EP&A Regulation and applicable environmental planning instruments, such as the SEPP Mining.

4.2.3 Consent Authority

Pursuant to section 89D of the EP&A Act, the Minister for Planning is the consent authority for SSD. However, section 23 of the EP&A Act enables the Minister or Secretary (referred to as Director-General within legislation) to delegate the Minister's functions to a number of other persons or authorities, depending on the circumstances, including the Planning Assessment Commission (PAC).

By Instrument of Delegation (dated 14 September 2011 and gazetted on 28 September 2011), the Minister delegated the Minister's functions in respect of determination of SSD under sections 89D and 89E of the EP&A Act to the PAC, in certain circumstances. Those circumstances are where an application is made by a private proponent and:

- A reportable political donation has been declared; or
- The application is objected to by the relevant council; or
- The application receives more than 25 objection submissions.

4.2.4 Gateway Certificate

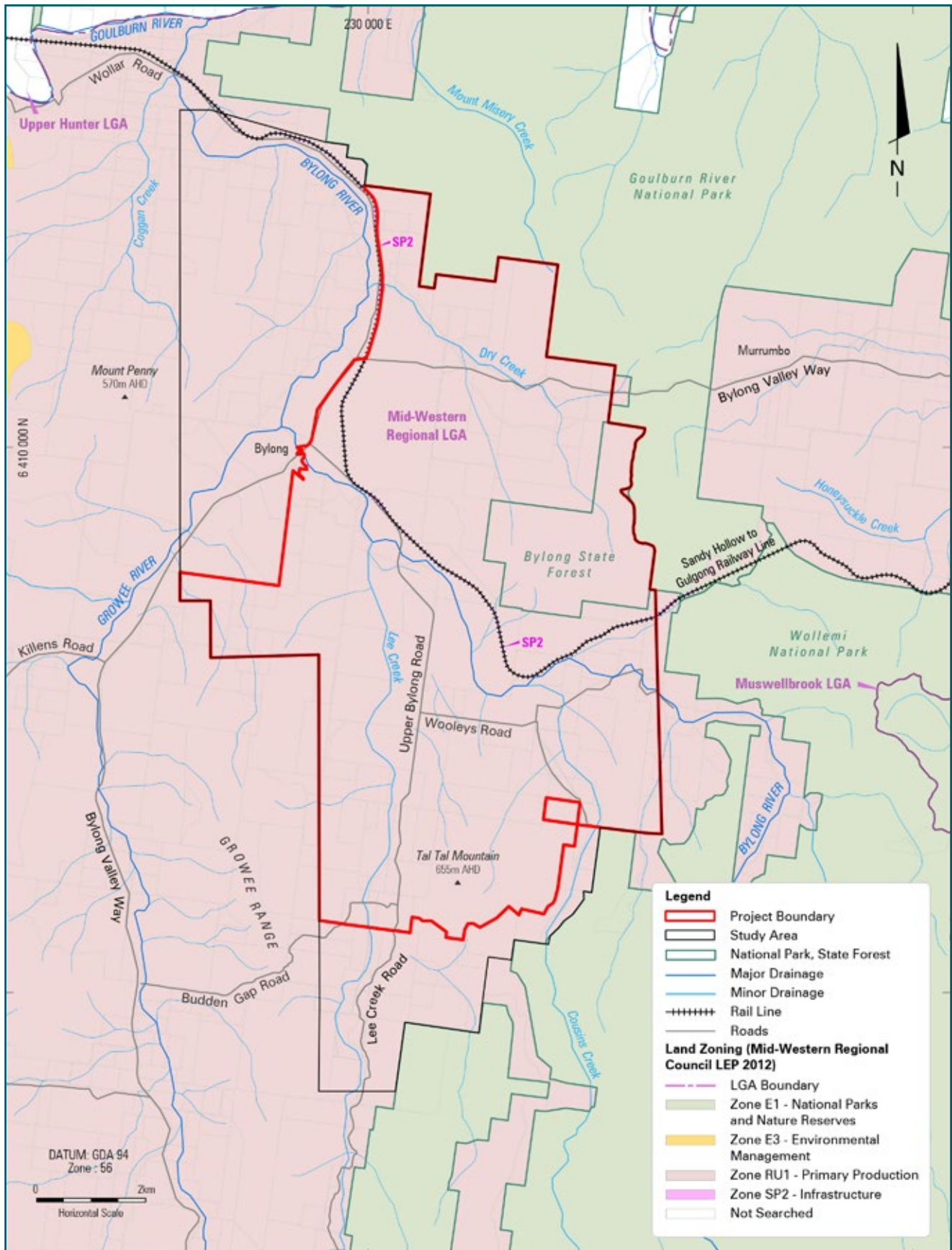
In September 2012, the NSW Government published the SRLUP which proposed an additional assessment process, known as the Gateway Process, for mining and petroleum development located on SAL. On 4 October 2013, Part 4AA of the SEPP Mining commenced and the Gateway Process described in the SRLUP was implemented.

The Gateway Process is described as a scientific assessment of the impacts of mining and petroleum development on SAL. SAL refers to land that is BSAL or CIC land. The Gateway process is required to occur prior to the lodgement of a development application under the EP&A Act.

The Gateway Process involves the verification of whether the land on which the mining or petroleum development is proposed is BSAL. If the land is BSAL, the assessment of the developments impacts on SAL by an independent panel of experts (known as the “Mining and Petroleum Gateway Panel”) against the criteria set out in the SEPP Mining. The Mining and Petroleum Gateway Panel is required to issue either an unconditional or conditional “Gateway Certificate” for the proposed mining or petroleum development.

Clause 17A of the SEPP Mining provides that Part 4AA applies to proposed mining developments for which there is currently no mining lease. Therefore, the Project is a mining development to which the Gateway Process applies.

FIGURE 36 Land Zoning



Strategic Agricultural Land

As set out above, there are two types of SAL, namely:

- BSAL; and
- CIC land which is comprised of Viticulture CIC and Equine CIC.

The SRLUP maps identify the presence of both BSAL and Equine CIC within the Project Boundary. Verification of the BSAL within the Project Boundary was undertaken in accordance with the criteria prescribed within the *Interim Protocol for Site Verification and Mapping of Biophysical Strategic Agricultural Land* (Interim Protocol).

As a consequence of BSAL and mapped Equine CIC occurring within the Project Boundary, it was determined that a Gateway Certificate was required prior to the lodgement of a development application for the Project.

Gateway Certificate Process

KEPCO lodged an application for a Gateway Certificate on 10 January 2014. This application assessed the potential impacts of the Project on BSAL and mapped Equine CIC within the Project Boundary in accordance with the *Strategic Regional Land Use Policy – Guidelines for Gateway Applicants* (NSW Government, 2013).

The Mining and Petroleum Gateway Panel issued a Conditional Gateway Certificate for the Project on 15 April 2014 which facilitates the lodgement of the current development application under Division 4.1 of Part 4 of the EP&A Act.

KEPCO identified a number of inconsistencies within the Mining and Petroleum Gateway Panel's Assessment Report provided with the Conditional Gateway Certificate and subsequently submitted a letter to the Regional Panels Secretariat of the Mining and Petroleum Gateway Panel on 1 May 2014. KEPCO's letter clarified queries that the Mining and Petroleum Gateway Panel raised within its Assessment Report for the Project. No feedback was received from the Mining and Petroleum Gateway Panel Secretariat on this correspondence.

Section 5.4 discusses the recommendations provided within the Conditional Gateway Certificate for the Project and outlines where each of these is addressed within this EIS.

4.2.5 Need for an Environmental Impact Statement

Section 78A(8A) of the EP&A Act states that a development application for SSD must be accompanied by an EIS prepared in accordance with the EP&A Regulation. The form and content requirements for an EIS are provided in Schedule 2 of the EP&A Regulation.

4.2.6 Environmental Assessment Requirements

Clause 3 of Schedule 2 of the EP&A Regulation states that prior to the preparation of an EIS, the applicant must make a written application to the Secretary for the SEARs.

A request for SEARs was made by KEPCO on 17 January 2014 and was supported by the *Bylong Coal Project Background Document* (Hansen Bailey, 2014). SEARs for the Project were issued by the Secretary on 23 June 2014 with reference to the Gateway Certificate received for the Project on 15 April 2014 (as discussed in **Section 4.2.4**). In light of minor adjustments to the Project, the SEARs were amended by DP&E on 11 November 2014. **Section 5.4.1** discusses the SEARs and specifies where each has been addressed in this EIS.

4.2.7 Public Participation

Pursuant to section 89F of the EP&A Act and clause 83 of the EP&A Regulation, the development application for the Project and this supporting EIS must be placed on public exhibition for a period of at least 30 days. During the exhibition period, any person may make a written submission in respect to the Project.

Clause 85A(1) of the EP&A Regulation requires the Secretary to provide the applicant for SSD with the submissions or a summary of the submissions received during the exhibition period. Clause 85(2) of the EP&A Regulation provides that the Secretary may require the applicant to provide a written response to those submissions as the Secretary considers necessary.

4.2.8 Evaluation – Matters for Consideration

Objects of the Act

As stated in section 5 of the EP&A Act, the objects of the Act are:

- “(a) to encourage:
 - (i) the proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment,
 - (ii) the promotion and co-ordination of the orderly and economic use and development of land,
 - (iii) the protection, provision and co-ordination of communication and utility services,
 - (iv) the provision of land for public purposes,
 - (v) the provision and co-ordination of community services and facilities, and
 - (vi) the protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities and their habitats, and
 - (vii) ecologically sustainable development, and
 - (viii) the provision and maintenance of affordable housing, and
- (b) to promote the sharing of the responsibility for environmental planning between the different levels of government in the State, and
- (c) to provide increased opportunity for public involvement and participation in environmental planning and assessment.”

Section 9.5 assesses the Project in the context of the objects of the EP&A Act.

Matters for Consideration by Determining Authority

Section 79C of the EP&A Act specifies the matters that the consent authority is to consider when determining a development application. Section 89H of the EP&A Act provides that section 79C applies to the determination of an SSD application.

Under section 79C of the EP&A Act, the consent authority is to consider the following matters that are relevant to the development application:

“(1) Matters for consideration—general

In determining a development application, a consent authority is to take into consideration such of the following matters as are of relevance to the development the subject of the development application:

- (a) the provisions of:
 - (i) any environmental planning instrument, and
 - (ii) any proposed instrument that is or has been the subject of public consultation under this Act and that has been notified to the consent authority (unless the Director-General has notified the consent authority that the making of the proposed instrument has been deferred indefinitely or has not been approved), and
 - (iii) any development control plan, and
 - (iv) any planning agreement that has been entered into under section 93F, or any draft planning agreement that a developer has offered to enter into under section 93F, and
 - (v) the regulations (to the extent that they prescribe matters for the purposes of this paragraph), and
 - (vi) any coastal zone management plan (within the meaning of the Coastal Protection Act 1979), that apply to the land to which the development application relates,
- (b) the likely impacts of that development, including environmental impacts on both the natural and built environments and social and economic impacts in the locality,
- (c) the suitability of the site for the development,
- (d) any submissions made in accordance with this Act or the regulations,
- (e) the public interest.”

Section 9.7 describes how each of these matters has been addressed in this EIS.

SEPP Mining

The SEPP Mining outlines the permissibility of mining related developments and the matters that must be considered by consent authorities when evaluating development applications for mining developments. The permissibility of mining and the associated activities within the Project Boundary is discussed in **Section 4.2.1**.

Clause 12AA states that:

“(1) In determining an application for consent for development for the purposes of mining, the consent authority must consider the significance of the resource that is the subject of the application, having regard to:

- (a) the economic benefits, both to the State and the region in which the development is proposed to be carried out, of developing the resource, and*
- (b) any advice by the Director-General of the Department of Trade and Investment, Regional Infrastructure and Services as to the relative significance of the resource in comparison with other mineral resources across the State.”*

As set out above, clause 12AA requires that the consideration of resource significance is the principal consideration under one part of one environmental planning instrument. However, the clause does not override the obligation on the consent authority to take into account other considerations under the EP&A Act, including those matters set out in section 79C and the objects of the EP&A Act. Amongst other things, the consent authority is required under section 79C of the EP&A Act to consider the likely impacts of the development, including environmental, social and economic impacts.

In July 2015, the NSW Government released the draft *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) Amendment (Significance of Resource) 2015* (Draft SEPP Mining Amendment) for public comment.

The Draft SEPP Mining Amendment proposes the removal of clause 12AA to alleviate the perceived community concerns that the social and environmental aspects of a mining related development may not be given the appropriate weighting during the approvals process under the current legislative regime.

Even if the Draft SEPP Mining Amendment is made and clause 12AA is removed, the consent authority will still be required to take into account the significance of the resource and any social and economic benefits for the region and the State as a whole arising from the resource extraction. Such consideration is required under section 79C of the EP&A Act. The only change will be that the significance of the resource is not to be the principal consideration under the relevant part of SEPP Mining.

As summarised in **Section 9.7**, this EIS has been prepared in consideration of the relevant environmental, social and economic impacts of the Project. Accordingly, this EIS provides the information required for the consent authority to consider during its assessment of the development application.

Clause 12AB of the SEPP Mining specifies “non-discretionary development standards for mining”. These standards are performance measures relating to air quality, noise, blasting and groundwater impacts. Clause 12AB states that if the proposed development complies with the non-discretionary development standards, the consent authority cannot impose more onerous standards. The consent authority may grant development consent even if the proposed development does not comply with all non-discretionary development standards.

The consent authority is required to consider the compatibility of the proposed development with surrounding land uses. Clause 12 of the SEPP Mining requires that:

“Before determining an application for consent for development for the purposes of mining, petroleum production or extractive industry, the consent authority must:

- (a) consider:*
 - (i) the existing uses and approved uses of land in the vicinity of the development, and*
 - (ii) whether or not the development is likely to have a significant impact on the uses that, in the opinion of the consent authority having regard to land use trends, are likely to be the preferred uses of land in the vicinity of the development, and*
 - (iii) any ways in which the development may be incompatible with any of those existing, approved or likely preferred uses and*

- (b) *evaluate and compare the respective public benefits of the development and the land uses referred to in paragraph (a)(i) and (ii), and*
- (c) *evaluate any measures proposed by the applicant to avoid or minimise any incompatibility, as referred to in paragraph (a)(iii)."*

The land uses in the vicinity of the Project are described in **Section 2.4**. The dominant land use in the locality of the Project is agriculture. The impacts of the Project on surrounding land uses have been extensively assessed in this EIS and mitigation and management measures have been proposed to avoid or alleviate potential land use incompatibilities. The overall objective of rehabilitation is to return the land back to the community once mining is completed.

Pursuant to clause 14 of the SEPP Mining, the consent authority is required to consider whether or not to impose conditions to ensure that impacts on significant water resources, impacts on threatened species and biodiversity and greenhouse gas emissions are minimised.

Clause 15 of the SEPP Mining requires the consent authority to consider the efficiency of resource recovery for the proposed development. The consent authority must also consider whether or not to impose conditions in order to optimise the resource recovery. The Project has adopted a mine plan that seeks to optimise resource recovery without causing unacceptable environmental impacts. KEPCO considered a number of alternatives for the recovery of the resource, as discussed in **Section 3.17**. The Project was determined to be the most appropriate alternative for recovering the coal resource within the Project Boundary.

Pursuant to clause 16 of the SEPP Mining, the consent authority must consider whether or not to impose conditions on the transportation of coal by public roads. The Project will not involve any coal transportation by public road.

Under clause 17 of the SEPP Mining, the consent authority must consider whether or not to impose conditions to ensure the rehabilitation of the land. The Project involves the rehabilitation of land that is disturbed in the course of mining operations, as described in **Section 7.15**.

Part 4AA of the SEPP Mining implements the Gateway Process for assessment of proposed mining developments on SAL (refer to **Section 5.4.2**).

Preliminary Hazard Analysis

State Environmental Planning Policy 33 – Hazardous and Offensive Development (SEPP 33) governs the assessment of developments for the purposes of a “potentially hazardous industry” or “potentially offensive industry” which are respectively defined as:

“potentially hazardous industry” means a development for the purposes of an industry which, if the development were to operate without employing any measures (including, for example, isolation from existing or likely future development on other land) to reduce or minimise its impact in the locality or on the existing or likely future development on other land, would pose a significant risk in relation to the locality:

- (a) *to human health, life or property, or*
- (b) *to the physical environment and includes a hazardous industry and a hazardous storage establishment.*

“potentially offensive industry” means a development for the purposes of an industry which if the development were to operate without employing any measures (including, for example, isolation from existing or likely future development on other land) to reduce or minimise its impact in the locality or on the existing or likely future development on other land, would emit a polluting discharge (including for example, noise) in a manner which would have a significant adverse impact in the locality or on the existing or likely future development on other land, and includes an offensive industry and an offensive storage establishment.”

The Project is a potentially hazardous industry as it could pose a significant risk to human health and the biophysical environment if mitigation measures were not implemented.

Clause 12 of SEPP 33 requires a Preliminary Hazard Analysis (PHA) to be prepared in accordance with current circulars or guidelines.

The relevant guidelines for the preparation of PHAs are *Hazardous and Offensive Development Application Guidelines – Applying SEPP 33* (DoP, 2011) and *Hazardous Industry Planning Advisory Paper No. 6 – Guidelines for Hazard Analysis* (DoP, 2011). The PHA is discussed in **Section 7.24**.

Clause 13 of SEPP 33 requires the consent authority to consider the following:

- (a) *current circulars or guidelines published by the Department of Planning relating to hazardous or offensive development, and*
- (b) *whether any public authority should be consulted concerning any environmental and land use safety requirements with which the development should comply, and*
- (c) *in the case of development for the purpose of a potentially hazardous industry – a preliminary hazard analysis prepared by or on behalf of the applicant, and*
- (d) *any feasible alternatives to the carrying out of the development and the reasons for choosing the development the subject of the application (including any feasible alternatives for the location of the development and the reasons for choosing the location the subject of the application), and*
- (e) *any likely future use of the land surrounding the development."*

Contaminated Land Assessment

Pursuant to clauses 7(2) and 7(4) of *State Environmental Planning Policy 55 – Remediation of Land* (SEPP 55), a report specifying the findings of a preliminary investigation of the land concerned must be undertaken in accordance with the contaminated land planning guidelines. If the proposed development represents a change in use of this land, the consent authority cannot grant consent to the development application unless it has considered the report providing the findings of the preliminary investigation of the land.

The Project will involve a change in the use of the land from agriculture to mining. A report specifying the findings of the preliminary investigation of the land concerned is discussed in **Section 7.23**.

The preliminary investigation determined that there is no material contamination of the land within the Project Boundary, where a change of use is proposed.

Koala Habitat

The ecology surveys conducted for the Project did not identify the Koala or any evidence of the species (such as scats and claw marks) within the Project Boundary. There also are no historical records of Koalas within the Project Boundary.

Therefore, the land on which the Project will be carried out is not "core koala habitat" and no plan of management is required under *State Environmental Planning Policy 44 – Koala Habitat Protection* (SEPP 44).

Infrastructure SEPP

Development that involves a new level crossing or a likely significant increase in the total number of vehicles or the number of trucks used in a level crossing that is in the vicinity of the Development will require the concurrence of the Chief Executive Officer of the relevant rail authority. The Project will impact existing level crossings and proposes the construction and decommissioning of a temporary level crossing over the Sandy Hollow to Gulgong Railway Line. Consultations with ARTC are underway in this regard.

4.2.9 Planning Assessment Commission

The Minister or the Secretary can refer a development application to the PAC for its review and to report back any findings to the Minister. As explained in **Section 4.2.3**, the Minister's power to determine applications for SSD has been delegated to the PAC.

The functions of the PAC are prescribed by section 23D(1) of the EP&A Act:

"(1) The Commission has the following functions:

- (a) *any function delegated to the Commission under this Act,*
- (b) *if requested to do so by the Minister or the Director-General:*
 - (i) *to advise the Minister or the Director-General as to planning or development matters, environmental planning instruments or the administration or implementation of the provisions of this Act, or any related matter, and*
 - (ii) *to review any (or any aspect or part of any) development, activity, infrastructure or project to which this Act applies, and*
 - (iii) *to hold a public hearing into any matter the subject of any such advice or review, and*

- (iv) *(Repealed)*
- (v) *to review a proposal to constitute, alter or abolish a development area under section 132 or 133,*
- (c) *any function of a regional panel, an independent hearing and assessment panel or a planning assessment panel conferred on it by order in writing by the Minister,*
- (d) *if a regional panel has not been appointed for any part of the State, any function that is conferred on a regional panel under an environmental planning instrument applicable to that part or that is otherwise conferred on a regional panel under this Act."*

4.2.10 Determination and Appeals

As explained in **Section 4.2.3**, the Minister has delegated certain functions in respect of the determination of applications for SSD to the PAC. It is likely that the Project will satisfy the circumstances in which the PAC is the determining authority under that delegation.

Pursuant to section 89E of the EP&A Act, the consent authority can determine an application for SSD by either granting consent or refusing consent. If the consent authority decides to grant consent, the consent can be subject to conditions as determined by the consent authority. Under section 82(1) of the EP&A Act, a development application is deemed to have been refused consent if a determination has not been made within the relevant period. The relevant period for SSD applications is 90 days, as provided by clause 113(1)(c) of the EP&A Regulation. Section 82(2) of the EP&A Act provides that the expiration of the relevant deemed refusal period does not preclude the consent authority from making a determination. However, the deemed refusal of the development application does give rise to the right of appeal.

Section 97 of the EP&A Act states that an applicant who is dissatisfied with the consent authority's determination can lodge an appeal in the Land and Environment Court within six months after the determination. If the appeal is against a deemed refusal under section 82(1) of the EP&A Act, the appeal must be commenced within six months after the expiration of the relevant deemed refusal period.

Section 98 of the EP&A Act allows an objector to appeal against a consent authority's decision to grant consent within 28 days after the date on which notice of the determination was given.

Section 23F of the EP&A Act states that a decision made by the PAC (in exercising its function) cannot be challenged if the decision was made by the PAC after a public hearing.

4.2.11 Development Contributions

Section 94 of the EP&A Act enables the consent authority to impose a condition requiring the applicant to provide a development contribution if the consent authority

"... is satisfied that development for which development consent is sought will or is likely to require the provision of or increase the demand for public amenities and public services within the area".

Section 93F of the EP&A Act enables the applicant to enter into a Voluntary Planning Agreement (VPA) with planning authorities (such as local government). Under a VPA, the proponent commits to providing a contribution that is to be applied towards a public purpose. Provided that the Minister is a party to the agreement, a VPA can exclude the application of section 94 of the EP&A Act. Section 93F essentially allows for the proponent's contribution to be facilitated through a VPA rather than as a condition of development consent.

Following the numerous consultations with MWRC throughout the preparation of this EIS, KEPCO has made an offer to MWRC for consideration over a VPA for the Project. Discussions are continuing with the MWRC and DP&E in relation to the finalisation of the VPA. Further details are provided in **Section 5**.

4.2.12 Disclosure of Reportable Political Donations and Gifts

Pursuant to section 147 of the EP&A Act, an applicant is required to provide full public disclosure of any political donations and gifts at the time of making a development application. A person making a submission regarding a development application is also required to provide full disclosure of any political donations and gifts.

This disclosure requirement applies to all relevant planning applications or submissions made on or after 1 October 2008. In certain circumstances, the making of political donations or gifts can limit the Minister's power to determine an application for development consent.

The proponent (KEPCO) has provided a statutory declaration to the DP&E affirming that no such reportable donations or gifts have been made. As a result, the Minister (or one of his delegates) has the authority to determine the Development Application.

4.3 EXEMPTIONS FROM OTHER NSW APPROVAL REQUIREMENTS

Under section 89J of the EP&A Act, the following relevant authorisations are not required for any SSD that is authorised by development consent:

- A permit under section 201, 205 or 219 of the *Fisheries Management Act 1994*;
- An approval under Part 4, or an excavation permit under section 139, of the *Heritage Act 1977* (Heritage Act);
- An Aboriginal Heritage Impact Permit (AHIP) under section 90 of the *National Parks and Wildlife Act 1974* (NPW Act);
- An authorisation referred to in section 12 of the *Native Vegetation Act 2003* (NV Act) (or under any Act repealed by that Act) to clear native vegetation or State protected land;
- A bushfire safety authority under section 100B of the *Rural Fires Act 1997*; and
- A water use approval under section 89, a water management work approval under section 90 or an activity approval (other than an aquifer interference approval) under section 91 of the *Water Management Act 2000* (WM Act).

The approvals which have potential relevance to the Project are discussed in the following sections.

4.3.1 Heritage Act 1977

The Heritage Act governs the management of:

- Items of non-indigenous heritage significance listed on the NSW State Heritage Register (SHR); and
- “Relics”.

Items on the SHR are subject to the provisions of Part 4 of the Heritage Act. A “relic” is defined under section 4 of the Heritage Act as:

“any deposit, artefact, object or material evidence that:

- (a) relates to the settlement of NSW; and*
- (b) is of State or local heritage significance.”*

Section 139(1) of the Heritage Act states that:

“A person must not disturb or excavate any land knowing or having reasonable cause to suspect that the disturbance or excavation will or is likely to result in a relic being discovered, exposed, moved, damaged or destroyed unless the disturbance or excavation is carried out in accordance with an excavation permit”.

Pursuant to section 89J(1)(c) of the EP&A Act, an approved SSD does not require an approval under Part 4 of the Heritage Act for impacts to heritage items listed on the SHR or an excavation permit under the Heritage Act. There are no items of State Heritage Significance involved in the proposed development. There are some heritage items that will be directly impacted by the Project. The proposed management of these impacts is discussed in **Section 7.12**.

4.3.2 National Parks and Wildlife Act 1974

Under section 86 of the NPW Act, it is an offence to harm or desecrate an Aboriginal place or object. However, section 87 states that a valid defence exists where the harm or desecration occurred in accordance with an AHIP issued under section 90 of the NPW Act.

Pursuant to section 89J(1)(d) of the EP&A Act, an approved SSD does not require an AHIP prior to the salvage or destruction of Aboriginal objects. However, Aboriginal cultural heritage impacts assessments and management plans are required and must be consistent with the NSW Office of Environment and Heritage (OEH) guidelines. **Section 7.11** provides a summary of the Aboriginal Archaeology and Cultural Heritage Impact Assessment which has been completed for the Project, including the proposed management of items identified within the assessment.

Part 8A of the NPW Act establishes offences pertaining to the harming of threatened species, populations, ecological communities and critical habitats. However, sections 118A(3)(b)(i), 118C(5)(b)(i) and 118D(2)(b)(i) state that a valid defence exists where the act causing the harm is essential to the carrying out of a development for which development consent has been granted.

4.3.3 Native Vegetation Act 2003

Section 12 of the NV Act prohibits the clearing of native vegetation, except where authorised by a property vegetation plan or a development consent granted in accordance with the NV Act.

Pursuant to section 89J(1)(e) of the EP&A Act, the authorisations referred to in section 12 of the NV Act are not required for an approved SSD.

4.3.4 Water Management Act 2000

Section 89 of the WM Act states that a water use approval is required to authorise the use of water for a particular purpose at a particular location. A water management work approval under section 90 is required for the construction and use of a water supply work, drainage work or flood work.

A controlled activity approval under section 91(2) of the WM Act is required for any work undertaken on “*waterfront land*”. “*Waterfront land*” includes the bed of any stream and the land within 40 m of the bank of the stream. An aquifer interference approval under section 91(3) of the WM Act is required for any activity that involves penetration of an aquifer. Both underground and open cut mining constitute aquifer interference activities.

Pursuant to section 89J(1)(g) of the EP&A Act, an approved SSD is exempt from the requirement for water use approvals, water management work approvals and controlled activity approvals under the WM Act.

However, this exemption does not extend to aquifer interference approvals. It follows that the Project will require an aquifer interference approval under section 91 of the WM Act. In order to obtain an aquifer interference approval, the Project must comply with the requirements of the Aquifer Interference Policy (AIP) (NOW, 2012), as outlined in **Section 4.6**.

Water Access Licences

The licensing and approvals provisions of the WM Act apply to water sources that are the subject of a Water Sharing Plan (WSP). Parts 2 and 5 of the *Water Act 1912* (Water Act) continue to apply to water sources that are not the subject of a WSP.

The *Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources 2009* (Hunter Unregulated WSP) applies to the surface water and alluvial water sources in the locality of the Project (see **Figure 37**). The Hunter Unregulated WSP includes the unregulated rivers and creeks within the Hunter River catchment, the highly connected alluvial groundwater (above the tidal limit), and the tidal pool areas.

In total there are 39 water sources covered by the Hunter Unregulated WSP and nine of these are further sub-divided into management zones. The Project is located within the Goulburn Extraction Management Unit within the Bylong River management zone.

This water source has an area of 697.5 km², with approximately 63% of this area being forested (DWE, 2009). Pursuant to clause 4 of the WSP, these water sources include all surface water and any groundwater contained in alluvial sediments.

Section 60A of the WM Act provides that water can only be taken from a water source in accordance with a WAL. KEPCO will therefore require WALs to account for the capture of surface runoff and any groundwater extraction from alluvial aquifers. WALs are also required for water that is involuntarily taken from the water source, such as mining induced leakage from alluvial aquifers.

Clause 4 of the Hunter Unregulated WSP states that the water sources in the WSP do not include fractured rock aquifers or basement rocks. Accordingly, groundwater stored in the deeper rock strata is not currently the subject of WSPs. The licensing provisions of the Water Act apply to water taken from the deeper rock strata (refer to **Section 4.5.1**).

KEPCO will hold WALs with the necessary water allocation at all times that water is taken from water sources. The necessary water allocation will be equivalent to the maximum quantity of water taken by the Project in any given “water year” (i.e. 1 July to 30 June).

KEPCO currently holds eight WALs with a total allocation of 2,535 ML/Year. Further WALs are likely to be secured by KEPCO into the future as the Project progresses through the planning approval's process. The water licensing requirements for the Project are summarised in **Table 13**.

FIGURE 37 Water Sharing Plan for the Hunter Unregulated and Alluvial Water Source

TABLE 13 Project Water Licensing Requirements

Water Type	Water Source	Predicted Annual Take (ML/Year)		KEPCO Current Entitlements Held	Licence Allocation Required (ML/Year or Units)	Water Available in Water Source
		Avg	Max			
Water Management Act 2000						
Alluvial Groundwater	Hunter Unregulated and Alluvial Water Source – Bylong River Water Source	153	295	2,535 units	0	5,843 ML/Year
Alluvial Groundwater (Borefield)		338	1,172	2,535 units	0	5,843 ML/Year
Surface Water (loss of Baseflow)		111	230	2,535 units	0	5,843 ML/Year
Surface Water (loss of catchment runoff)		-	149 ¹	2,535 units	0	5,843 ML/Year
Total from Bylong River Water Source for licensing		491	1,149	2,535 units	0	5,843 ML/Year
Water Act 1912						
Permian Groundwater	Coal seam and Bedrock Aquifers	1,200	2,093	0	2,093	N/A

¹ Based on the estimated maximum undisturbed natural catchment draining to site water management system

Licensing Exemptions

Clause 18(1) of the *Water Management (General) Regulation 2011* (WM Regulation) states that a WAL is not required for any of the purposes listed under Part 1 of Schedule 5.

Clause 12 of Part 1 of Schedule 5 provides a WAL is not required for water taken by means of “*Excluded works*”. “*Excluded works*” are listed under Schedule 1 of the WM Regulation. Clause 3 provides:

“Dams solely for the capture, containment and recirculation of drainage and/or effluent, consistent with best management practice or required by a public authority (...) to prevent the contamination of a water source, provided such dams are located on a minor stream.”

A WAL does not need to be obtained for water captured in water diversion drains or sediment dams, provided that these are located on a minor stream. A “*minor stream*” is defined as a 1st or 2nd order stream that does not maintain permanent flows.

Harvestable Rights

Landholders in rural areas are entitled to capture and use a portion of the rainfall runoff on their property. Section 53 of the WM Act states that a landholder may use the rainfall collected in a dam without the need for a WAL. The construction and use of the dam must be in accordance with the harvestable rights order for the area.

The Project is situated within the Central Division of NSW. The harvestable rights order for the Eastern and Central Division allows a landholder to capture 10% of the average regional rainfall runoff on the land. This imposes a limit on the total capacity of the dams that are constructed pursuant to harvestable rights. Since the total allowable dam capacity is dictated by runoff volume, the capacity is dependent on the regional rainfall and the size of the landholder’s property.

As at July 2015, KEPCO had a total landholding of 5,425 ha within the Project Boundary. In consideration of this landholding area, KEPCO’s maximum harvestable right dam capacity has consequently been determined to be 355 ML/Year. KEPCO’s landholdings comprise 63 dams from which water is currently collected and used without a WAL. All of these dams are located on minor streams. These dams have an annual average capture volume of 89 ML, leaving an available harvestable rights volume of 266 ML for the Project.

4.4 APPROVALS TO BE APPLIED CONSISTENTLY

In order to carry out the Project, KEPCO will require a number of approvals in addition to development consent. Section 89K of the EP&A Act states that various authorisations cannot be refused if they are necessary for carrying out SSD that is authorised by development consent. Those relevant to the Project include the following:

- *"a mining lease under the Mining Act 1992,"*
- *"an environment protection licence under Chapter 3 of the Protection of the Environment Operations Act 1997 (for any of the purposes referred to in section 43 of that Act),"*
- *"a consent under section 138 of the Roads Act 1993,"*

These are discussed below.

4.4.1 Mining Act 1992

The Mining Act governs the mining of coal in NSW. Section 5 of the Mining Act states that it is an offence to mine for minerals, except in accordance with a valid authorisation. Section 6 of the Mining Act provides that an authorisation is also needed to carry out mining purposes that are incidental to mining, including water storages, OEAs, tailings emplacement areas and stockpiles.

The Project will require a mining lease(s) under the Mining Act prior to commencement of mining operations. The proposed extents of future mining lease application(s) are illustrated on **Figure 38**. The actual area included within mining lease application(s) may vary from that shown and will be detailed within the applications lodged with DRE.

KEPCO intend to retain the areas of A287 and A342 which will fall outside of the future mining lease(s) boundary(s) to enable the coal resource within these areas to be further investigated through detailed exploration and feasibility studies.

It is envisaged that the mining lease(s) for the Project will require the preparation of a MOP to the satisfaction of DRE, in relation to the proposed construction and mining related activities. An Extraction Plan will also be required for any longwall panel extraction associated with the underground mining operations. The Extraction Plan(s) will be prepared in consultation with the relevant regulators, any potentially impacted landholders and to the satisfaction of DP&E.

4.4.2 Protection of the Environment Operations Act 1997

Section 48 of the POEO Act provides that an EPL is required to carry out scheduled activities listed under Schedule 1 of the POEO Act. Under clause 28 of Schedule 1 of the POEO Act, *"mining for coal"* is declared to be a scheduled activity if the activity has the capacity to produce more than 500 t of coal per day, or will disturb a total surface area of more than 4 ha.

Both these thresholds will be satisfied by the Project and, therefore the Project is a scheduled activity and will require an EPL.

4.4.3 Roads Act 1993

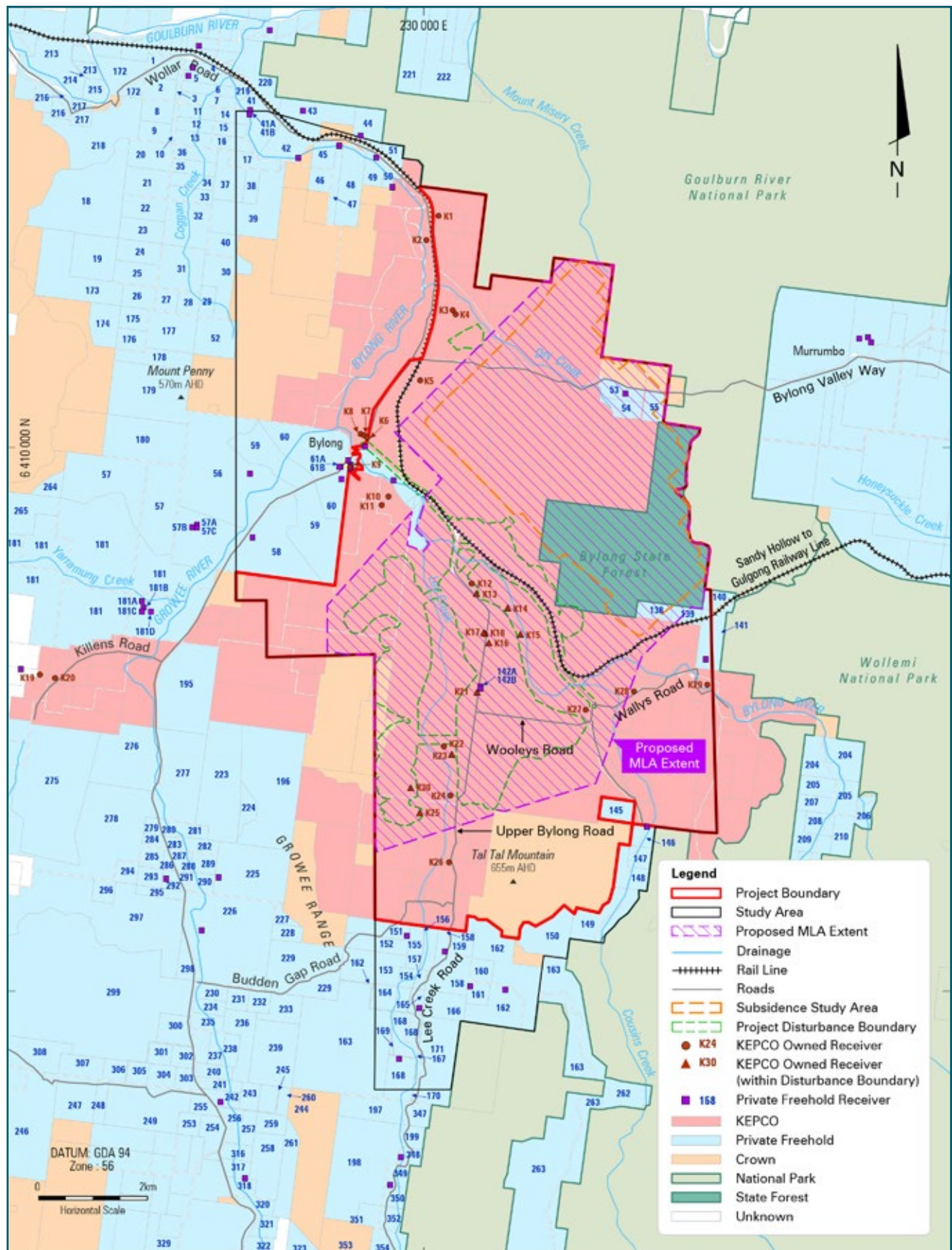
Under section 138 of the Roads Act, work cannot be carried out in, on or over a public road unless the appropriate roads authority has given consent. Further, a section 138 consent cannot be granted with respect to a classified road except with the concurrence of the Roads and Maritime Services.

The consent of the roads authority will be required under section 138 for a number of activities that are proposed to occur in or over a public road, including (but not limited to):

- Construction of the site access roads to the open cut and underground MIAs;
- Realignment and decommissioning of sections of Upper Bylong Road;
- Potential upgrade of existing public roads to provide alternate property access for local landholders; and
- Intersection upgrades to satisfy future anticipated capacity requirements (see **Sections 3.13, 3.14 and 7.18**).

Section 7 of the Roads Act provides that the local council is the roads authority for all roads other than freeways and Crown roads. The roads that will be subject to construction activities are neither freeways nor Crown roads. Therefore, the consent of MWRC is required for any work to be completed on or adjacent to these roads. The Project does not require any works on, in or under a classified road and, therefore the concurrence of Roads and Maritime Services is not required.

FIGURE 38 Proposed Mining Lease Applications



4.5 REQUIREMENTS UNDER OTHER NSW LEGISLATION

4.5.1 Water Act 1912

Given that water contained in porous rock aquifers and basement rocks are excluded from the Hunter Unregulated WSP, water taken from these sources will require a licence under the Water Act.

Section 112 of the Water Act provides that “a licence is required for the sinking of a bore, or the enlargement, deepening or alteration of a bore”. The definition of “bore” under section 105 includes “any bore or well or any excavation or other work connected or proposed to be connected with sources of sub-surface water”. Based on this broad definition, open cut mining areas and underground workings are considered bores. Therefore, groundwater inflows from the porous rock and basement rock aquifers to mining areas (open cut and underground) will need to be authorised by a bore licence under section 112 of the Water Act.

There are currently no embargoes against the granting of licences for the Permian porous and basement rock aquifers in the locality of the Project.

KEPCO does not currently hold a bore licence under Part 5 of the Water Act. Therefore an application will be submitted to seek a new licence to account for the predicted groundwater takes from the porous rock and basement rock aquifers. The Project licensing requirements for takes from the rock aquifers under the Water Act are summarised in **Table 13**.

4.5.2 Dams Safety Act 1978

The *Dams Safety Act 1978* (Dams Safety Act) requires the NSW Dams Safety Committee (DSC) to “formulate measures to ensure the safety of dams” and to “maintain a surveillance of prescribed dams”. A “prescribed dam” is any dam or proposed dam, specified or described in Schedule 1 of the Dams Safety Act.

The detailed design process for the proposed dams for the Project will include an assessment of consequence categories to determine whether any of the proposed dams will be required to be prescribed under the Dams Safety Act.

4.5.3 Work Health and Safety (Mines) Regulation 2014

The *Work Health and Safety (Mines) Act 2013* (WHS (Mines) Act) and *Work Health and Safety (Mines) Regulation 2014* (WHS (Mines) Regulation) were enacted to align mine specific safety laws with the general work health and safety laws. They also provide a single legislative framework for the regulation of safety in mining workplaces in all sectors (e.g. coal, metalliferous and extractive). The laws were developed based on the national model WHS Regulations for mining and additional mining provisions agreed by NSW, Queensland and Western Australia.

Formerly, an approval of the Minister under section 100 of the *Coal Mine Health and Safety Act 2002* (CMHS Act) was required prior to the development of *emplacement areas*.

Emplacement areas are listed as a “high risk activity” under Schedule 3 of the WHS (Mines) Regulation. Notification of high risk activities is required to be provided to DRE prior to the activities being undertaken.

Reject material generated by the Project will be disposed of in OEAs and backfilled mining areas. These fall within the definition of “*emplacement area*”. Therefore, KEPCO will provide the appropriate notification for the emplacement areas (and any other “high risk activities” to be established for the Project prior to the commencement of construction activities.

4.5.4 Threatened Species Conservation Act 1995

The *Threatened Species Conservation Act 1995* (TSC Act) provides a framework for the listing and protection of threatened species, populations and ecological communities and critical habitat within NSW. The TSC Act also provides a framework for the assessment of the impacts of a development on threatened species, populations, ecological communities and critical habitat. An assessment of the Project's impacts on threatened species and ecological communities is provided in **Section 7.2** and **Section 7.3**.

4.5.5 Forestry Act 2012

The Project will involve underground mining and some surface infrastructure development within the Bylong State Forest. Accordingly, the Project will require a permit under section 60 of the *Forestry Act 2012* to authorise the use of the Bylong State Forest for non-forestry purposes.

KEPCO will continue to consult with the Forestry Corporation of NSW in relation to the Project and its intention to apply for a permit under section 60 of the *Forestry Act 2012*.

4.5.6 Public Health Regulation 2012

The exhumation and relocation of burials located on KEPCO owned land within the grounds of the former Catholic Church and Cemetery of Our Lady of the Sacred Heart will require approval from NSW Health. Any exhumations will be carried out in consultation with identified descendants.

Section 134 of the *Public Health Act 2010* provides that the associated regulations may make provision for, or with respect to the exhumation of the bodies of deceased persons. Relevantly, clause 69 of the *Public Health Regulation 2012* prohibits a person from exhuming the remains of a body unless the exhumation of those remains has been ordered by a coroner or approved by the Director-General of the NSW Health. KEPCO will prepare and lodge an application with NSW Health, and will not exhume any remains of a body without the approval of the Director-General of NSW Health under clause 71 of the *Public Health Regulation 2012*.

The relevant application under Section 70 of the *Public Health Regulation 2012* will be prepared and lodged with NSW Health for approval.

Section 7.13 refers to a Deed Poll in relation to the land occupied by the former Bylong Catholic Church and Cemetery. The Deed Poll imposes a number of obligations relating to the maintenance and access to the Cemetery for representatives of the Catholic Diocese of Bathurst, direct descendants of those buried there and persons undertaking legitimate historical research. KEPCO has and will continue to satisfy the maintenance and access obligations regarding the Cemetery.

However, if development consent is granted in relation to the Project, KEPCO understands that the Deed Poll shall no longer apply by operation of section 28 of the EP&A Act and clause 1.9A of the Mid-Western Regional LEP.

Together, these provisions operate so as to enable KEPCO to carry out the Project despite the restrictions contained in the Deed Poll, if development consent is granted for the Project. In light of this position, KEPCO has commenced consultation with the beneficiaries of the Deed Poll and will continue to do so throughout the assessment of the development application for the Project.

Section 7.13 provides further information on the proposed process for the exhumation of burials.

4.6 AQUIFER INTERFERENCE POLICY

Under section 91 of the WM Act, an aquifer interference approval is required for any aquifer interference activity. Aquifer interference activities are defined under the WM Act as activities which involve any of the following:

- The penetration of an aquifer;
- The interference with water in an aquifer;
- The obstruction of the flow of water in an aquifer;
- The taking of water from an aquifer in the course of carrying out mining or other activity prescribed by the regulations; and
- The disposal of water taken from an aquifer in the course of carrying out mining or any other activity prescribed by the regulations.

The AIP sets out the relevant considerations for the Minister when determining an application for an aquifer interference approval. The AIP states that “*all water taken by aquifer interference activities, regardless of its quality, needs to be accounted for within these extraction limits*” which are set by the relevant water sharing plans.

A water licence is required for any aquifer interference activity regardless of whether water is taken directly for consumptive use or incidentally. Activities may induce flow from adjacent groundwater sources or connected surface water.

Flows induced from other water sources also constitute take of water. Separate access licences are required to account for the take from all individual water sources.

The Groundwater Impact Assessment (see **Section 7.6**) has predicted the volumes of water that will be taken as a result of aquifer interference. KEPCO will obtain the necessary water licences under the WM Act and Water Act. The water licensing requirements for the Project are summarised in **Table 13**.

The AIP prescribes “*minimal impact considerations*” for different types of aquifers. For example, the minimal impact considerations for highly productive groundwater are more onerous than the considerations for less productive groundwater. These “*minimal impact considerations*” are presented in **Table 1** of the AIP. An assessment of the Project's impacts with reference to the minimal impact considerations is provided at **Section 7.6.3**.

When deciding whether to grant an aquifer interference approval, the Minister will consider the proponent's:

- Ability to obtain the licences needed to account for the take of water;
- Ability to comply with the minimal impact considerations; and
- Proposed remedial measures for actual impacts greater than the predicted impacts.

NOW and the Commonwealth Independent Expert Scientific Committee (IESC) completed a review of the Gateway Application and supporting documentation and provided advice to the Gateway Panel in relation to the groundwater and surface water impact assessments. Recommendations from the letters from the IESC and NOW dated 14 March 2014 and 26 March 2014 respectively have been incorporated into this EIS as discussed in **Section 7.6**.

4.7 COMMONWEALTH LEGISLATION

4.7.1 Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act prescribes the Commonwealth's role in environmental assessment, biodiversity conservation and the management of protected areas of national significance. The EPBC Act is administered by DoE and provides protection for listed Matters of National Environmental Significance (MNES).

If a proposed action is likely to have a significant effect on one or more MNES, it is deemed to be a *"controlled action"*. Under section 68 of the EPBC Act, a proposed action must be referred to the Commonwealth Minister for the Environment if the proponent considers that the action is or may be a controlled action. If the Minister declares that the proposed action is a controlled action, the action must be the subject of an impact assessment under Part 8 of the EPBC Act. A controlled action cannot be carried out unless the Minister has granted approval under section 133 of the EPBC Act.

The Project was referred to DoE on 12 February 2014. On 12 March 2014, DoE declared that the Project is a controlled action and that the assessment process would be as per a bilateral agreement (20 December 2013) between NSW and Commonwealth Governments.

The Project was considered a controlled action due to its potential impacts on two MNES, namely:

- Threatened species and communities (sections 18 and 18A of the EPBC Act); and
- Protection of water resources from coal seam gas development and large coal mining development (sections 24D and 24E of the EPBC Act).

DoE has confirmed that the assessment process under the EP&A Act has been accredited for the assessment of the Project. The SEARs for the Project incorporate the DoE's environmental assessment requirements (see **Appendix B**). **Section 5.4.1** provides an overview of the SEARs and where each has been addressed within this EIS.

4.7.2 Native Title Act 1993

The *Native Title Act 1993* (NT Act) provides for the recognition and protection of native title. Under section 13 of the NT Act, any person can apply to the Federal Court for a determination of native title.

Section 23A of the NT Act states that native title is extinguished by *"previous exclusive possession acts"* attributable to the Commonwealth. Under section 23B of the NT Act, native title over land is extinguished by the grant of a freehold estate over that land, provided that the grant occurred on or before 23 December 1996. Native title has the potential to exist on Crown Land. The Project will involve mining and infrastructure development on some areas of Crown Land.

There are currently no native title determination applications on foot over any land within the Project Boundary.

5

Stakeholder Engagement

Stakeholder Engagement

A Stakeholder Engagement Strategy was prepared for the Project. This Stakeholder Engagement Strategy identified key stakeholders and engagement approaches and also included a monitoring and reporting component.

This section provides a summary of the stakeholder engagement undertaken for the Project. Consultation occurred with near neighbours and the surrounding community, local service providers, the Aboriginal community, government regulators and neighbouring industry. It also provides an overview of the engagement process applied, a description of the various phases and the findings that have been incorporated into the EIS and KEPCO's commitment to ongoing engagement.

A Social Impact Assessment (SIA) was undertaken as a component of this EIS. The consultation program for the SIA is summarised in this section and the findings are discussed in **Section 7.21**.

An Aboriginal Archaeology and Cultural Heritage Impact Assessment (AACHIA) was also undertaken as a component of this EIS. The consultation program for the AACHIA is also summarised in this section and is discussed further in **Section 7.11**. Other assessments prepared for this EIS also detail consultation, including Historic Heritage, Archaeological Assessment for Historical Burials, Soils and Land Capability, Rehabilitation and Agriculture.

5.1 EIS STAKEHOLDER ENGAGEMENT OBJECTIVES

The aim of stakeholder engagement for the Project was to identify stakeholders' issues in relation to the Project and ensure that the relevant issues were addressed in the EIS. The consultation process was therefore designed with the following objectives:

- Identify Project stakeholders;
- Inform stakeholders of the Project;
- Identify and understand all stakeholder issues in relation to the Project; and
- Develop and implement response strategies to address relevant stakeholder issues.

Stakeholder engagement completed in support of the EIS is discussed in detail below.

5.2 STAKEHOLDER IDENTIFICATION

A comprehensive list of Project stakeholders was developed through:

- The compilation of land ownership information;
- Exploration into the local and wider community, industry and service providers;
- Networking with different individuals and community organisations;
- Discussions with MWRC; and
- Inclusion of all stakeholders referenced in the SEARs.

The key stakeholders relevant to the Project and the methods of engagement employed for each are listed in **Table 14**.

TABLE 14 Project Stakeholders and Methods of Engagement

Stakeholders	Method of Engagement
COMMUNITY STAKEHOLDERS	
Near Neighbours / Community	- Regular Community Newsletters (April 2011, September 2011, January 2012, May 2012, August 2012, October 2012, April 2013, August 2013, February 2014, May 2014, November 2014, April 2015 and August 2015) - Community Fact Sheets (various between 2011 to 2015) - Letters and personal invitations to key near neighbour stakeholders at various stages of the planning approvals process (incl. Gateway, Background Document, EIS development, farm management and Project updates) - Open Days (held in 2011, 2012 and 2013) - Community Information Sessions (December 2013, February 2014 and November 2014) - Discussions with key landholders within the Bylong Valley (ongoing) - Face to face individual Project Briefings and presentations with 18 landholders regarding the Gateway Certificate application - Discussions with key landholders predicted to receive significant amenity/access impacts which will result in mitigation or acquisition (March to July 2015) - Project and EIS Briefing with the owners of the Bylong General Store (February 2013, December 2013, March 2014, May 2014, August 2014, April 2015 and June 2015) - Engagement with landholders potentially impacted by drilling program (27-30 April 2015) - Liaison with landholders regarding proposed drilling activities and associated approvals process (27-30 April 2015) and engagement of landholders potentially impacted by the drilling program (April to July 2015) - Various media highlighting EIS milestones and issues – Mudgee Guardian, Prime 7 and Newcastle Herald (from 2011 and ongoing) - SIA consultation (See Section 5.5) - Project website – www.bylongproject.com.au - Community information line – 1800 BYLONG - Bylong mailbox – bylong@worleyparsons.com - Involvement in community events, such as the Bylong Street Feast
MWRC LGA (residents)	- Regular Community Newsletters (April 2011, September 2011, January 2012, May 2012, August 2012, October 2012, April 2013, August 2013, February 2014, May 2014, November 2014, April 2015 and August 2015) - Community Fact Sheets (April 2011, September 2011, January 2012, May 2012, August 2012, October 2012, October 2012, April 2013, August 2013, February 2014, May 2014 and March 2015) - Community Information Sessions (December 2013, February 2014 and November 2014) - Community drop in day (Mudgee and Kandos in February 2014) - Project website – www.bylongproject.com.au - Community information line – 1800 BYLONG - Various media releases in locally available newspapers (such as Mudgee Guardian), from 2011 and ongoing
MWRC LGA (service providers)	- Regular Community Newsletters (various between 2011 and 2015) - Community Fact Sheets (various between 2011 and 2015) - Community Information Sessions (December 2013, November 2014) - Open Days (held in 2011, 2012 and 2013) - Project website – www.bylongproject.com.au - Community information line – 1800 BYLONG - Bylong mailbox – bylong@worleyparsons.com

Stakeholders	Method of Engagement
	▪ Involvement in various community events (e.g. Rylstone Street Feast) ▪ Various media releases in locally available newspapers (such as Mudgee Guardian), from 2011 to 2015 ▪ Rylstone and District Historical Society – discussions regarding potential church relocation and Homestation building works (March-April 2015) ▪ Project Briefings with: – Rylstone District Care and Transport (2 June 2015) – Barnardos (Orange) (26 May 2015) – Rylstone HealthOne (2 June 2015) – Bylong Rural Fire service (3 June 2015) – Mudgee Preschool – Introduction to the Project (4 June 2015) – Mudgee Hospital - Introduction to the Project (9 June 2015) – Rylstone Volunteer Rescue Association (15 June 2015) – Rylstone-Kandos Preschool (16 June 2015) – Mudgee Disability Support Services (23 June 2015) – Family Day Care (MWRC) (23 June 2015)
Aboriginal Community	▪ Public notice in Mudgee Guardian (15 January 2014) and the Hunter Valley News (15 January 2014) ▪ Letter inviting expressions of interest (6 February 2014) to all Aboriginal stakeholders identified by regulatory agencies ▪ Letter inviting expressions of interest (12 February 2014) to all Aboriginal stakeholders identified by OEH ▪ Onsite planning meeting (11 April 2014) ▪ Field archaeological survey (between 19 May and 27 June 2012) ▪ Arborist potential scar tree assessment (29 July 2014) ▪ Review of EIS findings (20 January 2015) ▪ Draft Aboriginal and Cultural Heritage Impact Assessment review (19 December 2014 to 30 January 2015) ▪ Bylong mailbox – bylong@worleyparsons.com, Project website – www.bylongproject.com.au, 1800 BYLONG ▪ Ongoing engagement as a component of Indigenous Participation Planning (2015) ▪ Project Briefing and Discussion – Tocomwall (7 January 2015)
Descendant Engagement	▪ Public Notices and initial engagement regarding former Upper Bylong Catholic Church Cemetery grave exhumations (March – July 2015)
Newcastle University - Tom Farrell Institute for the Environment	▪ Teleconference Professor Tim Roberts and Peter Andrews regarding Rehabilitation Trials (25 November 2014) ▪ Face to Face discussions regarding Rehabilitation Trials occurred with Professor Tim Roberts including Peter Andrews on 22 May 2015 ▪ Letter of Intent sent to Tom Farrell Institute on 7 August 2015
Outcomes Australia - Soils for Life	▪ Project Briefing to Major General the Honourable Michael Jeffery (28 August 2014) ▪ Correspondence regarding Project Rehabilitation Plan and proposed trial of Soil Hydrology Management (26 September 2014)
FEDERAL GOVERNMENT AGENCIES	
DoE	▪ Project Briefing and notice of intent to submit Referral (4 February 2014) ▪ Project Briefing and presentation of preliminary Biodiversity Offsets Strategy (6 August 2014) ▪ Offer of Project and technical assessment update (December 2014) including: – Minor optimisations to Project mine plan – Bilateral Agreement process and path required for Project – Proposed Biodiversity Offsets Strategy

Stakeholders	Method of Engagement
STATE GOVERNMENT AGENCIES	
DP&E	- Initial Project Briefing with Director of Major Projects (25 July 2012) - Project Briefing (5 December 2012) - Project update and Gateway process discussion (30 May 2013) - Project update (31 October 2013) - Combined meeting with DP&E, NOW and Department of Primary Industries – Office of Agricultural Sustainability and Food Security (DPI-OAS&FS) to discuss Gateway process and progress (13 November 2013) - Combined meeting with DP&E, NOW and DPI-OAS&FS to discuss Gateway conclusions (13 January 2014) - Submit Background Document (17 January 2014) - Planning Focus Meeting (13 February 2014) - Project SEARs Letter received (23 June 2014) - Project update and confirmation of SEARs (15 July 2014) - Project update including minor optimisations to Project mine plan and request for updated SEARs (20 October 2014) - Project Amended SEARs Letter received (11 November 2014) - Project update (17 March 2015) including the following key items: - Approvals process update - Biodiversity Offset Strategy (BOS) - Subsidence - Noise - Roads strategy - VPA - Presentation on EIS status and discussion of various matters for consideration (22 May 2015)
DRE	- Presentation of Conceptual Project Development Plan (9 December 2013) - Correspondence with DRE culminating in a letter from DRE to DP&E supporting the Project (16 December 2013) - Site visit with subsidence team (1 April 2014) - Project update including optimisations to mine plan (12 November 2014) - Project update including presentation on cliff line impacts (9 March 2015) - Presentation for proposed Mining Lease application (14 May 2015)
Department of Primary Industries (DPI) (Fisheries)	Offer of Project Briefing via telephone and follow up email (to be completed September 2015)
DPI-OAS&FS	- Combined meeting with DP&E, NOW and DPI-OAS&FS to discuss Gateway process and progress (13 November 2013) - Combined meeting with DP&E, NOW and DPI-OAS&FS to discuss Gateway conclusions (13 January 2014) - Offer of Project Briefing via telephone and follow up email (11 July 2014) - Offer of Project Briefing to present Agricultural Impact Statement results (September 2015)
NSW Office of Water (NOW)	- Project Briefing (27 June 2013) - Combined meeting with DP&E, NOW and DPI-OAS&FS to discuss Gateway process and progress (13 November 2013)

Stakeholders	Method of Engagement
	- Combined meeting with DP&E, NOW and DPI-OAS&FS to discuss Gateway conclusions (13 January 2014) - Planning Focus Meeting in Bylong Coal Project Site Office (13 February 2014) - Project Update Meeting – Draft Groundwater and Surface Water Impact Assessment Report Discussion (11 March 2015) - Various discussions in relation to the Aquifer Interference Policy (March – April 2015)
OEH (including Heritage Branch)	- Planning Focus Meeting in Bylong Coal Project Site Office (13 February 2014) - Project Briefing and presentation of preliminary Biodiversity Offsets Strategy (25 July 2014) - Project Update for Heritage Division and discussion regarding Burial Impact Assessment (29 August 2014) - Project Briefing regarding Ecology, Biodiversity Offsets Strategy and Aboriginal Archaeology and Cultural Heritage assessment, results and proposed mitigation and management strategies to address SEARs (11 February 2015) - Letter from OEH regarding BOS (2 March 2015) - BOS discussion in Sydney (26 March 2015) - BOS discussion in Dubbo (8 April 2015) - Letter from OEH regarding the BOS (6 May 2015)
EPA	- Planning Focus Meeting in Bylong Coal Project Site Office (13 February 2014) - Project Briefing and presentation of predicted noise and air quality impacts (28 April 2015)
NSW Department of Education & Communities (DoEd)	- Project Briefings and ongoing discussions regarding relocation of BUPs (3 December 2013) - Project Briefing in Sydney office (14 August 2014) - Site visit to review potential sites for Upper Bylong School relocation (15 September 2014) - Letter from DoEd to KEPCO to advise no enrolments at BUPs for 2015 and school has been placed into recess (7 January 2015)
Gateway Panel	- Submitted Gateway Application (10 January 2014) - Gateway Certificate issued (15 April 2014)
Catchment and Lands (Crown Lands Division)	Project Briefing (September 2015)
Forestry NSW	- Project Briefing and discussions (June 2014) - Project Briefing and discussions regarding Occupation Certificate (21 May 2015)
LOCAL GOVERNMENT AGENCIES	
MWRC	- Project Briefing (20 November 2013) - Project Briefing with Mayor, General Manager and Director of Development and Community Services (18 December 2013) - Planning Focus Meeting in Bylong Coal Project Site Office (13 February 2014) - VPA and SIA Assumption Briefing (28 May 2014) - Letter sent to MWRC to confirm SIA assumptions (30 June 2014) - Letter sent to MWRC to confirm VPA intent (26 June 2014) - Project Update Briefing for new General Manager (13 August 2014) - SIA consultation (Section 5.5) - Briefing Update (5 December 2014) - Project Update – WAF and various road related matters (15 January 2015)

Stakeholders	Method of Engagement
	- Project Briefing regarding Bylong Cemetery and grave reburials (March-April 2015) and traffic assessment (9 April 2015) - VPA discussion with General Manager, Mayor and Director of Environment (9 April 2015) - VPA discussions with General Manager (28 May 2015) - Road Strategy and VPA discussion (18 June 2015)
Muswellbrook Shire Council (MSC)	- Project Briefing (1 July 2014) (Mayor and General Manager) - Project update, specifically regarding traffic assessment outcomes (September 2015)
Singleton Shire Council	- Project Briefing (May 2014) (Mayor, General Manager) - Project Briefing to Singleton Councillors (May 2014)
INFRASTRUCTURE AND SERVICE PROVIDERS AND OTHER MINES	
Industry Engagement	- Australian Longwall Conference Hunter Valley NSW – Technical Presentation (27 October 2014) - Mining and Energy Services Council of Australia (MESCA) Project Briefing in Newcastle NSW – Project Briefing (10 September 2014) - Hunternet Project Briefing, Newcastle NSW (5 November 2014) - Hunternet Project Briefing, Newcastle NSW (21 January 2015) 9th Australian Bulk Handling Awards, Technical Award Sydney NSW (6 November 2014) - NSW Minerals Council CEO meeting (9 June 2015)
Transport for NSW (including Centre for Transport Planning, Roads and Maritime Services)	Project Briefing (to be completed September 2015)
Australian Rail Track Corporation	- Project Briefing (11 December 2014) - Geotechnical and access discussions (28 April 2015)
Endeavour Energy	Project Briefing, updates and discussions regarding potential network impacts and Project network needs (two formal meetings on 10 October 2014 and 6 November 2014 and ongoing fortnightly liaison via telephone and email)
John Holland Rail	Ongoing telephone and email liaison with Country Rail Network regarding access requirements (commenced liaison in March 2015)
Mudgee Chamber of Commerce	Project Briefing to 32 members in Mudgee (9 June 2014)
Pacific National	- Initial Project Briefing and pricing discussion for haulage services (11 December 2014) - Discussion regarding the provision of haulage services between Bylong and Newcastle Port (28 April 2015)
Aurizon	Discussion regarding provision of the haulage services between Bylong and Newcastle Port (29 April 2015)
Hunter Valley Coal Chain Coordinator	Project Briefing and discussion regarding logistic modelling and coordination (11 December 2014)
Newcastle Coal Industry Group	Initial Project Briefing and exploration of opportunities 29 April 2015
Relevant neighbouring mines and industry	- Yancoal Chief Development Officer Project Briefing, Sydney (7 November 2014) - Yancoal Moolarben Site Visit and Project Briefing (20 May 2015) - Peabody Wilpinjong various visits (2013-2015)

5.3 PROJECT BRIEFINGS AND ISSUE SCOPING

Engagement with community and regulatory stakeholders was conducted to inform stakeholders of the Project and assist in the identification of key Project issues.

Engagement purpose, methods and timing is summarised in **Table 14** and outlined below.

Issue scoping with the community and regulators for the Project was undertaken in accordance with the following key objectives:

- To engage with relevant stakeholders to understand and discuss stakeholder/community issues and concerns;
- To assess the compatibility of the Project with existing land uses in the local area and the values of the local community;
- To identify the perceived primary and higher order social impacts (direct and indirect) associated with the Project, particularly on those communities within MWRC LGA;
- To maintain a process for consistent, ongoing consultation and communication with key stakeholders and the local community;
- To enable stakeholders to have input into this EIS and Project planning;
- To proactively respond to and address relevant stakeholder issues; and
- To develop appropriate solutions and mitigation strategies to minimise the potential impacts of the Project.

Various methods were employed to engage with the local community. These included:

- Personal briefings;
- The distribution of newsletters;
- Community information sessions and open days;
- The delivery of presentations; and
- Participation in community events.

Follow up to issues raised during consultation was completed, as required, to further discuss individual's concerns in relation to the Project and to ensure that these were considered as appropriate in this EIS. KEPCO has also engaged Community Liaison Officers and a Farm Manager who reside within the Bylong Valley to facilitate and encourage communications between the local community and KEPCO.

5.3.1 Newsletters, Fact Sheets and Direct Correspondence

Engagement with KEPCO's near neighbours and the wider local community has been complemented by the distribution of several Project newsletters and fact sheets during the preparation of this EIS. **Appendix F** provides copies of newsletters and fact sheets distributed to the community. Approximately 130 copies of each newsletter and fact sheet were distributed to the local community, regulators, service providers and other interested stakeholders. Newsletters and fact sheets were distributed during April 2011, September 2011, January 2012, May 2012, August 2012, October 2012, October 2012, April 2013, August 2013, February 2014, May 2014, November 2014, March 2015, April 2015 and August 2015.

A further newsletter is proposed to be distributed immediately prior to this EIS being placed on public exhibition notifying stakeholders of the key findings from the assessments and where they will be able to view a copy of the EIS and to make a submission on the Project. This newsletter will also invite stakeholders to participate in EIS information events to be held during the public exhibition period.

Landholders within the Bylong Valley have been engaged via personalised letters, phone calls and face to face meetings. Key Project issues and concerns raised included land access, air and noise impacts, agricultural land practices, impacts to agricultural water, property acquisition, road access impacts, business and employment opportunities. The key community issues raised during consultation are included below in **Section 5.4.3**.

5.3.2 Community Information Sessions

Community information sessions were held during December 2013, February 2014 and November 2014. The Community Information Sessions were initiated by KEPCO to provide the local community an opportunity to gain additional information on the Project and to seek any face to face feedback from Project staff. Feedback forms were available for community submissions and data was recorded in a stakeholder contact database. Approximately 52 members of the local community attended the information sessions to discuss issues in relation to the Project.

There was also an Exploration Information Day held in October 2011. The session involved a brief safety induction before visiting a drill rig, viewing core samples, and two sites demonstrating the rehabilitation and environmental processes. Approximately 26 members of the community, including landholders and children from the local BUPs attended the information sessions.

KEPCO representatives fielded a number of questions from attendees covering a range of environmental and socio-economic issues. The matters raised were discussed at the time with additional follow up information provided as required. The issues raised were also recorded and considered for assessment within this EIS (see **Section 5.4.3**).

5.3.3 Local Service Providers Engagement

Engagement with key service providers within the MWRC LGA was completed as a component of the SIA consultation and is further discussed in **Section 5.5**. Relevant issues raised during consultation with service providers have been integrated into the issues summary provided in **Section 5.4.3**.

5.3.4 Regulatory Engagement

A series of Project Briefings and presentations were provided to the relevant regulators throughout the preparation of this EIS (see **Table 14**).

This consultation generally involved providing briefings on the Project description, confirming the proposed methodologies for assessment and providing updates on the results of environmental studies. This level of engagement assured that the SEARs were appropriately addressed within this EIS. Issues raised by regulatory stakeholders (including the SEARs) are discussed further in **Section 5.4**.

5.4 ISSUE RESPONSE

Following completion of the Project Briefings and issue scoping phases, responses were prepared for relevant issues raised by stakeholders in relation to the Project. Where possible, issues raised were addressed directly with the relevant stakeholders.

Stakeholder issues and any perceived impacts have been considered and assessed within this EIS. Strategies for the management and mitigation of these issues are also detailed in this EIS.

5.4.1 Secretary's Environmental Assessment Requirements

Department of Planning and Environment

In response to the regulatory consultation undertaken for the Project, the Secretary of DP&E issued SEARs (SSD 14_6367) on 23 June 2014. Revised SEARs were issued on 11 November 2014 to address the optimised mine plan.

The SEARs are provided in full in **Appendix B. Table 15** lists the SEARs and identifies the section of the EIS which addresses each requirement.

Regulatory Submissions to SEARs

Submissions to DP&E were received from the following regulatory agencies:

- DoE;
- DRE;
- DPI – Fisheries;
- DPI – OAS&FS;
- DPI – Crown Lands;
- DPI – NOW;
- OEH;
- EPA;
- Heritage Council of NSW;
- Transport for NSW – RMS; and
- MWRC.

The issues raised by each of the above mentioned regulatory agencies and where they have been addressed in this EIS are included in **Appendix B** and in individual technical appendices.

TABLE 15 Secretary's Environmental Assessment Requirements

Issue	Description	EIS Section
General Requirements	The Environmental Impact Statement (EIS) for the development must comply with the requirements in: ▪ Clauses 6 and 7 of Schedule 2 of the <i>Environmental Planning and Assessment Regulation 2000</i>; and ▪ the Mining & Petroleum Gateway Panel's Conditional Gateway Certificate. In particular, the EIS must include: ▪ a full description of the development, including: – the resource to be extracted, demonstrating efficient resource recovery within environmental constraints; – the mine layout and scheduling; – minerals processing; – associated infrastructure, including any temporary workers accommodation; – a waste (overburden, tailings, etc.) management strategy, dealing with the EPA's requirements (see Attachment 2); – a water management strategy, dealing with the Mining & Petroleum Gateway Panel's, EPA's, Department of Primary Industries' and (Commonwealth) Department of the Environment's requirements (see Attachments 2 & 3); – a rehabilitation strategy, dealing with the Mining & Petroleum Gateway Panel's, NSW Resource & Energy's and Department of primary Industries' requirements (see Attachments 2 & 3); and – the likely interactions between the development and any other existing, approved or proposed mining development in the vicinity of the site; ▪ a list of any approvals that must be obtained before the development may commence; ▪ an assessment of the likely impacts of the development on the environment, focusing on the specific issues identified below, including: – a description of the existing environment likely to be affected by the development, using sufficient baseline data; – an assessment of the likely impacts of all stages of the development, including any cumulative impacts, taking into consideration any relevant laws, environmental planning instruments, guidelines, policies, plans and industry codes of practice; – a description of the measures that would be implemented to mitigate and/or offset the likely impacts of the development, and an assessment of: ▪ whether these measures are consistent with industry best practice, and represent the full range of reasonable and feasible mitigation measures that could be implemented; ▪ the likely effectiveness of these measures; and ▪ whether contingency plans would be necessary to manage any residual risks; – a description of the measures that would be implemented to monitor and report on the environmental performance of the development if it is approved; ▪ a consolidated summary of all the proposed environmental management and monitoring measures, identifying all the commitments in the EIS; ▪ consideration of the development against all relevant environmental planning instruments (including Part 3 of the <i>State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007</i>); and ▪ the reasons why the development should be approved having regard to biophysical, economic and social considerations, including the principles of ecologically sustainable development.	EIS Statement Table 16 3, 7.25, 7.4, 7.6, 7.15 and 2.4.1 4.1 2, 7 and 8 8 and Table 102 4.2.8 9

Issue	Description	EIS Section
	While not exhaustive, Attachment 1 contains a list of some of the environmental planning instruments, guidelines, policies, and plans that may be relevant to the environmental assessment of this development. In addition to the matters set out in Schedule 1 of the <i>Environmental Planning and Assessment Regulation 2000</i>, the development application must be accompanied by a signed report from a suitably qualified expert that includes an accurate estimate of the: - capital investment value (as defined in clause 3 of the <i>Environmental Planning and Assessment Regulation 2000</i>) of the development, including details of all the assumptions and components from which the capital investment value calculation is derived; and - jobs that would be created during each stage of the development.	Refer to SSD Application
Key Issues	Subsidence – including an assessment of the likely conventional and non-conventional subsidence effects and impacts of the development, and the potential environmental consequences of these effects and impacts on both the natural and built environment, paying particular attention to those features that are considered to have significant economic, social or environmental values; Land – including: - an assessment of the likely impacts of the development on the soils and land capability of the site and surrounds, paying particular attention to any biophysical strategic agricultural land (BSAL), having regards to the Mining & Petroleum Gateway Panel's and Department of Primary Industries' requirements (see Attachments 2 & 3); - an assessment of the likely agricultural impacts of the development, paying particular attention to the mapped equine critical industry cluster in the area; - an assessment of the likely impacts of the development on landforms (topography), including: - the potential subsidence impacts on cliffs, rock formations and steep slopes, and - the long term geotechnical stability of any new landforms (such as mine waste emplacements); - an assessment of the compatibility of the development with other land uses in the vicinity of the development in accordance with the requirements in Clause 12 of <i>State Environmental planning policy (Mining, Petroleum Production and Extractive Industries) 2007</i>; Water – including: - an assessment of the likely impacts of the development on the quantity and quality of the region's surface and groundwater resources, having regard to the Mining & Petroleum Gateway Panel's, EPA's, Department of Primary Industries' and (Commonwealth) Department of the Environment's requirements (see Attachments 2 & 3); - an assessment of the likely impacts of the development on aquifers, watercourses, riparian land, water-related infrastructure, and other water users; and - an assessment of the likely flooding impacts of the development; Air Quality – including: - an assessment of the likely air quality impacts of the development in accordance with the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW, including the likely PM_{2.5} emissions (see Attachment 2); and - an assessment of the likely greenhouse gas impacts of the development, dealing with OEH's requirements (see Attachment 2); Noise and Blasting – including: - an assessment of the likely operational noise impacts of the development (including construction noise) under the NSW industrial Noise Policy, paying particular attention to the obligations in chapters 8 and 9 of the policy;	7.1 7.14, 7.15 and 7.16 7.4, 7.5 and 7.6 7.7 and 7.8 7.9 and 7.10

Issue	Description	EIS Section
	– if a claim is made for specific construction noise criteria for certain activities, then this claim must be justified and accompanied by an assessment of the likely construction noise impacts of these activities under the Interim Construction Noise Guideline; – an assessment of the likely road noise impacts of the development under the NSW Road Noise Policy; – an assessment of the likely rail noise impacts of the development under the NSW Rail infrastructure Noise Guideline; and – an assessment of the likely blasting impacts of the development on people, animals, buildings and infrastructure, and significant natural features, having regard to the relevant ANZEC guidelines;	
	▪ Biodiversity – including: – an assessment of the likely biodiversity impacts of the development, having regard to OEH's, the Department of Primary Industries' and the (Commonwealth) Department of Environment's requirements (see Attachment 2); – a comprehensive offset strategy to ensure the development maintains or improves the terrestrial and aquatic biodiversity values of the region in the medium to long term.	7.2 and 7.3
	▪ Heritage – including an assessment of the likely Aboriginal and historic heritage (cultural and archaeological) impacts of the development having regard to OEH's and the Heritage Council of NSW's requirements (see Attachment 2);	7.11, 7.12 and 7.13
	▪ Transport – including an assessment of the likely transport impacts of the development on the capacity, condition, safety and efficiency of the local and State road and rail network;	7.18
	▪ Visual – including an assessment of the likely visual impacts of the development on private landowners in the vicinity of the development and key vantage points in the public domain, paying particular attention to the creation of new landforms (overburden dumps, bunds, etc.), and minimising the lighting impacts of the development;	7.17
	▪ Public Safety – including an assessment of the likely risks to public safety, paying particular attention to potential subsidence risks, bushfire risks, and the transport, handling and use of any dangerous goods;	6 and 7.24
	▪ Social & Economic including: – an assessment of the likely social impacts of the development (including perceived impacts), paying particular attention to any impacts on Bylong village; and – an assessment if the likely economic impacts of the development, paying particular attention to: ▪ the significance of the resource; ▪ economic benefits of the project for the State and region; and ▪ the demand for the provision of local infrastructure and services	7.21 and 7.22
Consultation	During the preparation of the EIS you must consult with relevant local, State and Commonwealth Government authorities, service providers, community groups and affected landowners. The EIS must describe the consultation that was carried out, identify the issues raised during this consultation, and explain how these issues have been addressed in the EIS.	5 (this section)

Conditional Gateway Certificate

In addition to the regulatory submissions received, DP&E also attached the Conditional Gateway Certificate to the SEARs.

Table 16 lists the Conditional Gateway Certificate's recommendations over the Project and the section of the EIS where each is addressed.

TABLE 16 Gateway Certificate Recommendations

Relevant Criteria	Consideration	Recommendations	EIS Section
17H4(a)(i), (ii), (v), (vi)	The proposal to remove 194.4 ha of verified BSAL soils from within the planned open-cut mining area and the 're-creation' of this BSAL elsewhere lacks precedence and necessary detail.	With regard to the removal and recreation of verified BSAL soils: 1. Undertake a risk assessment that identifies the hazards and proposes controls with respect to the movement of BSAL soils; 2. Identify a final location for the verified BSAL soils within the Project Boundary area; 3. Detail the methods proposed for the handling, storage and treatment of the verified BSAL soils; 4. Propose alternate mitigation measures to be implemented in the event that the methodology selected results in the loss of verified BSAL soils post-implementation.	7.14.2, 7.15.3 and Appendix W Figure 63 7.14.4 and Appendix V 7.15.3 and Appendix W
17H4(a)(iv)	Significant impacts are anticipated on highly productive groundwater and the consequent connection between surface and groundwater in modelling requires more detailed evaluation.	1. Develop a more complex transient 3D numerical model for the EIS stage of the Development Application which includes improved time variant input data, more details on recharge, geological imperfections (dykes, sills & faults), fractures from subsidence, and a sensitivity/uncertainty analysis. 2. Complete baseline studies for the project area to improve knowledge on water levels, and groundwater dependent ecosystems. 3. Provide an assessment of the hydrochemistry of spoil and tailings materials, and potential impact on nearby water sources. 4. Provide a strategy for complying with the rules of the Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources. In particular the implication of reduced available water determinations (AWDs) and the cease to pump rule. 5. Supply a plan for monitoring actual water take and how any changes from the predictions will be accounted for with water licences and remediation.	7.6.1, 7.6.2 and Appendix M 7.2.4, 7.6.1 and Appendix M 7.6 and 7.20 7.4.3, 7.6.3, 7.6.4 and Appendix M 7.6.4 and Appendix M
17H4(a)(i)	Mine waste emplacements have been designed with steep slopes to minimise footprint disturbance areas.	1. Conduct an analysis of short and long term geotechnical stability risk of waste emplacement slope gradients. 2. Demonstrate that all final landform slope gradients are geotechnically stable in the long term and have factors of safety of 1.5 or better. 3. Demonstrate that all final landform slope gradients are erosionally stable.	3.17, 7.15.4, Appendix E and Appendix W 3.17, 7.15.4, Appendix E and Appendix W 3.17, 7.15.4, Appendix E and Appendix W
17H4(b)(i), (ii), (iii), (iv), (v)	NSW Government has verified 1,933 ha of land within the Project Boundary area as Equine CIC land. The potential impacts of the Project on the Equine CIC have not been properly assessed.	Using the Guideline for Gateway Applicants (September 2013) by Department of Planning & Infrastructure, provide a compliant and comprehensive assessment of the Project's potential impacts on the Equine CIC.	7.16.5 and Appendix X

5.4.2 Regulatory Stakeholder Issue Responses

A number of issues were raised by regulatory agencies that were not specifically raised by regulatory submissions to inform the SEARs throughout the stakeholder engagement program, including at Project Briefings or other meetings.

These issues have been addressed as relevant in this EIS. **Table 17** outlines the regulatory stakeholder issues raised and the section of the EIS where each is addressed.

TABLE 17 Regulatory Stakeholder Issues

Agency	Issues Raised	EIS Section
FEDERAL GOVERNMENT AGENCIES		
DoE	"Controlled Action" referral	4.7.1
	Impacts to Federally listed species (separate from State listed species)	7.2 and 7.3
	Potential impacts to water resources	7.4, 7.5 and 7.6
	Principals of ecological offsetting	7.2 and 7.3
STATE GOVERNMENT AGENCIES		
DP&E	Potential amenity impacts to Bylong Village	7.7, 7.9, 7.10 and 7.17
	VPA with MWRC	4.2.11, 7.18, 7.21 and 7.22
	Ecological offsetting	7.3
	Rehabilitation and mine closure (no final void)	7.15
	Mine plan alternatives considered	3.17.2
	Legislative requirements and EIS process	4
DRE	Mining authorities required for mining	4.4.1
	Regional geology including Project reserves and exploration	2.7
	Project mine plan progression and timing	3
	Rehabilitation and final landform	3.3 and 7.15
	Alternate mine plans, including OEA options considered	3.17
	Subsidence related impacts to sensitive surface features	7.1
DPI-OAS&FS	Impact to agricultural production through loss of agricultural land	7.16
	Impacts to SAL	7.16
	Impact to agricultural production through loss of agricultural water	7.16
	Agricultural land use post-mining	7.15 and 7.16
	Rehabilitation objectives and soil resource management	3.3, 7.14 and 7.15
	Groundwater and surface water assessment modelling methodologies	7.4, 7.5 and 7.6
NOW	Assessment of extreme climate scenarios, specifically extreme dry scenario to confirm available water for Project	7.4, 7.5 and 7.6
	Water quality impacts	7.4, 7.5 and 7.6
	Groundwater and surface water quantity impacts to private bores and licensing requirements	7.4, 7.5 and 7.6
	Connectivity between surface and groundwater systems	7.6
	Meeting AIP requirements	7.6

Agency	Issues Raised	EIS Section
OEH (including Heritage Branch)	Principals of ecological offsetting	7.2 and 7.3
	Subsidence impacts to overlying ecological attributes	7.1, 7.2 and 7.3
	Offsetting mechanism to be applied to BOS	7.3
	Assessment and management of Aboriginal archaeology and cultural heritage	7.11
	Comparing the results of Aboriginal archaeological field work with the predictive modelling	7.11
	Proposed process for exhuming the burials	7.13
	Outline of the management plan structure to be prepared in relation to the archaeological excavation	7.13
EPA	Justification of representative staged Project mine plans included in Air Quality and Noise modelling	7.7 and 7.9
	Assessment of diesel particulate matter within the Air Quality and Greenhouse Gas Impact Assessment	7.7
	Demonstration that all reasonable and feasible noise mitigation and management measures to the operations have been considered	7.9
	Surface water quality impacts	7.4
	Requirements for discharge of mine water and the mine water balance modelling	7.4
DoEd	Project staging and timing	3
	BUPS relocation timing and proposed locations	3
	Amenity impacts on proposed relocation site	7.7, 7.9 and 7.10
Catchment and Lands (Crown Lands Division)	Proposed use of Crown lands located within Project Boundary	3
Forestry NSW	Undermining of Bylong State Forest	3
	Access arrangements to Bylong State Forest	4.5.5
LOCAL GOVERNMENT AGENCIES		
MWRC	Subsidence related impacts on Bylong Valley Way and proposed remediation techniques	7.1
	Content of the VPA	4.2.11, 7.18, 7.21 and 7.22
	Project workforce size and proposed accommodation strategy	3.10, 3.11 and 7.21
	Local hire policy	7.21
	Proposed MWRC upgrades to Wollar Road and effects on accommodation strategy	3.11 and 3.12
	Local road closures, relocations and upgrades	3.13 and 3.14
	Traffic and road impacts resulting from the Project	7.18
	Project workforce transport and logistics	7.18
	Waste generation	7.25
	Impacts to potential heritage listed items, including assessments of significance	7.11, 7.12 and 7.13
Muswellbrook Shire Council (MSC)	Traffic and road impacts resulting from the Project	7.18
Singleton Shire Council	Traffic and road impacts resulting from the Project	7.18

5.4.3 Community Stakeholder Issue Responses

A number of issues were raised by community stakeholders, arising throughout the stakeholder engagement program

Table 18 outlines the community stakeholder issues raised and the section of the EIS where each issue is addressed.

TABLE 18 Community Stakeholder Issues

Issues Raised	EIS Section
Subsidence	
Subsidence impacts to Agricultural Land and surface features such as cliff lines	7.1
Underground mining impacts to creeks and the groundwater system	7.6
Subsidence impacts to Bylong Valley Way	7.1
Mining induced changes to the floodplain	7.5
Mining	
Local geology and mining schedule	2.7 and 3.3
Location of roads and details relating to infrastructure including coal processing	3
Distance from the infrastructure/pits to the floodplain, Bylong village and properties	3 and 7.6
Plans for future mining following this approval	3
Ecology and Biodiversity Offsets Strategy	
Loss of biodiversity value within the Project Disturbance Boundary	7.2 and 7.3
Allocating agricultural land for biodiversity value	7.16
Water	
Mine water usage and total net water loss to the valley	7.4, 7.6 and 7.16
Baseline water monitoring data	7.4 and 7.6
Loss of agricultural water	7.6, 7.16 and 7.22
Location of aquifers	7.6
Degradation of water quality within the vicinity of the Project and flow on effect to the Goulburn River	7.4, 7.5 and 7.6
Permanent change to water regime	7.6
Air Quality and Greenhouse Gas	
Loss of amenity due to mining related dust	7.7
Noise and Blasting	
Nuisance caused by noise created by Project construction and operations	7.9
Loss of amenity due to blasting	7.10

Issues Raised	EIS Section
Aboriginal and European Heritage	
Loss of Aboriginal Archaeology and Cultural Heritage	7.11
Dilapidation of historical heritage items within and surrounding the Project Boundary including Tarwyn Park and the BUPS	7.12
Loss of historical heritage items within the Project Disturbance Boundary	7.12
Rehabilitation	
Final height of overburden emplacement	3 and 7.15
Effectiveness of proposed rehabilitation	7.15
Timing of proposed rehabilitation	3 and 7.15
Agriculture	
Plans for the coexistence of agriculture and mining	7.16
Distribution of BSAL and CIC across the Study Area	7.14 and 7.16
Permanent loss of productivity of agricultural land	7.15 and 7.16
Visual	
Loss of scenic landscape of the Bylong Valley	7.17
Direct visual impacts to local residents	7.17
Traffic and Transport	
Road safety	7.18
Increase to road traffic	7.18
Increase in traffic to the gravel sealed portion of Wollar Road	3.12
Changes to the local road network including realignments, upgrades, and property access	3.13 and 3.14
Social	
Loss of Bylong community values and aspirations	7.21
The size and type of workforce the Project will attract	3.10 and 3.11
Increased demand to social infrastructure and service providers	7.21
Increased housing and accommodation stress in Mudgee	7.21
Strong demand for employment driven by rapidly expanding coal markets	7.21
Property acquisition and management of agricultural properties by KEPCO	2.5 and 7.16
Economic	
Negative impacts to land values within the Bylong Valley	7.22
Negative impact to the agricultural industry within the Bylong Valley	7.16

5.5 SOCIAL IMPACT ASSESSMENT STAKEHOLDER CONSULTATION

Consultation specific to informing the SIA was conducted by Hansen Bailey and is discussed in **Section 5.4.3**. Key issues relating to environmental or socio-economic impacts of the Project raised during the SIA consultation have been integrated into **Section 5.4.3**.

Findings of the consultation specific to the SIA are briefly described in this section.

5.5.1 Overview of Approach

The purpose of the SIA consultation was to:

- Inform the preparation of the socio-economic profile;
- Validate existing socio-economic data relevant to the MWRC LGA;
- Identify local community issues to assist in the prediction of potential socio-economic impacts;
- Identify stakeholder perceived impacts and opportunities of the Project; and
- Identify potential measures to manage impacts specific to Bylong Valley.

A number of different but complementary approaches were used to consult with stakeholders during the SIA consultation stage. These included:

- Individual face to face interviews were offered and held with landholders in the vicinity of the Project;
- Face to face and telephone meetings with MWRC LGA representatives; and
- Telephone discussions with relevant State government agencies and key service providers.

Bylong Valley Residents

Face to face interviews were conducted with 29 landholders, property managers and farmhands from 14 properties located in the Bylong Valley during the week commencing 4 August 2014. Participants in these interviews were current residents of the Bylong Valley.

Local Government

Telephone interviews and face to face meetings were held with relevant staff from MWRC.

State Government and Service Providers

Telephone interviews were held with relevant staff from the following NSW Government departments and services:

- NSW Rural Fire Service (RFS);
- NSW Police Service;
- NSW DoEd;
- NSW Health;
- NSW Ambulance Service; and
- Mudgee Health Council.

Ongoing discussions have also been conducted with the DoEd outside of the SIA specific consultation in relation to the future of BUPs and the management of Project related impacts.

Additional information was also received via email from key NSW Government agency staff following the phone interviews.

Table 19 details the service and facility providers consulted over the SIA and reference to the sections of the EIS where issues raised are addressed. Interviews were conducted by phone with these stakeholders to obtain relevant information regarding the status of servicing and available capacity for growth.

Findings of the consultation carried out with service and facility providers have informed the SIA as discussed in **Section 7.21**.

TABLE 19 SIA Consultation Conducted with Service and Facility Providers

Service and Facility Provider	Discussion Themes	EIS Section
Mudgee Health Council	Health service provision	7.21.3 and 7.21.5
Medicare Local Western NSW	Health service provision	7.21.3
Various GPs across Kandos, Rylstone and Mudgee	Health service provision	7.21.3 and 7.21.5
Barnardos – Mudgee	Social housing provision and youth services	7.21.5
Housing Plus NSW	Social housing provision	7.21.5
Mudgee Police Citizens Youth Club	Child and youth services	7.21.3 and 7.21.4
Rylstone-Kandos Preschool	Children's services	7.21.3
TAFE Western NSW – Mudgee College	Training and skilling programs	7.21.4
Kandos High School (HS)	Education services	7.21.3
Mudgee HS	Education services	7.21.3
St Mathews College Mudgee	Education services	7.21.3
Imaginations Early Learning Centre	Children's services	7.21.3 and 7.21.4
MWRC Family Day Care	Children's services	7.21.3 and 7.21.4
Mudgee Preschool	Children's services	7.21.3 and 7.21.4
State Emergency Service – Dubbo	Emergency service delivery	7.21.4
Cudgegong Rural Fire Service	Emergency service delivery	7.21.4
NSW Police – Mudgee and Kandos	Emergency service delivery	7.21.3
Mudgee Tourism Information Centre	Tourist events and short term accommodation	7.21.4

5.5.2 Key Issues Raised During SIA Consultation

Section 7.21 provides a description of community issues, values and aspirations in the Bylong Valley and the MWRC LGA.

A summary of key issues, values and aspirations raised during consultation held in August 2014 is provided in **Table 20**, along with references to sections of the EIS where issues are addressed.

Issues relating to environmental or socio-economic impacts of the Project raised during the SIA consultation have been integrated into **Section 5.4.3**.

TABLE 20 Summary of Bylong Community Issues, Values and Aspirations

Values	Assets	EIS Section
Economic	- Industries of agriculture, dairy farming, equine and tourism - Productivity of the land in Bylong Valley - Irrigation opportunities	7.16 and 7.22
Social	- Sense of community (sharing, volunteering, togetherness) - Bylong Mouse Races - Local cooperation and a willingness to assist - Friendliness - Range of skills and expertise in the local community - Historical connection to the land - Long term residents with strong connection to the location	7.21
Physical	- Bylong General Store – “[The] shop is the hub of the community” - BUPS - The Bylong Community Hall and recreation area - Remoteness of Bylong Valley but relative connectedness to Rylstone and Mudgee - Heritage elements – homesteads, buildings in Upper Bylong	7.12 and 7.21
Natural	- The rural setting – “Bylong is beautiful and scenic” - Access to groundwater and groundwater quality - Agricultural land quality - Surface water - Remoteness and peacefulness of the setting – “Unspoilt landscape” - Great Dividing Range Escarpment - Bylong State Forest, Wollemi National Park	7.4, 7.5, 7.6, 7.12, 7.16 and 7.17
Cultural Heritage	- St Stephen's Anglican Church and Cemetery, Bylong - Bylong Station - BUPS - Bylong Upper Hall - Upper Bylong Post Office and Store - Tarwyn Park House - Bylong Station House	7.12 and 7.13

5.6 ABORIGINAL COMMUNITY CONSULTATION

The Aboriginal community consultation for the Project was conducted by Hansen Bailey and RPS Australia East Pty Ltd (RPS) in accordance with the 'Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010' (DECCW, 2010a) (Aboriginal Consultation Guidelines).

The Aboriginal community consultation program generally consisted of the following components:

- Stage 1 – Notification and registration;
- Stage 2 – Project information;
- Stage 3 – Survey methodology and fieldwork; and
- Stage 4 – Draft Aboriginal Archaeological and Cultural Heritage Impact Assessment review.

A summary of the Aboriginal community consultation for the Project is described below. Further details regarding the consultation undertaken with the local Aboriginal community are described in detail in the Aboriginal Archaeological and Cultural Heritage Impact Assessment (AACHIA) (as discussed in **Section 7.11**).

5.6.1 Stage 1 - Notification and Registration

Consultation with Regulatory Agencies

In accordance with section 4.1.2 of the Aboriginal Consultation Guidelines, the following agencies were notified of the Project on 21 January 2014:

- OEH;
- NSW Department of Aboriginal Affairs – Office of the Registrar;
- HLLS;
- MWRC;
- Native Title Services (NTS Corp);
- National Native Title Tribunal;
- Mudgee Local Aboriginal Land Council (MLALC); and
- Wanaruah Local Aboriginal Land Council (WLALC).

These agencies were asked to assist in identifying and notifying Aboriginal persons who may possess the cultural knowledge needed for determining the cultural significance of Aboriginal objects or places in the area associated with the Project. Responses were requested from these agencies by 20 February 2014.

The following responses were received:

- On 22 January 2014, the NSW Department of Aboriginal Affairs – Office of the Registrar indicated that there are no Registered Aboriginal Owners (under Division 3 of the Aboriginal Land Rights Act 1983) of the land within the Project Boundary.
- On 29 January 2014, NTS Corp responded indicating that it could not release the details of any stakeholder groups due to privacy reasons, and would forward on correspondence to any persons whom NTS Corp are aware assert traditional interests in the land within the Project Boundary.
- On 3 February 2014, MWRC responded by providing a list of 19 stakeholder groups.
- On 4 February 2014, WLALC provided a list of 36 stakeholder groups. WLALC also expressed an interest in being consulted as part of this assessment.
- On 6 February 2014, OEH responded by providing a list of 24 stakeholder groups.
- On 6 February 2014, National Native Title Tribunal responded by providing the results of a native title search, however no additional Aboriginal stakeholders were identified.
- On 10 February 2014, MLALC expressed an interest in being consulted in regards to the assessment. MLALC did not provide any details of potentially interested stakeholder groups.

No response was received from HLLS. Requests were then mailed to all of the Aboriginal persons/groups that were identified by the above agencies inviting them to register their interest.

Public Notification

Section 4.1.3 of the Aboriginal Consultation Guidelines requires that a Project must be advertised in the local newspaper. In accordance with this requirement, a public notice of the Project was advertised in the Mudgee Guardian and Hunter Valley News on 15 January 2014. This notice invited Aboriginal stakeholders to register their interest to be consulted during the preparation of the AACHIA. In accordance with section 4.1.4 of the Aboriginal Consultation Guidelines, the registration period extended for 14 days to the 7 February 2014.

Invitations for Expressions of Interest

In accordance with section 4.1.3 of the Aboriginal Consultation Guidelines, a letter inviting expressions of interest was sent to all Aboriginal stakeholders identified by the regulatory agencies on 6 and 12 February 2014. A total of 87 Aboriginal stakeholders were invited to register an interest in being consulted as part of the AACHIA. The closing date for expressions of interest was 27 February 2014 providing the necessary 14 day period for expressions of interest.

By the closing date for expressions of interest 22 stakeholder groups had expressed an interest in the Project. A further five stakeholder groups registered following the closing date. All 27 groups were accepted as Registered Aboriginal Parties (RAPs) to inform the AACHIA as listed in **Table 21**.

The draft methodology for the archaeological survey component of this AACHIA was sent out to the RAPs on 18 March 2014, with invitation to comment on the draft methodology. Comment on the draft methodology was sought by the 15 April 2014. This was extended to 17 April 2014 at the request of the RAPs at the planning meeting. Additional comments in relation to the consultation conducted for the draft methodology is provided in the following sections.

In accordance with section 4.1.5 of the Aboriginal Consultation Guidelines, the draft methodology letter dated 19 March 2014 advised that contact details would be forwarded to OEH and Local Aboriginal Lands Councils unless they stipulated that they did not want their details distributed.

Notification of Registered Aboriginal Stakeholders

In accordance with section 4.1.6 of the Aboriginal Consultation Guidelines, the details of RAPs were provided to OEH, MLALC and WLALC on 10 April 2014.

The following documents were provided:

- A copy of the public notice advertised in the Mudgee Guardian and Hunter Valley News on 15 January 2014;
- A copy of the letter issued to all identified Aboriginal stakeholders providing notification of the assessment for the project, sent on 6 and 13 February 2014; and
- A record of RAPs who had registered for consultation as part of the AACHIA.

TABLE 21 Registered Aboriginal Parties

Ref	Registered Aboriginal Party
AGA	AGA Services
AFT	Aliera French Trading
BAT	Bathurst
BUD	Buddang
CA	Culturally Aware
CAC	Cacatua General Services
DD	Divine Diggers Aboriginal Cultural Consultants
GNTD	Gomeroi-Namoi Traditional Owners
GOM	Gomery
HEC	HECMO Consultants
JLC	JLC Cultural Services
KM	Katrina McKinnon
LHW	Lower Hunter Wonnarua Cultural Services
MG	Murong Gialinga
MIN	Mingaan Aboriginal Corporation
MLALC	Mudgee Local Aboriginal Land Council
NEW	North East Wiradjuri Company Ltd
PB	Paul Brydon
YAR	Yarrawalk
YIN	Yinaar Cultural Services
UAC	Ungooroo Aboriginal Corporation
WIC	Wonn 1 Contracting
WAL	Wallangan Cultural Services
WAR	Warrabinga Native Title Claimants Aboriginal Corp
WCE	Wiradjuri Council of Elders
WLALC	Wanaruah Local Aboriginal Land Council
WVWAC	Wellington Valley Wiradjuri Aboriginal Corporation

5.6.2 Stage 2 - Project Information

Planning Meeting

In order to satisfy section 4.2 of the Aboriginal Consultation Guidelines, a planning meeting was held at the Bylong Community Hall on 11 April 2014. Invitation letters outlining details of the meeting were sent to RAPs on 8 April 2014. The purpose of the planning meeting was to:

- Present a detailed briefing about the Project, including potential impacts on Aboriginal archaeology and cultural heritage values;
- Discuss the draft survey methodology and the nature and scope of the assessment;
- Outline the EIS process;
- Specify critical timelines and milestones for the completion of assessment activities and delivery of reports;
- Clearly define agreed roles, functions and responsibilities in relation to Aboriginal consultation;
- Identify, raise and discuss the RAPs cultural concerns, perspectives and assessment requirements (if any) and provide contact details should any individual discussions be required; and
- Provide a forum in which cultural knowledge of the land within the Project Boundary can be discussed.

A total of 22 RAPs were represented by 30 individuals at the planning meeting.

Site Visit

A site visit within and surrounding the Project Boundary was held for RAPs and Aboriginal Elders on 2 May 2014. The purpose of the site visit was to:

- Provide an opportunity to view the site and connect with Country;
- Identify and share cultural heritage values or areas of significance; and
- Refine the field survey coverage areas.

A total of seven RAPs were represented by nine individuals at the site visit.

5.6.3 Stage 3 - Survey Methodology and Fieldwork

Methodology

In accordance with section 4.3.1 of the Aboriginal Consultation Guidelines, the proposed methodology for the archaeological survey was provided to registered stakeholders on the 18 March 2014.

The draft methodology provided a description of the Project, previous Aboriginal archaeology and cultural heritage impact assessments and context, results from a desktop assessment along with the proposed archaeological survey methodology for the Project.

All RAPs were encouraged to provide comments and raise any concerns in relation to the draft methodology or cultural heritage issues either in writing, during the planning meeting or during any stage of the consultation process.

Fourteen stakeholder groups provided a response to the draft archaeological survey methodology including:

- Paul Brydon;
- Wonn 1 Contracting;
- AGA Services;
- Cacatua General Services;
- Wellington Valley Wiradjuri Aboriginal Corporation;
- HECMO Consultants;
- Alieria French Trading;
- Lower Hunter Wonnarua Cultural Services;
- Katrina McKinnon;
- Buddang;
- Culturally Aware;
- Divine Diggers Aboriginal Cultural Consultants;
- Murong Gialinga; and
- Wallangan Cultural Services.

The majority of these groups agreed with the content in the draft methodology, though some concerns were raised. Concerns generally included that the area to be covered per day during fieldwork was too large and hence should be reduced, a larger number of persons should be involved within the fieldwork, and a site visit should be conducted prior to fieldwork.

In response to these concerns, a site visit was held on 2 May 2014 prior to commencement of the fieldwork and the timeframe for the fieldwork was increased from two to four weeks.

Archaeological Survey

All Aboriginal stakeholders that had registered an interest prior to the registration date were offered the opportunity to participate in an archaeological survey of the land within the Project Boundary. All 22 eligible RAPs accepted the offer of participating in the archaeological survey.

As explained in the methodology, it was estimated that four weeks would be needed to survey the entire area within the Project Boundary. Due to the large number of groups involved in the assessment, the 22 groups involved in the archaeological survey were divided equally into four working groups. Each working group was allocated to one week of the archaeological survey. All stakeholder groups were asked to nominate an archaeological survey representative and to indicate the weeks that their representative would be available to undertake archaeological survey.

The final allocations for the 22 groups are shown in **Table 22**.

Each Aboriginal group was personally contacted by phone, email and post to confirm dates representatives were required in the field, request insurances and to provide other logistics. The archaeological survey was then scheduled for four weeks from 19 May 2014 to 17 June 2014 and consisted of the following:

- Week 1 (19 May 2014 – 23 May 2014);
- Week 2 (26 May 2014 – 30 May 2014);
- Week 3 (2 June 2014 – 6 June 2014); and
- Week 4 (10 to 12 June 2014 and 16 to 17 June 2014).

An additional one week of fieldwork was conducted to complete the survey within the Project Boundary on 23 to 27 June 2014. RAPs were randomly selected for fieldwork participation during this additional week of field work.

Cultural Values Interview

A cultural value interview meeting was held on 4 July 2014 for those parties wishing to share further cultural knowledge and values associated with the Project. Invitation letters outlining details of the meeting were sent to RAPs on 26 June 2014.

A total of six RAPs were represented by 13 individuals at the cultural value interview meetings.

TABLE 22 Archaeological Survey Fieldwork and Participants

Week	Survey Period	Stakeholder Group
1	19 to 23 May 2014	AGA Services
		Cacatua Cultural Consultants
		Wellington Valley Wiradjuri
		Yarrawalk/Tocomwall
		Lower Hunter Wonnarua
		Wonn 1 Contracting
2	26 to 30 May 2014	Wallangan Cultural Services
		Mudgee LALC
		Culturally Aware
		HECMO Consultants
		Lower Hunter Wonnarua
3	2 to 6 June 2014	Divine Diggers
		JLC Cultural Services
		Buddang
		Murong Gialing
		North East Wiradjuri
		Katrina McKinnon
4	10 to 12 June 2014 and 16 to 17 June 2014	Wanaruah LALC
		Ungooroo Aboriginal Corp
		Mingaan Aboriginal Corp
		Warrabinga NTCA
		Aliera French Trading
		Tom Miller
5	23 to 27 June 2014	AGA Services
		Cacatua Cultural Consultants
		Murong Gialinga
		Ungooroo Aboriginal Corporation
		Divine Diggers Aboriginal Cultural Consultants

5.6.4 Stage 4 - Draft AACHIA Review

The draft report was distributed to the RAPs on 19 December 2014 for review and comment. The RAPs were allocated a period of 6 weeks to provide any feedback and comments before 30 January 2015. In addition to contact details being provided for the purposes of discussing the report on the phone, a meeting was also held on 20 January 2015 to discuss the contents and outcomes of the report and any comments from the RAPs. The outcomes of these meetings were minuted.

Comment was provided by 16 RAPs on the draft AACHIA and three indicated they had no changes to the report. Nine RAPs did not provide comments. Of the 16 RAPs who provided comments, 11 indicated they were satisfied with the recommendations and contents of the draft report, subject to additional feedback. All feedback was considered and incorporated into the report, where possible.

A summary of the responses is provided below. The reviews of the assessment can be seen in full in the AACHIA (as discussed in **Section 5.4.3**).

RAP Responses

- MLALC generally agreed with the contents of the draft report and made several recommendations including:
 - More comprehensive surveying needs to be completed prior to approval;
 - The community and Elders need an opportunity to visit recorded sites and provide feedback, where appropriate;
 - Provide feedback to the community regarding where sites and artefacts were removed and outcomes of these actions;
 - Provide opportunities for the community for education and training, including voluntary on-ground work or paid employment and training; and
 - Where possible, sites should be avoided, and if this is not possible sites should be salvaged and moved to a safe area close to their original location, or held in a keeping place accessible to all parties until a point where they are able to be relocated back to their original location.
- JLC Cultural Services generally agreed with the contents of the draft report and had the following comments:
 - Objection to the Project in general;
 - Objection to the way the RAPs were chosen for the fifth week of field surveys; and
 - Concern on the adequacy of the coverage of the field survey.
- Murong Gialinga generally agreed with the contents of the draft report and had the following comments:
 - Further surveys need to be completed, mainly due to time wasted during field surveys; and
 - Need to conduct a full investigation regarding the desecration and theft of artefacts from a site within the Project Boundary.
- Buddang stated that the field survey was not completed due to wasted time during field surveys;
- WVVAC objected to the contents of the draft report and the Project in general, for the following reasons:
 - The proponent has not listened appropriately to the WVVAC or Elders;
 - Non-traditional Aboriginal persons and organisations should not have been involved in surveys, consultation or assessment of Aboriginal lands or cultural heritage;
 - Any reference to Wiradjuri and Wanaruah country and Traditional Owners should be removed from the report, as they are not within the location of the Project;
 - Field surveys should have included each group one day per week over the survey period, rather than one group over a five day block, and as such information and sites recorded cannot be verified for the entire field survey. This also creates objection to statements of significance levels of sites, for sites WVVAC persons were not involved in surveying;
 - Prior to any site or scar tree being removed from site, Elders must have the opportunity to visit the tree or site to hold a smoking ceremony, and WVVAC object to the removal of scar trees in general;
 - Disagreement with the statement that Eucalyptus species are not suitable for transplanting; and
 - Need to provide an update into the investigation regarding the desecration and theft of artefacts from a site within the Project Boundary.

Details of proposed mitigation and management strategies of all sites will be included as part of the Aboriginal Archaeological Cultural Heritage Management Plan (AACHMP) to be prepared following approval of the Project. The ACHMP will be developed in consultation with all RAPs. All other comments have been considered in the final AACHIA (as discussed in **Section 5.4.3**).

5.7 ONGOING STAKEHOLDER ENGAGEMENT

KEPCO is committed to effective engagement with identified stakeholders and will implement an Stakeholder Engagement Plan through the approvals process and beyond. Consultation for the Community Needs Assessment has commenced and will continue throughout the approvals process.

Various mechanisms will be implemented to ensure the effective ongoing engagement with Project stakeholders, including:

- Consultation with neighbouring landholders and representatives of key local and State regulatory authorities and industry bodies;
- Distribution of community newsletters, including upon submission of this EIS to provide an update on this EIS process and where this EIS may be viewed by the public; and
- Provision of regular updates and documentation on the KEPCO website.

An Annual Review will be prepared that summarises company activities and performance in the areas of health, safety, environment and community. A copy of the Annual Review will be made available in hard copy upon request or via the KEPCO website.

Current stakeholder engagement methods employed by KEPCO that will continue for the Project are provided in **Table 23**.

TABLE 23 KEPCO Ongoing Stakeholder Engagement

Activity	Details
Engagement and Communications	▪ Ongoing face to face engagement with near neighbours ▪ Community Needs Assessment consultation is scheduled with various stakeholders and community groups ▪ Newsletters and Fact sheets ▪ Project Information Sessions ▪ Letters and personal invitations to key near neighbour stakeholders ▪ Ongoing engagement with relatives of persons buried within the former Upper Bylong Catholic Church Cemetery ▪ Ongoing discussions with RAPs involved with the Project ▪ Website ▪ State and Local Government briefings and meetings ▪ Presentations to Local Government
Issues Management	▪ Community contact line and website ▪ Near neighbour engagement ▪ Issue response procedures ▪ Development of appropriate scope for environmental studies
Community Support	▪ Contributions to local community groups
Environmental Monitoring and Management	▪ Environmental impact monitoring ▪ Environmental Management Plans and procedures



6

Risk Assessment

Risk Assessment

This section provides a summary of the environmental and socio-economic risk assessment completed for the Project. It summarises the results of risk ranking the potential environmental, social and economic issues which may arise from the Project.

6.1 RISK ASSESSMENT

A preliminary environmental and socio-economic risk assessment was undertaken as part of the Bylong Coal Project Background Document as the first step in the process of seeking SSD development consent under the EP&A Act. The primary purpose of the risk assessment process was to prioritise and focus the required environmental and socio-economic impact assessments for this EIS.

Aspects identified as having a higher environmental impact risk ranking formed the primary focus of this EIS and were more intensively assessed. Aspects which have been identified as having a moderate to low risk were also assessed, however a smaller scope of works was conducted for these secondary issues, based on their lower risk rating.

Following the Gateway Certificate Application, Background Document, stakeholder engagement and preparation of the relevant technical environmental assessments undertaken for this EIS (consistent with the SEARs), the preliminary risk assessment was reviewed to incorporate additional requirements and proposed mitigation measures. The revised risk assessment included safeguards that would reduce the likelihood and/or severity of the consequences and risks to surrounding people and property.

Risk reduction is inherent in many aspects of the layout and design features of the Project. Risk reduction measures have been applied in the derivation of hazard consequence and likelihood, and these measures will be regularly monitored, audited and reviewed as part of KEPCO Bylong Australia's health and safety management strategies. The revised risk assessment is presented in full in **Appendix G**.

Each of the potential environmental issues was ranked in accordance with the KEPCO Bylong Australia Risk Classification Matrix (see **Appendix G**) as being of low, moderate, high or critical risk. The risk rating allocated to an impact is dependent upon the probability of the impact occurring and the potential consequence severity should the impact materialise.

Table 24 summarises findings from the revised risk assessment. The revised risk assessment indicates that in the presence of control measures, all aspects of the Project are rated as moderate or low risk. No critical or high risks were identified.

TABLE 24 Environmental and Socio-Economic Risk Rating

Critical	High	Moderate	Low
None	None	Subsidence	Surface Water (Runoff)
		Ecology	Social
		Surface Water (water take, licensing, discharges and flooding)	Acid Rock Drainage
		Groundwater	Spontaneous Combustion
		Air Quality	Hazardous Materials
		Greenhouse Gas	Waste and Contamination Management
		Noise	Cumulative Impacts
		Blasting	
		Historic Heritage	
		Aboriginal Archaeology and Cultural Heritage	
		Historic Burials	
		Soil and Land Capability	
		Rehabilitation	
		Agricultural Productivity and Land Use	
		Visual and Lighting	
		Road and Rail Traffic and Transport	
		Stygofauna	
		Geochemistry	
		Economic	

7

Impacts,
Management
and Mitigation

Impacts, Management and Mitigation

This section provides a summary of the potential environmental and social impacts of the Project and the measures that will be implemented to mitigate and manage these impacts. The issues have been prioritised in accordance with the SEARs, the risk assessment and outcomes of the stakeholder engagement program.

7.1 SUBSIDENCE

7.1.1 Background

A Subsidence Ground Movement Predictions and Subsidence Impact Assessments for all Natural Features and Surface Infrastructure (Subsidence Impact Assessment) has been undertaken for the Project by Mine Subsidence Engineering Consultants Pty Ltd (MSEC) and is presented in **Appendix H**.

The purpose of the Subsidence Impact Assessment was to predict the likely subsidence effects resulting from the proposed underground mining operations and to assess the impacts of these predicted subsidence effects on natural and built environmental features.

The term “*subsidence effects*” refers to the physical ground movements induced by underground mining operations. Subsidence effects include the vertical subsidence, horizontal displacement, tilt, curvature and strain. Further descriptions of these subsidence effects are presented within **Appendix H**.

The term “*subsidence impacts*” refers to the physical changes to the rock mass and ground surface as a result of the subsidence effects. Subsidence impacts can include tensile and shear failure of the rock mass, bedding shear and localised buckling of the strata.

“*Environmental consequences*” refers to the changes to the natural environment resulting from subsidence impacts. The term “*environmental consequences*” is broadly used to discuss changes to both the natural and built environment.

As mentioned in **Section 3.1**, the Subsidence Study Area for the Project is defined as the area bounded by the following limits:

- The 26.5° angle of draw from the limit of secondary extraction; and
- The predicted limit of vertical subsidence (i.e. the 20 mm subsidence contour. Due to natural surface movement, subsidence below this level is considered indistinguishable from naturally occurring movement).

The predicted limit of vertical subsidence for the Project occurs entirely within the 26.5° angle of draw line. Therefore, the Subsidence Study Area for the Project is defined exclusively by the 26.5° angle of draw. The depth of cover above the proposed longwall panels varies from 105 m to 310 m. Based on a 26.5° angle of draw, the Subsidence Study Area extends horizontally at distances of between 53 m and 155 m from the edge of longwall extraction.

There are features located outside the Subsidence Study Area that could be subjected to far-field horizontal movements or valley related movements, and could be sensitive to such movements. Therefore, the Subsidence Impact Assessment has considered a number of natural features and surface infrastructure outside the Subsidence Study Area.

The Subsidence Impact Assessment has comprehensively considered the potential impacts and environmental consequences for surface features in the vicinity of the underground mining operations for the Project. The land located within the Subsidence Study Area is predominantly owned by KEPCO, NSW Forests and the crown corridors.

The Bylong Quarry (Landowner IDs 53 to 55 on **Figure 12**) and a property in the south-eastern corner (Landowner IDs 138 to 141 on **Figure 12**) are the only privately owned land overlying the Subsidence Study Area.

Table 25 identifies the natural and built features that have the potential to be affected by subsidence impacts resulting from the underground mining operations for the Project. The 'status' column within **Table 25** indicates whether the feature is located within the Subsidence Study Area. Features that occur outside of the Subsidence Study Area that will potentially be impacted by non-conventional subsidence impacts have also been included in **Table 25**.

Figure 39 illustrates the location of known sensitive surface features both within and in the vicinity of the Subsidence Study Area.

SCT Operations Pty Ltd (SCT) was engaged to complete an independent peer review of the Subsidence Impact Assessment. The Peer Review was completed in two parts: broader review of Subsidence Impact Assessment report; and a specific review of the impact predictions associated with the cliff lines. The SCT peer review concluding letter reports are included within **Appendix I**.

7.1.2 Methodology

The conventional subsidence effects resulting from longwall mining associated with the Project were predicted using the Incremental Profile Method (IPM). The IPM is an empirical model developed by MSEC in 1994. The IPM is based on a large database of subsidence monitoring results from mining operations within the Illawarra, Newcastle, Hunter and Western Coalfields of NSW and the Bowen Basin in Queensland. The IPM utilises subsidence prediction curves which have been developed based on a range of historical observations from numerous mining operations within varying geological and physical site conditions.

The Project is a "Greenfield" site and therefore there is no subsidence monitoring data from the site or immediate locality that can be used to calibrate the IPM model to site specific conditions. The geology at the site is similar to that of other mines in the Western Coalfield. Accordingly, MSEC used the standard prediction curves for the Western Coalfield of NSW to develop the subsidence predictions for the Project.

For single seam mining in the Western Coalfield, maximum subsidence is generally between 60% and 65% of the extracted seam thickness. The nearest active longwall mining operation is the Ulan Mine located approximately 40 km to the north-west of the Project. The observed maximum subsidence at Ulan Mine is generally less than 50% of the extracted seam thickness. The lower levels of subsidence measured at Ulan Mine are attributed to the presence of thick Triassic sandstone units in the overburden. These Triassic units are present at the Project site, but are not as prevalent as at Ulan Mine. The Subsidence Impact Assessment has conservatively adopted the IPM prediction curves for the Western Coalfield, which predicts incremental subsidence of up to 65% of the extracted seam thickness.

MSEC (in conjunction with other specialist technical consultants) used the predicted subsidence effects for the Subsidence Study Area to assess the potential environmental consequences for natural and built features. These assessments also incorporated extensive past experience and knowledge from other longwall mining operations across the coalfields of NSW and Queensland.

7.1.3 Impact Assessment

Subsidence Effects

Conventional subsidence effects are predicted using subsidence profiles that are smooth in shape and can be explained by expected caving mechanisms associated with overlying strata spanning the extracted void. Conventional subsidence effects include vertical subsidence, tilt, curvature, strain and horizontal movement. Non-conventional subsidence effects are generally irregular movements associated sudden changes in geological conditions, steep topography or valley related mechanisms. Non-conventional subsidence effects include upsidence and valley closure (and associated strains).

TABLE 25 Natural Features and Surface Infrastructure in the Vicinity of the Subsidence Study Area

Item	Status	Item	Status
NATURAL FEATURES			
Catchment Areas or Declared Special Areas	✗	Electricity Transmission Lines or Associated Plants	✓
Rivers or Creeks	✓	Telecommunication Lines or Associated Plants	✓
Aquifers or Known Groundwater Resources	✓	Water Tanks, Water or Sewerage Treatment Works	✗
Springs	✗	Dams, Reservoirs or Associated Works	✗
Sea or Lake	✗	Air Strips	✗
Shorelines	✗	Any Other Public Utilities	✗
Natural Dams	✗	PUBLIC AMENITIES	
Cliffs	✓	Hospitals	✗
Pagodas	✗	Places of Worship	✗
Steep Slopes	✓	Schools	✗
Escarments	✗	Shopping Centres	✗
Land Prone to Flooding or Inundation	✓	Community Centres	✗
Swamps, Wetlands or Water Related Ecosystems	✓	Office Buildings	✗
Threatened or Protected Species	✓	Swimming Pools	✗
National Parks	✓	Bowling Greens	✗
State Forests	✓	Ovals or Cricket Grounds	✗
State Conservation Areas	✗	Race Courses	✗
Natural Vegetation	✓	Golf Courses	✗
Areas of Significant Geological Interest	✗	Tennis Courts	✗
Any Other Natural Features Considered Significant	✗	Any Other Public Amenities	✗
PUBLIC UTILITIES		FARM LAND AND FACILITIES	
Railways	✓	Agricultural Utilisation or Suitability of Farm Land	✓
Roads (All Types)	✓	Farm Buildings or Sheds	✓
Bridges	✗	Tanks	✓
Tunnels	✗	Gas or Fuel Storages	✗
Culverts	✓	Poultry Sheds	✗
Water, Gas or Sewerage Infrastructure	✗	Glass Houses	✗
Liquid Fuel Pipelines	✗	Hydroponic Systems	✗
		Irrigation Systems	✗

Item	Status
Fences	✓
Farm Dams	✓
Wells or Bores	✓
Any Other Farm Features – Silos	✓
INDUSTRIAL, COMMERCIAL AND BUSINESS ESTABLISHMENTS	
Factories	✗
Workshops	✗
Business or Commercial Establishments or Improvements	✓
Gas or Fuel Storages or Associated Plants	✗
Waste Storages or Associated Plants	✗
Buildings, Equipment or Operations that are Sensitive to Surface Movements	✗
Surface Mining (Open Cut) Voids or Rehabilitated Areas	✓
Mine Infrastructure Including Tailings Dams or Emplacement Areas	✗

Item	Status
Any Other Industrial, Commercial or Business Features	✗
AREAS OF ARCHAEOLOGICAL OR HERITAGE SIGNIFICANCE	✓
ITEMS OF ARCHITECTURAL SIGNIFICANCE	✗
PERMANENT SURVEY CONTROL MARKS	✓
RESIDENTIAL ESTABLISHMENTS	
Houses	✗
Flats or Units	✗
Caravan Parks	✗
Retirement or Aged Care Villages	✗
Associated Structures such as Workshops, Garages, Onsite Waste Water Systems, Water or Gas Tanks, Swimming Pools or Tennis Courts	✗
Any Other Residential Features	✗
ANY OTHER ITEM OF SIGNIFICANCE	✗
ANY KNOWN FUTURE DEVELOPMENTS	✗

The conventional subsidence parameters vary across the Subsidence Study Area due to variability in depths of cover, longwall geometries (i.e. panel width and chain pillar width) and extraction heights. The longwall panel design widths have been predicted to result in supercritical subsidence behaviour. The maximum predicted subsidence, tilt and curvatures following extraction of all longwall panels are presented in **Table 26**.

The predicted subsidence contours are presented in **Figure 40**. The values shown in **Table 26** are localised and peak maximum vertical subsidence levels, with levels of subsidence varying across the Subsidence Study Area between 20 mm and 3,300 mm. This variable nature of predicted subsidence is illustrated within **Figure 40**.

TABLE 26 Maximum Predicted Conventional Subsidence Effects

Longwalls	Maximum Predicted Total Conventional Subsidence (mm)	Maximum Predicted Total Conventional Tilt (mm/m)	Maximum Predicted Total Conventional Hogging Curvature (km ⁻¹)	Maximum Predicted Total Conventional Sagging Curvature (km ⁻¹)
LW101 to LW109 and LW201 to LW206	3,300	75	3.5	2.5

FIGURE 39 Indicative Natural Features and Surface Infrastructure

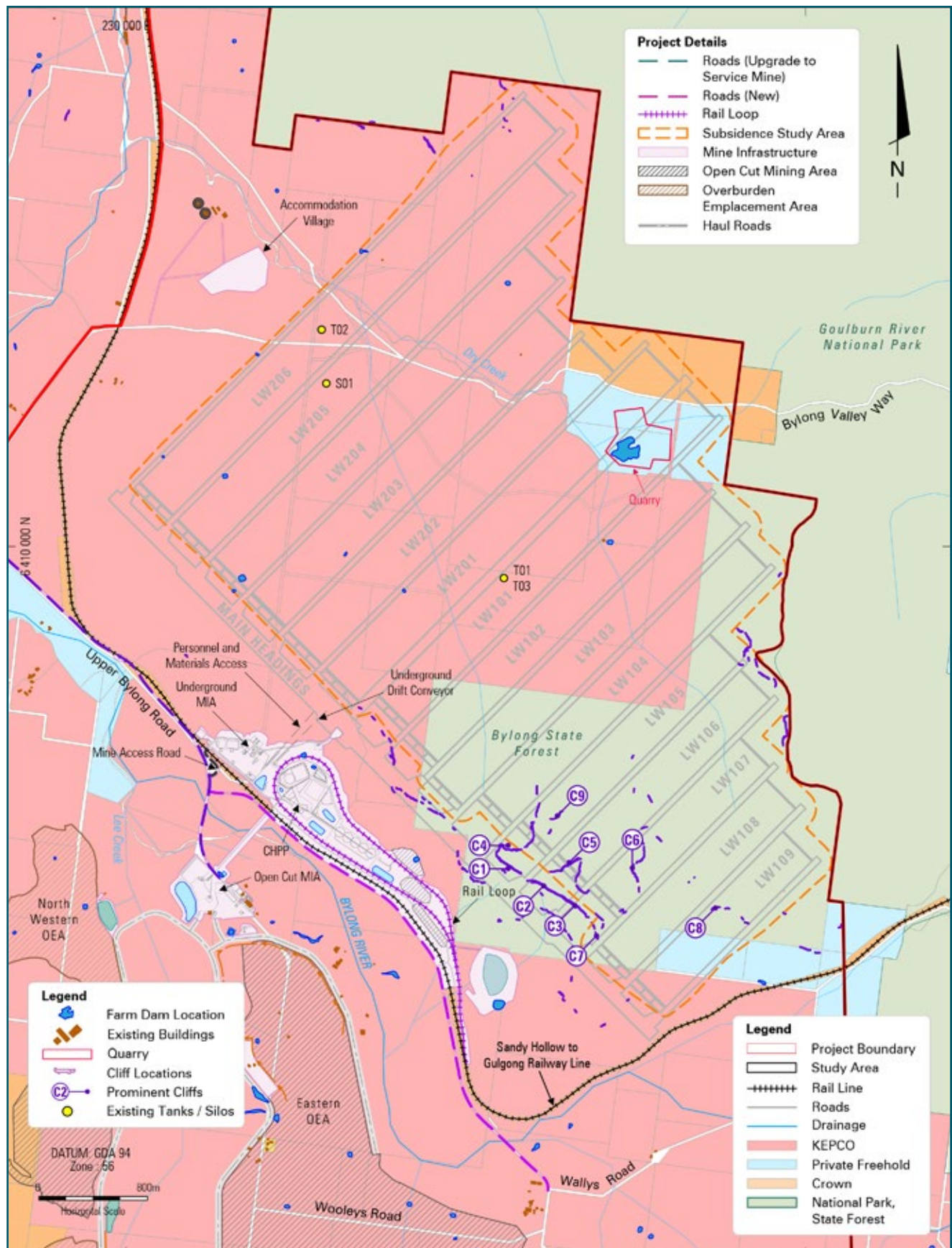
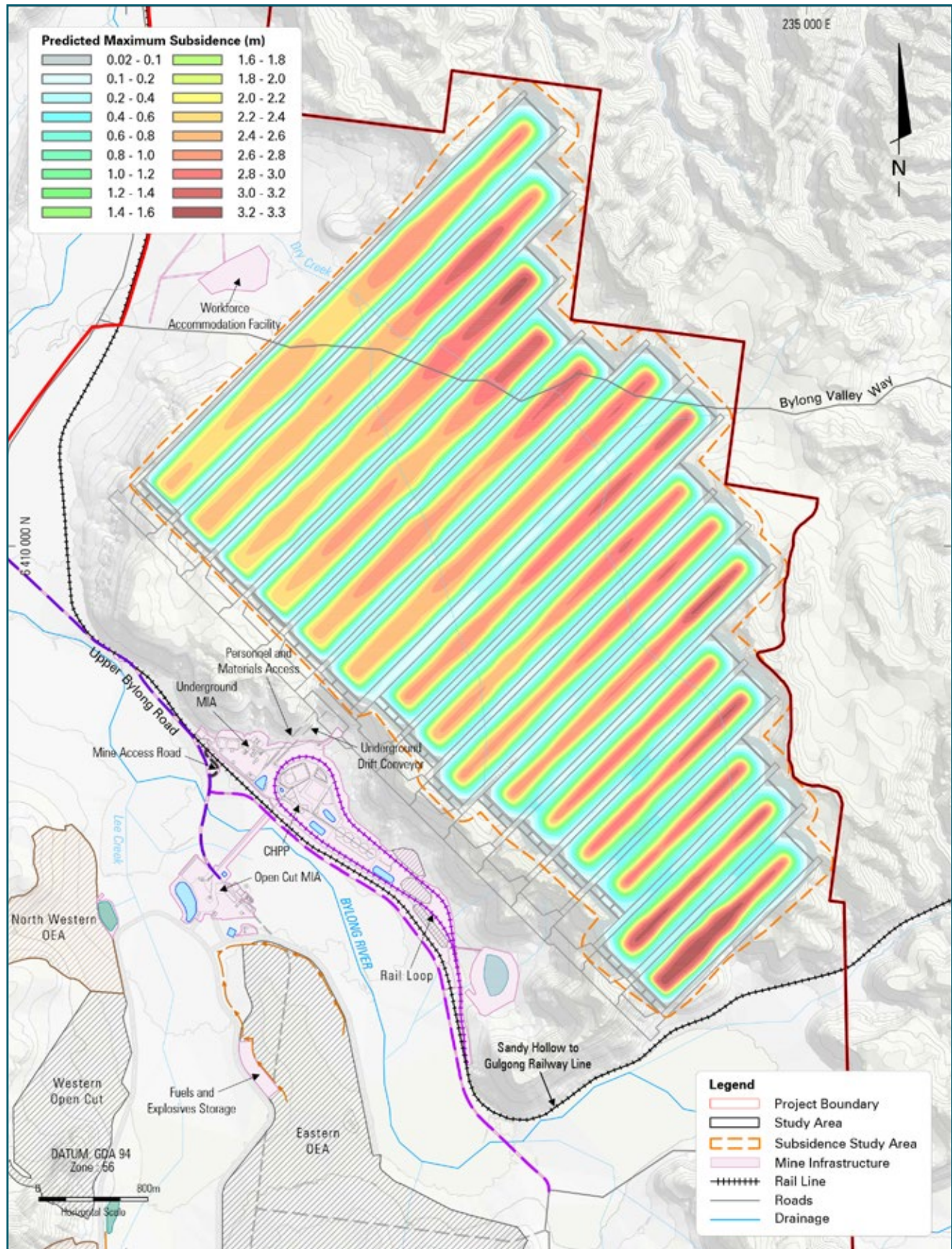


FIGURE 40 Predicted Subsidence Contours

The maximum total subsidence, after the completion of the proposed longwalls, is predicted to be 3,300 mm, which represents approximately 68% of the extraction height. The maximum predicted total conventional tilt is 75 mm/m (i.e. 7.5%), which represents a change in grade of approximately 1 in 13. The maximum predicted total conventional curvatures are 3.5 km⁻¹ hogging and 2.5 km⁻¹ sagging, which represent minimum radii of curvature of 290 m and 400 m, respectively.

The prediction of ground strain is more difficult than the prediction of subsidence, tilt and curvature. This is due to strain being affected by many factors, including ground curvature and horizontal movement, as well as local variations in the near surface geology, the locations of pre-existing natural joints in the bedrock and the depth of bedrock.

The predicted strains for the Project have been developed based on statistical analyses of strains measured in the Hunter and Western coalfields. The statistical analyses have shown that for single-seam mining conditions, applying a constant factor to the predicted maximum curvatures provides a conservative prediction for the maximum normal or conventional strains. For the Hunter and Western coalfields, a factor of 10 provides a reasonable relationship between the predicted maximum curvatures and the predicted maximum conventional strains.

Using this approach, the maximum conventional strains for the Project are predicted to be 35 mm/m of tensile strain and 25 mm/m of compressive strain. It is noted however that localised and elevated strains greater than the predicted conventional strains can occur as a result of non-conventional subsidence movements.

The locations that are predicted to experience hogging or convex curvature are expected to be net tensile strain zones. Conversely, the locations that are predicted to experience sagging or concave curvature are generally expected to be net compressive strain zones.

Valley related movements (upsidence and closure) were predicted using the empirical method outlined in *ACARP Research Project No. C9067* (Waddington and Kay, 2002).

The extraction of the proposed longwall panels may also generate far-field horizontal movements. Far-field horizontal movements refer to movements outside of the area directly overlying the longwall panels. These are small bodily movements towards the extracted longwall panels.

The predicted far-field horizontal movements resulting from the extraction of the proposed longwalls are small and could only be detected by precise surveys. Such movements tend to be bodily movements towards the extracted goaf area, and are accompanied by very low levels of strain, which are generally less than the order of survey tolerance (i.e. <0.3 mm/m). The impacts of far-field horizontal movements on natural and built features are not expected to be significant. Far-field horizontal movements only have the potential to affect large structures that are sensitive to small differential movements. Apart from the identified cliffs, there have been no such structures identified in the vicinity of the proposed longwall panels.

Subsidence Impacts

Subsidence has the potential to result in cracking or deformation of the ground surface. Transient tensile cracking may occur during extraction of a longwall panel. These cracks occur behind and parallel to the moving extraction face (i.e. after the longwall miner has passed beneath a point). These tensile cracks generally close once the land has fully settled following longwall extraction.

Permanent surface cracking will generally occur in the tensile zone, which generally extends a horizontal distance of up to 0.4 times the depth of cover from the longwall panels. Most surface cracks will occur within a distance of 0.1 times the depth of cover from the longwall panels. Cracking may also occur in compressive zones if compressive strains result in buckling of the surface strata. Unlike transient tensile cracks, these cracks will remain open unless remediated.

Surface cracks in the flatter areas are generally expected to vary in width from 25 mm to 50 mm, although isolated cracks of up to 100 mm width may occur. In steeper areas, surface crack widths are generally expected to be in the order of 50 mm to 100 mm, with possible isolated examples of cracking wider than 200 mm.

In light of the proposed BOS partially reliant on the use of some land within the Subsidence Study Area for biodiversity conservation purposes, MSEC completed an assessment of the area which would be affected by surface cracking. MSEC has conservatively estimated that the total area of surface cracking resulting from subsidence is predicted to represent well less than 1% of the Subsidence Study Area.

The remediation of these surface cracks may result in additional disturbance to develop tracks and the minor earthworks associated with the remediation of the landform. Although the degree of disturbance varies depending on the remediation method and access constraints, the total disturbance is expected to be less than 10% of the Subsidence Study Area (even when using conservative estimates). In some areas, the surface cracking may infill through natural processes, and would not require any proactive remediation. Other areas may not be practically accessible for remediation activities and may likely naturally remediate over time.

Environmental Consequences

Water Resources

The only named drainage line within the Subsidence Study Area is Dry Creek. Dry Creek is a third order stream for much of its length. Dry Creek and its tributaries are ephemeral streams characterised by shallow incisions into surface soils. Some isolated sections of Dry Creek are steep with deeper incisions into the landscape. The stream bed gradient varies from 1% to 6%, with an average gradient of 4%.

The maximum predicted tilt for Dry Creek is 65 mm/m (6.5%) at the western (lower) end of the stream and 40 mm/m (4%) in the eastern (upper) reaches of the stream. The maximum predicted tilts are generally greater than the natural grades along the western reaches and less than the natural grades along the eastern reaches of the creek. There are reaches of Dry Creek, primarily at the western end of the creek, that are expected to experience increased ponding and flooding.

Areas of ponding are expected to be between 50 m to 100 m in length and less than 1 m deep. Areas of Dry Creek and associated tributaries affected by ponding will be appropriately managed to reinstate natural gradients as discussed in **Section 7.1.4**.

Conversely, increased scouring of the stream beds may occur along Dry Creek, primarily downstream of the chain pillars in the shallower grades. Scouring may occur during periods of high flow where flow velocities exceed 1 m/s. Areas with the potential for bed scouring as a result of subsidence effects will be appropriately managed as discussed in **Section 7.1.4**.

Changes in topography due to subsidence may result in changes to stream alignment. Steeper reaches of Dry Creek and its tributaries are unlikely to be affected by changes in topography. However, the lower stream reaches with shallower grades are more susceptible to localised changes in alignment.

The maximum strains along Dry Creek are predicted to be 34 mm/m tensile and 25 mm/m compressive. Tensile strains have the potential to result in fracturing of the bedrock. Previous experience at mine sites has indicated that fracturing may occur when tensile strain is greater than 0.5 mm/m. Compressive strains may result in buckling or dilation of bedrock when strain is greater than 2 mm/m.

There is the potential for connective cracking to occur between the mined coal seam and the surface in areas where the depth of cover is shallower. There is the potential for cracking to occur in the reaches of Dry Creek (and its tributaries) that overlie the Underground Extraction Area. Stream bed surface cracking that occurs as a result of mining will be remediated by infilling and regrading (where accessible) as soon as practical after being identified. In the period after the occurrence of cracking but before remediation can be undertaken, there is the potential for some surface flows (following extensive rainfall) to drain from the sections of Dry Creek (and its tributaries) into the underlying mine workings. **Section 7.4** provides an assessment of the potential impacts to the surface water.

The uppermost bedrock lies directly beneath the surface soils hosting Dry Creek and its tributaries. Any fractures that form in this bedrock material as a result of subsidence are expected to gradually infill with surface soils during flow events. To mitigate the losses of stream flow into the mine workings, remediation of the fractured bedrock material within the stream alignments can be proactively undertaken in the circumstance where the infilling of these fractures does not occur naturally.

The groundwater impact assessment has identified a minor perched Triassic aquifer and Permian bedrock aquifers within the Subsidence Study Area. The perched Triassic aquifer has been identified as a localised aquifer and does not form part of the regional groundwater system. The predicted extent of bedrock fracturing was accounted for in the groundwater modelling undertaken for the Project as discussed in **Section 7.6**.

Cliffs

A cliff is defined as a continuous rockface having a maximum height greater than 10 m, a minimum length of 20 m and a minimum slope of 2 in 1. The Bylong Valley is lined with numerous escarpment type features, cliffs and rock ledges of various sizes. There are more than 730 cliffs within the Study Area, ranging between 10 m to 80 m in height and 20 m to more than 500 m in length. In general, the cliffs increase in size and number in the south-eastern portion of the Study Area (near Tal Tal Mountain), and into the adjoining Wollemi National Park.

The presence of cliffs within the Study Area and the potential constraints to mining operations has been recognised by the Project team from the outset of the mine planning process for the Project. A Subsidence Constraints Study was undertaken in 2012 to identify the potential constraints to underground mining operations. The study utilised high resolution topographic information to identify cliffs within the Study Area and to categorise these features according to the level of constraints to mining operations.

Within the vicinity of the proposed longwalls for the Project, three cliffs (24278 (C4), 24279 (C1) 24324 (C3)) as illustrated on **Figure 39**) were identified of particular importance. The final design of the Underground Extraction Area has considered these particular cliffs and has specifically amended the proposed longwall extraction to minimise significant impacts to each.

MSEC has identified 41 cliffs within the Subsidence Study Area, including 30 cliffs directly overlying the proposed longwall panels. Most of these cliffs are located within the Bylong State Forest, and occur above Longwalls 105 to 107 and Longwall 109.

A small number of cliffs are also located in the north of the Subsidence Study Area above Longwall 206. Cliffs within the Subsidence Study Area are typically 10 m to 20 m in height and less than 100 m in length. There are also four cliffs between 20 m and 40 m in height, six cliffs with lengths up to 150 m and one cliff with a length of up to 300 m within the Subsidence Study Area.

The mine plan has been specifically designed to limit the impacts to the three most prominent cliffs (C4, C1 and C3 illustrated on **Figure 39**) which are located outside the Subsidence Study Area. These cliffs have been considered in this assessment due to their size and prominence. None of the cliffs in the vicinity of the Project constitute escarpments.

The maximum predicted subsidence effects at cliff locations within and in the immediate vicinity of the Subsidence Study Area are presented in **Table 27**. Cliffs C4, C1 and C3 are not expected to experience any significant conventional tilts, curvatures or strains, even if the predicted vertical subsidence were exceeded by a factor of two times. These cliffs may experience up to 150 mm to 200 mm of horizontal movement. These far-field movements are bodily movements and are not expected to result in any significant strains. Consequently, these cliffs are not predicted to experience adverse consequences.

The cliffs within the Subsidence Study Area are predicted to experience more substantial movements. The stability of cliffs is dependent on a large range of factors (including natural processes) other than the magnitude of the movements. As such, the likelihood of cliff instability is difficult to predict.

TABLE 27 Maximum Predicted Subsidence Effects for Cliffs

Cliff	Maximum Total Subsidence (mm)	Maximum Total Tilt (mm/m)	Maximum Total Hogging Curvature (km ⁻¹)	Maximum Total Sagging Curvature (km ⁻¹)
C4 (24278)	< 20	< 0.5	< 0.01	< 0.01
C1 (24279)	< 20	< 0.5	< 0.01	< 0.01
C3 (24324)	< 20	< 0.5	< 0.01	< 0.01
Cliffs within Subsidence Study Area	3,300	40	2.0	1.5

Observations at Ulan Mine, which possesses similar mining conditions, have been used to estimate the impacts that may result from the Project. Monitoring undertaken at Ulan Mine of more than 8 km of cliff length (which has been directly undermined) has confirmed that rock falls have occurred over approximately 20% of the length of the cliffs with visible mining subsidence movements occurring in approximately 50% to 70% of the sandstone formations greater than 3 m high. No rock falls were observed at cliffs that do not directly overlie longwall panels, although some cracking was observed (SCT, 2009).

Within the Subsidence Study Area, there are 11 cliffs that do not directly overlie the Underground Extraction Area. Based on the experience at Ulan Mine, no major instability is expected to occur at these cliffs and no rock falls are expected.

When comparing the experiences observed at Ulan Mine with the Project, it is noted that while panel widths and depths of cover are similar, the maximum measured subsidence at Ulan Mine is less than predicted for the Project on account of a lower extraction height. However, the maximum measured tilt and strain at Ulan Mine are similar in magnitude to those predicted for the Project.

The Ulan Mine experiences provide a reasonable indication of the level of impacts that may occur at the cliffs that are located above the proposed longwall panels. Therefore, rock falls are likely to be experienced from approximately 20% of the length of the cliffs within the Underground Extraction Area. Further, visible mining subsidence movements within the Underground Extraction Area are expected to occur in approximately 50% to 70% of this subset of cliffs.

It is expected that cliffs with greater height and continuous length will be more susceptible to impacts. Subsequently, two cliffs (C5 and C6) located directly above the longwalls with heights between 30 m and 40 m and one of these (C5) with a length of between 250 m and 300 m are at risk of greater visible mining subsidence movements and rock falls.

The Visual Impact Assessment carried out for the Project (as discussed in **Section 7.17**) indicates that impacts to these two larger cliffs above the longwalls (C5 and C6) will be screened from reasonable, every-day public vantage points by the ridge to the south-west of the Subsidence Study Area. Some smaller cliff impact locations may be visible from isolated locations outside the Subsidence Study Area but will generally be at distances greater than 1.5 km.

Steep Slopes

A steep slope has been defined as an area of land having a gradient greater than 1 in 3 (33% or 18.3°). The minimum slope of 1 in 3 would generally be considered stable for slopes consisting of rocky soils or loose rock fragments. The maximum predicted tilt for the steep slopes is 75 mm/m (7.5%). The predicted tilts are small when compared to the natural grades of the steep slopes, which are greater than 1 in 3. Therefore, the predicted tilts are unlikely to adversely affect the stability of the steep slopes.

Steep slopes are more likely to be affected by curvatures and strains. There is the potential for tension cracking to occur at upper or side slopes and for compressive ridges to form on the lower slopes. These consequences can be remediated by infilling the cracks or regrading the surface.

Protected Areas

The Subsidence Study Area does not include any land reserved under the NPW Act or any land declared as a wilderness area under the *Wilderness Act 1987*.

The Subsidence Study Area includes land contained within the Bylong State Forest. However, these areas are not readily accessible to the public.

Railway Lines

The Sandy Hollow to Gulgong Railway Line is located external to the Subsidence Study Area. At its closest point, the railway line is approximately 170 m from the proposed longwall panels and is predicted to experience less than 20 mm of conventional subsidence.

The majority of the railway (including a tunnel) is located more than 800 m from the proposed longwall panels. At these distances, the railway may experience up to 150 mm of far-field horizontal movement, although such movements are generally expected to be less than 50 mm. These movements are not expected to significantly impact the railway line.

Roads

The only public road passing through the Subsidence Study Area is Bylong Valley Way, which was upgraded to a sealed road in 2008. The maximum subsidence effects that are predicted to occur along Bylong Valley Way at various stages of extraction are presented in **Table 28**. The predicted tilts may result in increased ponding along flatter sections of roads. Changes in grade due to subsidence can be remediated by regrading/re-levelling the road.

TABLE 28 Predicted Subsidence Effects Along Bylong Valley Way

Longwall	Maximum Subsidence (mm)	Maximum Tilt Along Alignment (mm/m)	Maximum Hogging Curvature (km ⁻¹)	Maximum Sagging Curvature (km ⁻¹)
LW101	450	5	0.3	<0.01
LW201	2,900	30	0.6	0.5
LW202	3,000	30	0.6	0.6
LW203	3,000	50	2.0	1.5
LW204	3,000	60	2.5	2.5
LW205	3,000	60	3.0	2.5
LW206	3,000	60	3.0	2.5

Sections of the Bylong Valley Way are predicted to experience maximum strains of 30 mm/m tensile and 25 mm/m compressive. These strains are expected to result in cracking, heaving and stepping of the road surfaces. The widths of tensile cracks are generally expected to be in the order of 50 mm to 100 mm. Heaving resulting from compressive strains is predicted to be in the order of 25 mm high.

There are 12 road culverts (along Bylong Valley Way) within the Subsidence Study Area. The pipe diameters of the culverts vary from 375 mm to 1,200 mm. The predicted tilts are greater than the constructed grades of some culverts. The flow of water through a culvert may be affected if the predicted tilts cause the grade to reverse. The predicted curvatures and strains could also be of sufficient magnitudes to result in cracking of the culverts or headwalls. Impacts to road culverts are expected to be of a nature that can be remediated by re-levelling or repairing the structure.

There are no road bridges or tunnels within the Subsidence Study Area.

Utilities Infrastructure

There is a 22 kV distribution line located within the Subsidence Study Area. This distribution line is owned by Endeavour Energy and services properties near Bylong Valley Way. This distribution line is aligned alongside the road and is supported by timber and concrete poles.

The 22 kV distribution line is predicted to experience maximum subsidence of 2,500 mm, maximum tilt of 50 mm/m along its alignment, and maximum tilt of 45 mm/m across its alignment. Distribution lines are sensitive to tilts because these can result in displacement of the support poles.

Remediation is generally required where the displacement at the top of a pole is greater than twice the pole's diameter. The poles supporting the 22 kV distribution line are approximately 15 m high and have diameters of 250 mm. Based on these dimensions, the distribution line can tolerate up to 33 mm/m of tilt. Given that the maximum predicted tilts are greater than 33 mm/m, it is expected that remediation and repair work will be required. Impacts can also be prevented by implementing preventative measures such as guide wires, cable sheaves, additional poles or adjustment of cable catenaries.

There are no potable water or sewerage pipelines located within the Subsidence Study Area. There is no gas infrastructure located within the Subsidence Study Area.

Telecommunications Infrastructure

Approximately 3,450 m of copper cables are located within the Subsidence Study Area. These Telstra cables are direct buried and generally follow the alignment of Bylong Valley Way. The copper cables are expected to experience similar levels of subsidence effects to those effects predicted for Bylong Valley Way (see **Table 28**).

Given that copper cables are linear features, the most relevant subsidence effect is strain. The copper cables are predicted to experience maximum strains of 30 mm/m tensile and 25 mm/m compressive. MSEC's previous experience indicates that copper cables can generally tolerate strains of up to 20 mm/m. However, higher strain values have been measured in the Hunter Coalfield without any adverse impacts on telecommunications cables. Impacts to telecommunications cables are generally infrequent and minor in nature. It is expected that any impacts that may occur will be readily repairable.

Agricultural Enterprises

The Subsidence Study Area includes KEPCO owned properties and two privately owned properties (Landowner IDs 53 to 55 and 138 to 141 on **Figure 12**) that currently support a quarry and a cattle grazing enterprise respectively. The Subsidence Study Area also includes a proportion of the Bylong State Forest. The Subsidence Study Area also includes a small area of land that is mapped as part of the Equine CIC. Surface cracking and deformations resulting from subsidence may present a hazard to livestock and workers on these properties. These impacts (if they occur) can be readily remediated by infilling cracks or regrading and compacting the surface.

Potential impacts of subsidence on agricultural productivity are discussed in **Section 7.16**. It is noted that a portion of the property owned by KEPCO within the Subsidence Study Area is proposed to be included within the Project's BOS and as such any impacts from subsidence to agricultural activities will not be experienced.

KEPCO will seek the relevant Occupation Agreement from NSW Forests, which will include a number of requirements, including conditions of access and remediation and rehabilitation requirements which will be addressed within the Property Subsidence Management Plan.

Rural Infrastructure

A galvanised shed, known as the 'Shooters Hut', is located above LW102 on KEPCO owned land. The maximum subsidence effects that this structure may experience are predicted to be:

- Maximum subsidence of 950 mm;
- Maximum tilt of 35 mm/m (3.5%);
- Maximum tensile strain of 10 mm/m; and
- Maximum compressive strain of 4 mm/m.

The shed is a structure of lightweight construction with dimensions of 8 m x 10 m. The predicted maximum tilt is not expected to result in impacts to the structural integrity of such a structure. However, the predicted tilts may result in serviceability impacts such as door swings or changes to drainage. Due to its small size and lightweight construction, the shed is expected to withstand the predicted strains. Impacts to serviceability (if they occur) can be managed using ordinary building maintenance practices.

There is one silo located on KEPCO owned land within the Subsidence Study Area. This silo is approximately 7 m in diameter and is supported on a concrete pad. The silo is predicted to experience the following subsidence effects:

- Maximum subsidence of 2,400 mm;
- Maximum tilt of 60 mm/m (6%);
- Maximum tensile strain of 16 mm/m; and
- Maximum compressive strain of 25 mm/m.

The predicted tilt may affect the stability of the silo; however, impacts can be readily remediated by re-levelling the silo. The concrete pad supporting the silo rests on the ground surface. As a result, the predicted strains are unlikely to be transferred to the structure.

There is one galvanised iron water tank and two concrete water tanks located on KEPCO owned land within the Subsidence Study Area. The maximum subsidence effects that the tanks are predicted to experience are presented in **Table 29**. Based on the predicted maximum curvatures, the maximum strains are predicted to be 15 mm/m tensile and 12 mm/m compressive.

Tilt has the potential to affect the serviceability of water tanks by altering water levels. This can alter the minimum level at which water can be released from the outlets. Impacts to serviceability can be remediated by re-levelling the tank.

The three water tanks within the Subsidence Study Area all rest on the ground surface. Therefore, the predicted curvatures and strains are unlikely to be transferred to be structures. Strains may affect the serviceability of any buried pipelines associated with the water tanks. Physical damage to pipelines (if any) is expected to be readily repairable.

TABLE 29 Predicted Subsidence Effects at Water Tank Locations

Tank ID	Maximum Subsidence (mm)	Maximum Tilt (mm/m)	Maximum Hogging Curvature (km ⁻¹)	Maximum Sagging Curvature (km ⁻¹)
T01	1,100	25	0.5	0.3
T02	1,100	25	0.5	0.3
T03	2,400	0.5	1.5	1.2

A number of concrete watering troughs are located within the Subsidence Study Area. These troughs are very small and are supported directly on the ground surface. As a result, these structures are unlikely to be affected by subsidence movements.

A number of fences are located within the Subsidence Study Area. Fence posts may be affected by tilt and the fence wires may be affected by tensile strains. Wire fences are flexible structures and are generally expected to be able to tolerate tilts of up to 10 mm/m and tensile strains of up to 5 mm/m. Impacts to wire fences are expected to be minor in nature and can be remediated by re-tensioning the wire, straightening the fence posts or replacing some sections of fencing (if necessary).

There are 11 farm dams (owned by KEPCO) within the Subsidence Study Area. These dams are earthen dams that have been established by cut and fill operations. The largest dam (D11) has a surface area of approximately 21,000 m² and a maximum plan dimension of 200 m. The remaining dams have surface areas ranging from 150 m² to 1,800 m², and maximum plan dimensions ranging from 15 m to 60 m.

The maximum subsidence effects at the locations of farm dams are predicted to be:

- Maximum subsidence of 3,150 mm;
- Maximum tilt of 70 mm/m (7%);
- Maximum tensile strain of 35 mm/m; and
- Maximum compressive strain of 20 mm/m.

The predicted tilts for the farm dams within the Subsidence Study Area vary from 2 mm/m to 70 mm/m. Tilts may alter water levels in dams, resulting in changes in freeboard. The lower side of the dam will experience a reduction in freeboard, and therefore becomes more prone to overflows. The predicted changes in freeboard for each of the dams in the Subsidence Study Area are presented in **Table 30**.

Six of the dams (D02, D05, D07, D08, D10 and D11) are predicted to experience reductions in freeboard of greater than 1,000 mm. These changes in freeboard are unlikely to result in instability of dam walls. However, these changes in freeboard may result in reductions in the storage capacities of dams. Storage capacities can be restored by raising the dam walls.

TABLE 30 Predicted Changes in Freeboard Due to Subsidence

Dam	Maximum Predicted Change in Freeboard after Subsidence (mm)									
	LW101	LW102	LW103	LW109	LW201	LW202	LW203	LW204	LW205	LW206
D01	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	100
D02	< 50	< 50	< 50	< 50	< 50	< 50	< 50	1,600	1,600	1,600
D03	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50
D04	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	150
D05	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	1,800	1,750
D06	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50
D07	< 50	< 50	< 50	< 50	< 50	< 50	< 50	1,950	2,000	2,000
D08	< 50	< 50	< 50	< 50	< 50	< 50	1,700	1,700	1,700	1,700
D09	< 50	< 50	< 50	< 50	500	450	450	450	450	450
D10	< 50	2,200	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300
D11	2,750	2,750	2,750	2,750	2,700	2,700	2,700	2,700	2,700	2,700

The predicted tensile and compressive strains may result in cracking, heaving or stepping of the dam bases or walls, which may lead to leakage of stored water. If leakage from farm dams is observed, remediation will be undertaken to re-instate the dam base and walls.

There are no privately owned bores within the Subsidence Study Area. Three groundwater monitoring bores (owned by KEPCO) are located within the Subsidence Study Area. These bores may experience impacts such as lowering of the piezometric surface, blockage of the bore due to differential horizontal displacements at different horizons within the strata, changes to groundwater quality, and horizontal shearing of the bores.

Industrial and Commercial Infrastructure

The only commercial enterprise operating within the Subsidence Study Area is the Bylong Quarry. There are no permanent structures at the site. The highwalls at the quarry are approximately 10 m in height.

The predicted tilts may result in instability of the quarry's highwalls. The highwalls may experience rock falls (in a similar fashion to the cliffs within the Subsidence Study Area) if longwall mining occurs directly beneath the highwalls.

The predicted strains may result in cracking and deformation of the ground surface within the quarry. Cracking and heaving may present a hazard to personnel and equipment working in the quarry. A site specific Management Plan will be put in place in consultation with the owner of the Bylong Quarry to ensure its continued safe operation.

Residential Structures

There are no residential structures located within the Subsidence Study Area.

Archaeological Sites

A total of 146 archaeological sites (cultural heritage sites) have been identified within the Subsidence Study Area and an additional five sites are in close proximity. Impacts to cultural heritage sites are discussed in **Section 7.11.3**.

Sensitivity Analysis

A sensitivity analysis was undertaken to determine the potential consequences in the event that actual subsidence exceeds the predictions. **Table 31** describes the likely consequences to the subsidence predictions. The sensitivity analysis considered the consequences that may occur if actual subsidence effects were double the predicted values.

7.1.4 Mitigation and Management

Avoidance

Subsidence related issues, particularly potential consequences for natural rock structures, cliff lines, groundwater systems, agricultural land and ecological habitats, were recognised from the outset as being a key factor for consideration in the mine planning design process. Accordingly, substantial areas of viable underground coal resources which exist within the Authorisations held by KEPCO have not been included as part of the Project.

As discussed in **Section 3.17**, a number of underground mine plan layouts and areas were considered during the mine planning process. The Project mine plan proposes mining within only one of the four areas within the Authorisations which were identified as containing viable underground coal resources. Additionally, the Project mine plan has adopted setback distances from the Bylong River alluvium and also from the three most prominent cliffs that are visible from the valley areas.

Extraction Plans

KEPCO will develop an Extraction Plan prior to the commencement of longwall mining activities. The Extraction Plan will include a monitoring program to measure subsidence effects and identify environmental consequences.

The Extraction Plan will also include management plans addressing predicted impacts to all natural and built features. The Extraction Plan (and associated management plans) will be developed in consultation with relevant regulators and infrastructure owners.

Property Subsidence Management Plans

As mentioned above, the Subsidence Study Area comprises one privately owned agricultural property, the Bylong Quarry, Bylong State Forest, Bylong Valley Way and other communication infrastructure located on KEPCO owned land. Property Subsidence Management Plans will be developed in consultation with owners of properties or infrastructure that have the potential to be impacted by subsidence. These plans will generally include the following information:

- A description of the structures or assets on the property;
- Predicted impacts to the structures or assets;
- A risk assessment for each structure or asset prior to mining, to forecast and manage any hazards that may arise prior to mining;

TABLE 31 Sensitivity Analysis of Subsidence Predictions

Feature	Likely Consequences
Streams	Doubling the predicted subsidence effects would result in maximum tilt greater than 100 mm/m (>10%). The extent of ponding and scouring would increase. The risk of stream realignment and cracking of stream beds would also increase. Remediation methods are still expected to be effective, although the extent of remediation required would be greater.
Cliffs	Cliffs C4, C1 and C3 are not expected to be impacted, even if subsidence effects are double the predicted values. Doubling the predicted subsidence would result in cliffs within the Subsidence Study Area experiencing up to 6,600 mm of subsidence. Cliffs that overlie the proposed longwall panels may encounter more frequent and greater rock falls.
Steep Slopes	Doubling the predicted subsidence effects would result in maximum tilt greater than 100 mm/m (>10%). Slope instability is not expected to occur because these values are less than the existing gradient.
Roads	Doubling the predicted subsidence effects would result in a greater degree of ponding and greater levels of damage to the road surface or culverts. Remediation techniques are expected to remain unchanged; however, a greater degree of remediation may be necessary.
Transmission Lines	Doubling the tilt will increase the relative displacement between the power poles. This can be managed through the implementation of preventative and remedial measures.
Telecommunications Cables	If the predicted strains were doubled, the likelihood of impacts to the buried copper cables would increase. Impacts that may occur are expected to be readily repairable.
Sheds	If the predicted tilt was doubled, the 'Shooters Hut' would experience 70 mm/m of tilt. This is expected to increase the incidence of serviceability impacts, but is not expected to affect the structural integrity of the structure. Serviceability impacts are expected to be repairable using ordinary building maintenance techniques.
Water Tanks	Doubling the predicted tilt would result in greater impacts on the serviceability of water tanks. Such impacts can be remediated by re-levelling the water tanks. Doubling the predicted strains is not expected to affect the integrity of water tanks themselves. The incidence of serviceability impacts to buried pipelines may increase; however, these impacts are expected to be readily repairable.
Farm Dams	Doubling the predicted tilts and strains would result in greater changes in freeboard and greater risks of cracking or heaving. These impacts can be mitigated by raising dam walls or repairing any cracked surfaces.
Silo	Doubling the predicted tilt will result in greater risk of impacts to the safety and serviceability of the silo. Re-levelling of the silo is still expected to be an effective remediation measure. Doubling the predicted strains is not expected to result in greater impacts, given that the strains will not be experienced by the structure itself.
Doubling the predicted subsidence effects does not result in any adverse/unmanageable impacts.	

- A protocol for monitoring subsidence effects and environmental consequences during mining;
- A protocol for regular inspections of structures that are considered to be at risk; and
- Measures for mitigating or remediation of adverse consequences.

Remediation

As explained in **Section 7.1.3**, predicted consequences are expected to be able to be remediated. Generally, consequences that arise as a result of tilt can be remedied by re-levelling the structure or the land on which it is constructed. Consequences that arise as a result of tensile strains can usually be remediated by infilling of fractures with a suitable material. Consequences that arise as a result of compressive strains can generally be remediated by regrading and re-compacting the affected land. Any minor impacts to rock structures will discolour and meld with the natural weathering process over time.

7.2 ECOLOGY

7.2.1 Background

An Ecological Impact Assessment has been undertaken for the Project by Cumberland Ecology Pty Ltd (Cumberland Ecology) and is provided in **Appendix J**. As part of this ecological assessment, Eastcoast Flora Survey has also conducted extensive flora surveys of the Study Area. Eastcoast Flora Survey's findings form part of the Ecological Impact Assessment.

The purpose of the Ecological Impact Assessment was to determine the likely impacts of the Project on the existing terrestrial and aquatic flora and fauna within the Study Area, including threatened species, populations and ecological communities listed under State and Commonwealth legislation. The assessment has been undertaken generally in accordance with applicable NSW and Commonwealth legislation and planning policies relevant to the protection of biodiversity as discussed in **Section 4**.

The vegetation present within the Study Area includes intact patches of native woodland and forest, partially disturbed woodland and forest remnants, derived native grassland and cultivated lands. The Study Area has had a history of agricultural development. Such land use has resulted in the degradation and clearing of native vegetation on the valley floor and lower slopes. Intact vegetation within the Study Area is typically associated with the slopes, escarpments, ridgelines and plateaus which have not been extensively used for agriculture or forestry. Areas within the Bylong State Forest have been selectively logged in the past for old growth timber.

Woody vegetation within the Study Area is dominated by a variety of eucalypts forming both grassy and shrubby woodlands.

Lower lying alluvial slopes along Bylong Valley support remnant stands of *Eucalyptus conica* (Fuzzy Box), which then grade into *Eucalyptus moluccana* (Grey Box), then *Eucalyptus albens* (White Box) or *Eucalyptus dawsonii* (Slaty Gum) on slopes, with *Eucalyptus melliodora* (Yellow Box) on higher elevation soils derived from basalt.

Ironbark-dominated forests are the most widespread in sandstone areas. Riparian vegetation has historically been cleared and now occurs as highly degraded woodland in scattered patches.

Two listed ecological communities within the Study Area comprise the White Box-Yellow Box-Blakely's Red Gum Grassy Woodlands and Derived Native Grassland which is listed as a Critically Endangered Ecological Community (CEEC) under the EPBC Act and the White Box Yellow Box Blakely's Red Gum Woodland listed as an Endangered Ecological Community (EEC) under the TSC Act (referred to as Box Gum Woodland and Derived Native Grassland). The Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Bioregion (Slaty Gum Woodland) also occurs within the Study Area and is listed as a Vulnerable Ecological Community (VEC) under the TSC Act. Additionally, the Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions (Hunter Floodplain Red Gum Woodland) occurs within the Study Area and is listed as an EEC under the TSC Act.

Extensive areas of remnant native vegetation, including woodland and forest communities, occur within the wider locality of the Study Area. Notable vegetated areas occur within Wollemi National Park and Goulburn River National Park generally to the east and north-east of the Study Area respectively. An extensive tract of remnant native vegetation also occurs to the west of the Study Area along the elevated areas of the Growee Ranges. The agricultural land uses also extend beyond the Study Area, generally along the valley floors.

7.2.2 Methodology

Desktop Assessment

A desktop assessment was undertaken to review available ecological literature relevant to the Study Area. The assessment considered published information from several ecological surveys undertaken within the Study Area and general vicinity of the Project. The findings of these studies assisted in gaining a comprehensive understanding of the local environment and were incorporated into the Ecological Impact Assessment where appropriate. Key documentation reviewed for the Project included:

- *The Native Vegetation of North-west Wollemi National Park and Surrounds – Draft* (OEH, 2012);
- *The Greater Hunter Vegetation Mapping Project* (OEH, 2012);
- *Mt Penny Coal Project: Preliminary Environmental Assessment* (Wells Environmental Services, 2011);
- *The Vertebrate Fauna of North-western Wollemi National Park* (DEC, 2006);
- *Ulan Coal - Continued Operations Ecological Assessment* (Umwelt, 2009);

- *Moolarben Coal Project Stage 2 Ecological Impact Assessment* (Ecovision Consulting, 2008);
- *Moolarben Coal Project Flora, Fauna and Aquatic Ecology Assessment* (Moolarben Biota, 2006);
- *Wilpinjong Coal Project Terrestrial Fauna Assessment* (Mt King Ecological Surveys, 2005); and
- *Wilpinjong Coal Project Bat Fauna Assessment* (Greg Richards and Associates, 2005).

The literature review also considered a number of ecological studies which have been completed by Cumberland Ecology for the various exploration activities within the Authorisations. Other existing information on the biodiversity values within the Study Area and its surrounds were obtained via interrogation of the '*Atlas of NSW Wildlife*' (OEH, 2014) and the '*EPBC Act Protected Matters Search Tool*' (DoE, 2014h). The *Atlas of NSW Wildlife* was utilised to develop a list of all the threatened species recorded within a 10 km buffer from the extents of the Study Area.

The '*Protected Matters Search Tool*' provided a list of the MNES that are predicted to occur within the locality of the Study Area, based on the presence of suitable habitat.

The information collected during the literature review and database analysis assisted in determining the likelihood of threatened species occurring within the Study Area and guided the methodology implemented for the field surveys.

Field Surveys

In order to understand the key biodiversity values within the Study Area and to validate findings from the desktop assessment, extensive field surveys were undertaken by Cumberland Ecology and Eastcoast Flora Survey between 2011 and 2014. Surveys included comprehensive flora, fauna and aquatic investigations over a range of seasons to maximise opportunities of recording migratory and breeding species and accurately identify plants in flower or with fertile material. The overall survey effort within the Study Area is summarised in **Table 32**.

TABLE 32 Ecological Field Survey Effort

Survey Dates	Tasks Completed
FLORA	
31 October - 2 November 2011	Vegetation mapping and targeted threatened flora species searches
15-17 February 2012	Vegetation mapping, targeted threatened flora species searches and characterisation of woody vegetation units
2-4 May 2012	Vegetation mapping, targeted threatened flora species searches and characterisation of non-woody vegetation units
26-29 June 2012	Vegetation mapping, targeted threatened flora species searches and characterisation of woody vegetation units
4-6 September 2012	Vegetation mapping, targeted threatened flora species searches and characterisation of woody vegetation units
9-11 October 2012	Targeted threatened flora species searches and characterisation of woody vegetation units
21-24 May 2013	Vegetation mapping, targeted threatened flora species searches and characterisation of woody vegetation units
2-5 July 2013	Vegetation mapping, targeted threatened flora species searches and characterisation of woody vegetation units
20-23 August 2013	Vegetation mapping, targeted threatened flora species searches and characterisation of woody vegetation units
5-8 November 2013	Vegetation mapping, targeted threatened flora species searches and characterisation of woody and non-woody vegetation units
2-3 April 2014	Characterisation of non-woody vegetation units
9-11 May 2014	Characterisation of non-woody vegetation units and BioBanking surveys
5-9 May 2014	BioBanking surveys

Survey Dates	Tasks Completed
FAUNA	
12-16 November 2012	General habitat assessment and fauna surveys
14 November 2011 – 25 February 2014	Infra-red (IR) camera detection
18-22 February 2013	General habitat assessment and fauna surveys
20-24 May 2013	General habitat assessment and fauna surveys
19-23 August 2013	General habitat assessment and fauna surveys
18-19 March 2014	Fauna surveys targeting bird census
2 April 2014- 12 May 2014	IR camera detection
2, 7-9 April 2014	Fauna surveys targeting bird census
5-9 May 2014	Hollow-bearing tree assessment and bird census
11-15 November 2014	Targeted cliff line assessment
AQUATIC	
18-19 March 2014	Aquatic habitat assessment and macroinvertebrate sampling

Flora Survey

Field investigations of vegetation and flora species mapping within and/or surrounding the Study Area are summarised in **Table 33**. Eastcoast Flora Survey completed the majority of flora surveys within the Study Area, with the exception of some ancillary surveys of the grasslands and some BioBanking surveys which were completed by Cumberland Ecology. Flora surveys were undertaken by Eastcoast Flora Survey from October 2011 to November 2013; and by Cumberland Ecology from April 2014 to May 2014 and included:

- Vegetation mapping through the collection of 2,471 Rapid Data Points (RDPs);
- Grassland surveys to assess grassland for compliance with Box Gum Woodland and Derived Native Grassland, including 28 grassland plots (eighteen 10 m x 10 m and ten 20 m x 20 m quadrats), 71 rapid assessments points and 15 BioBanking plots;
- Quadrat sampling to aid the classification of vegetation communities and woody vegetation units, comprising 62 quadrats (20 m x 20 m or 40 m x 10 m);
- BioBanking surveys included 49 BioBanking plots (15 grassland plots and 34 woodland plots), to provide a measure of the ecological impacts of the Project and to allow for an assessment of adequacy of proposed offsets; and
- Threatened flora surveys to target the detection of potentially occurring threatened species. Targeted searches included 52 km of transect searches (driving and foot traverses) in conjunction with RDP collection.

The surveys were consecutively designed to adequately target flora species of conservation value and to meet the requirements of *Threatened Biodiversity Survey and Assessment Guidelines for Development and Activities (Working Draft)* (OEH Threatened Species Guidelines) (DEC, 2004). In particular, surveys of Box Gum Woodland were undertaken in accordance with the *EPBC Act Policy Statement 3.5 - White Box - Yellow Box - Blakely's Red Gum grassy woodland and derived grasslands* (DEH, 2006) and the *Final Determination for Box Gum Woodland and Derived Native Grassland under the TSC Act* (NSW Scientific Committee, 2002b).

TABLE 33 Flora Survey Methods

Survey Task	Survey Effort
Vegetation Mapping	2,471 RDPs and throughout survey period
Characterisation of non-woody vegetation units (grassland surveys)	28 grassland plots (18 10 m x 10 m quadrats and ten 20 m x 20 m quadrats), 71 rapid grassland assessments points, 15 BioBanking plots
Characterisation of woody vegetation units (quadrat sampling)	62 quadrats (20m x 20 m or 40 m x 10 m) (woody vegetation)
Threatened Species Searches	Throughout survey period, 52 km of transect searches (driving and foot traverses) for terrestrial orchids

Surveys were timed to follow rainfall in February and March 2014 (62 mm and 149 mm, respectively), to maximise the detection of native non-grass species in the understorey. BioBanking surveys followed the *BioBanking Assessment Methodology* (BBAM) (DECC, 2009).

All information gathered during field surveys was synthesised using a GIS to create a database of spatial records; then analysed to produce a detailed vegetation unit map of the Study Area.

Fauna Survey

Fauna surveys were undertaken over a number of time periods, different seasonal conditions and at a range of locations within the Study Area to maximise the likelihood of detecting fauna species present. Fauna surveys were conducted across the Study Area from November 2012 to May 2014 in accordance with the Threatened Species Guidelines (DEC, 2004) and the various Commonwealth *Survey Guidelines for Australia's Threatened Species* (DEWHA, 2010a, b; and SEWPAC, 2011a, b).

Terrestrial fauna surveys were undertaken over several survey seasons within the Study Area to enhance the range of detection. Fauna survey methods and efforts for the Project are summarised in **Table 34** and have encompassed:

- General habitat assessments noting the abundance of various habitat features as well as an assessment of the likelihood of occurrence of potentially occurring threatened fauna species;

TABLE 34 Fauna Survey Methods

Survey Task	Survey Effort
General Habitat Assessment	Throughout survey period and 25 targeted sites
Hollow-bearing Tree Assessment	34 plots at 20 m x 50m
Targeted Cliff Line Assessment	17 direct assessments and 18 observation points
Trapping Transects – Elliot A (terrestrial)	1,200 trap nights (12 sites)
Trapping Transects – Elliot B (arboreal)	480 trap nights (12 sites)
Trapping Transects - Cage	96 trap nights (12 sites)
Hair Tube Transect	5,760 trap nights (8 sites)
Bird Census	42 hours (84 sites)
Amphibian and Reptile Survey	7.5 hours (15 sites)
Ultrasonic Call Detection	32 trap nights (16 sites)
Harp Trapping	30 trap nights (12 sites)
Spotlighting Transect	Approximately 27 person hours
Call Playback	16 sites
IR Camera Detection	34 sites (1,699 nights)

- Hollow-bearing tree assessments to determine approximate densities of hollow-bearing trees per hectare within the Project Disturbance Boundary (34 plots 20 m x 50 m);
- Targeted cliff line assessments including the collection of data from direct assessment points and observation points, IR camera surveys and scat searches;
- Trapping for terrestrial and arboreal fauna including a total of 12 trap lines across the Study Area, each comprising 25 Elliot A traps, 10 Elliot B traps and 2 wire cage traps;
- Hair tube surveys for terrestrial and arboreal mammals using 'Faunatech' hair tubes;

- Diurnal bird surveys, including targeted surveys at census points;
- Amphibian and reptile surveys of suitable habitat involving lifting of bark, fallen logs, bush rock and scraping of topsoil, including targeted surveys at search points;
- Microchiropteran bat surveys including the use of 'Anabats' for ultrasonic call detection and harp traps;
- Spotlighting transects for amphibians, birds, mammals and reptiles;
- Call playback for threatened nocturnal birds and mammals;
- IR camera surveys for a variety of species for long, medium and short term durations; and
- Any incidental vertebrate fauna species that were observed, heard calling, or otherwise detected on the basis of tracks or signs were recorded and listed in the total species list for the Study Area.

Aquatic Survey

Aquatic surveys were conducted in accordance with *The Australia Wide Assessment of River Health: NSW Australian River Assessment System (AusRivAS) Sampling and Processing Manual* (Turak and Waddell, 2001). This approach involved completing habitat assessments, insitu water quality measurements and collecting aquatic macro-invertebrate samples to provide an indication of the current condition of the aquatic survey locations.

A total of 11 sites were surveyed within the Study Area, focusing on waterways potentially impacted by the Project and in locations where water was known to be relatively permanent. Habitat assessments were undertaken at all of the 11 sites surveyed. However, only six sites had surface water present at the time of the survey. These were subject to water quality measurements and macro-invertebrate sampling. The aquatic survey did not include vertebrate sampling (e.g. fish), as no permanent watercourses were identified within the Study Area. Any fish species that were observed incidentally during aquatic surveys were recorded.

Groundwater Dependent Ecosystem Assessment

Cumberland Ecology conducted a desktop assessment to identify the potential presence of Groundwater Dependent Ecosystems (GDEs) within the Study Area. The desktop assessment investigated the Commonwealth's *Atlas of GDEs*. The *Atlas of GDEs* uses remotely sensed data and expresses the likelihood that ecosystems are accessing additional water sources (soil water, surface water or groundwater) other than direct rainfall.

The *Atlas of GDEs* indicates a low to moderate potential for GDEs to occur in a thin riparian zone along the Growee River and the lower portions of Bylong River. There were no GDEs identified in the Study Area along the Bylong River and Lee Creek catchments, upstream of the Growee River confluence.

Physical searches for potential GDEs also were undertaken during the vegetation mapping surveys, guided by the potential presence of GDEs determined by the desktop assessment. Areas where ground seepage was evident were investigated, as well as patches of vegetation that supported moisture-loving flora species such as sedges, rushes or ferns. The assessment of potential impacts to GDEs considered field surveys and modelling undertaken as part of the Groundwater Impact Assessment (see **Section 7.6**) which determined the potential water quality and water level drawdown impacts of the Project on GDEs.

7.2.3 Existing Environment

Vegetation Communities

A total of 24 vegetation communities have been mapped as occurring within the Study Area, and are summarised in **Table 35**. **Table 35** also provides the status of each as prescribed under the TSC Act or EPBC Act. **Figure 41** provides the spatial distribution of vegetation communities within the Study Area.

Of the 24 vegetation communities mapped within the Study Area, three vegetation communities have been identified as Threatened Ecological Communities (TECs) as noted in **Table 35**, including:

1. Hunter Valley Footslopes Slaty Gum Woodland: listed as a VEC under the TSC Act and not listed under the EPBC Act;
2. Hunter Floodplain Red Gum Woodland: listed as an EEC TSC Act: and not listed under the EPBC Act; and
3. White Box Yellow Box Blakelys Red Gum Woodland and the White Box, Yellow Box, Blakelys Red Gum Woodland and Derived Native Grassland (both referred to as Box Gum Woodland and Derived Native Grassland) which is listed as an EEC under the TSC Act and a CEEC under the EPBC Act respectively.

TABLE 35 Vegetation Communities Within the Study Area

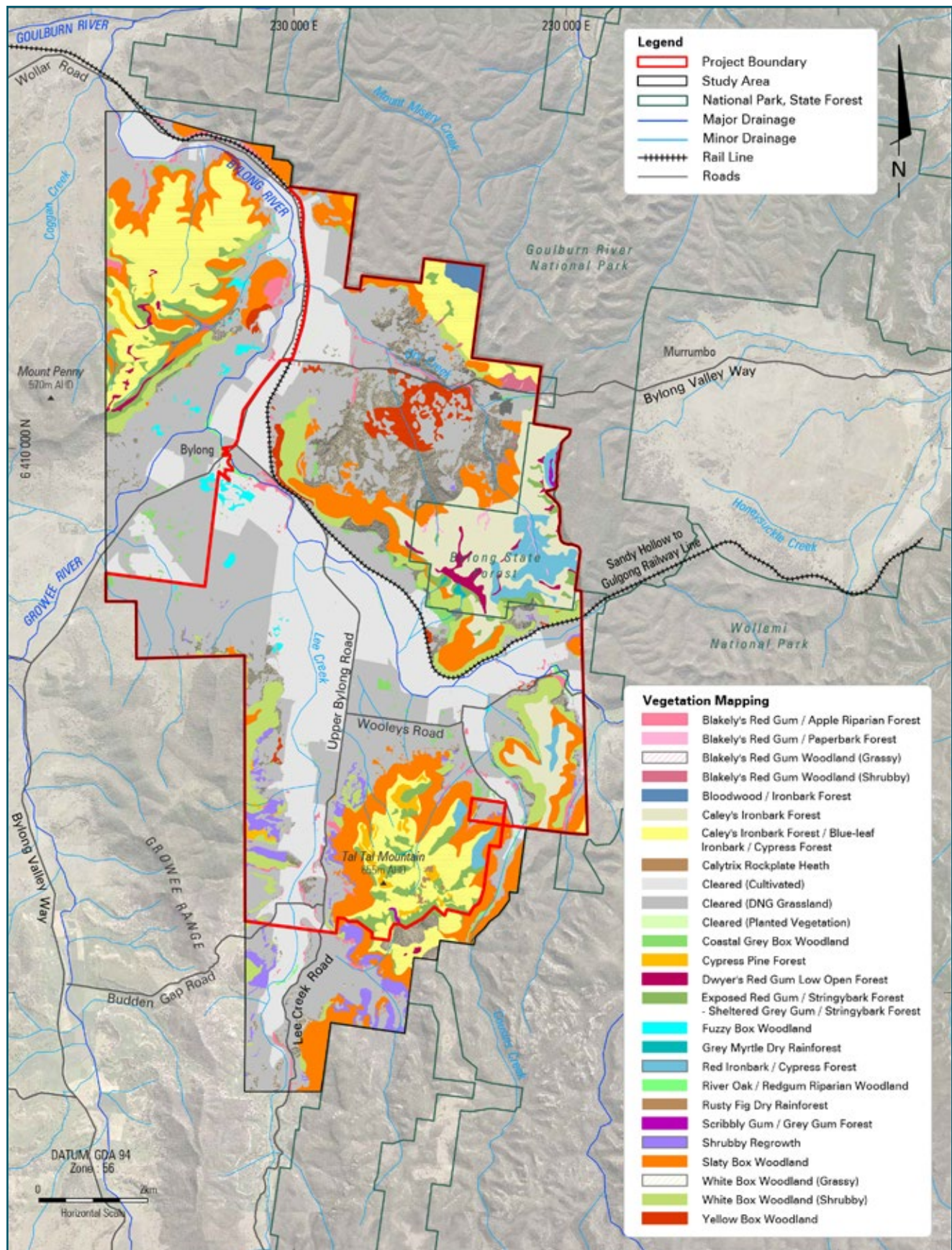
Vegetation Community	TSC Act	EPBC Act	Study Area (ha)
Slaty Box Woodland ¹	VEC	N/A	1,144
River Oak / Redgum Riparian Woodland ²	EEC	N/A	39
Yellow Box Woodland ³	EEC	CEEC	161
White Box Woodland (Grassy) ³	EEC	CEEC	714
White Box Woodland (Shrubby)	N/A	N/A	502
Blakely's Red Gum Woodland (Grassy) ³	EEC	CEEC	16
Blakely's Red Gum Woodland (Shrubby)	N/A	N/A	22
Coastal Grey Box Woodland	N/A	N/A	100
Fuzzy Box Woodland	N/A	N/A	60
Rusty Fig Dry Rainforest	N/A	N/A	1
Grey Myrtle Dry Rainforest	N/A	N/A	5
Blakely's Red Gum / Apple Riparian Forest	N/A	N/A	161
Blakely's Red Gum / Paperbark Forest	N/A	N/A	15
Calytrix Rockplate Heath	N/A	N/A	8
Shrubby Regrowth	N/A	N/A	199
Dwyer's Red Gum Low Open Forest	N/A	N/A	70
Caley's Ironbark Forest	N/A	N/A	514
Blue-leaf Ironbark / Cypress Forest	N/A	N/A	911
Red Ironbark / Cypress Forest	N/A	N/A	154
Cypress Pine Forest	N/A	N/A	82
Bloodwood / Ironbark Forest	N/A	N/A	29
Scribbly Gum / Grey Gum Forest	N/A	N/A	6
Exposed Grey Gum / Stringybark Forest	N/A	N/A	295
Sheltered Grey Gum / Stringybark Forest	N/A	N/A	
River Oak/Redgum Riparian Woodland Derived Native Grassland ²	EEC	N/A	453
Blakely's Redgum/Apple Riparian Forest Derived Native Grassland ³	EEC	CEEC	
Yellow Box Woodland Derived Native Grassland ³	EEC	CEEC	137
White Box Woodland Derived Native Grassland ³	EEC	CEEC	1,114
Blakely's Redgum Woodland Derived Native Grassland ³	EEC	CEEC	10
Slaty Box Woodland Derived Native Grassland	N/A	N/A	152
Coastal Grey Box Woodland Derived Native Grassland	N/A	N/A	838
Fuzzy Box Woodland Derived Native Grassland	N/A	N/A	284
Cleared/Cultivated Lands and Other (cleared, planted vegetation)	N/A	N/A	2,115
TOTAL			10,313

Notes: Discrepancies may be present in totals due to rounding

¹ Hunter Valley Footslopes Slaty Gum Woodland

² Hunter Floodplain Red Gum Woodland

³ Box Gum Woodland and Derived Native Grassland

FIGURE 41 Vegetation Communities

Two vegetation communities occurring within the Study Area have been identified as regionally significant communities. Coastal Grey Box Woodland and Fuzzy Box Woodland have been assessed in detail and determined to not conform to any listed TECs under the TSC Act and/or EPBC Act. Despite this, it has been recognised that these communities are of regional significance (see **Appendix J** for further information).

It is noted that a number of listings for threatened species, populations and communities under the EPBC Act have changed (either new listings or up-listings) since the Project was deemed a Controlled Action, some of which are relevant to the Project. For the purposes of the Ecological Impact Assessment (which has been prepared over a period of more than two years), MNES have been noted, assessed and discussed in accordance the listings as they were at the time of the Project being deemed a Controlled Action (12 March 2014).

Flora

The Study Area contains a variety of vegetation habitats including intact woodland, forest vegetation and modified grassland areas, which provides potential habitat for a diverse range of flora species. Over 550 flora species have been recorded within the Study Area, including more than 100 exotic species. A full list of the flora species identified during the field assessments is provided in **Appendix J**.

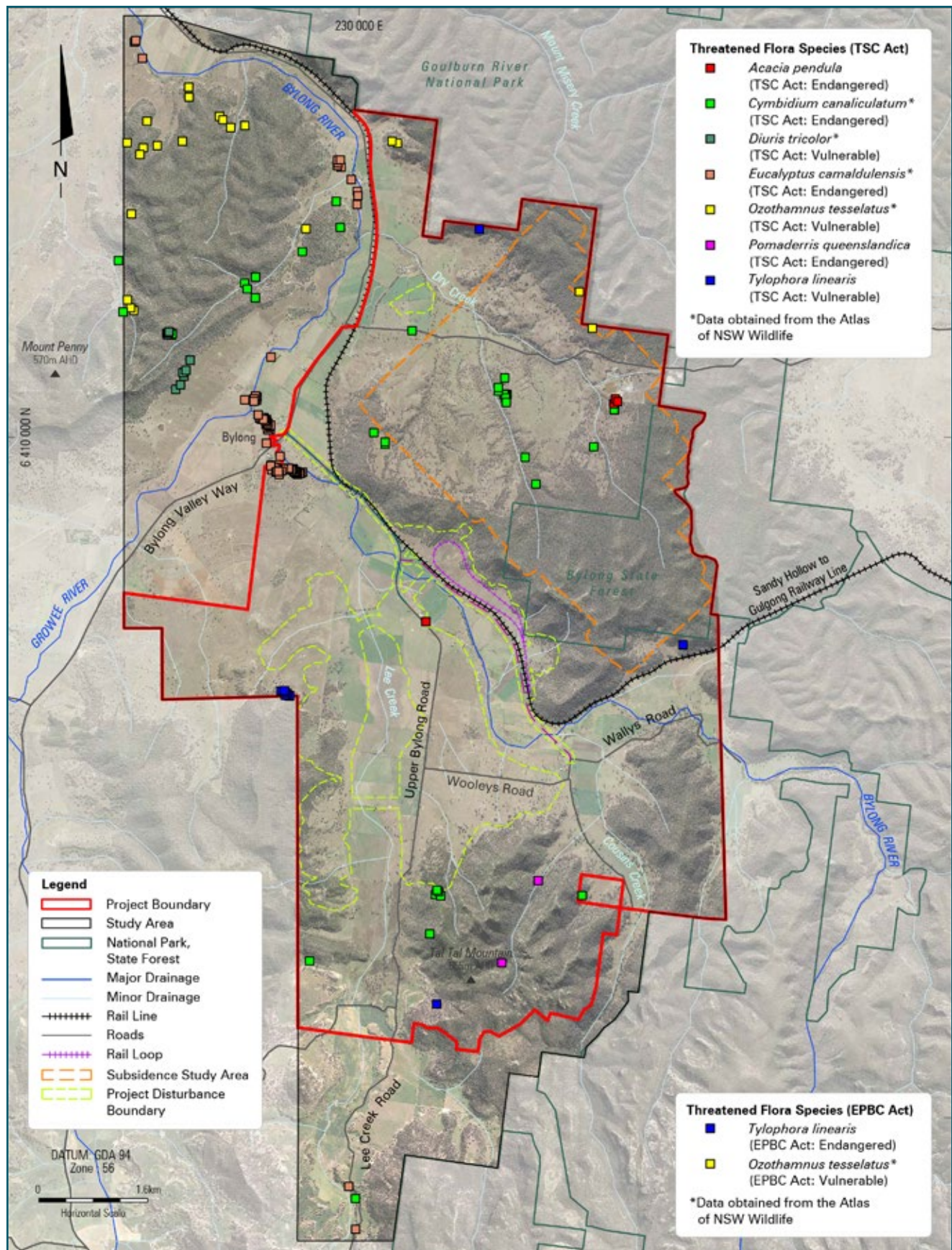
Seven threatened flora species listed under the TSC Act and/or EPBC Act have been recorded within the Study Area. An additional eight listed threatened flora species are known to occur within the surrounding locality and due to the presence of suitable habitat within the Study Area, these may potentially occur within the Study Area. The threatened flora species recorded within the Study Area or have the potential to occur are listed in **Table 36**. The locations of the threatened flora species identified in the Study Area are shown on **Figure 42**.

TABLE 36 Threatened Flora Species Recorded or Potentially Occurring Within the Study Area

Scientific Name	Common Name	TSC Act Status	EPBC Act Status
SPECIES RECORDED WITHIN THE STUDY AREA			
<i>Tylophora linearis</i>	N/A	V	E
<i>Ozothamnus tessellatus</i>	N/A	V	V
<i>Acacia pendula</i>	<i>Acacia pendula</i> (in the Hunter catchment)	EP	Not Listed
<i>Eucalyptus camaldulensis</i>	<i>Eucalyptus camaldulensis</i> (in the Hunter catchment)	EP	Not Listed
<i>Cymbidium canaliculatum</i>	<i>Cymbidium canaliculatum</i> (in the Hunter catchment)	EP	Not Listed
<i>Diuris tricolor</i>	Pine Donkey Orchid	V	Not Listed
<i>Pomaderris queenslandica</i>	Scant Pomaderris	E	Not Listed
SPECIES POTENTIALLY OCCURRING WITHIN THE STUDY AREA			
<i>Prostanthera cryptandroides</i> subsp. <i>cryptandroides</i>	Wollemi Mint-bush	V	V
<i>Prostanthera discolor</i>	N/A	V	V
<i>Commersonia rosea</i> (syn. <i>Androcalva rosea</i>)	N/A	E	E
<i>Eucalyptus cannonii</i>	Capertee Stringybark	V	Not Listed
<i>Homoranthus darwinioides</i>	N/A	V	V
<i>Pomaderris sericea</i>	Silky Pomaderris	E	V
<i>Philothea ericifolia</i>	N/A	Not Listed	V
<i>Thesium australe</i>	Austral Toadflax	V	V

TSC Act / EPBC Act Status: V = Vulnerable, E = Endangered, EP = Endangered Population

FIGURE 42 Threatened Flora Species



In addition to the threatened flora species known to occur or that have the potential to occur within the Study Area, a total of 14 regionally significant flora species have been identified. These species are considered as regionally significant as they are rare, extend the known distributional ranges or support few recent records. The regionally significant flora species identified within the Study Area include:

- *Acacia harpophylla*;
- *Acaena echinata* var. *subglabricalyx*;
- *Bertya linearifolia*;
- *Boronia angustisepala*;
- *Epacris coriacea*;
- *Chenopodium desertorum* subsp. *Microphyllum*;
- *Gonocarpus longifolius*;
- *Hakea tephrosperma*;
- *Hibbertia pilifera*;
- *Homoranthus cernuus*;
- *Melaleuca lanceolata*;
- *Myoporum platycarpum* subsp. *Platycarpum*;
- *Scaevola albida* var. *pallida*; and
- *Rhynchosia minima* (approaching southern limit).

Additionally, three species collected within the Study Area have been confirmed by taxonomic experts to likely represent new flora species including:

- *Hibbertia* sp. aff. *acicularis* (Dilleniaceae);
- *Sannantha* sp. aff. *cunninghamii* (Myrtaceae); and
- *Grevillea* sp. aff. *patulifolia/sericea* (Proteaceae).

Fauna Habitat

The Study Area contains extensive areas of intact woodland, forest vegetation and modified grassland areas, which provides potential habitat for a range of native fauna species. Fauna habitats occur within the various vegetation formations, topographical formations and ephemeral water resources, which provide potential foraging, shelter and breeding opportunities for a suite of fauna species. Key habitat features within the Study Area include:

- Riparian environments, including drainage lines and agricultural dams;
- Ground and shrub layer vegetation, leaf litter, coarse woody debris and rocky outcrops suitable as shelter;

- Hollow-bearing trees and stags suitable as shelter and breeding habitat;
- Blossom-producing trees and shrubs suitable as forage;
- Koala feed tree species; and
- Cliff lines and associated features such as caves, rocky outcrops and other shelter.

The Study Area is located within the wildlife corridor delineated by the 'Great Eastern Ranges Initiative', which aims to maintain and improve connectivity of the mountainous ecosystems of eastern Australia. The corridor comprises a linked series of biodiversity hotspots interconnected by a wide diversity of native vegetation (OEH, 2011). The woodland and forest vegetation within the Study Area is directly connected to Wollemi National Park and Goulburn River National Park, as well as extensive areas of unreserved vegetation to the west and south-west (see **Figure 41**). The vegetation and landscape of the Study Area indicates numerous movement corridors for wildlife. Movement of some species within the Study Area and to adjacent areas of habitat is impeded by existing cleared agricultural land. However, the isolated remnant patches and scattered paddock trees within the agricultural landscape provide stepping stone habitat for a number of fauna species, particularly woodland birds.

Within the region surrounding the Study Area, there is a diverse range of vegetation, ranging from rainforests and wet sclerophyll forest, to dry sclerophyll forests, woodlands, shrublands and grasslands. These extensive areas of varied habitat are largely protected in formal conservation reserves and will continue to provide important areas of good quality habitat for locally occurring species, including threatened flora and fauna species that have been recorded or have the potential to occur within the Study Area. Key habitat features recorded in the Study Area are also found elsewhere in the region and provide habitat for threatened species.

Fauna

The matrix of fauna habitats within the Study Area provides potential foraging, shelter and breeding opportunities for a suite of fauna species. Field surveys identified 186 vertebrate fauna species within the Study Area including six amphibian species, 130 bird species, 37 mammal species, nine reptilian species and 13 exotic species. Of the species recorded within the Study Area, 24 are threatened fauna species listed under the TSC Act and/or the EPBC Act. An additional 23 threatened fauna species are considered to have some potential to occur within the Study Area due to the presence of suitable habitat. A total fauna species list for the Study Area is provided in **Appendix J**.

The occurrence of threatened fauna species within the Study Area, including those identified or with the potential to occur is presented in **Table 37**.

The location of threatened fauna identified within the Study Area is illustrated in **Figure 43**.

TABLE 37 Threatened Fauna Species

Common Name (Latin Name)	TSC Act Status	EPBC Act Status	Occurrence
BIRDS			
Regent Honeyeater (<i>Anthochaera phrygia</i>)	CE	E	Recorded
Black-chinned Honeyeater (eastern subspecies) (<i>Melithreptus gularis gularis</i>)	V	Not Listed	Recorded
Little Lorikeet (<i>Glossopsitta pusilla</i>)	V	Not Listed	Recorded
Turquoise Parrot (<i>Neophema pulchella</i>)	V	Not Listed	Recorded
Speckled Warbler (<i>Chthonicola sagittata</i>)	V	Not Listed	Recorded
Brown Treecreeper (eastern subspecies) (<i>Climacteris picumnus victoriae</i>)	V	Not Listed	Recorded
Hooded Robin (south-eastern form) (<i>Melanodryas cucullata cucullata</i>)	V	Not Listed	Recorded
Grey-crowned Babbler (eastern subspecies) (<i>Pomatostomus temporalis temporalis</i>)	V	Not Listed	Recorded
Diamond Firetail (<i>Stagonopleura guttata</i>)	V	Not Listed	Recorded
Glossy Black-Cockatoo (<i>Calyptorhynchus lathami</i>)	V	Not Listed	Recorded
Gang-gang Cockatoo (<i>Callocephalon fimbriatum</i>)	V	Not Listed	Recorded
Spotted Harrier (<i>Circus assimilis</i>)	V	Not Listed	Recorded
Little Eagle (<i>Hieraaetus morphnoides</i>)	V	Not Listed	Recorded
Barking Owl* (<i>Ninox connivens</i>)	V	Not Listed	Recorded

Common Name (Latin Name)	TSC Act Status	EPBC Act Status	Occurrence
Powerful Owl* (<i>Ninox strenua</i>)	V	Not Listed	Recorded
Rainbow Bee-eater (<i>Merops ornatus</i>)	Not Listed	M	Recorded
White-throated Needletail* (<i>Hirundapus caudacutus</i>)	Not Listed	M	Recorded
Painted Honeyeater (<i>Grantiella picta</i>)	V	Not Listed	Potential to Occur
Swift Parrot (<i>Lathamus discolor</i>)	E	E	Potential to Occur
Varied Sittella (<i>Daphoenositta chrysoptera</i>)	V	Not Listed	Potential to Occur
Scarlet Robin (<i>Petroica boodang</i>)	V	Not Listed	Potential to Occur
Flame Robin (<i>Petroica phoenicea</i>)	V	Not Listed	Potential to Occur
Square-tailed Kite (<i>Lophoictinia isura</i>)	V	Not Listed	Potential to Occur
Masked Owl (<i>Tyto novaehollandiae</i>)	V	Not Listed	Potential to Occur
White-bellied Sea-eagle (<i>Haliaeetus leucogaster</i>)	Not Listed	M	Potential to Occur
Fork-tailed Swift (<i>Apus pacificus</i>)	Not Listed	M	Potential to Occur
Cattle Egret (<i>Ardea ibis</i>)	Not Listed	M	Potential to Occur
Eastern Great Egret (<i>Ardea modesta</i>)	Not Listed	M	Potential to Occur
Satin Flycatcher (<i>Myiagra cyanoleuca</i>)	Not Listed	M	Potential to Occur
Rufous Fantail (<i>Rhipidura rufifrons</i>)	Not Listed	M	Potential to Occur
MAMMALS			
Spotted-tailed Quoll* (<i>Dasyurus maculatus</i>)	V	E	Recorded

Common Name (Latin Name)	TSC Act Status	EPBC Act Status	Occurrence
Large-eared Pied Bat (<i>Chalinolobus dwyeri</i>)	V	V	Recorded
Eastern Bentwing-bat (<i>Miniopterus schreibersii oceanensis</i>)	V	Not Listed	Recorded
Corben's Long-eared Bat* (<i>Nyctophilus corbeni</i>)	V	V	Recorded
Yellow-bellied Sheath-tail-bat (<i>Saccolaimus flaviventris</i>)	V	Not Listed	Recorded
New Holland Mouse (<i>Pseudomys novaehollandiae</i>)	Not Listed	V	Recorded
Brush-tailed Rock-wallaby (<i>Petrogale penicillata</i>)	E	V	Recorded
Koala (<i>Phascolarctos cinereus</i>)	V	V	Potential to Occur
Squirrel Glider (<i>Petaurus norfolcensis</i>)	V	Not Listed	Potential to Occur
Grey-headed Flying-fox (<i>Pteropus poliocephalus</i>)	V	V	Potential to Occur

Common Name (Latin Name)	TSC Act Status	EPBC Act Status	Occurrence
Eastern False Pipistrelle (<i>Falsistrellus tasmaniensis</i>)	V	Not Listed	Potential to Occur
Little Bentwing-bat (<i>Miniopterus australis</i>)	V	Not Listed	Potential to Occur
Greater Broad-nosed Bat (<i>Scoteanax rueppellii</i>)	V	Not Listed	Potential to Occur
Eastern Cave Bat (<i>Vespadelus troughtoni</i>)	V	Not Listed	Potential to Occur
REPTILES			
Broad-headed Snake (<i>Hoplocephalus bungaroides</i>)	E	V	Potential to Occur
Pink-tailed Legless Lizard (<i>Aprasia parapulchella</i>)	V	V	Potential to Occur
Rosenberg's Goanna (<i>Varanus rosenbergi</i>)	V	Not Listed	Potential to Occur

*Data obtained from the Atlas of NSW Wildlife (OEH, 2014b)
TSC Act / EPBC Act Status: V = Vulnerable, E = Endangered,
CE = Critically Endangered, M = Migratory

Aquatic Habitat

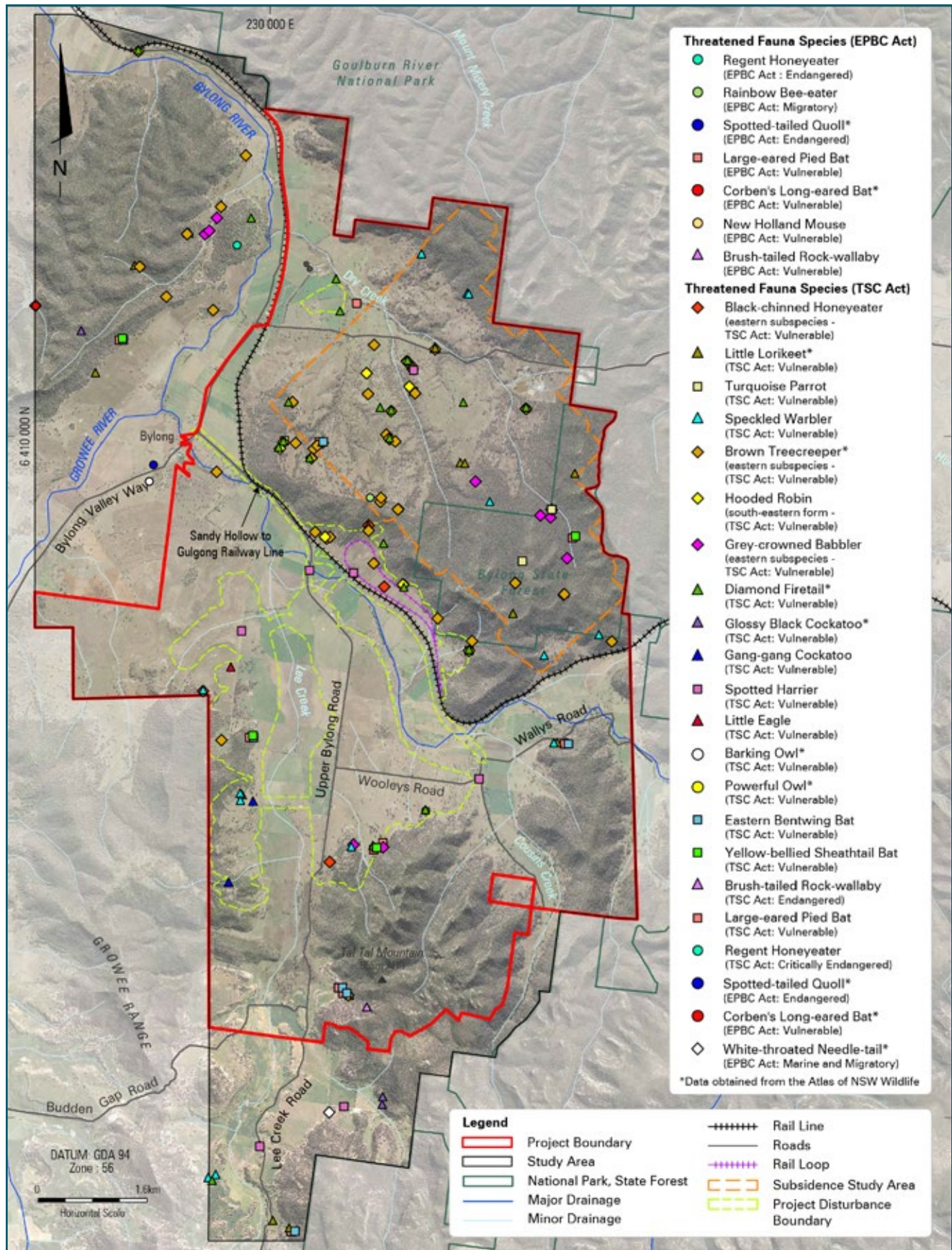
The Study Area is located within the catchment of the Bylong River, a tributary of the Goulburn River, which in turn is a tributary of the Hunter River. Several surface drainage systems, including Bylong River, Growee River, Dry Creek, Lee Creek and Cousins Creek, and their tributaries occur within the Study Area. The Bylong River drains generally northwards, from the south-east, through the Project Boundary (see **Section 7.4**).

Waterways within the Study Area are ephemeral and only flow during periods of sufficient rainfall. Field surveys identified some relatively permanent small to large pools of water at specific locations.

Some aquatic vegetation was recorded in pools where water persists for longer durations. The drainage lines within the Study Area provide suitable foraging and breeding habitat for a number of fauna species, including amphibians, birds, mammals and reptiles. Temporary pools of water would provide a valuable drinking source in hot and dry months.

Due to human disturbance of the riparian zone, in stream modifications and the water quality of these systems, the aquatic habitat along the waterways within the Study Area are considered to be highly degraded and unsuitable to support significant macro-invertebrate or fish populations. Currently, agricultural land (generally improved pastures for grazing activities) extends adjacent to the waterways. The majority of native riparian and floodplain vegetation has been removed and there are few mature trees present. Key limitations of the aquatic habitat for macro-invertebrate and fish species include:

- The aquatic habitat is highly simplified due to clearing of vegetation and the uniform nature of the substrate makes it unsuitable for fish spawning or macro-invertebrate colonisation and survival;
- There is a high potential for erosion due to the substrate type, which has likely been exacerbated by sedimentation and disturbance to banks by livestock; and

FIGURE 43 Threatened Fauna Species

- There are significant barriers to fish movement due to the ephemeral nature of the waterways.

Limited pools were identified during the field surveys where relatively permanent water is present with water deep enough to support some fish species. Additionally these pools are likely to provide a drinking water source for livestock and other fauna species.

There are also a number of agricultural dams present within the Study Area on the valley floors. Many of the dams observed during the field surveys feature little aquatic and semi-aquatic vegetation and are surrounded by cleared land. The agricultural dams within the Study Area do not generally support aquatic vegetation. However, these dams do provide some limited habitat for wetland dependent species, including birds and amphibians. Additionally, the water contained within dams provides a drinking source for terrestrial mammals, microbats, birds and reptiles, including native and non-native species.

Aquatic Fauna

Although no surveys targeting vertebrate aquatic species were carried out onsite due to the ephemeral nature of the waterways, incidental sightings of Eastern Gambusia (*Gambusia holbrooki*) were observed at a number of locations within the Study Area and Carp (*Cyprinus carpio*) were observed in the Bylong River. The presence of these species indicates that if populations of native fish are present, they would currently be adversely affected by competition with Eastern Gambusia (native to south-eastern USA) and Carp (native to central Asia) and likely to be under significant stress.

The macro-invertebrate communities sampled throughout the Study Area are dominated by True Flies (Diptera), Mayflies (Ephemeroptera) and Beetles (Coleoptera), accounting for 45%, 18% and 15% respectively of all the organisms identified in the surveys. A list of macro-invertebrates recorded within the Study Area is provided within **Appendix J**.

An analysis of the particular species presence or absence, diversity, composition and abundance of communities confirmed that waterways within the Study Area have been significantly altered or affected by surrounding land use practices and do not support a diverse assemblage of aquatic macro-invertebrate fauna.

No aquatic ecological communities or aquatic fauna species that are listed as critically endangered, endangered or vulnerable ecological communities under the EPBC Act, TSC Act or *Fisheries Management Act 1994* (FM Act) were recorded during the surveys.

One threatened species listed under the FM Act, the Darling River Hardyhead (*Craterocephalus amniculus*), has been identified as occurring within the MWRC LGA, in which the Bylong River occurs. Despite extensive sampling throughout its potential distribution, no individuals have been detected within the catchment since 2003 (DPI, 2014). Due to the poor quality of available habitat and the identified presence of competing species during the surveys, none are considered likely to occur within the Study Area.

Groundwater Dependent Ecosystems

Four main GDEs have been classified throughout NSW (Hatton, 1998), including:

- Terrestrial vegetation;
- River base flow systems;
- Aquifer and cave ecosystems; and
- Wetlands.

The alignment of Bylong River and Lee Creek is characterised by shallow water tables that could have the potential to support GDEs. Species and communities recorded within floodplain and creek line areas are considered likely to have some root access to groundwater. Communities assessed as GDEs within the Study Area include:

- River Oak / Redgum Riparian Woodland; and
- Blakely's Red Gum / Apple Riparian Forest.

It is difficult to ascertain the degree of dependence of these terrestrial ecosystems on groundwater. Given that the watercourses within the Study Area are typically ephemeral and historically have been degraded due to surrounding land use and water extraction, it is likely only trees from these communities would have sufficient root systems to penetrate shallow groundwater of perched aquifers. These species would have a moderate reliance, but not a complete dependence, on groundwater.

7.2.4 Impact Assessment

A diverse range of vegetation communities and habitat occur within the Study Area, including intact patches of native woodland and forest, partially disturbed woodland and forest remnants, derived native grassland and cultivated lands. The largest direct impact of the Project is the removal of native vegetation communities that also provide habitat for a wide range of flora and fauna species.

The Project Disturbance Boundary is 1,160 ha in size and includes the Open Cut Mining Areas, the associated Mining Infrastructure Areas and other supporting infrastructure.

In addition to the direct impacts caused as a result of the Project, a range of indirect ecological impacts could potentially occur. Subsidence impacts have been predicted to occur within an area defined as the Subsidence Study Area, which covers an area of approximately 1,714 ha. Although subsidence impacts can vary in terms of surface expression, typical subsidence effects can include surface cracking, rock fall and alterations to hydrological regimes. The Subsidence Impact Assessment has assessed the likely impacts resulting from surface cracking as discussed in **Section 7.1**. A conservative estimate has also been provided on the extent of disturbance which would be required to the ground vegetation during the remediation of this surface cracking.

Other potential indirect impacts to vegetated areas and biodiversity values located outside of the Project Disturbance Boundary may include:

- Alteration to hydrological regimes;
- Fragmentation of habitats;
- Alteration of wildlife corridors;
- Edge effects where woodland is cleared;
- Noise, vibration and dust generated by construction and operation of the Project;
- Increased artificial night-lighting levels;
- Increased likelihood of vehicle strike;
- Erosion and sediment/dust movement by wind or water resultant from vegetation clearing; and
- Competition from overabundant native species, weeds and feral animals, which results from alterations to habitat conditions favouring introduced or hardy native species.

Vegetation Communities

The dominant vegetation communities impacted by the Project are cultivated lands and various forms of Derived Native Grasslands (both listed and non-listed forms).

The extent of these vegetation communities within the Project Disturbance Boundary and above the Subsidence Study Area is summarised in **Table 38** and illustrated on **Figure 41**.

Of the vegetation communities recorded within the Project Disturbance Boundary and Subsidence Study Area, two are listed as TECs under the TSC Act and/or EPBC Act including:

- Hunter Valley Foothills Slaty Box Woodland; and
- Box Gum Woodland and Derived Native Grassland.

The extent of the two TECs within the Project Disturbance Boundary and above the Subsidence Study Area is indicated in **Table 39**.

Threatened Flora

One threatened flora species, *Acacia pendula* (Weeping Myall), has been recorded within the Project Disturbance Boundary and will be removed as a result of the Project. This species also occurs within the Subsidence Study Area and will be subject to indirect impact. The removal of one of these individuals and the potential indirect impacts to the remaining individuals are not considered to result in a significant impact to the endangered population.

An additional two species: *Ozothamnus tessellatus* and *Cymbidium canaliculatum* have been recorded within the Subsidence Study Area and have the potential to be indirectly impacted by the Project. Given that no individuals of this species have been recorded within the Project Disturbance Boundary and the extent of potential habitat within the Study Area, locality and conservation reserves, the removal and possible modification of potential habitat is not considered to result in a significant impact to these species.

There are several additional threatened flora species listed under the EPBC Act and TSC Act recorded in the Study Area that are considered to have the potential to occur within the Project Disturbance Boundary due to the presence of suitable habitat. Many of the potentially occurring threatened flora species would occur outside of the Project Disturbance Boundary, with habitat for these species present within the Subsidence Study Area and surrounding locality.

The potential changes to these habitats resulting from subsidence are expected to be localised and overall are not considered to cause a substantial impact to these species.

Impacts to numerous individuals of *Tylophora linearis*, which is listed as Vulnerable under the TSC Act and Endangered under the EPBC Act, have specifically been avoided as a result of the amendments made within the Feasibility Study to the design of the North Western OEA.

A full list of the flora species with the potential to occur within the Project Disturbance Boundary and Subsidence Study Area is provided in **Appendix J**.

TABLE 38 Indicative Disturbance to Vegetation Communities

Vegetation Community	Study Area (ha)	Project Disturbance Boundary (ha)	Subsidence Study Area (ha)
Slaty Box Woodland ¹	1,144	11	124
River Oak / Redgum Riparian Woodland ²	39	0	0
Yellow Box Woodland ³	161	8	112
White Box Woodland (Grassy)	714	54	407
White Box Woodland (Shrubby)	502	71	34
Blakely's Red Gum Woodland (Grassy) ³	16	0	0
Blakely's Red Gum Woodland (Shrubby)	22	0	15
Coastal Grey Box Woodland	100	31	4
Fuzzy Box Woodland	60	5	0
Rusty Fig Dry Rainforest	1	0	0
Grey Myrtle Dry Rainforest	5	0	< 1
Blakely's Red Gum / Apple Riparian Forest	161	5	15
Blakely's Red Gum / Paperbark Forest	15	0	15
Calytrix Rockplate Heath	8	0	0
Shrubby Regrowth	199	40	2
Dwyer's Red Gum Low Open Forest	70	0	31
Caley's Ironbark Forest	514	0	348
Blue-leaf Ironbark / Cypress Forest	911	0	86
Red Ironbark / Cypress Forest	154	0	105
Cypress Pine Forest	82	4	0
Bloodwood / Ironbark Forest	29	0	17
Scribbly Gum / Grey Gum Forest	6	0	1
Exposed Grey Gum / Stringybark Forest	295	0	33
Sheltered Grey Gum / Stringybark Forest			
River Oak / Redgum Riparian Woodland Derived Native Grassland ²	453	11	1
Blakely's Redgum / Apple Riparian Forest Derived Native Grassland ³			
Yellow Box Woodland Derived Native Grassland ³	137	15	67
White Box Woodland Derived Native Grassland ³	1,114	174	251
Blakely's Redgum Woodland Derived Native Grassland ³	10	0	2
Slaty Box Woodland Derived Native Grassland	152	31	16
Coastal Grey Box Woodland Derived Native Grassland	838	241	12
Fuzzy Box Woodland Derived Native Grassland	284	53	0
Cultivated Lands	2,025	386	0
Other (cleared, planted vegetation)	90	21	16
TOTAL	10,313	1,160	1,714
Total Native Vegetation	8,198	753	1,698
Total Woodland	5,208	229	1,578

Notes: Discrepancies may be present in totals due to rounding

¹ Hunter Valley Footslopes Slaty Gum Woodland

² Hunter Floodplain Red Gum Woodland

³ Box Gum Woodland and Derived Native Grassland

TABLE 39 Indicative Disturbance of Threatened Ecological Communities

Vegetation Community	TSC Status	EPBC Act Status	Project Disturbance Boundary (ha)	Subsidence Study Area (ha)
Hunter Valley Footslopes Slaty Gum Woodland				
Slaty Box Woodland	VEC	Not Listed	11	124
Box Gum Woodland and Derived Native Grassland				
Yellow Box Woodland	EEC	CEEC	8	112
White Box Woodland (Grassy)	EEC	CEEC	53	407
DNG – 6(1) ^A : Yellow Box Woodland Derived Native Grassland	EEC	CEEC	6	5
DNG – 6(2) ^B : Yellow Box Woodland Derived Native Grassland	EEC	Not Listed	8	62
DNG – 7(1) ^A : White Box Woodland Derived Native Grassland	EEC	CEEC	68	146
DNG – 7(2) ^B : White Box Woodland Derived Native Grassland	EEC	Not Listed	63	105
DNG – 8(1) ^A : Blakely's Red Gum Woodland Derived Native Grassland	EEC	CEEC	-	2
Total EEC/VEC (TSC Act)			217	964
Total CEEC (EPBC Act)			135	672
TOTAL			217	964

Notes: Discrepancies may be present in totals due to rounding ^A Meets both TSC Act and EPBC Act listing ^B Meets TSC Act listing only

Threatened Fauna

As outlined in **Table 37**, 24 listed threatened fauna species were recorded within the Study Area during the field surveys. An additional 23 threatened fauna species are considered likely to occur within the Study Area due to the presence of suitable habitat.

The Project Disturbance Boundary includes various woodlands, forests, shrublands and grasslands which are likely to provide important foraging, shelter and breeding opportunities for a range of fauna species. The Project will result in the removal of various habitat features within the Project Disturbance Boundary including:

- Riparian environments suitable for wetland birds, some amphibians and reptiles;
- Terrestrial habitat features such as ground and shrub layer vegetation, leaf litter, coarse woody debris and rocky outcrops suitable as shelter for small terrestrial fauna species;

- Hollow-bearing trees and stags suitable as shelter and breeding habitat for a range of hollow-dependent fauna;
- Blossom-producing trees and shrubs suitable as forage for a range of nectarivores; and
- Koala feed tree species.

Despite the Project resulting in the removal of potential habitat, extensive areas of land containing similar habitat features occurs elsewhere within the Study Area and surrounding locality. It is anticipated that the types of flora and fauna species utilising the habitat within the Project Disturbance Boundary will continue to persist within other areas of the Study Area and surrounding locality, where suitable habitat is present.

The majority of threatened fauna species known, or with the potential, to occur within the Study Area are highly mobile and are considered likely to utilise habitat resources throughout the locality and within adjacent conservation reserves. However removal of certain habitat within the Project Disturbance Boundary is considered significant for the Regent Honeyeater.

Aquatic Habitat

The Project has a low potential to impact on aquatic biodiversity, as the ephemeral waterways present within the Study Area are significantly degraded due to past agricultural land uses. Pooled surface water was observed to be of low quality and contained significantly impaired macro-invertebrate communities and exotic fish species. Nevertheless, the Project has the potential to impact aquatic ecosystem health through ground movements, surface water runoff, water extraction and post-mining water quality impacts.

River Condition Index

In light of potential water quality impacts predicted to be experienced in the Bylong River catchment more than 100 years post-mining (as discussed in **Section 7.6.3**), the Ecological Impact Assessment reviewed the potential implications this may have on the condition category under the River Condition Index. The assessment confirmed that the potential water quality impacts are likely to be negligible in relation to the existing riparian vegetation and the biodiversity values within the Bylong River catchment. **Appendix J** provides further detail on this assessment.

Groundwater Dependent Ecosystems

Given that the watercourses within the Study Area are typically ephemeral in nature, it is likely that communities considered as GDEs have a moderate reliance on, and certainly not a complete dependence, on groundwater. The portions of communities occurring along drainage lines above the valley floor are considered to have a lower dependence than those occurring on the valley floor. The remaining water balance for these communities would be made up of rainfall, surface water and water stored in the soil.

The rate of recharge within the Study Area is considered to mitigate the potential significant impacts from alteration of groundwater levels. However, ongoing monitoring of these potential GDE communities will be undertaken throughout the life of the Project to confirm their sustainability.

In addition, the alluvial aquifers are known to provide habitat for stygofauna. An assessment of the impacts of the Project on stygofauna is provided in **Section 7.19**.

Cumulative Impacts

Cumulative impacts can arise from the compounding activities of a single operation or multiple mining and processing operations in the same area, as well as the interaction of mining impacts with other past, current and future activities that may not be related to mining (Franks *et al.*, 2008).

Extensive vegetation clearing has already and continues to occur in the locality through vegetation clearing for agricultural activities. These practices result in the degradation and loss of topsoil through ploughing and the introduction of additional nutrients and exotic species, thus impacting habitat for native flora species. The most fertile areas of soil have predominantly been cleared in the past, which would have previously supported Box Gum Woodland. This historical clearing has led to the fragmentation of habitat for flora and fauna, with species reliant on vegetation derived from high-nutrient soils becoming threatened.

A number of operational and proposed mines occur within the wider region, as discussed in **Section 2.4.1**. These occur as both open cut and underground mines and are predicted to generate similar impacts to the Project. The Project will add to the loss of vegetation from within the valleys of the location, adding to the historic farming impacts and also adding some further cumulative mining impacts to those of other projects such as have occurred at mines in the wider region.

The long term impacts associated with the Project as well as other mines in the wider region will be compensated by the implementation of mine site rehabilitation activities and appropriate conservation strategies.

7.2.5 Mitigation and Management

Management measures proposed for the Project have generally followed the *NSW Biodiversity Offsets Policy for Major Projects* (OEH, 2014i) and the *DoE Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy* (SEWPaC, 2012), with the aim to avoid, mitigate or offset all identified impacts, as follows:

- **Avoid:** to the extent possible, developments should be designed to avoid or minimise ecological impacts;
- **Mitigate:** where certain impacts are unavoidable through design changes, mitigation measures should be introduced to ameliorate the ecological impacts of the proposed development; and
- **Compensate:** the residual impacts of the Project should be compensated for in some way.

Each of these principles has been applied to the Project and are further discussed below.

Avoidance

As discussed in **Section 3.17**, significant modifications were made to the design of the Project to improve biodiversity outcomes. The Project mine plan has been refined through the consideration of a number of alternatives, which were developed to reduce the potential for adverse impacts to the environment, including specific impacts on threatened ecological communities and species.

Key avoidance measures undertaken during development of the mine plan specific to biodiversity values within the Study Area include:

- Positioning the MIAs, OEAs and WAF predominantly within previously cleared land, thus reducing the impacts to woodland habitats;
- Positioning of the MIAs adjacent to existing infrastructure (e.g. Sandy Hollow to Gulgong Railway Line), thus minimising the amount of clearing of flora and fauna habitat required by the Project;
- Positioning the CHPP within the proposed Rail Loop area to reduce footprints required for mining related infrastructure;
- Additional specific modifications to the extent of the open cut mining areas, MIAs and OEAs to reduce the extent of impacts to Box Gum Woodland, which is also considered as critical habitat for the Regent Honeyeater;
- Refined mine planning to reduce the footprints of the OEAs to avoid a large population of *Tylophora linearis*; and
- Positioning of the longwall panel layouts to ensure that mine subsidence does not damage the most significant cliff lines which have been identified within the vicinity of the mining area.

The mine plan and Project Disturbance Boundary adopted for the Project achieves the minimum practical disturbance whilst still allowing access to a mineable coal resource. During the detailed design and construction phases of the Project, KEPCO will assess the potential to avoid sensitive biodiversity beyond that is assessed within this EIS as the mine plan and associated infrastructure are developed.

Mitigation

In order to coordinate the implementation of the ecological mitigation measures proposed for the Project, a Biodiversity Management Plan (BMP) will be prepared for approval prior to the commencement of construction activities. In addition to the description of mitigation measures for the Project, the BMP will also provide specifications for the restoration and ongoing management of biodiversity offset areas (see **Section 7.3**).

Management measures proposed for the Project to mitigate impacts to sensitive flora and fauna include:

- Preparation and implementation of a detailed BMP;
- Dust minimisation to reduce the indirect impacts on vegetation condition and the habitat quality for all native species;
- Noise minimisation to reduce the potential for disturbance of animals in habitat patches around the Project;
- Visual and lighting management to reduce the potential for disturbance of nocturnal animals via night light emissions around the Project;
- Pre-clearing survey for proposed disturbance areas to limit vegetation and habitat loss and as far as practical and ensure safe removal of fauna as required prior to any disturbance occurring;
- Removal (and relocation where practicable) of key habitat features such as tree hollows from the Project Disturbance Boundary;
- Progressive rehabilitation of disturbed areas including select reinstatement of native vegetation;
- Implementing a monitoring program and appropriate reference sites; and
- Aquatic mitigation measures relating to ground movements and management of surface water, erosion and sedimentation.

Land Disturbance Protocol

As part of the BMP, KEPCO will implement a Land Disturbance Protocol for the Project which will require that the Environmental Manager (or delegate) carry out a pre-clearing survey of proposed areas prior to any disturbance activities occurring.

This Land Disturbance Protocol also provides a process to ensure compliance with the relevant licences and approvals and that appropriate environmental safeguards and mitigation measures are implemented prior to any disturbance.

Aquatic Measures

As detailed in **Section 7.1.4**, an Extraction Plan will be developed for relevant longwall panels to be extracted. The Extraction Plan will include visual monitoring, erosion protection measures and surface remediation measures to ensure there are no significant impacts on aquatic habitats as a result of subsidence related effects.

As detailed in **Section 7.4.4**, a Water Management Plan will be developed to ensure water runoff and changes to the flood regime as a result of the Project do not impact upon aquatic communities. This will include management of 'clean' and 'dirty' water to ensure any water released from the site complies with the ANZECC Water Quality Guidelines and the mine site water demands are appropriately met. Additionally, the final design of the haul roads across Lee Creek and the overland conveyor embankments are appropriately designed so as to avoid any adverse flood impacts on the drainage lines from the Project.

Rehabilitation

Approximately 1,000 ha of land disturbed within the Project Disturbance Boundary will be progressively rehabilitated over the life of the Project. A site-specific Rehabilitation Management Plan will be prepared to specify how areas will be rehabilitated for specific post-mining land uses. This will include approximately 34 ha of woodland and will incorporate species representative of analogue sites of the targeted woodland communities which may include Hunter Valley Footslopes Slaty Gum Woodland and Box Gum Woodland and Derived Native Grassland.

Rehabilitation will provide additional areas of habitat adjacent to existing remnant vegetation. This is particularly important in areas adjacent to known populations of threatened fauna, as the addition of habitat will allow for greater movement of species within the Study Area.

Monitoring

An ecological monitoring program will be established as a component of the BMP to monitor the ongoing status and health of flora and fauna communities that will be retained within the Project Boundary, in order to assess the success of the mitigation and compensation measures.

Details of the monitoring program will be contained within the BMP and will include monitoring of vegetation, threatened species, aquatic habitat and reporting requirements. The proposed monitoring program includes the use of appropriate reference sites that are located away from mining activities to use as a baseline against which to compare the status of habitats in close proximity to mining.

Compensate

In addition to the significant avoidance and mitigation measures applied to the Project, a substantial BOS has been developed to compensate the likely impacts of the Project on biodiversity values within the Study Area. Further detail is provided in **Section 7.3**.

Conclusion

The Project will disturb up to 753 ha of native vegetation, including three communities listed as TECs under the TSC Act and/or EPBC Act. Additional areas of vegetation have the potential to be indirectly impacted by subsidence related effects within the Subsidence Study Area. A number of listed flora and fauna species are also predicted to be impacted by the Project.

The proposed avoidance, mitigation and offset measures will sufficiently ameliorate the impacts to the extent that no threatened species are likely to become extinct as a result of the Project. Importantly, the long term objective of the BOS is to provide for a net benefit to flora and fauna within the locality and region by substantially increasing the proportions of native woodland and threatened species habitat under conservation tenure.

7.3 BIODIVERSITY OFFSETS STRATEGY

7.3.1 Background

The Ecological Impact Assessment (as discussed in **Section 7.2**) indicates that there is likely to be residual impacts on State and Commonwealth listed TECs and a suite of threatened species if compensatory measures (such as biodiversity offsetting) are not implemented.

KEPCO has developed a BOS to compensate for the residual impacts of the Project on the biodiversity values in the bioregion. A copy of the report prepared by Cumberland Ecology providing a detailed description of the BOS is provided in **Appendix K**. A summary of the BOS and a discussion on how the implementation of proposed offset measures will maintain and improve biodiversity values in the locality is provided in the following sections.

7.3.2 Principles for Biodiversity Offsets

The Project was declared a “*controlled action*” for threatened species, ecological communities and water resources. Accordingly, the Project will be assessed under a bilateral agreement between the Commonwealth and NSW Governments.

The State and Commonwealth Governments have developed principles for the use of offsets to compensate for impacts of development on biodiversity. The relevant policies and guidelines that are applicable to the principles include:

- Ratio method whereby for every hectare of habitat cleared, a multiple of habitat is provided as an offset;
- The *NSW Biodiversity Offsets Policy for Major Projects* (OEH, 2014); and
- *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy* (SEWPaC, 2012).

The *NSW Biodiversity Offsets Policy for Major Projects* (OEH, 2014) is underpinned by the Framework for Biodiversity Assessment (FBA), which is an assessment approach that standardises the methods and procedures for assessing biodiversity impacts on development sites and determining biodiversity offsets for those impacts.

On the State level, the principles for biodiversity offsetting and the requirements of assessment have been subject to transition during the period of completing the Ecological Impact Assessment and development of the BOS for the Project. In this regard, OEH has confirmed that the Project will be treated as a “Transitional” Project under the *NSW Biodiversity Offsets Policy for Major Projects* (OEH, 2014) and is therefore afforded a level of flexibility in meeting the requirements in this policy. As the Ecological Impact Assessment was largely prepared prior to the introduction of the *NSW Biodiversity Offset Policy for Major Projects* (OEH, 2014), surveys and reporting methodology from this policy have generally not been able to be addressed fully. As such, the assessment of the BOS for the Project has used the *NSW Biodiversity Offset Policy for Major Projects* (OEH, 2014) as a tool for assessing the adequacy of the offsets for the Project.

For biodiversity offsets to be considered “appropriate”, the principles outlined within these policies must be adhered to where possible. The direct offsets which have been proposed for the Project will have a significant net benefit to the biodiversity values within the locality over the medium to long term. The Project will result in a net increase in woodland in and around the Study Area and locality.

7.3.3 Biodiversity Offset Strategy

Methodology

Several high level desktop analyses and site specific field surveys of suitable offset properties were undertaken between 2013 and late 2014. Important considerations in determining which properties were to potentially form part of the BOS included:

- The known occurrence of Box Gum Woodland and Derived Native Grassland;
- The likely availability of habitat for relevant threatened flora and fauna species that could be impacted by the Project;
- Linkages to sustainable ecological features (particularly permanent water sources);
- The potential to form new, or improve existing ecological corridors; and
- Land currently owned by KEPCO.

The primary target for the BOS was the conservation of Box Gum Woodland and Derived Native Grassland and other woodland communities which provide habitat for the suite of threatened flora and fauna species known to occur within the Project Disturbance Boundary.

During the initial desktop and field assessments, limited properties within the vicinity of the Project were identified to contain substantial areas of suitable Box Gum Woodland and Derived Native Grassland. Several properties containing suitable qualities were presented to OEH and DoE in July 2014 and August 2014 respectively to seek feedback. These properties comprised land owned by KEPCO both within and immediately adjacent to the Project Boundary and included one property partially overlying the Underground Extraction Area (i.e. area named as Offset Area 5).

Discussions held with OEH and DoE were positive in relation to the inclusion of the properties presented and indicated that the risk of impact to the biodiversity values within Offset Area 5 as a result of subsidence related effects should be appropriately quantified within the EIS (as described in **Section 5.4.2**). OEH further reinforced this approach in a letter dated 5 September 2014 which confirmed that the northern block of Offset Area 5 will potentially be suitable for inclusion within the National Park Estate.

In light of this feedback, KEPCO continued with the detailed field assessments of the biodiversity offset areas. The primary objectives of the field assessments were to determine the biodiversity values of each property, including mapping of vegetation communities, habitats and the identification of the various flora and fauna species present within each property.

Additional surveys were undertaken across all offset areas by Cumberland Ecology in late 2014 to collect an additional level of information required to assess the adequacy of the biodiversity values present. **Appendix K** provides detail on the various surveys which have been completed across the Biodiversity Offset Areas to date.

Biodiversity Offset Areas

KEPCO has devised a BOS that primarily relies on “direct” biodiversity offsets. The two main areas proposed for conservation as biodiversity offsets areas include approximately 4,082 ha of land and 3,684 ha of native vegetation (with discount applied to Offset Area 5 as discussed in **Section 7.3.4**) including:

- **Onsite Offset Areas**, comprising:
 - Conservation and ongoing management of existing vegetated land within Offset Area 1, Offset Area 2, Offset Area 3, Offset Area 4 and Offset Area 5; and
 - Restoration of vegetation communities and associated habitat within the aforementioned onsite offset areas.
- **Offsite Offset Area**, comprising:
 - Conservation and ongoing management of existing vegetated land within the Yarran View Offset Area; and
 - Restoration of vegetation communities and associated habitat within the aforementioned offsite offset area.

The location of the Onsite and Offsite Offset Areas are shown in **Figure 44**.

The vegetation communities present in the Offset Areas represent significant “like for like” habitat for threatened flora and fauna species known or considered likely to occur within the Project Disturbance Boundary. The vegetation communities occurring within the offset areas and respective TSC Act and EPBC Act status are outlined in **Table 40**. The vegetation communities mapped within the Onsite and Offsite Offset Areas are illustrated in **Figure 45** and **Figure 46** respectively.

The offset areas provide approximately 2,022 ha of TSC Act listed communities, including approximately 421 ha of Hunter Valley Footslopes Slaty Gum Woodland, approximately 15 ha of Hunter Floodplain Red Gum Woodland and approximately 1,586 ha of Box Gum Woodland and Derived Native Grassland. Approximately 1,332 ha of the TSC Act listed Box Gum Woodland and Derived Native Grassland community also confirms to TEC listed under the EPBC Act as Box Gum Woodland and Derived Native Grassland.

The biodiversity offset areas also provide potential habitat for a suite of threatened species listed under the TSC Act and/or the EPBC Act that are known to occur in the locality. **Table 41** summarises the occurrence of these threatened species within the Onsite and Offsite Offset Areas and are illustrated in **Figure 47** and **Figure 48** respectively.

The majority of the threatened flora and fauna species known to occur within the Project Disturbance Boundary have also been recorded within the Biodiversity Offset Areas. As the offset areas are in close proximity to the Study Area and contain similar habitat, it is expected that the majority of threatened species with the potential to occur within the Study Area are likely to also occur within the Biodiversity Offset Areas.

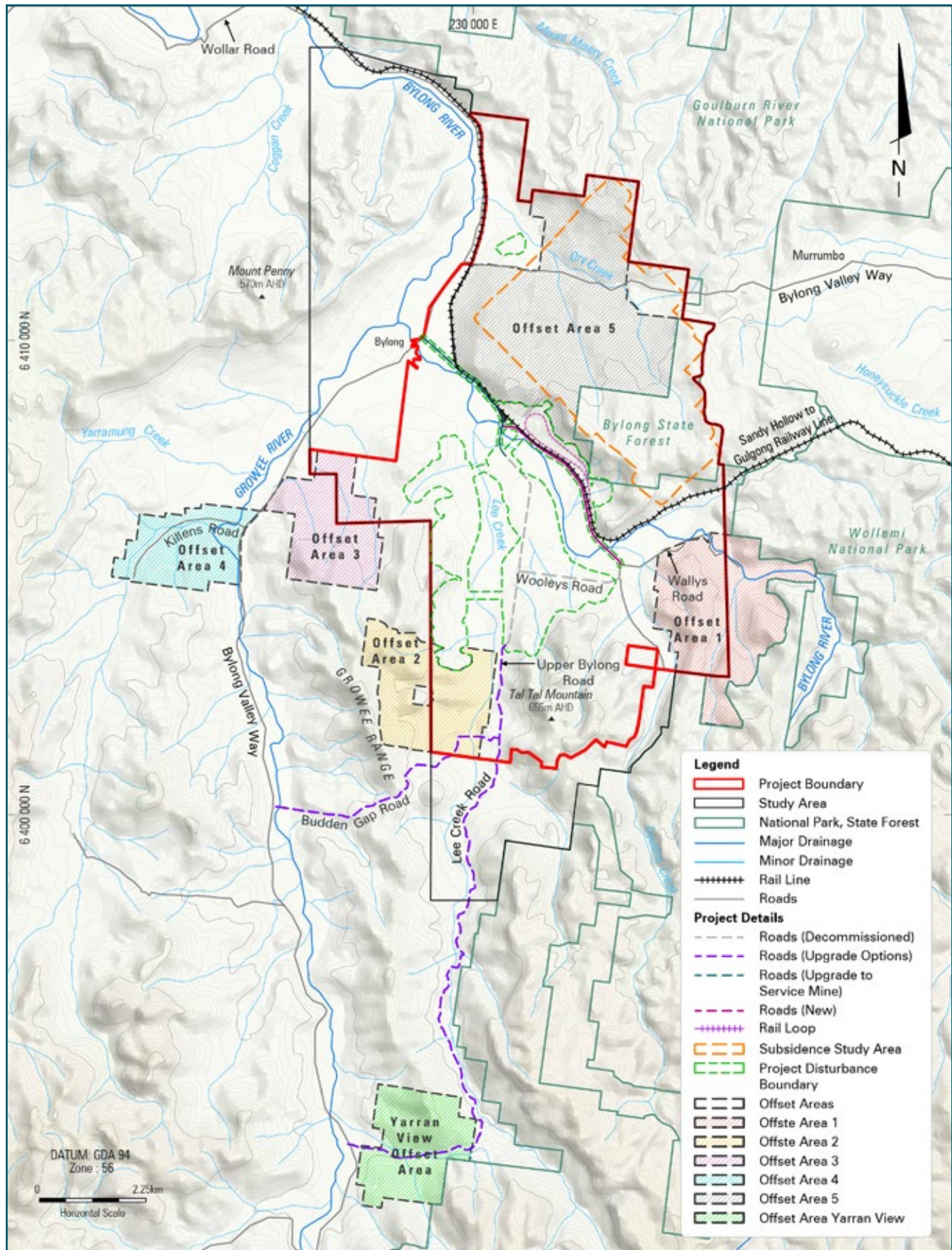
FIGURE 44 Biodiversity Offset Strategy

TABLE 40 Vegetation Communities Within Biodiversity Offset Areas and Approximate Areas

Vegetation Community	TSC Act Status	EPBC Act Status	Onsite Offset Areas (ha)					Offsite Offset Area (ha) Yarran View Offset Area	Total Offsets (ha)
			Offset Area 1	Offset Area 2	Offset Area 3	Offset Area 4	Offset Area 5		
Slaty Box Woodland	VEC	N/A	141	17	2		209	52	421
River Oak / Redgum Riparian Forest	EEC	N/A	15						15
Yellow Box Woodland									
<i>Yellow Box Woodland (Grassy)</i>	EEC	CEEC	6		5	19	129		159
<i>Yellow Box Woodland (Grassy)</i>	N/A	N/A					<1		<1
<i>Yellow Box Woodland (Shrubby)</i>	N/A	N/A	8						8
White Box Woodland									
<i>White Box Woodland (Grassy)</i>	EEC	CEEC	36	15	49	5	429	19	553
<i>White Box Woodland (Grassy)</i>	N/A	N/A	2	<1					2
<i>White Box Woodland (Shrubby)</i>	N/A	N/A	159	135	111		84	173	662
Blakely's Red Gum Woodland									
<i>Blakely's Red Gum Woodland (Grassy)</i>	EEC	CEEC		3					3
<i>Blakely's Red Gum Woodland (Shrubby)</i>	N/A	N/A					4		4
Coastal Grey Box Woodland	N/A	N/A	1		5	2	7		14
Fuzzy Box Woodland	N/A	N/A			<1				<1
Apple Riparian Forest									
<i>Blakely's Red Gum / Apple Riparian Forest</i>	N/A	N/A	26	14			13	10	63
<i>Apple/Yellow Box Riparian Forest</i>	N/A	N/A				7			7
Blakely's Red Gum / Paperbark Forest	N/A	N/A					1		1
Shrubby Regrowth	N/A	N/A	3	47	5		1	8	64
Dwyer's Red Gum Low Open Forest	N/A	N/A	2				1		3
Caley's Ironbark Forest	N/A	N/A	167				57		224
Blue-leaf Ironbark / Cypress Forest	N/A	N/A	21				103		123
Red Ironbark / Cypress Forest	N/A	N/A	11						11
Cypress Pine Forest	N/A	N/A		47	14				60
Bloodwood / Ironbark Forest	N/A	N/A					29		29
Exposed Grey Gum / Stringybark Forest	N/A	N/A	14	<1			11	3	29
Sheltered Grey Gum / Stringybark Forest									
Grey Gum / Caley's Ironbark Forest	N/A	N/A	4						4

Vegetation Community	TSC Act Status	EPBC Act Status	Onsite Offset Areas (ha)					Offsite Offset Area (ha) Yarran View Offset Area	Total Offsets (ha)
			Offset Area 1	Offset Area 2	Offset Area 3	Offset Area 4	Offset Area 5		
Grey Gum / White Box Forest	N/A	N/A		13					13
Rough-barked Apple Forest	N/A	N/A		15					15
Rough-barked Apple Woodland / Tall Shrubland	N/A	N/A		23					23
Derived Native Grassland									
River Oak / Redgum Riparian Woodland Derived Native Grassland	N/A	N/A	21	11		33	1	19	85
Apple Riparian Forest Derived Native Grassland									
Yellow Box Woodland Derived Native Grassland	EEC	CEEC	8		2	49	20		79
Yellow Box Woodland Derived Native Grassland	EEC	N/A				11	77		88
Yellow Box Woodland Derived Native Grassland	N/A	N/A	2			25			27
White Box Woodland Derived Native Grassland	EEC	CEEC	32	19	152	34	168	133	538
White Box Woodland Derived Native Grassland	EEC	N/A		22	7	17	119		166
White Box Woodland Derived Native Grassland	N/A	N/A	<1	34	11	109			154
Blakely's Redgum Woodland Derived Native Grassland	EEC	CEEC					<1		<1
Slaty Box Woodland Derived Native Grassland	N/A	N/A	3				22	1	26
Coastal Grey Box Woodland Derived Native Grassland	N/A	N/A	9		90	<1	12		111
Fuzzy Box Woodland Derived Native Grassland	N/A	N/A			1				1
Cypress Pine Forest Derived Native Grassland	N/A	N/A		<1					<1
Angophora floribunda Forest Derived Native Grassland	N/A	N/A		5					5
TOTAL NATIVE VEGETATION			688	420	455	311	1,497	418	3,791
TOTAL NON-NATIVE VEGETATION AND CLEARED			74	105	2	69	15	25	292
TOTAL AREA			762	526	458	380	1,512	443	4,082

Notes: Discrepancies may be present in totals due to rounding

FIGURE 45 Onsite Biodiversity Offset Areas Vegetation Communities

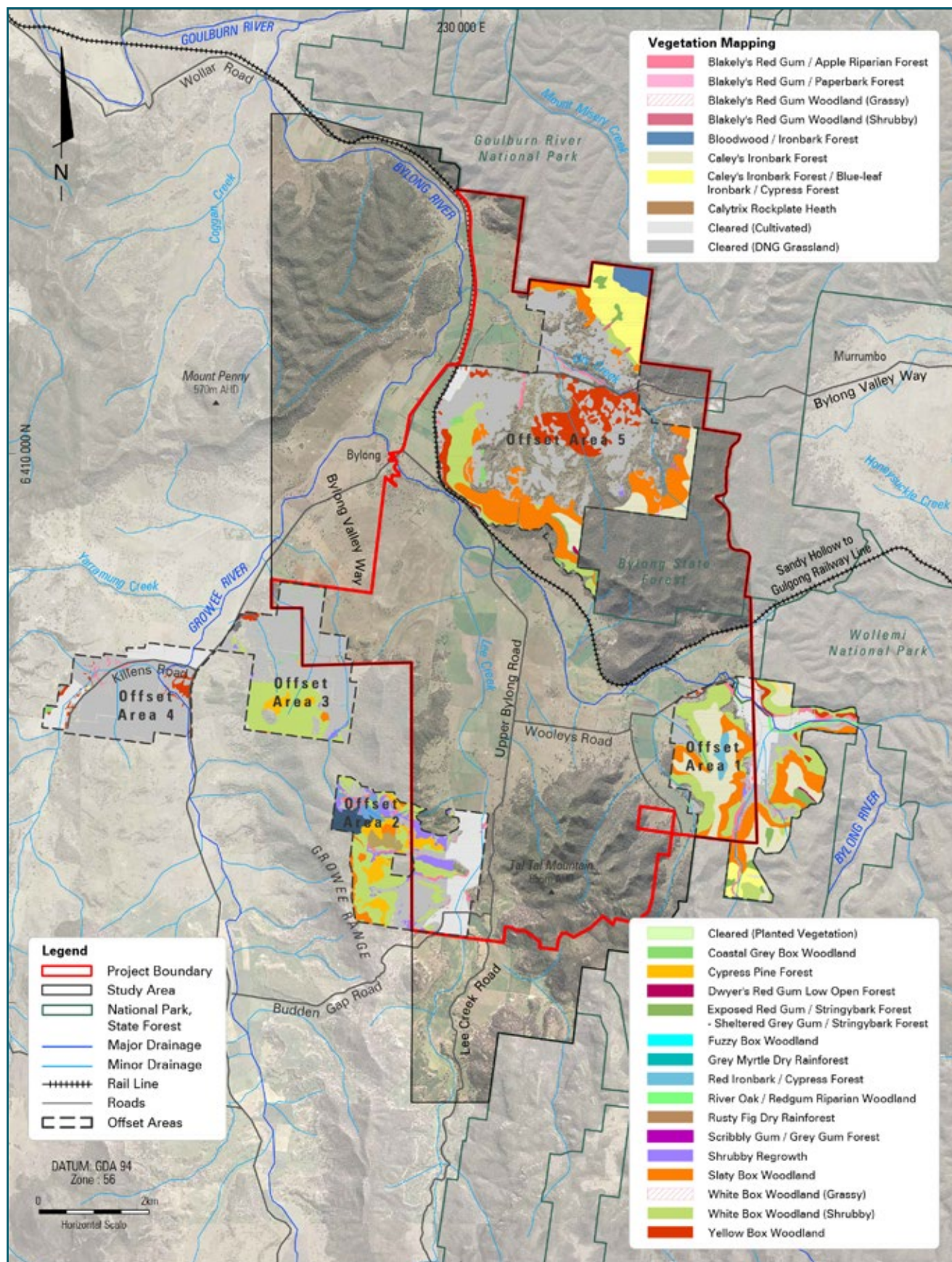


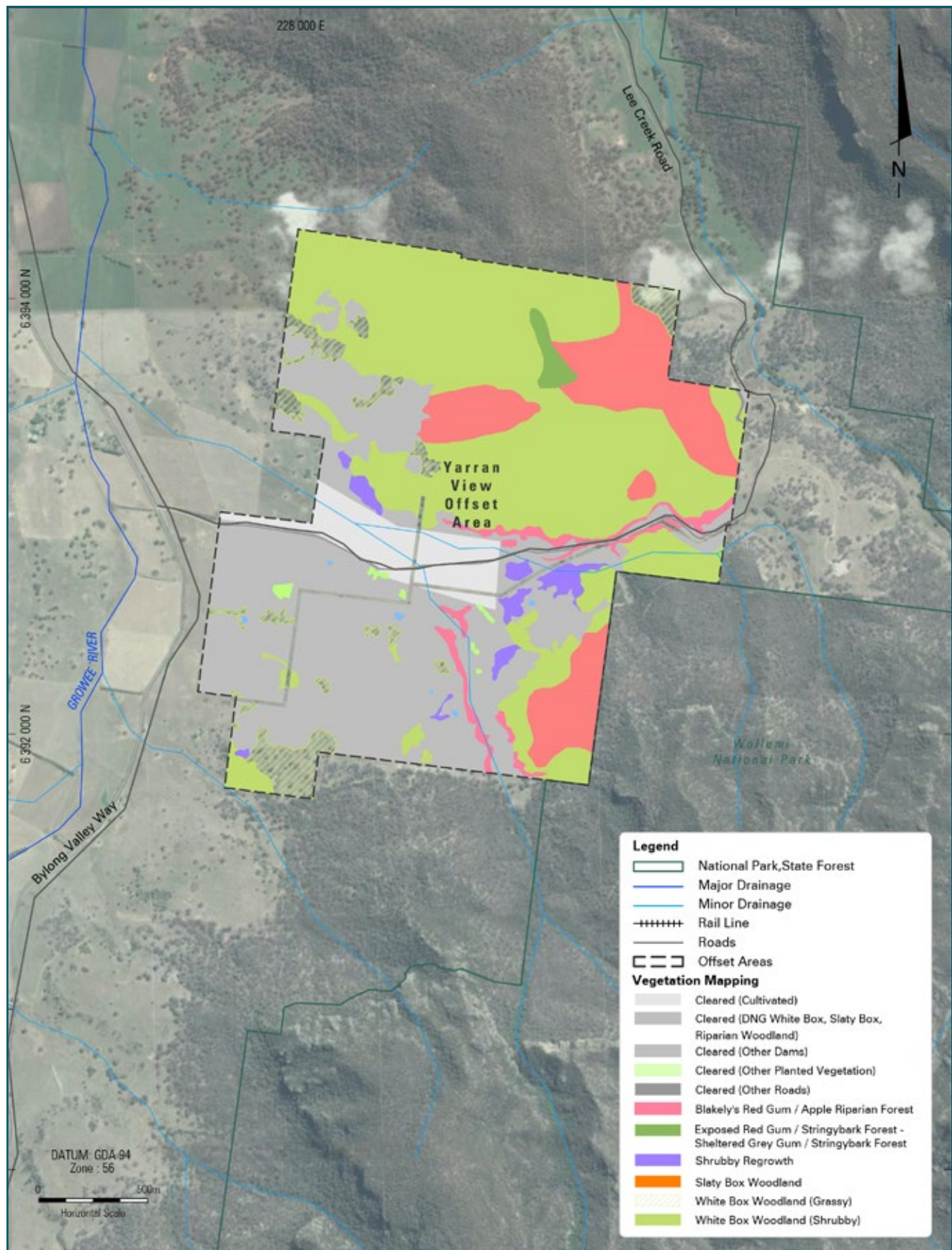
FIGURE 46 Offsite Biodiversity Offset Areas Vegetation Communities

TABLE 41 Threatened Flora and Fauna Within Biodiversity Offset Areas

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Study Area	Project Disturbance Boundary	Offset Area 1	Offset Area 2	Offset Area 3	Offset Area 4	Offset Area 5	Yarran View Offset
FLORA											
<i>Tylophora linearis</i>		V	E	Known	P	Known	P	P	-	P	P
<i>Ozothamnus tessellatus</i>		V	V	Known	P	P	P	-	-	Known	P
<i>Acacia pendula</i>	<i>Acacia pendula</i> population in the Hunter catchment	EP		Known	Known	-	-	-	-	Known	-
<i>Prostanthera cryptandroides</i> subsp. <i>cryptandroides</i>	Wollemi Mint-bush	V	V	P	-	P	P	-	-	P	P
<i>Prostanthera discolor</i>		V	V	P	-	P	P	-	-	P	P
<i>Commersonia rosea</i> (syn. <i>Androcalva rosea</i>)		E	E	P	-	P	-	-	-	P	-
<i>Eucalyptus camaldulensis</i>	<i>Eucalyptus camaldulensis</i> population in the Hunter catchment	EP		Known	-	-	-	-	-	-	-
<i>Eucalyptus cannonii</i>	Capertee Stringybark	V		P	-	P	P	-	-	P	P
<i>Homoranthus darwinioides</i>		V	V	P	-	P	-	-	-	P	-
<i>Cymbidium canaliculatum</i>	<i>Cymbidium canaliculatum</i> population in the Hunter Catchment	EP		Known	P	Known	Known	Known	P	Known	Known
<i>Diuris tricolor</i>	Pine Donkey Orchid	V		Known	P	P	P	P	P	P	P
<i>Pomaderris queenslandica</i>	Scant Pomaderris	E		Known	-	P	P	-	-	P	P
<i>Pomaderris sericea</i>	Silky Pomaderris	E	V	P	-	P	P	-	-	P	P
<i>Philotheca ericifolia</i>			V	P	-	P	P	-	-	P	P
<i>Thesium australe</i>	Austral Toadflax	V	V	P	P	P	P	P	P	P	P
FAUNA											
Birds											
<i>Chthonicola sagittata</i>	Speckled Warbler	V		Known	Known	Known	Known	Known	P	Known	P
<i>Circus assimilis</i>	Spotted Harrier	V		Known	Known	P	P	P	P	P	P
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle		M	P	P	P	P	P	P	P	P

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Study Area	Project Disturbance Boundary	Offset Area 1	Offset Area 2	Offset Area 3	Offset Area 4	Offset Area 5	Yarran View Offset
<i>Hieraaetus morphnoides</i>	Little Eagle	V		Known	Known	P	P	P	P	P	P
<i>Lophoictinia isura</i>	Square-tailed Kite	V		P	P	P	P	P	P	P	P
<i>Apus pacificus</i>	Fork-tailed Swift		M	P	P	P	P	P	P	P	P
<i>Hirundapus caudacutus</i>	White-throated Needletail		M	Known*	P	P	P	P	P	P	P
<i>Ardea ibis</i>	Cattle Egret		M	P	P	P	P	P	P	P	P
<i>Ardea modesta</i>	Eastern Great Egret		M	P	P	P	P	P	P	P	P
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo	V		Known	Known	Known	Known	P	P	P	Known
<i>Calyptorhynchus lathamii</i>	Glossy Black-Cockatoo	V		Known	P	P	P	P	-	P	P
<i>Climacteris picumnus victoriae</i>	Brown Treecreeper (eastern subspecies)	V		Known	Known	Known	Known	Known	P	Known	Known
<i>Stagonopleura guttata</i>	Diamond Firetail	V		Known	Known	P	Known	Known	P	Known	Known
<i>Anthochaera phrygia</i>	Regent Honeyeater	CE	E	Known	P	P	P	P	P	P	P
<i>Grantiella picta</i>	Painted Honeyeater	V		P	P	P	P	P	P	P	P
<i>Melithreptus gularis gularis</i>	Black-chinned Honeyeater (eastern subspecies)	V		Known	Known	P	P	P	P	Known	P
<i>Merops ornatus</i>	Rainbow Bee-eater		M	Known	Known	P	P	P	P	Known	P
<i>Myiagra cyanoleuca</i>	Satin Flycatcher		M	P	P	P	P	P	-	P	P
<i>Daphoenositta chrysoptera</i>	Varied Sittella	V		P	P	P	P	Known	P	P	Known
<i>Melanodryas cucullata cucullata</i>	Hooded Robin (south-eastern form)	V		Known	Known	P	P	P	P	Known	Known
<i>Petroica boodang</i>	Scarlet Robin	V		P	P	P	P	P	P	P	P
<i>Petroica phoenicea</i>	Flame Robin	V		P	P	P	P	P	-	P	P
<i>Pomatostomus temporalis temporalis</i>	Grey-crowned Babbler (eastern subspecies)	V		Known	Known	P	Known	P	P	Known	P
<i>Glossopsitta pusilla</i>	Little Lorikeet	V		Known	Known	Known	P	P	P	Known	P
<i>Lathamus discolor</i>	Swift Parrot	E	E	P	P	P	P	P	P	P	P
<i>Neophema pulchella</i>	Turquoise Parrot	V		Known	Known	Known	P	P	-	Known	P

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Study Area	Project Disturbance Boundary	Offset Area 1	Offset Area 2	Offset Area 3	Offset Area 4	Offset Area 5	Yarran View Offset
<i>Rhipidura rufifrons</i>	Rufous Fantail		M	P	P	P	P	P	-	P	P
<i>Ninox connivens</i>	Barking Owl	V		Known*	P	Known	P	Known	P	P	Known
<i>Ninox strenua</i>	Powerful Owl	V		Known*	P	P	P	P	-	P	P
<i>Tyto novaehollandiae</i>	Masked Owl	V		P	P	P	P	P	-	P	P
Mammals											
<i>Dasyurus maculatus</i>	Spotted-tailed Quoll	V	E	Known*	P	P	P	P	-	P	P
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	V		Known	Known	Known	Known	P	P	P	P
<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	E	V	Known	P	P	P	-	-	P	P
<i>Petaurus norfolcensis</i>	Squirrel Glider	V		P	P	P	P	P	P	P	P
<i>Phascolarctos cinereus</i>	Koala	V	V	P	P	P	P	P	P	P	P
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V	P	P	P	P	P	P	P	P
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	Known	Known	Known	Known	P	Known	Known	Known
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	V		P	P	P	P	Po	Po	P	Po
<i>Miniopterus australis</i>	Little Bentwing-bat	V		P	P	P	P	P	P	P	P
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat	V		Known	Known	Known	Known	Known	Known	Known	Known
<i>Nyctophilus corbeni</i>	Corben's Long-eared Bat	V	V	Known*	P	P	P	P	P	P	P
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	V		Po	Po	Po	P	Po	P	Po	Po
<i>Vespadelus troughtoni</i>	Eastern Cave Bat	V		Po	Po	Po	Po	Po	Po	Po	Po
<i>Pseudomys novaehollandiae</i>	New Holland Mouse		V	Known	P	Known	P	P	-	P	P
Reptiles											
<i>Hoplocephalus bungaroides</i>	Broad-headed Snake	E	V	P	P	P	P	-	-	P	P
<i>Aprasia parapulchella</i>	Pink-tailed Legless Lizard	V	V	P	P	P	P	P	P	P	P
<i>Varanus rosenbergi</i>	Rosenberg's Goanna	V		P	P	P	P	P	-	P	P

*Data obtained from the Atlas of NSW Wildlife (OEH, 2014)

TSC Act / EPBC Act Status: V = Vulnerable, E = Endangered, CE = Critically Endangered,

M = Migratory Occurrence; P = Potential; Po = Possibly present but not reliably identified; - = Unlikely

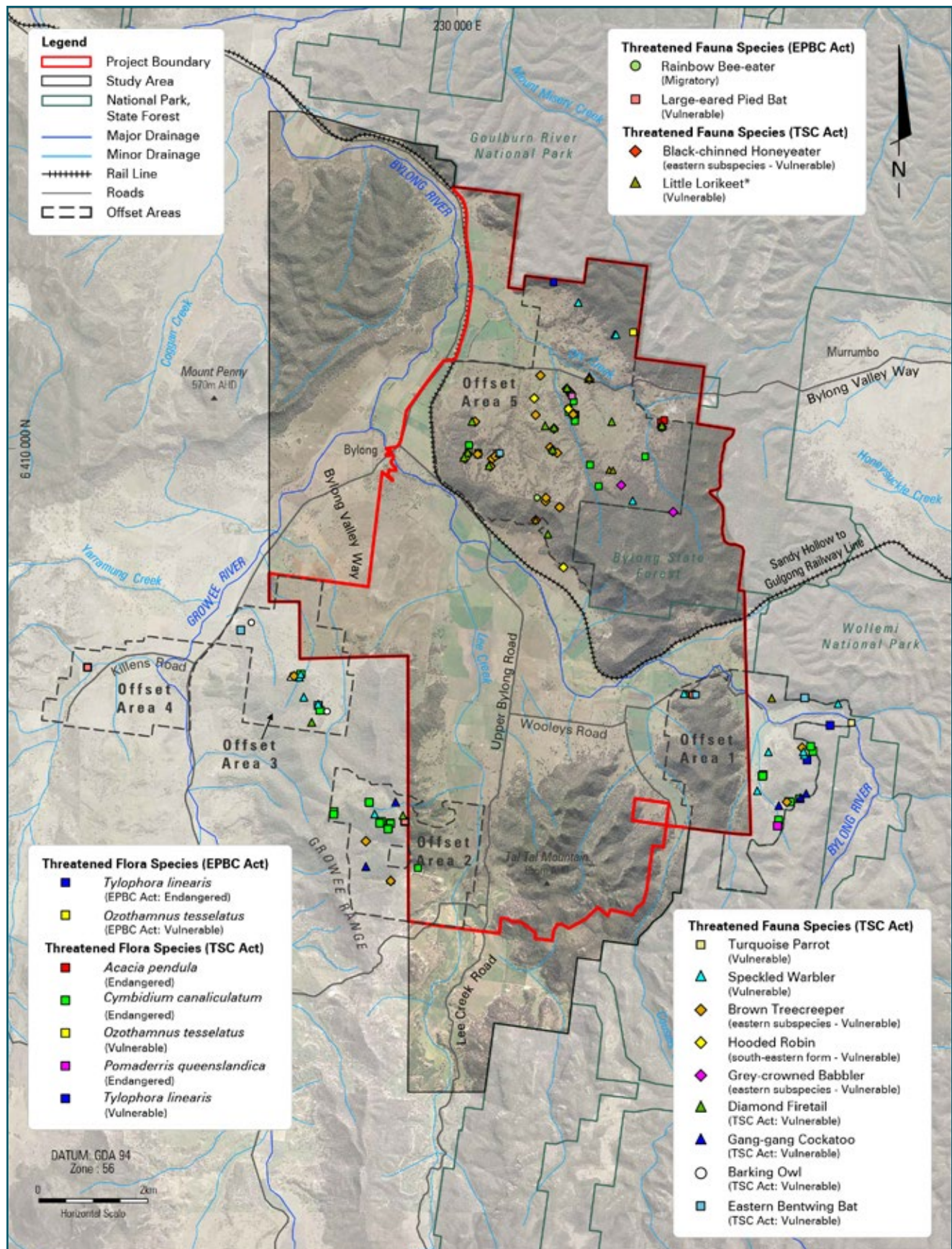
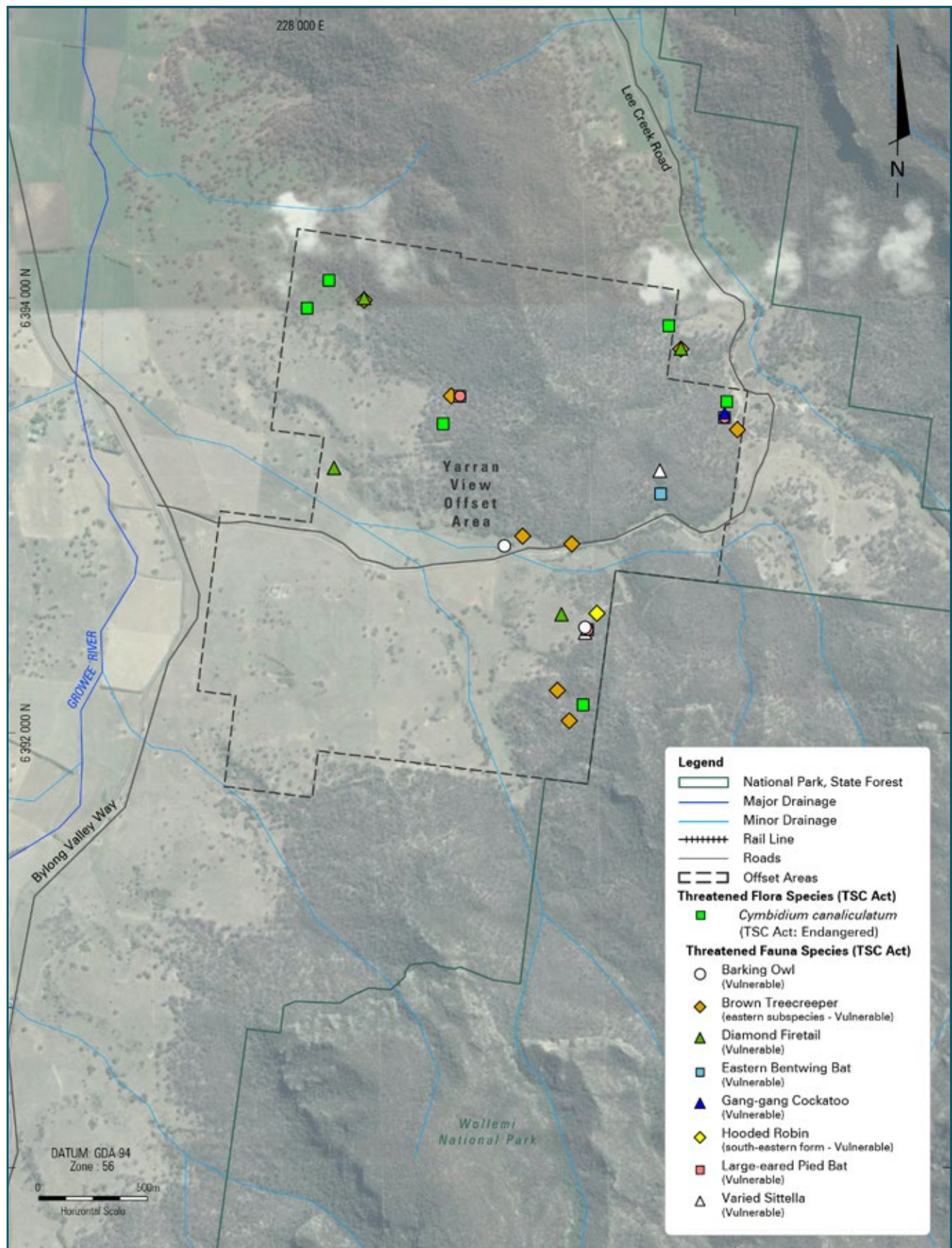
FIGURE 47 Onsite Biodiversity Offset Areas Threatened Flora and Fauna

FIGURE 48 Offsite Biodiversity Offset Areas Threatened Flora and Fauna



Summary of Biodiversity Values

All of the Biodiversity Offset Areas are located in close proximity to the Project Disturbance Boundary. Several strategic values of the Biodiversity Offset Areas have been identified and include:

- Are proximate to the location of the Project;
- Contain comparable, or “like for like” vegetation community types to the vegetation within the Project Disturbance Boundary;
- Contain areas of TECs (including Box Gum Woodland and Derived Native Grassland);
- Contain known habitat for threatened species predicted to be impacted by the Project;
- Contain potential habitat for threatened species predicted to be impacted by the Project;
- Portions of the properties have the potential to be improved to provide additional areas of TECs;
- Portions of the properties have the potential to be improved to provide additional areas of threatened species habitat;
- Portions of the properties have the potential to be improved to provide additional connectivity across previously cleared land;
- Are connected directly to existing conservation reserves; and
- Due to current agricultural pressures, each proposed offset area is currently under threat of further biodiversity deterioration.

Further details of the values of the BOS are described in **Appendix K**.

7.3.4 Offset Area 5 Within Subsidence Study Area

As indicated in **Section 7.3.3**, a portion of Offset Area 5 is located above the Underground Extraction Area and has the potential to experience subsidence related effects throughout the life of the underground mining operations.

The potential subsidence related effects resulting from underground mining operations are predicted to occur within the Subsidence Study Area. Approximately 70% (or 1,064 ha) of Offset Area 5 is located within the Subsidence Study Area. As a result, there is the potential for certain flora and fauna values within this portion of the offset to be marginally impacted by subsidence related effects.

Cumberland Ecology has identified that Offset Area 5 exhibits vast areas of Box Gum Woodland and Derived Native Grassland and areas of habitat for a number of the threatened species known to occur within the Project Disturbance Boundary.

Subsidence related effects may potentially result in the reduction to flora and fauna values through surface cracking, tree and rock fall and alteration to the hydrological regimes.

Predicted surface cracking impacts as a result of the underground mining operations is discussed in **Section 7.1.3**. It is standard practice in underground mining operations for visible surface cracking overlying underground mining areas to be remediated shortly after mining below the area to avoid potential safety issues for the public and any environmental related issues such as erosion or water losses.

MSEC (2015) has conservatively estimated that cracking above the underground mining areas may extend to the surface. Visible surface cracking has been conservatively estimated to cover less than 1% of the Subsidence Study Area for the proposed longwalls. Further to this, it is expected that remediation works may require additional disturbance to the ground vegetation.

The extent of disturbance for visible surface cracking and associated remediation works has been conservatively estimated at 10% of the Subsidence Study Area, largely comprising the ground layer. It has been identified that with appropriate management during the remediation works, the impacts to the surface could reduce this impact to less than 5% of the Subsidence Study Area (see **Section 7.1**). It is noted that the remediation of surface cracking will progressively be undertaken generally following the mining of each longwall panel and the estimated 10% (or 5%) is the cumulative disturbance predicted over the life of the underground mining operations and not the area that is disturbed at any one time.

The risk of subsidence effects resulting in tree fall within Offset Area 5 and resulting in extensive destruction of habitat is considered to be extremely low. Similar to the effects of surface cracking, subsidence related impacts will be experienced on the surface on a staged basis consistent with the progression of underground mining operations. Accordingly, the impact of any infrequent tree fall that occurs during the extraction of a particular longwall is likely to be outweighed by the habitat improvements which the Project has committed to within other areas of Offset Area 5 and the other Biodiversity Offset Areas.

The land within Offset Area 5 which is located within the Subsidence Study Area does not contain extensive areas of cliffs or steep slopes. Accordingly, the loss of vegetation from Offset Area 5 through rock fall is considered to be negligible.

Despite the predicted changes to the groundwater regime overlying the Underground Extraction Area, the water currently utilised by the terrestrial vegetation in this area (groundwater monitoring indicated this is predominantly surface moisture) will continue to be available.

Appendix J provides further information in relation to the extent of impacts within the Subsidence Study Area.

As was suggested by OEH and DoE, Cumberland Ecology, with the assistance of MSEC, has confirmed the impacts of subsidence on the biodiversity values within the Subsidence Study Area are negligible. However, in order to develop a risk based approach to the perceived impacts from subsidence related effects, an extremely conservative 10% discount has been applied to the value of Offset Area 5.

That is, 1,064 ha of vegetation (and associated habitat) within Offset Area 5 above the Subsidence Study Area has been assigned a value of "958 ha" for inclusion within the BOS.

7.3.5 Adequacy of the Biodiversity Offset Strategy

A substantive BOS has been proposed to offset the predicted residual impacts of the Project. Assessment of the adequacy of the BOS has been undertaken using the three relevant policies, the results of which has confirmed that the offsets proposed for the Project will adequately offset any biodiversity impacts.

Offsetting Ratios

The BOS meets the targets established for the TECs directly impacted by the Project through the provision of at least the following offset ratios:

- 7:1 for TSC Act listed Box Gum Woodland and Derived Native Grassland;
- 9:1 for EPBC Act listed Box Gum Woodland and Derived Native Grassland; and
- 37:1 for TSC Act listed Hunter Valley Foothills Slaty Gum Woodland.

A detailed discussion on the biodiversity offset ratios and commitments to compensate for the impacts on biodiversity values are provided in **Appendix K**. The offset areas provide well in excess of native vegetation than the typical requirements as calculated on a ratio basis.

Biodiversity Offset Policy for Major Projects

The relevant level of evaluation of the BOS against the *NSW Biodiversity Offsets Policy* for FBA has been conducted and is presented within **Appendix K**.

A summary of the ecosystem credits generated for the Project is provided in **Table 42**. All native vegetation types within the Project Disturbance Boundary were assessed as being in moderate/good condition.

When assessed using the *NSW Biodiversity Offsets Policy for Major Projects* and FBA, the Project was estimated to require a total of 21,741 ecosystem credits. Of this, an estimated 6,276 ecosystem credits are required for Box Gum Woodland and Derived Native Grassland and 643 ecosystem credits are required for Hunter Valley Foothills Slaty Gum Woodland.

All native vegetation types within the biodiversity offset areas were assessed as being in moderate/good condition. The biodiversity offset areas were assessed to provide a total of 43,006 ecosystem credits. The BOS provides a substantial amount of ecosystem credits beyond the total amount of ecosystem credits required for the Project.

The Project requires 13,031 species credits for the Regent Honeyeater, 12 species credits for the Brush-tailed Rock-wallaby, 1,300 species credits for the Eastern Bentwing-bat (breeding habitat) and 1,300 species credits for the Large-eared Pied Bat (breeding habitat).

It is estimated that the Project provides an excess of 150 species credits for the Regent Honeyeater, 2,025 species credits for the Brush-tailed Rock-wallaby, 6,264 species credits for the Eastern Bentwing-bat (breeding habitat) and 6,264 species credits for the Large-eared Pied Bat (breeding habitat).

Commonwealth Environmental Offset Policy

The Commonwealth Environmental Offsets Policy was utilised to allow an objective assessment of the suitability of the offset areas. The process has been useful in gaining an understanding of the required offset area to development area ratio.

The results indicated that for Box Gum Woodland and Derived Native Grassland, when woodland and components are combined, the BOS provides greater than 100% of the offset requirement through retention and management of existing habitat. The BOS also provides greater than 100% of the offset requirement for Regent Honeyeater.

Further details of the assessment against the Environmental Offset Policy are provided in **Appendix K**.

TABLE 42 Total Ecosystem Credits Generated by the Project

Vegetation Community	Plant Com. Type Code	TSC Act Status	EPBC Act Status	Project Disturbance Boundary		Offset Areas		Surplus
				Area (ha)~	Credits Required	Area (ha)~	Credits Generated	
HUNTER VALLEY FOOTSLOPES SLATY GUM WOODLAND								
9: Slaty Box Woodland	HU869	VEC		11	643	411	6,111	5,468
HUNTER FLOODPLAIN RED GUM WOODLAND								
3: River Oak / Redgum Riparian Forest	HU599	EEC				15	181	181
BOX GUM WOODLAND AND DERIVED NATIVE GRASSLAND								
6a(1)A: Yellow Box Woodland (Grassy)	HU732	EEC	CEEC	8	472	148	2,034	1,562
7a(1)A: White Box Woodland (Grassy)	HU690	EEC	CEEC	55	2,989	518	5,262	2,273
8a: Blakely's Red Gum Woodland (Grassy)	HU714	EEC	CEEC			3	39	39
DNG – 6(1)A: Yellow Box Woodland Derived Native Grassland	HU732	EEC	CEEC	6	95	76	802	707
DNG – 6(2)B: Yellow Box Woodland Derived Native Grassland	HU732	EEC		8	140	82	724	584
DNG – 7(1)A: White Box Woodland Derived Native Grassland	HU690	EEC	CEEC	68	1,466	526	4578	3,112
DNG – 7(2)B: White Box Woodland Derived Native Grassland	HU690	EEC		63	1,113	156	1,524	411
DNG – 8(1)A: Blakely's Red Gum Woodland Derived Native Grassland	HU714	EEC	CEEC			0	3	3
Subtotal TSC Act Box Gum Woodland and Derived Native Grassland				207	6,275	1,509	14,965	8,690
Subtotal EPBC Act Box Gum Woodland and Derived Native Grassland				137	5,022	1,267	12,676	7,654

Notes: Discrepancies may be present in totals due to rounding

7.3.6 Consideration of Offsetting Principles

The BOS for the Project aims to meet the principles for the provision of offsets under the *NSW Biodiversity Offsets Policy for Major Projects*. **Table 43** shows how each of these principles has been addressed. This indicates, as a “Transitional” project, that the BOS provides adequate offsets for the biodiversity values which are predicted to be impacted by the Project.

The BOS has also been prepared with considerations of the provision of offsets under the *DoE Environmental Offsets Policy*. **Table 44** shows how each of these principles has been addressed. The results of the assessment of the Project against the *DoE Environmental Offsets Policy* indicate that the BOS provides adequate offset for the MNES predicted to be significantly impacted by the Project.

TABLE 43 Consideration of NSW Offsetting Principles

Principle	Assessment
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.	Changes have been made to the design of the Project to minimise disturbance to established woodland areas, in particular reduction in areas of Box Gum Woodland and Derived Native Grassland and avoidance of a large population of <i>Tylophora linearis</i> . Details of the avoidance and mitigation measures for the Project are outlined within the Ecological Impact Assessment.
2. Offset requirements should be based on a reliable and transparent assessment of losses and gains.	Extensive surveys have been conducted within the Study Area and offset areas to provide a basis for determining the losses and gains from the Project. The FBA and BBAM calculators have been used as one method to assess these losses and gains. Based on the results of this assessment, the Project will provide 43,006 ecosystem credits to offset the loss of 21,741 ecosystem credits (including provision of 14,965 ecosystems credits for TSC Act listed Box Gum Woodland and Derived Native Grassland). The Project also provides sufficient species credits for the Regent Honeyeater, Brush-tailed Rock-wallaby, Eastern Bentwing-bat and Large-eared Pied Bat.
3. Offsets must be targeted to the biodiversity values being lost or to higher conservation priorities.	The BOS has been developed to target the communities and species impacted by the Project. The BOS provides extensive areas of TEC vegetation. Where there is a shortfall of offsets for vegetation communities, additional areas of communities of higher conservation value have been included (e.g. additional Box Gum Woodland provided to compensate for loss of Coastal Grey Box Woodland and Fuzzy Box Woodland as there is limited availability of these communities in the locality). The offset areas also provide extensive areas of known and potential habitat for the suite of threatened species known to be impacted.
4. Offsets must be additional to other legal requirements.	The proposed offsets are supplementary in that they are proposed exclusively for the Project and are not already funded or being managed for biodiversity value for another development proposal.
5. Offsets must be enduring, enforceable and auditable.	The proposed offset areas will be secured by an appropriate mechanism. A BMP will be prepared to manage the offset areas and will include provisions for ongoing monitoring and maintenance. When the offsets are formalised and a BMP is in place, it is anticipated that the Farm Manager (or equivalent) appointed by KEPCO will oversee and coordinate activities for the purposes of biodiversity management.
6. Supplementary measures can be used in lieu of offsets.	The BOS is underpinned by the provision of substantial direct offsets.

TABLE 44 Consideration of Commonwealth Offsetting Policy

Principle	Assessment
1. Suitable offsets must deliver an overall conservation outcome that improves or maintains the viability of the protected matter.	The BOS has been assessed via a number of methods including the Offsets Assessment Guide. Results of these assessments indicate that the BOS will improve the viability of the relevant MNES.
2. Suitable offsets must be built around direct offsets but may include other compensatory measures.	The BOS primarily consists of direct offsets, however some supplementary measures are also proposed. All indirect offsets will be targeted towards the biodiversity values relevant to the Project. The results of the Offsets Assessment Guide indicate that the direct offsets fulfil the offsetting requirements for the species considered to be significantly impacted by the Project.
3. Suitable offsets must be in proportion to the level of statutory protection that applies to the protected matter.	The Offsets Assessment Guide, as well as the proposed ratios for the Project have taken into account the level of protection afforded to each MNES to be potentially impacted by the Project.
4. Suitable offsets must be of a size and scale proportionate to the residual impacts on the protected matter.	The Offsets Assessment Guide has taken into account the size and quality of the impact and offsets. The results of the assessment indicate that the BOS provides above the requirement for the relevant MNES through direct offsets.
5. Suitable offsets must effectively account for and manage the risks of the offset not succeeding.	The Offsets Assessment Guide takes into account the risks associated with the offsets not succeeding. The risks of the offset not succeeding have also been minimised by the provision of additional areas of direct offsets (above the 100% requirement) and the advance provision of offsets. Additionally, the risks associated with inclusion of the portion of Offset Area 5 occurring above the Subsidence Study Area have been taken into account during calculations.
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.	The proposed offsets are supplementary in that they are proposed exclusively for the Project and are not already funded or being managed for biodiversity value for another development proposal.
7. Suitable offsets must be efficient, effective, timely, transparent, scientifically robust and reasonable.	The proposed offsets are considered to be efficient and effective, as measurable conservation gains will be achieved with reasonable investment of time and money. They are timely as they are being provided in advance of the disturbance (with the exception of any restoration works which will occur progressively) and are proposed to be long lasting. They are transparent, in that measurable conservation gains will be achieved and monitoring of results will be conducted. They are scientifically robust, and are known to produce conservation outcomes. They are reasonable, and utilise well-known approaches for biodiversity conservation.
8. Suitable offsets must have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced.	A comprehensive BMP will be prepared for monitoring and auditing the performance of the offset lands. When the offsets are formalised and a BMP is in place, it is anticipated that the Farm Manager (or equivalent) appointed by KEPCO will oversee and coordinate activities for the purposes of biodiversity management.
9. In assessing the suitability of an offset, government decision-making will be informed by scientifically robust information and incorporate the precautionary principle in the absence of scientific certainty.	Not relevant to this assessment. The Offsets Assessment Guide takes into account the risks and uncertainties associated with the establishment and management of offsets. The risks of the offset not succeeding have also been minimised by the provision of additional areas of direct offsets (above the 100% requirement) and the advance provision of offsets. Additionally, the risks associated with inclusion of the portion of Offset Area 5 occurring above the Subsidence Study Area have been taken into account during calculations.
10. In assessing the suitability of an offset, government decision-making will be conducted in a consistent and transparent manner.	Not relevant to this assessment.

7.3.7 Management of Onsite and Offsite Offset Areas

In order to provide a comprehensive framework for the implementation of the proposed biodiversity impact mitigation and offset measures, a BMP will be developed for the Project. The BMP will ensure that the Project's conservation objectives are met and that impacts to biodiversity are adequately managed for the life of the Project.

The objectives for the management of existing vegetation within the offsets are:

- Maintenance and improvement of the condition of existing forest and woodland;
- Maintenance and improvement of the condition of riparian vegetation and habitats;
- Maintenance and improvement of habitat for threatened flora and fauna;
- Improvement of derived native grassland to promote, natural succession towards woodland and or open forest;
- Revegetation, where required, of areas of low diversity native grassland by replanting trees and shrubs to promote a more rapid regeneration towards forest or woodland; and
- Improvement of habitat connectivity within the offset areas in order to improve wildlife movement in the long term.

Conservation and Ongoing Management of Existing Vegetation

The Biodiversity Offset Properties contain extensive areas of existing woodland and open forest that will form nuclei for the ongoing regeneration of trees and shrubs into grassland areas. Such areas will provide immediate and ongoing habitats for native plants and animals. Existing forest and woodland areas are currently mature, functioning examples of natural ecosystems, but their condition is expected to improve with time as trees further mature, tree hollows are generated and as regeneration of understorey takes place when livestock are progressively removed (McIntyre *et al.*, 2002).

Derived native grasslands within the offset areas are in variable condition. Many of the grasslands adjacent to remnant vegetation have a diversity of native grasses and non-grass understorey species. Grasslands occurring in actively used agricultural areas and riparian areas have fewer native species in the understorey.

It is intended that grazing management, combined with the management of weeds and feral animals will accelerate regeneration of derived native grasslands to forest and woodland areas. Such habitats are semi-natural and cannot currently be considered fully functional as they generally lack trees and shrubs.

In the medium to long term, trees and shrubs are expected to regenerate in many grassland areas if the condition of the land is improved through grazing and weed management (Lindenmayer *et al.*, 2010). It is expected that substantial regeneration will occur during the life of the Project and a mature, functional ecosystem will be established across much of these grassland areas within 50 years.

There are some portions of grassland within the offset areas that will require revegetation. These areas occur where remnant woodland and forest patches are largely absent (e.g. large parts of Offset Area 4) (see **Appendix K**).

Revegetation

Revegetation is proposed to occur within the portions of the offset areas containing grasslands associated with Box Gum Woodland, that do not meet the criteria to be listed under the TSC Act or EPBC Act. The objectives for revegetation within the offset areas are:

- Restore extensive areas of Box Gum Woodland;
- Restore extensive areas of habitat for the suite of threatened species impacted by the Project; and
- Establish linkages between patches of remnant vegetation.

It is not contended that the revegetated woodland will be a facsimile of the original woodland. However, broad areas of such grassland will be revegetated with trees and shrubs and as such, it is predicted that sufficient native trees and shrubs will be reintroduced to provide self-regenerating vegetation.

Restoration of forest and woodland to a structural complexity with diverse age classes comparable to the original community structure will take many decades, but natural regeneration can be achieved with supplemented revegetation to replace missing community layers.

A major part of this is maintaining or increasing the number of large old canopy trees (in areas where they remain) which provide habitat resources including hollows, woody debris and reliable blossom production. Restoration of forest and woodland also involves protection of any remaining medium sized trees that are future large old canopy trees.

It is anticipated that initial revegetation work will be focussed on expanding existing patches of woodland. Trees and shrubs will be planted into such areas to form nuclei of regenerating woody habitats that will then be able to progressively grow back into woodland or open forest. Replanting of such areas will take place early in the life of the Project (within the first five years) and it is expected that substantial regeneration of woody plants will occur within the life of the Project.

Security of Onsite and Offsite Offset Areas

KEPCO owns all of the properties contained within the BOS for the Project. KEPCO is considering a number of mechanisms to permanently secure the offset properties for conservation and management. There are a number of options to permanently protect offset land for conservation and these include:

- Formal BioBanking Agreements;
- Voluntary conservation agreements, which are a joint agreement between landowners and the Minister for the Environment under the NPW Act;
- Conservation covenants under section 88 of the *Conveyancing Act 1919*; this is a joint agreement between the landowner (i.e. KEPCO) and an authorised body; and
- Application to change zoning regulation that dictates land use.

The final decision on the method of securing the offsets will be made by KEPCO following consultations with the relevant regulatory agencies.

7.4 SURFACE WATER

7.4.1 Background

A Surface Water Impact Assessment was undertaken by WRM Water and Environment Pty Ltd (WRM) and is provided in **Appendix L**. The purpose of the assessment was to:

- Characterise the existing catchments;
- Develop a water balance for the Project with consideration of the proposed water management system;
- Determine the impacts to the surface water regime as a result of the Project; and
- Recommend measures to mitigate and manage impacts.

Existing Catchment

The Project is located in the Bylong Valley, within the catchment of the Bylong River, a tributary of the Goulburn River, which in turn is a tributary of the Hunter River. The headwaters of the catchment are typically steep and well vegetated.

In the lower portions of the catchment, extensive vegetation clearing has occurred for agricultural purposes, particularly in alluvial areas adjacent to the river channel. The Bylong River drains generally northwards, from the south-east. A number of tributaries feed into the Bylong River in the vicinity of the Project, including:

- Wattle Creek;
- Cousins Creek;
- Lee Creek;
- Growee River;
- Dry Creek; and
- Coggan Creek.

The primary areas of disturbance for the Project are on elevated land along a short reach of Lee Creek and the Bylong River where mine infrastructure and open cut mining areas are located and in the Dry Creek catchment, where underground mining is proposed. The remaining tributaries are not affected by the Project (refer to **Figure 7**).

The streams within the Study Area have been classified according to the Strahler Stream Classification System (Strahler, 1952). In the vicinity of various components of the Project, the Bylong River is a fourth order stream. In its lowest reaches, Dry Creek is a third order stream. There are no other third or fourth order streams which will be intercepted by the Project's water management system.

Drainage Characteristics

As described above, the drainage network in the Bylong Valley varies from steep headwater gullies to wide, flat, alluvial floodplains. The lower reaches of Lee Creek consist of a wide, flat floodplain, with a small, poorly defined low-flow channel. Extensive clearing of the Lee Creek floodplain has been undertaken as part of the historical farming activities, with complete removal of riparian vegetation along substantial reaches. Significant bank erosion is evident in the mid-reaches of Lee Creek in the vicinity of the proposed open cut mining areas.

Dry Creek is a tributary of the Bylong River and flows in a general northerly direction before entering it approximately 3.1 km north-east of the intersection of Bylong Valley Way and Upper Bylong Road. The upper reaches of Dry Creek are located in the Bylong State Forest. Dry Creek is intersected by numerous first and second order streams and continues as a third order stream in its lower sections on KEPCO land. Dry Creek is discontinuous with intermittent flow. Sections of this creek have no discernible channel. The tributaries of Dry Creek are heavily incised with minimal riparian vegetation due to historical clearing for agricultural use.

Existing Water Use Entitlements

Surface water within the Bylong River catchment is managed under the Hunter Unregulated WSP as discussed in **Section 4.6**. All water extraction that is not for basic landholder rights or is exempt from requiring a licence must be authorised by a WAL under the WM Act. KEPCO currently holds eight WALs from the Bylong River water source, with a total allocation of 2,535 units (currently equivalent to 2,535 ML/Year). These WALs are for access to groundwater which is highly connected to the surface water regime.

Under the WM Act, landholders in most rural areas are permitted to collect a proportion of the rainfall runoff on their property and store it in one or more dams up to a certain size. This is known as a "harvestable right". A dam can capture up to 10 percent of the average regional rainfall runoff for their landholding without requiring a licence. The total harvestable right for the landholdings held by KEPCO within the Project Boundary has been calculated at 355 ML/Year.

KEPCO's landholdings within the Project Boundary include 63 existing farm dams with a combined total surface area of 5.9 ha. Based on an average depth of 1.5 m, the total capacity of existing farm dams is estimated at 89 ML. Subtracting the capacity of existing farm dams (89 ML) from the harvestable right (355 ML) leaves an available harvestable rights volume of 266 ML/Year.

Existing Water Quality

Surface water quality data from the extensive water monitoring network (see **Section 2.8**) provides an indication of the state of the watercourses within and adjacent to the Project Boundary, including the Bylong River, Lee Creek and Dry Creek.

Baseline surface water quality monitoring has been undertaken at nine sites from February 2012 to August 2014. This monitoring regime was recommenced in December 2014. Sampling has been generally undertaken on a monthly basis, subject to climate conditions, for salinity, pH, temperature, Dissolved Oxygen, turbidity, alkalinity as well as a number of metals and organic compounds. One monitoring site, located on the Growee River was noted as dry on all sampling occasions.

Bylong River

The Bylong River is characterised as slightly alkaline, with pH ranging from 7.3 to 8.4. Salinity varies from fresh in the upper catchment which drains from the Wollemi National Park and Nullo Mountain State Forest to brackish downstream of the Growee River confluence. Median electrical conductivity (EC) values downstream of the Growee River exceed ANZECC irrigation trigger levels. There is a distinct difference in salinity between upstream locations on Lee Creek and the Bylong River, where salinity is generally below 400 $\mu\text{S}/\text{cm}$ and downstream of the Growee River where salinity increases generally to within the range of 1,800 to 2,200 $\mu\text{S}/\text{cm}$.

Generally, major ions and trace elements are within the trigger values for ecosystem protection and recreation and livestock purposes as specified within the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC Guidelines) (ANZECC and ARMCANZ, 2000), with the exception of elevated levels of total phosphorous, sodium, chloride, ammonia, aluminium, chromium, copper, dissolved manganese, dissolved cadmium, dissolved zinc and total iron. Additionally, the level of turbidity in the system is mostly within the acceptable range for ecosystem protection, with median field and laboratory measured values ranging from 2.6 to 17.5 NTU.

Lee Creek

The surface water quality in Lee Creek is characterised as slightly alkaline (with pH ranging from 7.4 to 8.2) and fresh, with field and laboratory measured EC ranging from 180 to 385 $\mu\text{S}/\text{cm}$. Major ions and trace elements are generally within the ANZECC trigger values for ecosystem protection and recreation and livestock purposes with the exception of elevated levels of total phosphorous (monitoring location SW9 only), ammonia, total aluminium, total chromium, dissolved copper, dissolved manganese, dissolved zinc and dissolved and total iron. The level of turbidity in Lee Creek is mostly within the acceptable turbidity range for ecosystem protection.

Dry Creek

The surface water quality in Dry Creek is characterised as slightly alkaline (with median pH values ranging from 8.2 to 8.5) and fresh to brackish, with field and laboratory measured EC ranging from 418 to 1,202 $\mu\text{S}/\text{cm}$. Major ions and trace elements are generally within the ANZECC trigger values for ecosystem protection and livestock purposes with the exception of elevated levels of total phosphorus, sodium, aluminium (one occasion only), total aluminium, total chromium, total and dissolved copper, total iron and dissolved zinc. Turbidity levels in Dry Creek were mostly within the acceptable turbidity range for ecosystem protection.

Proposed Water Management System and Infrastructure

A key objective of the water management system will be to maximise the diversion of clean water flows around the mining operations. Further, the poorer quality mine water will be prioritised for onsite reuse over extracting water from external fresh water sources (such as the borefield). As discussed in **Section 3.7**, the main components of water management infrastructure for the Project include:

- Sediment dams to collect and treat runoff from the OEAs;
- Dirty water drains to divert sediment-laden runoff from the OEAs to sediment dams;
- Clean water drains to divert runoff from undisturbed catchments around areas to be disturbed by mining;
- A borefield with up to approximately 15 bores in the alluvial; and
- A mine-affected water system to store water pumped out of the open cut and underground mining areas and to collect runoff from the CHPP and coal stockpile areas.

All water management structures will be suitably engineered to the standard required to safely capture, store and divert water of various qualities and avoid adverse impacts to the neighbouring environment.

The sediment dams have been sized as "Type F" sediment basins with a settling zone volume based on the 90th percentile 5-day duration rainfall in accordance with current recommended design standards in the following guidelines:

- Managing Urban Stormwater, Soils and Construction (Landcom, 2004); and
- Managing Urban Stormwater, Soils and Construction, Mines and Quarries (DECC, 2008).

The Eastern Void within the eastern mining area and its associated catchment will remain at the completion of open cut mining (at the end of PY 10) for the emplacement of coarse and fine rejects materials generated by the processing of coal from the longer term underground mining operations.

The capacities of the water storages and the associated catchment areas are presented in **Table 45**. The relationships between the components of the conceptual water management system are illustrated in **Figure 49**. These details were adopted in the site water balance model.

TABLE 45 Indicative Water Storage Capacities and Catchment Areas

Storage Facility	Total Volume Required (ML)	Maximum Catchment Area (ha)
Raw Water Dam	300.0	96.6
CPP Supply Dam	22.2	1.7
CPP Coal Contact Dam	23.3	10.3
Open Cut MIA Dam	106.1	14.3
Underground MIA Dam	15.7	9.3
Underground Raw Coal Stockpile Dam	3.4	7.6
Product Stockpile Dam	18.0	10.8
Feeder Floor and Reject Overflow Dam	6.0	2.1
Fill Point Dam	2.0	0.4
Sediment Dam 1	34.6	100.5
Sediment Dam 2	38.4	111.3
Sediment Dam 4	35.7	103.7
Sediment Dam 5	45.8	132.9
Sediment Dam 6	25.3	73.5
Sediment Dam 8	15.4	44.8
TOTAL	691.9	N/A*

* Maximum catchment areas represented for each of the storages occur at varying stages of Project

7.4.2 Methodology

Site Water Balance

A computer-based simulation model (OPSIM) was used to assess the dynamics of the site water balance (both volume and salt loads) under varying rainfall and catchment conditions. The OPSIM model works to dynamically simulate the operation of the water management system and in doing so keeps a complete account of all site water volumes and representative water qualities on a daily time step.

The model was configured to simulate the operations of all major components in the water management system. The simulated inflows and outflows included in the model are provided in **Table 46**.

The performance of the water management system and associated site water balance was modelled using static and forecast simulations. The static water balance results are based on a long term simulation (using 125 years of historical climate data) with the model configuration fixed to a particular phase of mine development. These results provide an indication of the relative magnitude of inflows and outflows at that particular phase of mining.

The forecast water balance results are generated by running multiple climate sequences through the model and taking a statistical representation of the results for the different climate cases modelled. These results more accurately reflect the actual performance of the system because they take into account the dynamic nature of the mining phases, groundwater inflows and CHPP throughputs.

In these runs, the model configuration changes over time to reflect the changes due to mine development. The forecast water balance model has been run on a daily timestep for a 23 year period, corresponding to the period of proposed mining operations for the Project.

For both the static and forecast simulations, five representative stages of the Project life (PYs 3, 5, 7, 9 and post open cut mining) were modelled to reflect variations over time. Although the catchment areas will continuously change as the Project progresses, the adopted approach of modelling discrete stages provide a reasonable representation of conditions over the 23 year operational period.

To assess the effects of varying climatic conditions, the model was run for 102 realisations with each realisation corresponding to the 23 year operational life of the Project. A different rainfall input sequence is applied to each realisation. The first realisation adopts climatic data from 1889 to 1911, the second from 1890 to 1912 and so on through the 125 years of historical climatic data. A statistical analysis of the resultant 102 realisations was then undertaken to assess the behaviour of the various storages over extended dry and wet periods.

The Australian Water Balance Model (AWBM) was relied upon to simulate catchment runoff inflows to the mine water management system. Catchments across the site have been characterised into the following land use types:

- Natural/undisturbed;
- Roads/hardstand;
- Mining areas;
- Spoil;
- Rehabilitated spoil; and
- Coal stockpiles.

The model parameters adopted for compacted areas provide a volumetric runoff coefficient similar to an urban catchment with similar characteristics. The AWBM model parameters for OEAs were adopted from a previous study of runoff from disturbed mine catchments in the Hunter Valley region (ACARP, 2001).

Further detail of modelling assumptions and calibration can be found in **Appendix L**.

TABLE 46 Simulated Inflows and Outflows to the Water Management System

Inflows	Outflows
Direct rainfall on water surface of storages	Evaporation from water surface of storages
Catchment runoff	CHPP demands
Groundwater inflows	Dust suppression demands
Raw (borefield) water supply	Underground water supply
	Mine infrastructure area demands
	Offsite spills from storages*

* Good engineering practice is to include a stabilised spillway as a contingency for dam safety. This does not indicate that spills will occur.

Surface Runoff Salinity Assessment

The OPSIM model has been configured to use salinity as an indicator of water quality and to undertake an assessment of the likely impact of the Project on the salt load released to receiving waters as surface flow. This has been achieved by assigning representative levels of Total Dissolved Solids (TDS) to runoff from catchments and other sources of water.

The salinity concentrations for runoff from spoil, stockpiles and mining pit catchments was determined based on information provided in the Geochemical Impact Assessment (see **Section 7.20**). The salinity of natural catchment runoff was based on the median of the recorded EC data at the Bylong River and Lee Creek receiving water monitoring sites. It has been assumed that runoff salinity from rehabilitated catchments will be similar to the natural catchments. Salinity of the mining area groundwater inflows and borefield water supplies was based on the groundwater monitoring data (DP, 2014).

7.4.3 Impact Assessment

Overall Water Balance

The simulated water balance results for PYs 3, 5, 7, 9 and from PY 11 onwards are summarised in **Table 47**. The water balance results provided in **Table 47** are those for the single realisation with median inflows (realisation 72 utilising meteorological data from 1960 to 1982) and include direct rainfall, catchment runoff and groundwater inflows over the life of the Project. The results for this single realisation provide inflows, outflows and overall water balance for each of the mine phases for a representative climate sequence.

The results for a single realisation with median inflows show that over the life of the Project:

- Borefield water is required in all phases, with the greatest amount required in PY 3;
- The largest demand from the water management system is dust suppression;
- Total mine water demand (including CHPP make-up, dust suppression, WAF, Open Cut and Underground MIA usages, underground operations) supplied from the water management system ranges between approximately 1,317 ML/Year and 1,942 ML/Year, with the highest demand in PY 9 (during combined open cut and underground operations);
- No overflows from the mine water management system for this simulation; and
- The combined spill volume from the sediment dams is highest in PY 11+ (152 ML/Year), and ranges between 0 ML/Year and 56 ML/Year for the remaining phases.

TABLE 47 Average Annual Water Balance – Realisation 72

	PY 3	PY 5	PY 7	PY 9	PY 11+
WATER INPUTS (ML/YEAR)					
Rainfall/runoff yield	220	737	961	563	729
Groundwater inflows	129	174	231	1,393	1,172
Raw (bore) water intake	931	472	548	21	0
Gross Water Inputs	1,280	1,383	1,740	1,958	1,901
WATER OUTPUTS (ML/YEAR)					
Evaporation from storages	47	51	72	107	312
Dam overflows (offsite)					
Mine water system	0	0	0	0	0
Sedimentation system	0	0	56	0	152
Total	0	0	56	0	152
CHPP demand (loss)	249	266	269	395	366
Dust suppression	1,041	1,041	1,041	1,041	500
WAF	22	22	0	0	0
OC MIA Dam usage	5	7	7	1	0
UG MIA Dam usage	0	0	5	5	7
Underground operations usage	0	0	50	500	500
Gross Water Outputs	1,364	1,387	1,500	2,049	1,837
WATER BALANCE (ML/YEAR)					
Change in storage volumes	-84	-4	240	-91	64

The results presented include wet and dry periods distributed throughout the Project. Rainfall yield for each phase is affected by the variation in climatic conditions within the adopted climate sequence.

Mining Area Water Storage

The water management system is configured to pump excess water to the mining areas when the capacity of the water management system is exceeded. The stored water is available for reuse, as required.

The modelling results indicate the following for mining pit inundation characteristics:

- Prior to the commencement of underground mining, there is a low risk of significant volumes of water accumulating in the open cut mining areas. Once underground operations commence, groundwater inflows increase significantly. This may result in water accumulating within the open cut mining voids if wet climatic conditions occur.
- During open cut only operations (PY 3 to PY 6), there is a:
 - 1% chance of storing up to 1,000 ML in the open cut mining areas;
 - 10% chance of storing up to 380 ML in the open cut mining areas; and
 - 50% chance that the mining area will not be required to store significant volumes of water.
- During combined operations and underground only (PY 7 to PY 25), there is a:
 - 1% chance of storing up to 3,560 ML in the Eastern open cut mining area;
 - 10% chance of storing up to 2,000 ML in the Eastern open cut mining area; and
 - 50% chance of storing up to 1,330 ML in the Eastern open cut mining area.

During open cut only operations, the accumulation of water with the open cut mining operations is manageable with the extensive void areas and low quantities of water generated. Once underground operations commence, the additional groundwater inflows and reduction in site water demands increases the risk of water accumulation within the water management system. This water will be managed within the voids remaining within the Eastern Open Cut.

Once open cut operations are completed in PY 10, the capacity of the East Void will be around 18,800 ML, providing ample capacity to store any excess water should very wet climatic conditions occur. If wet conditions occur over this period, the Eastern Open Cut Mining Area will be used to store reject materials and any excess water. The total bulk volume of rejects during underground operations is estimated to be around 11,700 ML. This would indicate approximately 7,000 ML of remaining capacity available within the East Void to store excess mine water captured through surface runoff and groundwater inflows.

Depending on climatic conditions over the Project life, there may be water contained within the East Void at the completion of mining. The proposed management strategy for the water contained within the East Void at the end of mine life is to return it to the abandoned underground mine workings. The impacts of returning this water underground are discussed in **Section 7.6**.

The results of the site water balance modelling demonstrate that the site water management system can be operated to ensure with at least a 99% probability that no uncontrolled release of saline water will occur throughout the life of the Project. The only uncontrolled offsite releases will be from the sediment dams during periods of rainfall greater than the relevant design criteria. Available geochemical information indicates that the runoff draining to most of the sediment dams should have salinity consistent with receiving waterways and therefore it is unlikely that a measurable impact will be experienced to receiving water quality.

Regional Impact from External Water Supplies

A significant proportion of mine site water requirements will be sourced from water collected on the site. In addition, water will also need to be sourced from a borefield constructed within the Bylong River alluvium. **Table 48** provides a summary of the borefield water demands for the various stages of the proposed mining operations.

The results of the water balance modelling show that KEPCO's existing WALs providing 2,535 ML/Year will satisfy all site demands for all years of operation (even in the driest climatic sequence experienced over the past 125 years).

The impact of the groundwater extraction and interception on regional water availability is provided in the Groundwater Impact Assessment for the Project completed by AGE (2015). There is not anticipated to be any adverse impact on other licensed groundwater users within the water source who will still have access to their entitlement (subject to climatic conditions and the operation of the water supply scheme).

TABLE 48 Summary of Indicative Borefield Water Demand

Operational Period	Borefield Water Demand (ML/Year)		
	1% Chance of Requiring	10% Chance of Requiring	50% Chance of Requiring
Open cut only operations (PY 3 to PY 6)	985 to 1,170	940 to 1,140	560 to 990
Combined mining operations (PY 7 to PY 10)	380 to 1,005	195 to 895	0 to 500
Underground operations only (PY 11 to PY 25)	55 to 150	0 to 60	0

Uncontrolled Spills

The results of the water balance modelling indicate that under the current model assumptions and configuration, there are no uncontrolled spills from the mine water management system including the Product Stockpile Dam, Fill Point Dam, CHPP Coal Contact Dam, Feeder Floor and Reject Overflow Dam, OC MIA Dam, UG MIA Dam or the open cut mining areas. Therefore the mine water management system is sufficient to protect the environmental values of the receiving waters.

Some overflow of water from sediment dams may occur during wet periods that exceed the design standard of the sediment control system. Available geochemical information indicates that the runoff draining to most of the sediment dams should have salinity consistent with receiving waterways.

Overflows would only occur during significant rainfall events which will also generate runoff from surrounding undisturbed catchments. Hence, it is unlikely that sediment dam overflows will have a measurable impact on receiving water quality.

Loss of Catchment

During active mining operations, the mine water management system will capture runoff from areas that would have previously flowed to the receiving waters of Bylong River, Lee Creek and Growee River.

The maximum catchment area captured within the mine water management system during active mining operations (assuming no water overflows are released from sediment dams following treatment) is:

- Less than 1.3% of the Bylong River catchment to a point downstream of the Project Boundary (this includes Lee Creek and Growee River catchments);

- Approximately 5.8% of the Lee Creek catchment to the confluence with the Bylong River; and
- Less than 0.1% of the Growee River catchment to the confluence with the Bylong River.

These reductions in catchment areas indicate that the likely reduction in surface flow would represent only a small proportion of total catchment runoff. The loss of flow in the Goulburn River catchment, which has an area of more than 3,300 km², would be immeasurably small.

Final Landform

The final landform at the completion of the Project (as discussed in **Section 7.15**) will consist generally of the following:

- Rehabilitated OEAs which are shaped to integrate with the surrounding natural topography;
- Rehabilitated open cut mining areas and associated OEAs to blend into the surrounding natural topography, including no final void; and
- Removal and rehabilitation of all infrastructure related disturbed areas including haul roads and MIAs.

At the completion of mining, surface runoff from rehabilitated OEAs will be released from the site. As there will be no final void at the completion of the Project, there is not anticipated to be any significant changes in catchment areas between pre-mining and post-mining, and therefore no measurable impact on the receiving water volumes.

Flow Impact Assessment

Dry Creek

The effects of subsidence beneath the Dry Creek catchment will affect flow behaviour along Dry Creek and its tributaries. The impacts on Dry Creek drainage characteristics may be summarised as:

- Potential for reduced flow due to infiltration through subsidence-induced cracking and additional water captured in ponds created by subsidence;
- Potential changes to the longitudinal profile of Dry Creek and its tributaries caused by subsidence resulting in:
 - Increased flow depth and reduced flow velocity upstream of longwall chain pillars; and
 - Reduced flow depth and increased flow velocity downstream of longwall chain pillars; and
- A potential flow breakout along the lower reaches of a Dry Creek tributary.

The potential for infiltration through subsidence-induced cracks is considered in **Section 7.1** and **Section 7.6**. The subsidence report indicates that fracturing, buckling and dilation are likely to occur in the uppermost bedrock beneath the soil beds of the drainage lines, which may result in additional infiltration of surface water flows. The rate of inflow to groundwater via cracks is estimated in the groundwater assessment to be up to about 0.15 ML/day (AGE, 2015). However, such losses are expected to occur only after moderate-sized events when sufficient water flow depth occurs to saturate the alluvium and fracture network overlying the active longwall panel. The potential loss of surface water to groundwater (estimated to be less than 0.1% of runoff) via cracking is considered to be negligible.

Due to the steep topography of the existing Dry Creek catchment, the results of low-flow modelling showed minimal impacts resulting from ponding. Increased ponding is predicted to essentially be confined to the channels of the waterway immediately upstream of longwall chain pillars.

The total area of ponding anticipated across the entire Dry Creek catchment based on the subsidence predications is approximately 2.3 ha, indicating a potential total ponded volume of the order of 10 ML if no mitigation measures are implemented. Subtracting this volume from runoff events over the 125 year simulation period indicates a potential capture volume of the order of approximately 4,200 ML over the simulation period, representing about 6% of the total runoff volume.

This potential capture volume in ponded areas could have benefits for the maintenance of riparian vegetation along Dry Creek. However, the volume of water captured in ponded areas will be mitigated by drainage works to limit the net impact on runoff volume in the Dry Creek catchment to a few percent.

An analysis of the potential hydraulic impacts on Dry Creek and its tributaries was undertaken utilising the 2 year Average Recurrence Interval (ARI) design flood event (i.e. 1 in 2 year event) and 100 year ARI design flood event (i.e. 1 in 100 year event) velocity, stream power and bed shear stress modelling results (as discussed in **Section 7.5**). The results indicate a number of locations (generally located across chain pillars), where predicted increases in velocity, stream power and bed shear stress are potentially significant along Dry Creek and its associated tributaries.

It has been identified that scouring of the channel bed is likely in areas where stream flow occurs across the chain pillars whilst sedimentation is likely to occur in the lower lying areas of the stream within the subsidence zones until stream flow equilibrium level is reached. Flooding impacts on Dry Creek are discussed further in **Section 7.5.3**.

Water Quality and Salinity Impacts

The water management system will be designed and operated to minimise the impacts of the Project on downstream water quality. Wherever possible, runoff from undisturbed areas will be diverted around the Project using diversion drains. This will minimise the volume of fresh water collected in onsite storages and the potential impacts on downstream catchments. Runoff from disturbed areas will be collected and treated in sediment dams prior to reuse within the water management system or release to the natural catchment. If the quality of this water is not suitable for release into receiving waters, it will be contained in the water management system for reuse.

The potential impacts during the construction phase of the Project primarily relate to the potential for release of sediment in surface runoff due to land disturbance from construction activities. Water use during the construction phase (estimated at approximately 5.2 ML/Year) will be very small compared to the operational water requirements. Water requirements for the construction phase will be obtained from appropriately licensed groundwater bores or dams.

Some overflow of water from sediment dams may occur during periods of rainfall that exceed the design standard of the sediment control system. The Geochemical Impact Assessment (see **Section 7.20**) indicates that the runoff draining to most of the sediment dams should have salinity consistent with receiving waterways. Overflows from the sediment dams will only occur during significant rainfall events, which will also generate substantial runoff from surrounding undisturbed catchments. Hence, it is unlikely that the anticipated overflows from the sediment dams will have a measurable impact on receiving water quality.

The salt load from surface water runoff to the receiving environment in Bylong River is potentially impacted in two ways:

- A reduction in catchment area results in an effective reduction in salt load to the receiving environment; and
- An increase in salt load from sediment dam overflows.

The net impact on the Bylong River at a location immediately downstream of the Bylong River/Lee Creek confluence has been assessed.

Table 49 provides a summary of the predicted salt balance for the pre-mine catchments and each mining phase throughout the life of the Project. The model results show that the total average salt load released offsite in surface runoff is reduced by the Project, when compared with the pre-mine case. The average annual salt load released to the Bylong River is reduced by around 5.6% to 8.4%, depending on the mining phase. It should be noted that this estimate represents a likely upper limit of the salt load impact, since the quality of surface runoff from rehabilitated areas is likely to improve over time.

Once the post-mining landform is established and rehabilitated, it is expected that long term water quality from surface runoff should be similar to pre-mining conditions.

Water Licensing Requirements

Under median climatic conditions, the water balance modelling has indicated that the Project will require up to 1,000 ML/Year of fresh water from the borefield water supply to supplement water demands for the CHPP and mining activities. The existing WALs held by KEPCO will more than satisfy this requirement for external water supplies for all years of operation, even in the driest climatic sequence experienced over the past 125 years.

Due to the exemption for excluded works, a WAL under the WM Act is not required for the catchment areas of the clean water diversion drains. The other dams in the water management system are solely for the capture, containment and re-circulation of mine affected water for the purpose of preventing water contamination. The exemption for excluded works also applies to water captured in these dams. A WAL is only required for water taken from the undisturbed catchment areas draining to the mine water management system.

The undisturbed catchment that is proposed to be captured by the water management system is approximately 123 ha. The estimated maximum annual runoff capture from the undisturbed area of approximately 123 ha is approximately 149 ML. The available harvestable rights volume of 266 ML (as discussed in **Section 4.3.4**) significantly exceeds the estimated maximum runoff capture volume from undisturbed areas of approximately 149 ML. Hence, the capture of runoff from undisturbed catchment within the mine water management system does not require licensing.

TABLE 49 Predicted Long Term Average Annual Bylong River Salt Balance

	Pre-mine (t/Year)	PY 3 (t/Year)	PY 5 (t/Year)	PY 7 (t/Year)	PY 9 (t/Year)	PY 11+ (t/Year)
Catchment Runoff	3,947	3,610	3,553	3,546	3,539	3,539
Sediment Dam Overflows	-	5	142	178	119	128
TOTAL	3,947	3,615	3,695	3,724	3,658	3,668

7.4.4 Mitigation and Management

Surface Water Monitoring

At commencement of operations, the existing surface water monitoring program will be expanded to include samples from key storages within the water management system, such as sediment dams and the primary mine water storages. The parameter suite and sampling frequency for surface water monitoring will be initially undertaken in accordance with the current monitoring program and then refined over time. The Water Management Plan (as discussed in **Section 7.6.4**) will present the surface water monitoring program to be implemented according to the relevant stage of the Project.

Monitoring of upstream, onsite and downstream water quality will assist in demonstrating that the site water management system is effective in meeting its objective of minimal impact on receiving water quality and will allow for early detection of any impacts and appropriate corrective action. An inspection of the site water management system (particularly sediment control infrastructure) will be undertaken when more than 25 mm of rainfall is recorded in 24 hours. The post-event monitoring will include field-based assessment of water quality for any sediment dam overflows. Daily rainfall and dam volumes will also be recorded at site to assist in identifying significant rainfall events.

Sediment and Erosion Control

A Sediment and Erosion Control Management Plan will be prepared as part of the Water Management Plan in accordance with *Managing Urban Stormwater, Soils and Construction* (Landcom, 2004) and *Managing Urban Stormwater, Soils and Construction, Volume 2E Mine and Quarries* (DECC, 2008). The design of sediment control measures will be based on the principle of ensuring that runoff from disturbed areas is separated from clean area runoff and collected in sediment dams for treatment.

Sediment dams will be partially dewatered within five days after a runoff event to provide free storage capacity of at least the settling zone volume. Where the Total Suspended Solids (TSS) concentration in sediment dams after a runoff event is less than the selected water quality objective, sediment dams may be dewatered to receiving waters with the appropriate licences. Where TSS exceeds the water quality objective, water will be:

- Pumped to another water storage with available capacity;
- Pumped in to the water management system; or
- Flocculated to reduce TSS to less than the water quality objective.

Waterway Rehabilitation and Management

Bylong River Catchment

Potential impacts on the Bylong River may occur due to increased flow velocity caused by constriction of the floodplain at proposed road crossings and the conveyor embankment. The waterway management program will include inspection of these locations following any significant river flow event to assess impacts, if any, on bed and bank stability and riparian vegetation. The appropriate corrective action will be determined based on the nature and scale of any observed impacts, but may potentially include repair and revegetation of any locations where scouring has occurred.

Dry Creek Catchment

The riparian vegetation in the Dry Creek catchment is currently in relatively poor condition due to historical land clearing. Subsidence associated with underground mining will increase the risk of geomorphic impacts through increased water ponding at some locations along the waterway channel and increased bed gradient and flow velocities at other locations.

The management strategy for Dry Creek and its tributaries will be based on monitoring of changes in surface levels and erosion as a result of subsidence. Regular visual inspections and comparative ground level survey will be undertaken before, during and following longwall panel extraction to assess changes in the condition of the streams during mining, with a particular focus on the identified areas of higher risk.

Targeted management actions will be developed to respond to the observed impacts, ensuring that any intervention minimises surface disturbance. Potential mitigation measures will include:

- Sealing of any observable bed cracking along watercourses by filling and compaction with suitable material, followed by revegetation;
- Draining of any new ponded areas caused by subsidence to minimise additional water capture if required; and
- Implementation of in-stream bed controls, such as rock rip-rap or large woody debris, in locations where increased bed gradients result in observable change in geomorphic characteristics.

A key component of this management action will be the revegetation of the riparian corridor, with a focus on rehabilitation of the stream to a condition equivalent to or better than that prior to mining using soft engineering techniques, where possible.

This will be undertaken in consultation with the HLLS. Mitigation works within the Dry Creek tributary will also be undertaken to reduce the potential for breakouts of flow from the current flow path.

7.5 FLOOD

7.5.1 Background

A Flood Study was undertaken by WRM as part of the Surface Water Impact Assessment and is provided in **Appendix L**. The purpose of the flood assessment was to assess the potential of the Project to affect flood flows along the Bylong River, Lee Creek and Dry Creek.

7.5.2 Methodology

Bylong River

The flood behaviour of the Bylong River was assessed by utilising a runoff routing model (XP-RAFTS) to estimate flow rates and a two-dimensional hydraulic model (TUFLOW) to simulate flood levels and flow velocities.

The XP-RAFTS model was used to estimate flood discharges in the Bylong River catchment based on design rainfall Intensity–Frequency–Duration data from *Australian Rainfall and Runoff* (IEAust, 1998). Design flood discharge hydrographs were estimated for a range of storm durations up to 72 hours for the 2, 50 and 100 year ARI design events. In the absence of suitable historical data for calibration, the model was verified using peak discharges for individual sub catchments. This information was compared to discharges calculated using the Rational Method.

Modelled daily flows for the January 1974 flood event were compared against recorded data at the Bylong No. 2 gauge (Station No. 210062), which is located on the Bylong River about 8 km upstream of its confluence with the Goulburn River. The 1974 flood event was the largest flood event recorded at the Bylong No. 2 stream gauge for which data is available.

The TUFLOW model was used to estimate design flood levels and velocities of the waterways and floodplains in the vicinity of the Project for the 100 year ARI event. TUFLOW estimates flood levels and velocities on a fixed grid pattern by solving the full two-dimensional depth averaged momentum and continuity equations for free surface flow.

Appendix L provides further detail on the flood modelling methodology.

Dry Creek

A similar modelling approach to the Bylong River modelling was adopted for the modelling of the Dry Creek catchment. The XP-RAFTS runoff routing model was used to estimate the 2, 50 and 100 year ARI design event flood discharges within the Dry Creek Catchment. There are no stream flow gauging stations in the Dry Creek catchment. Hence, the hydrologic model was verified by comparing model-predicted design discharges to the Rational Method. Design rainfall data for events up to the 100 year ARI design event was obtained from the BoM *AR&R87 IFD tool* (BoM, 2014). The ground levels within the existing case hydraulic model were amended to include the proposed post-subsidence ground elevations predicted following the mining of the last longwall panel (LW206). The depth of the predicted subsidence within the model is up to 3.2 m along the Dry Creek alignment.

A TUFLOW model was developed to estimate design flood levels, depths, velocities and extents in the Dry Creek catchment area for the 2, 50 and 100 year ARI design events for existing conditions and post-subsidence conditions.

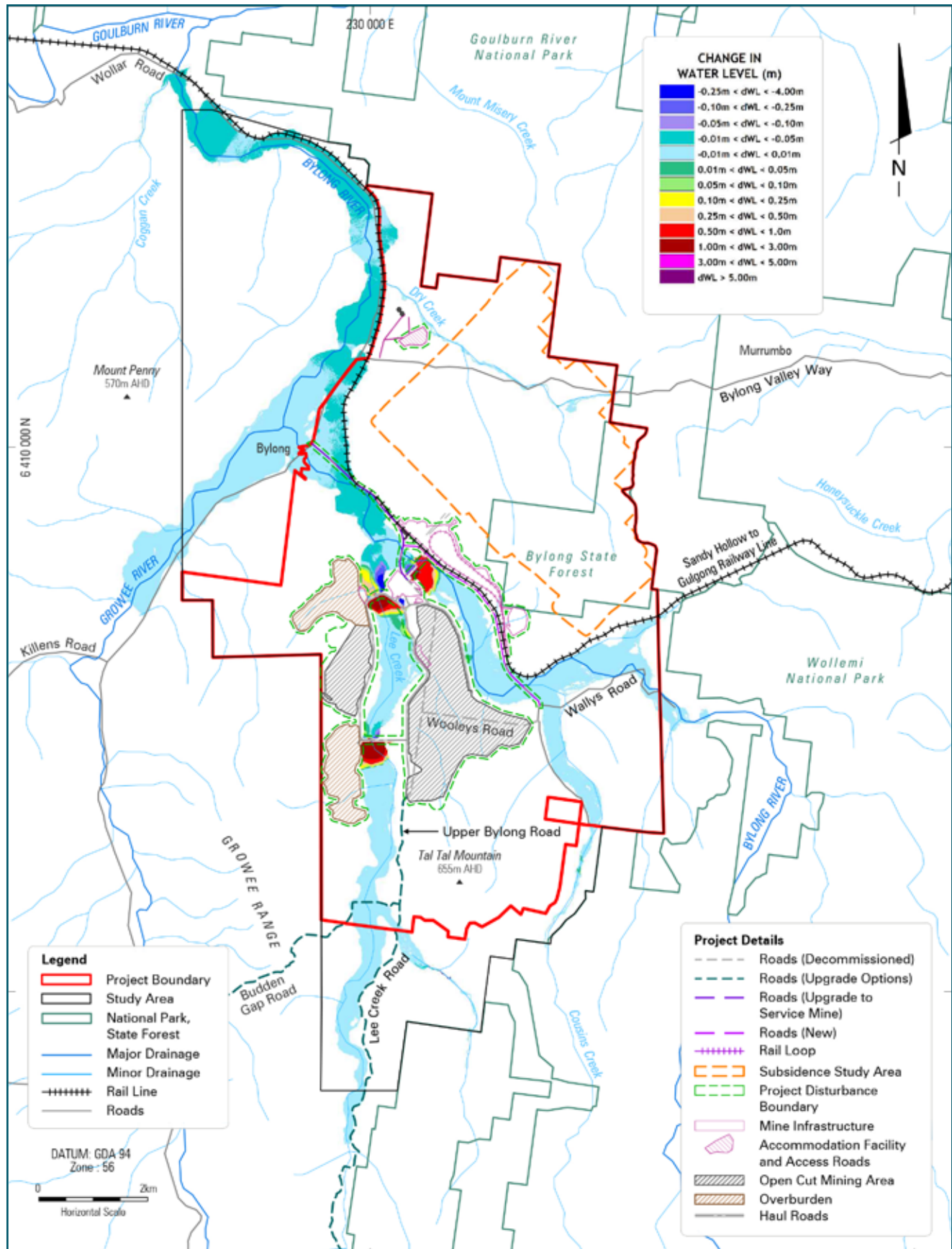
Appendix L provides further detail on the flood modelling methodology.

7.5.3 Impact Assessment

Bylong River

Figure 50 shows the extent of flooding and the flood depths for the 100 year ARI design flood in comparison with the relevant Project components. The inclusion of the proposed mine infrastructure was identified to result in isolated changes in water levels in the vicinity of the proposed haul roads and the overland conveyor embankment for all modelled design events. The increase in flood depth ranges from 1.0 m to 2.5 m immediately upstream during the 100 year ARI design event. Impacts on water levels from the haul roads and overland conveyor embankment which are proposed on the floodplain propagate approximately 0.5 km upstream of these structures during the 100 year ARI design event. The flood impacts would be confined to KEPCO owned land.

This predicted impact on existing flood levels was identified to be smaller for the 2 year and 50 year ARI design events. There is an increase in flood levels of between 1.0 m and 2.0 m and between 0.5 m and 1.0 m upstream of the structures in the 50 year and 2 year ARI design events, respectively.

FIGURE 50 100 Year ARI Change in Water Level in the Bylong River Catchment

The presence of the haul roads and overland conveyor embankment and associated service road (to be built at ground level) on the floodplain also results in an isolated change in velocity for all modelled design events. There is a decrease in velocity of between 0.2 m/s and 1.0 m/s upstream of these structures and isolated increases in velocity between 1.0 m/s and 2.0 m/s immediately downstream of the structures during the 100 year ARI design event. This increase in flow is the result of the concentration of flood flows occurring at the culvert outlets. The predicted impact to flood velocities is not as severe during the 2 year and 50 year ARI design events.

It should be noted that the flood modelling results presented are the final outcome of a number of model iterations resulting in amendments to the original design of Project infrastructure. The length of the overland conveyor embankment was adjusted from its original design in order to avoid adverse impacts to the Bylong River floodplain.

Dry Creek

Subsidence effects will generally result in lowering the elevations of flood levels along Dry Creek. This is because the water levels will drop with the land surface changes. Changes in water level typically reflect the change in ground elevations caused by the subsidence with a maximum reduction in water level of 3.0 m occurring along the main channel of Dry Creek during the 100 year ARI design event.

This difference is replicated in the 2 year and 50 year ARI design events. The predicted subsidence also results in isolated increases in water level where the channel capacity has reduced.

The predicted subsidence results in a change in stream velocity, in all design events, with some isolated increases located between the subsided longwall panels (i.e. in areas across the chain pillars). Flood velocities are typically reduced in the base of the subsided longwall panel as a result of reducing the gradient of the channel.

Predicted flood flows are typically contained within the channels of Dry Creek and its tributaries under post-subsidence conditions in a similar manner to existing conditions. The exception is a potential breakout of flow located along the western edge of the final subsided longwall panel (LW206) in the vicinity of Bylong Valley Way during the 50 year and 100 year ARI design events.

The predicted subsidence is shown to result in the flow of a tributary of Dry Creek breaking out of the existing channel and flowing in a north-easterly direction along the edge of the subsided longwall panel and across the Bylong Valley Way before flowing to the north towards the alignment of Dry Creek. The depth and velocity of the flow in this breakout are less than 0.25 m and 0.75 m/s, respectively, for both the 50 year and 100 year design events. **Figure 51** shows the 100 year ARI design event post subsidence conditions change in water levels in the Dry Creek catchment.

7.5.4 Mitigation and Management

Bylong River

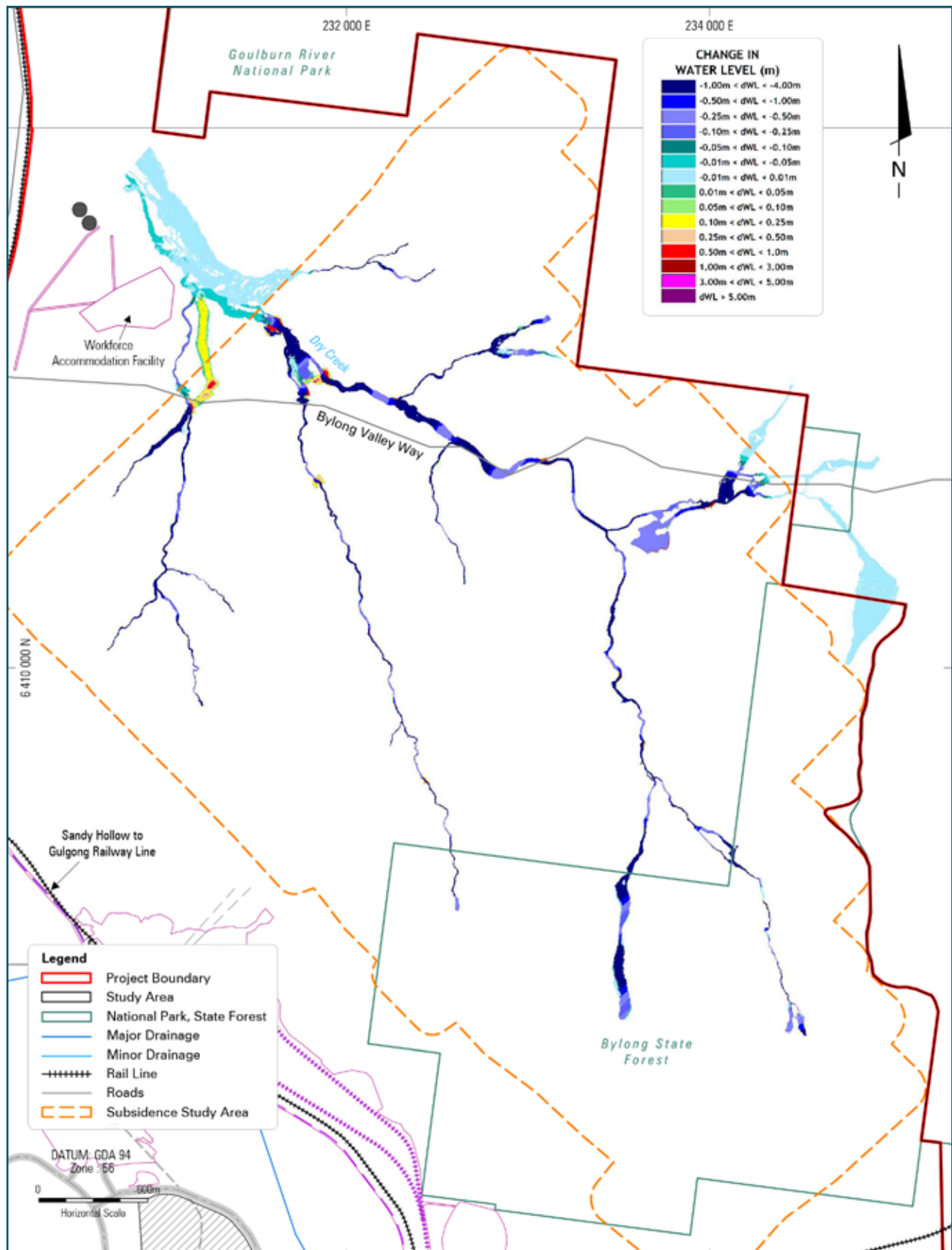
The key elements of the Project which impact flood behaviour are the two haul road crossings of Lee Creek and the overland conveyor embankment crossing of the Bylong River. Each of these structures results in local increases in upstream flood levels and an increase in the downstream velocities as a result of constraining flood flows. As for any waterway crossing structure, appropriate erosion control measures, such as rock protection, will be required to mitigate local velocity impacts.

The modelling results indicate that rock protection will be required downstream of the haul road culverts crossing Lee Creek and immediately adjacent to the downstream side of the overland conveyor embankment on the Bylong River floodplain to prevent erosion during flood events. The extent of required local erosion mitigation measures will be determined during the detailed infrastructure design phase.

The haul road crossings and overland conveyor embankment will be removed and rehabilitated at the completion of mining operations which will ensure that floodplain conditions post-mining will be similar to or better than existing conditions.

Dry Creek

At the predicted breakout location on the Dry Creek tributary, the modelling shows that the flows are confined to the main channel for the 2 year ARI design event. However, the floodwater is predicted to break out and drain along the surface expression of the longwall panel and cross the Bylong Valley Way. Minor drainage works will be undertaken within the tributary at this location to reduce the frequency of potential overflows. Given that the impacts on the flows are not expected to occur until the extraction of the final longwall panel (i.e. in PY 25), the indicative detailed design of these works will be undertaken at a later date in consultation with the HLLS prior to the mining of this longwall panel.

FIGURE 51 100 Year ARI Post Subsidence Change in Water Levels in the Dry Creek Catchment

The management strategy for Dry Creek and its tributaries will comprise monitoring the surface subsidence compared to the predicted levels and inspections for erosion and sedimentation along the drainage lines within the Subsidence Study Area. Regular visual inspections of the drainage lines will be undertaken throughout the underground mine life to assess changes in the condition of the streams during mining, with a particular focus on the areas that have been identified to be of higher risk of impact. Targeted management actions will be developed to respond to the observed impacts, ensuring that any intervention minimises surface disturbance.

As discussed in **Section 7.4.4**, a key component of management will be the revegetation of the riparian corridor of Dry Creek, with a focus on the rehabilitation of the stream to a condition equivalent to or better than existing using soft engineering techniques where possible. This will be undertaken in consultation with the HLLS.

7.6 GROUNDWATER

7.6.1 Background

A Groundwater Impact Assessment for the Project has been undertaken by Australasian Groundwater and Environmental Consultants (AGE). A summary of the Groundwater Impact Assessment is discussed in the following sections and is provided in full in **Appendix M**. The purpose of the Groundwater Impact Assessment was to:

- Characterise the existing groundwater sources, regimes and water users;
- Predict inflows into the open cut and underground mining areas throughout the life of the Project;
- Predict recovery in groundwater levels and water quality conditions post-mining;
- Assess the impacts of the Project on groundwater sources and water users, including the potential for depressurisation, water quality contamination and any cumulative effects; and
- Recommend measures to monitor, mitigate and manage impacts to the groundwater regime.

The relevant legislation, WSPs and the AIP are discussed in **Section 4.6**.

Previous Groundwater Investigations

The Project has been subjected to two levels of groundwater assessment in order to meet the relevant requirements of the NSW approvals process. The initial groundwater assessment addressed the requirements of the NSW Gateway Certificate Assessment process and considered the potential risks of the Project to nearby agricultural activities. The groundwater report included field investigations managed by Douglas Partners (DP) (2013b, 2014a and 2014b) to assess groundwater regime at the Project site. This preliminary work led to the development of a simple numerical groundwater flow model (AGE, 2013).

The Conditional Gateway Certificate issued on 15 April 2014 by the Gateway Panel for the Project states that "Significant impacts are anticipated on highly productive groundwater and the consequent connection between surface and groundwater in modelling requires more detailed evaluation".

With the above in mind, the Groundwater Impact Assessment prepared for this EIS represents a second far more detailed level of assessment involving further field investigations and the development of a sophisticated numerical model to assess (with improved confidence) the groundwater impacts associated with the Project. Further, the Groundwater Impact Assessment prepared for this EIS has specifically considered each of the recommendations in the Gateway Certificate issued in respect of the Project.

Field Investigation Program

KEPCO commenced the installation of a network of groundwater monitoring bores specific to the Project in early 2011. This groundwater monitoring network was developed as land access arrangements were reached and in concert with geological exploration activities.

DP began preliminary hydrogeological field investigations in December 2011. As part of the conditions of renewal of A287 and A342 in 2013, DP prepared a '*Preliminary Hydrogeological Assessment and Water Monitoring Plan*' (PHA&WMP) (Douglas Partners, 2013) which outlined a groundwater and surface water monitoring program to be undertaken throughout the exploration phase. Investigative work has included the following:

- Mapping the extent of alluvial and colluvial sediments based examination of stereo-pair photos and LiDAR survey data;
- Testing rock strata permeability with packers within coal exploration holes;
- Installing standpipe piezometers in exploration holes;

- Drilling, soil logging and installing twin nested standpipe piezometers in alluvium;
- Cone Penetrating Testing to confirm the extent and depth of alluvium at selected locations;
- Rising head hydraulic testing within installed standpipe piezometers;
- Automated logging of piezometric head and salinity in selected locations;
- Manual monitoring of piezometric levels;
- Multi-level pore water pressure measurements (piezometric levels) through Vibrating Wire Piezometer (VWP) installations;
- Surface water and groundwater sampling and chemical analyses at selected locations; and
- Automated logging of surface water flow velocity at three locations.

DP integrated the groundwater field investigation program with the coal resource drilling, resulting in the monitoring network being installed over several drilling campaigns. The monitoring bore network currently comprises:

- 43 bores screened within alluvium;
- 20 bores screened within the shallow hardrock zone; and
- 22 in the deep hardrock, including within the Coggan and Ulan Seams.

In addition to the monitoring bores there are 9 VWPs, which have automatic data loggers. The location of the groundwater monitoring bores and VWPs are shown on **Figure 17**.

Existing Groundwater System

The available data indicates the presence of the following hydrostatic units in the vicinity of the Project:

- Alluvium and colluvium;
- Weathered Permian bedrock;
- Tertiary basalt capping; and
- Permian coal seams.

A conceptual cross section of the groundwater systems within the vicinity of the Project is illustrated in **Figure 52**. The main source of recharge to the groundwater system is from rainfall infiltration through the soil zone during periods of prolonged rainfall that wets up the soil profile and allows water to drain to the water table.

Leakage from creeks and rivers into the underlying water table also provides a source of recharge to the groundwater system. Rainfall runoff from steeply sloping elevated areas also collects where slopes reduce allowing water to infiltrate through the colluvium and stream beds into the groundwater system. Due to the permeability and storage of the alluvial sediments, a larger volume of recharge occurs to the alluvium compared to the Permian Coal Measures and other consolidated and weathered formations. Each hydrostatic unit within the vicinity of the Project is discussed below.

Alluvium

The alluvium and colluvium occurs along the valley floors adjacent to the Bylong River, Growee River, Lee Creek and other minor tributaries of the Bylong Valley. Detailed mapping at a local scale was used to update the boundary of the alluvium as defined on the 1:100,000 Singleton Geological Sheet. The proposed open cut mining areas have been designed to remain more than 150 m from the alluvium. In general, the open cut mining areas are more than 180 m from the alluvium, 200 m from the Bylong River and 260 m from Lee Creek.

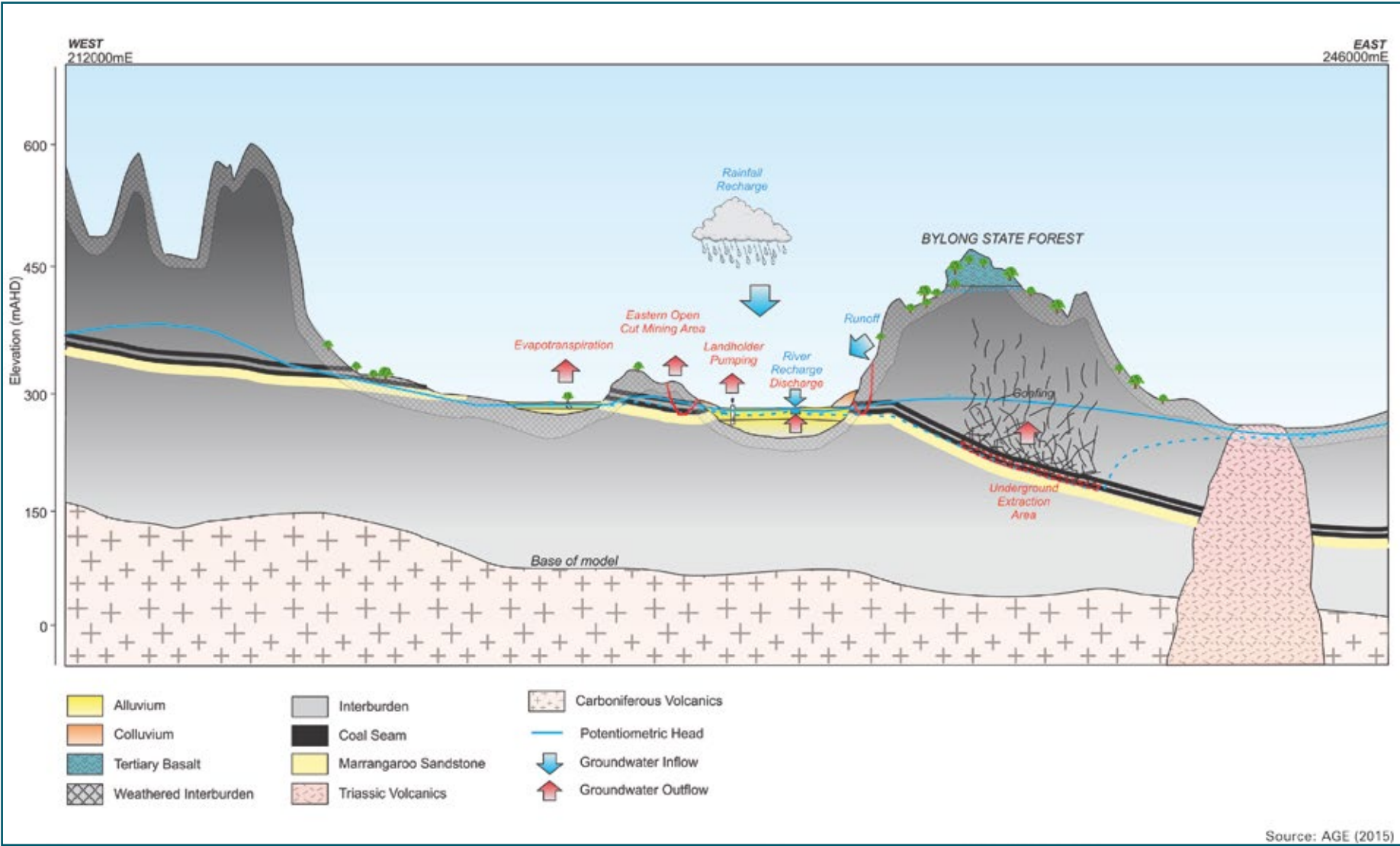
The alluvium is predominantly permeable sand and gravels and provides a groundwater source to the majority of registered bores within the Bylong River catchment. Investigative drilling has indicated that these sediments consist of an upper layer of sand/silt/clay overlying a basal layer of sand and gravel. Whilst the upper sediments in the alluvial sequence are commonly fine grained, groundwater levels respond rapidly to rainfall indicating recharge readily infiltrates the upper sequence.

Testing indicates alluvial sediments are typically less than 20 m in depth along the Bylong River floodplain. The transmissivity varies from high (in the thicker sequences of sand and gravel) to low (where shallow rock bars act as local barriers to groundwater flow). Hydraulic testing suggests that the hydraulic conductivity of the alluvium is generally moderate to high ranging from 0.04 m/day to 14 m/day. The basal gravelly sand reports the highest values.

The Bylong River is mapped and is considered to meet the definition of “*highly productive groundwater*”, being capable of supplying groundwater at a rate of greater than 5 Litres per second (L/s) in some areas with a salinity of less than 1,500 milligrams per litre (mg/L). This alluvial aquifer system has been identified to be relatively thin and is highly connected to the adjacent surface water systems.

No surface water is present in the lower reaches of the Growee River, suggesting the permeability of the alluvium is sufficient to allow all rainfall runoff to flow underground.

FIGURE 52 Conceptual Hydrogeology Schematic



Mapping published by NOW, which is based on regional scale geology maps, indicate the Dry Creek alluvium forms part of a highly productive groundwater source overlying the area where longwall mining is proposed. Exploration holes drilled in the Underground Extraction Area within the area mapped as “highly productive groundwater” indicate bedrock, being either basalt or sandstone typically occurs at between 5 m and 10 m below the ground surface. This is typically overlain by a mixture of weathered rock in a clayey matrix, with minor sands and gravels. The drilling results indicate that a thick and continuous interconnected sequence of alluvial sediments does not occur along this drainage line in the Underground Extraction Area.

Whilst no groundwater has been detected within the shallow Dry Creek alluvium, it is possible that a thin zone of perched water occurs ephemerally at the interface between the weathered rock/alluvium and the less permeable fresh unweathered rock along the alignment of Dry Creek. Any groundwater would be perched, fed by seepage through the creek when running, and not the regional water table.

The data indicates the alluvium along Dry Creek (in the vicinity of the Underground Extraction Area) does not meet the definition of highly productive groundwater.

The proposed open cut mining areas have been designed to be more than the 150 m from the alluvium as per the *Management of Stream/Aquifer Systems in Coal Mining Developments – Hunter Region* (DIPNR, 2005). Hydraulic testing suggests that the hydraulic conductivity of the alluvium is generally moderate to high ranging from 0.04 m/day to 14 m/day.

The regional direction of groundwater flow in the alluvial aquifer is from south to north.

The background water quality data shows the salinity has a similar range in the alluvium and Permian, and is slightly lower in the surface water. This reflects the hydraulic connectivity between the alluvium and Permian groundwater systems and the surface waters. Alluvial water samples ranges from relatively fresh (190 $\mu\text{S}/\text{cm}$) to brackish (3,100 $\mu\text{S}/\text{cm}$).

Weathered Permian Bedrock

The weathering of the Tertiary and Permian strata within the Project Boundary ranges from 5 m to 30 m below ground surface. This zone of weathering can act as a zone of enhanced permeability compared with the fresh unweathered rock.

Groundwater measurements have indicated that the weathered Permian above the proposed Underground Extraction Area is unsaturated. Weathered formations in elevated areas to the south-east of the Underground Extraction Area have also been found to be unsaturated. In the lower lying valley floor areas, the weathered zone rock that is adjacent to and underlying the alluvium is saturated.

This is of particular interest in the region between the proposed open cut mining areas and the alluvium associated with the Bylong River and Lee Creek where the weathered zone may yield groundwater directly to the open cut mining areas when excavated during mining. The potential for the weathered zone to act as a conduit for flow from the alluvium during mining appears high in the northern portion of proposed Eastern Open Cut and the eastern edge of the proposed Western Open Cut.

Tertiary Basalt Capping

A minor perched basalt groundwater system exists above the proposed Underground Extraction Area and overlies the less permeable Permian units. Data indicates the basalt forms a localised perched groundwater system in the elevated plateau areas where it is permeable. The basalt only appears saturated where it is thickest and at low points in the Permian paleosurface that the basalt unconformably overlies. Dry Creek also appears to contribute leakage to this minor system. The data indicates the basalt groundwater system is not extensive, or directly connected to the regional groundwater system.

Permian Coal Measures

The Permian Coal Measures form another distinct groundwater system within the Project Boundary. The Permian units occur in a regularly layered sequence across the Study Area and form a relatively low yield aquitard unit.

The Coggan and Ulan Seams are the main economic targets for mining. These also form the most permeable layers within the Permian strata. There are several coal seams overlying the Coggan and Ulan Seams which are unsaturated over most of the Project Boundary, but may contain groundwater at lower elevations below about 250 m AHD further to the north-east.

The sandstone, interbedded siltstone and claystone of the Permian interburden, overburden and unweathered overburden constitute lower permeability units and as such are considered to be aquitards. Packer testing was undertaken on selected exploration holes to provide an estimate of the hydraulic conductivity. Testing focused on the proposed underground mining area, within the overburden and multiple overlying coal seams from which the Coggan Seam will be mined. Rising head tests on piezometers within the Coggan Seam indicate that the hydraulic conductivity of the coal seams can be high compared to interburden and overburden. The Coggan Seam recorded the highest mean median hydraulic conductivity at 0.2 m/day, with the Ulan seam being much lower at 6×10^{-3} m/day.

EC for the Permian Coal Measures indicates fresh to brackish water quality ranging from 930 $\mu\text{S}/\text{cm}$ to 3,900 $\mu\text{S}/\text{cm}$. The salinity range for the Permian Coal Measures suggests connectivity with the alluvium.

The Permian groundwater resource in this area does not meet the definition of highly productive groundwater.

Existing Users

The report card for the Bylong River water source under the Hunter Unregulated WSP indicates the area has a total water entitlement of 5,843 ML/Year (100% used for irrigation purposes). There are 23 groundwater licences and two surface water licences within the water source. Groundwater is primarily extracted from the alluvium for agricultural purposes.

As at 1 June 2015, KEPCO held eight WALs providing 2,535 units (or ML/Year) of water allocation for the Bylong River water source for a combination of agricultural and industrial purposes. The locations of existing water bores were surveyed on properties owned by KEPCO and surrounding private landholders where access was possible. The survey confirmed the locations of bores and wells and provided coordinates for measuring drawdown within the groundwater model.

The survey identified 84 bores or wells comprising:

- Nine bores;
- Two government monitoring bores;
- 69 wells; and
- Four sites unable to be identified.

7.6.2 Methodology

Data Review

A desktop assessment was undertaken to review data collected as part of the field investigation program and previous hydrogeological investigations, as described above. The information acquired from the desktop assessment was considered as inputs in the development of the groundwater model.

Predictive Groundwater Model

A three-dimensional groundwater flow model (MODFLOW SURFACT) was used to simulate the Project's impacts on the groundwater regime over time. The model was constructed in accordance with the approach recommended in the *Australian Groundwater Modelling Guidelines* (Barnett *et al*, 2012) as required by the AIP. The model includes the current understanding of the interactions between the aquifers within the Project Boundary and the regional groundwater system. Ten layers represented the hydrostratigraphic units within the Project Boundary.

The model grid was 33 km in width (east to west) and 39 km in length (north to south). The boundaries were set at 10 km to 11 km from the proposed mining areas, to prevent no flow cells influencing the predictions. The model adopted a cell size of 500 m x 500 m, which was refined to 50 m x 50 m within the proposed mining areas. The cells within the transition zone were each 1.5 times larger than the size of the neighbouring cells. The model comprised a total of 1,164,000 cells.

The groundwater model was calibrated to both steady state and transient conditions to ensure the seasonal response to rainfall, surface water flow and irrigation pumping was represented. The steady state model was calibrated by adjusting aquifer parameters and stresses to produce the best match between the observed and simulated water levels.

The steady state calibration utilised 94 bores, consisting of:

- 23 bores from the NOW PINNENA database, which are predominantly screened in the Quaternary alluvium; and
- 71 monitoring bores and vibrating wire piezometers from the Study Area, which provided data on the Quaternary alluvium, weathered Permian, interburden and coal seam water levels.

A more detailed transient calibration to time series water level measurements reproduced the transient water level fluctuations measured in the monitoring bore network installed for the Project. The calibration of the model followed the objectives set out in the *Australian Groundwater Modelling Guidelines* (Barnett *et al*, 2012). The objective of the transient calibration of the model was to replicate the seasonal fluctuations observed in the groundwater level and surface water monitoring data collected between 2011 and 2014. Time was discretised into 412 stress periods and two day time steps.

The transient model was calibrated by adjusting parameters across the entire domain in collaboration with the steady state model to ensure the models and budgets were consistent. Rainfall, river stage heights and landholder pumping varied every two days based on observed or synthesised data. The calibrated parameters adjusted in the transient calibration were:

- Horizontal and vertical hydraulic conductivity;
- Specific yield;
- Specific storage;
- Diffuse recharge rates to geological units;
- Recharge rates in irrigation areas; and
- Vertical hydraulic conductivity of river beds.

Both models were then manually adjusted following the automated Parameter Estimating Tool (PEST) calibration to ensure baseflow measured at surface water gauges was replicated by the model.

The model simulated make-up water for the Project as being obtained from the alluvial aquifer system through the development of a new borefield. The proposed borefield consists of up to 15 shallow bores as indicated on **Figure 18**. These proposed bores are sited close to the proposed CHPP to reduce potential impacts on private bores and reduce the necessity for a more extensive water reticulation network across the Project site.

Sensitivity Analysis

A sensitivity analysis was carried out to demonstrate the response of the groundwater model to input parameters. The objective of the sensitivity analysis was to rank the input parameters in terms of their influence on the predicted results.

A sensitivity analysis was also undertaken on the unsaturated zone method and parameters to specifically address queries that have been raised in the assessment processes of other recent mining related applications.

The results showed that changes to the hydraulic conductivity in the saturated zone had the largest impact on the Bylong River alluvium. The model was also sensitive to changes in storage (both saturated and unsaturated), which increased the maximum predicted groundwater seepage into the underground mining area by almost two times compared to the base case. The results indicated that the base case model is a conservative tool for assessing the impacts of the Project from the open cut mining area during the mine life.

In contrast, more extreme impacts were predicted for the underground mining area when the vadose zone properties were changed compared to the base case.

Appendix M presents further information on the sensitivity analyses completed on the groundwater model.

Uncertainty Analysis

The uncertainty in the model predictions was assessed using a traditional sensitivity analysis where model inputs were changed individually to assess the impact upon the predictions. A more complex Monte Carlo style uncertainty analysis was also undertaken where numerous model inputs were changed at the same time.

Appendix M presents further information on the uncertainty analyses completed on the groundwater model.

Independent Peer Review

An independent peer review of the Groundwater Impact Assessment and associated groundwater modelling was undertaken by Dr Noel Merrick of HydroSimulations. Dr Merrick is a groundwater modeller, hydrogeologist and geophysicist with 40 years' experience in groundwater modelling, management and policy development. A copy of the peer review report is provided in **Appendix N**.

The independent peer review assessed the groundwater model against the criteria in the *Australian Groundwater Modelling Guidelines 2012* and the *Murray Darling Basin Commission Groundwater Flow Modelling Guideline 2000*.

The peer review examined the content of the Groundwater Impact Assessment with a key focus on the model design, calibration, verification, predictions, sensitivity and uncertainty analyses. Outcomes from the staged peer review process were addressed throughout the preparation of the assessment.

7.6.3 Impact Assessment

The groundwater model simulated the existing groundwater conditions and provided predictions of the potential changes in the local and regional groundwater regimes as a result of the future open cut and underground mining activities. These predictions are discussed in the following sections.

Mining Area Seepage

It is predicted that groundwater seepage will vary throughout the various stages of the Project life in relation to the mining depths, the mining method and the hydraulic gradients induced by depressurisation within and surrounding the mining areas.

The groundwater model predicts the seepage rates into the two open cut mining areas from the Permian being less than 360 ML/Year (< 1 ML/day). Groundwater inflows into the Western Open Cut Mining Area are predicted to decrease to zero at PY 7, as mining activities in this area advance up-dip and occur at a higher elevation than the regional groundwater levels.

The eight years of open cut mining operations is predicted to result in an average water take from the Permian coal measures of 138 ML/Year, peaking at a maximum of 354 ML/Year in PY 9.

Following the completion of open cut mining activities, groundwater continues to seep into the coarse/fine rejects areas remaining in the Eastern Open Cut Mining Area as water levels stabilise. This seepage volume reduces over the remaining mine life as hydraulic gradients equilibrate around the Eastern Open Cut.

Groundwater inflows to the longwall panels, main headings and drift are predicted to be higher than those for the open cut mining areas due to the larger footprint, hydraulic gradients above the mining area and the effects of fracturing of the strata above the longwall panels. The predicted groundwater seepage from the Permian coal measures averages 1,248 ML/Year throughout the 19 years of underground mining operations with a peak during PY 18 at a maximum of 2,093 ML/Year.

These predicted seepage rates represent the total groundwater loss from the groundwater systems and does not represent the water readily available for use in the water management system. In reality, evaporation from the exposed coal faces within the open cut mining areas will remove a proportion of this groundwater seepage. Similarly, various losses will occur to seepage in underground mining areas as a result of moisture removed with ROM coal, ventilation and water entrained within the mining goaf. The appropriate adjustments have been made to provide the readily available groundwater seepages for use within the mine water balance as discussed in **Section 7.4.3**.

Changes in Potentiometric Surface/Water Table Levels

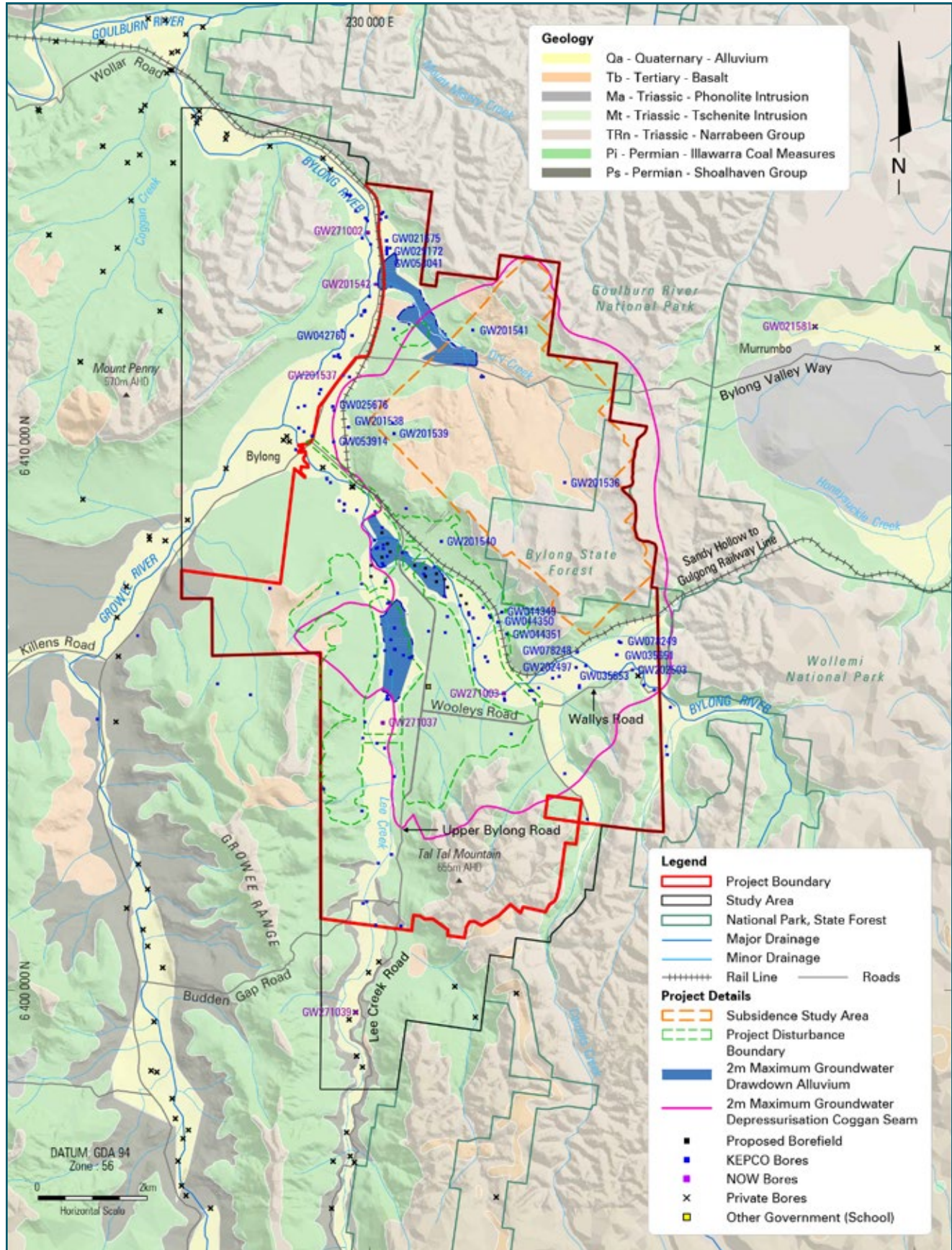
The proposed open cut and underground mining activities are predicted to result in a reduction in the potentiometric surface and water levels in surrounding aquifers. The extent of the zone affected is dependent on the hydraulic properties of the aquifers/aquitards. The zone of depressurisation is defined as the changes to the potentiometric surface within a confined aquifer, such as the Permian coal seams. The zone of drawdown refers to the changes in water table levels within an unconfined aquifer such as the alluvial aquifer. The predicted impacts to these zones are discussed in the following sections.

Permian Depressurisation

The open cut and underground mining operations are predicted to depressurise the groundwater in the coal seam in a zone that extends to a maximum of 2.3 km from the proposed open cut mining areas (refer to **Figure 53**).

The predicted depressurisation in the coal seam extends up to 2.4 km from the longwall panels, but is generally restricted to less than 1.0 km to the north of Underground Extraction Area. This is due to the reduced hydraulic conductivity of the coal seams with depth. The maximum drawdown within the mined footprint occurs as the longwall passes through the area, but outside the mined footprint the maximum depressurisation occurs around 5 to 10 years following mining.

In the absence of mining, the groundwater model predicts a net upward flow from the underlying Permian bedrock to the alluvial aquifers at rates of between 1.1 ML/day and 8.5 ML/day across the whole model domain.

FIGURE 53 Maximum Predicted Groundwater Drawdown in the Alluvium and Depressurisation in the Permian (Coggan Seam)

Whilst this flow from the Permian occurs through the base of the alluvium, it is considered recharge to the alluvium and is part of the alluvial system water budget. Within the zone of depressurisation, upward flow from the Permian to the alluvium is predicted to reduce. This is due to changes in hydraulic gradients between the alluvium and Permian that reduce the rate of upward flow, and in some areas adjacent to the proposed mining areas will reverse the flow to downward flow.

Alluvial Drawdown

Drawdown in the alluvium is dependent on proximity to the open cut and underground mining areas and borefield. The modelling indicates the proposed mining induces drawdown in the alluvium during the first eight operational years of the Project life when open cut mining is active. Beyond PY 10, pumping demands from the borefield reduces and the zone of drawdown begins to retract with the groundwater levels in the alluvium gradually recovering.

When open cut mining operations are completed, the temporary void remaining within the Eastern Open Cut is divided into two compartments for storage of coarse and fine reject materials and mine water. One of these compartments will be gradually filled with coarse and fine reject material from the processing of underground ROM coal for the remainder of the mine life.

The modelling indicates the backfilled mined area in the Eastern Open Cut Mining Area is slow to fill with groundwater, and there is a gradual drainage of groundwater from the alluvium into the backfilled mining area. Despite the slow recovery of groundwater levels within the backfilled open cut mining area, the adjacent alluvium still recovers due to the recharge rate on the floodplain and subsurface flow from upstream exceeding the rate of drainage of groundwater into the backfilled mining area. The temporary void remaining within the Eastern Open Cut at the end of open cut mining operations has a relatively small footprint and therefore does not have a significant influence on the recovery of groundwater levels within the alluvium.

The underground mining activities depressurise the overlying strata, inducing steeper hydraulic gradients between the alluvium and Permian. This results in groundwater drawdown within the alluvium to the north-west of the underground mining area by PY 22.

Figure 53 illustrates that drawdown within the alluvium extends approximately 1 km from the Eastern Open Cut Mining Area. In contrast, the drawdown extends some 2.3 km from the northern limit of the Underground Extraction Area but influences only the very fringes of the alluvial aquifers. Drawdown due to extraction from the borefield proposed for make-up water is less than 0.5 km around each pumping bore. However, groundwater levels are generally reduced by 5 m to 9 m close to the borefield.

Maximum drawdown within the Bylong River alluvium occurs at PY 10, which coincides with the final year of mining within the Eastern Open Cut Mining area. Drawdown in the Lee Creek alluvium will gradually move upstream with the majority of the drawdown occurring in response to open cut mining activities.

Some drawdown is also predicted to occur within the alluvial aquifers after open cut mining operations are completed. This is due to water levels in the open cut mining areas slowly drawing water from the alluvium whilst the system reaches a new equilibrium water level. Maximum drawdown in the Dry Creek alluvium occurs at PY 25 as the underground mining operations progressively depressurise the strata overlying the longwall panels. The drawdown in Bylong River alluvium downstream of the open cut mining areas and adjacent the Underground Extraction Area is most extensive in PY 25, when the longwall mine is fully developed.

Alluvial Water Take

The predicted water take from the alluvial groundwater systems due to mining operations averages 153 ML/Year throughout the 25 years of the Project, peaking at 295 ML/Year in PY 25. A total of 3,829 ML is anticipated to be intercepted from the alluvium by depressurisation due to mining throughout the 25 years of the Project.

Additional to this, the Project proposes to extract water from a borefield constructed within the alluvium. For the purposes of groundwater modelling, the borefield water demand for extreme dry conditions (i.e. 1 percent chance of exceedance) was utilised from the water balance model (as discussed in **Section 7.4.3**). The groundwater modelling indicates up to approximately 15 bores will be required to operate to supply the make-up water from PYs 3 to 8 when the requirement peaks at 1,172 ML/Year. The demand for make-up water is anticipated to reduce when the underground mine development commences and therefore only eight bores will be required to operate from PYs 9 to 11. As underground mining ramps up, the model indicates the seepage rates into the underground mine will increase and therefore only two bores extracting between 55 to 85 ML/Year will be required to supply make-up water for the remainder of the Project life.

As at 1 June 2015, KEPCO had secured 2,535 units (equivalent to 2,535 ML/Year) of WALs for the Bylong River Water Source under the Hunter Unregulated WSP. These WALs are more than sufficient to license the predicted direct and indirect take of water from the alluvium as discussed above. There is also the potential to obtain additional water licences if KEPCO acquires other properties within the Study Area.

Reduction in Baseflow to Creeks/River

Modelling indicates the impact of mining on the alluvium subsequently leads to reduced baseflows from the alluvium to Lee Creek and the Bylong River. No measurable impacts are predicted to occur to the baseflow in Growee River, because it is more distant from the proposed mining operations. Similarly, there is no predicted impact to the baseflows to Goulburn River as the maximum extent of depressurisation does not extend close to the Goulburn River.

The modelling results indicate that the reduction in baseflows to the Bylong River occur consistently throughout the Project in the period when the borefield is operating. During the period of open cut mining operation, the baseflow to the Bylong River reduces by up to 918 ML/Year.

Once the open cut mining is completed and the make-up water requirements from the borefield reduce, the model indicates the net loss of baseflow to the Bylong River reduces to less than 150 ML/Year. A second smaller peak in baseflow loss occurs at PY 25 (205 ML/Year) as the longwall panels move closer to the Bylong River.

The net change in Bylong River baseflow is due to a combination of the reduced baseflow from the underlying alluvium to surface water and (vice versa) the increased rate of leakage of surface water to the alluvial aquifer. In the area around the borefield, the drawdown induces leakage from the surface into the aquifer, particularly during PYs 3 to 8 when the demand for make-up water is highest.

Depending on climatic conditions during PYs 5 to 10 of the Project, there is the potential for a detectable change in flow within the Bylong River and a change to the flow duration. The model predicts baseflow to Lee Creek reduces by up to 103 ML/Year, and averages 51 ML/Year over the Project life. Further detail on impacts to surface waters is provided in **Section 7.4**.

Dry Creek Inflows

The potential height of connected fracturing induced above the longwall panels could extend to a maximum of 260 m above the roof of the longwall mine (SCT, 2015). This means that fracturing could extend to the land surface over a large proportion of the Underground Extraction Area.

The groundwater modelling indicates that the volume of water flowing from Dry Creek into the underground longwall mine will be relatively low (<0.2 ML/day), compared to predicted inflow from the wider groundwater systems (average 1,248 ML/Year). The surface water impact assessment (see **Section 7.4**) indicates that surface water flows within the Dry Creek catchment are ephemeral and short term in nature and are unlikely to flow for longer than 1-2 days. This suggests that the groundwater model conservatively estimates the possible inflows of surface water to the underground mining area. It should be noted that the groundwater model does not simulate the natural infilling of subsidence cracks with time and assumes a perfect connection through the fractured zone, which is considered highly conservative. The loss of surface water from Dry Creek is therefore considered negligible.

Impacts on Existing Groundwater Users

Private Bores

There are no bores on privately owned land where the drawdown is predicted by the groundwater model to be greater than 0.1 m at any time throughout the life of the Project. A number of bores located on KEPCO owned land are present within the zone of drawdown around the mining area. The AIPs "*minimal impact considerations*" specify a maximum of a 2 m decline cumulatively at any water supply work. Drawdown of less than 1 m is generally considered undetectable, given the seasonal variation of water levels in the area.

Changes to Water Quality

It is proposed to emplace coarse and fine reject materials into the Western and Eastern Open Cut Mining Areas during the years of open cut mining operations. Additionally, reject materials generated during the underground mining operations will be emplaced within the void within the Eastern Open Cut Mining Area. A water and salinity balance has indicated that post-mining, pore water from the backfilled overburden and coarse and fine rejects will seep into the alluvial aquifer and there is potential for a small increase in salinity within the alluvium and the connected surface waters of Bylong River and Lee Creek. Despite the potential for an increase in salinity within the alluvium, the salinity balance suggests the environmental value and beneficial use of the water within the alluvium and connected surface water system will not change due to the Project.

Impacts to Groundwater Dependent Ecosystems

The majority of the vegetation to be retained within and immediately adjacent to the Project Boundary is located in areas where the depth to groundwater is greater than 50 m. The exceptions include the lower lying areas of the Project Boundary along Bylong River, Lee Creek and Growee River floodplains and sections of the Dry Creek catchment.

The Hunter Unregulated WSP does not list any high priority GDEs which occur within the Project Boundary. The Ecological Impact Assessment (as discussed in **Section 7.2**) identified three potential GDEs along the thin riparian zones along Lee Creek, Bylong River and Dry Creek:

- Blakely's River Red Gum / Apple Riparian Forest occurring along the lower to mid reaches of Dry Creek, and also in remnants along Lee Creek and Bylong River;
- Blakely's Red Gum / Paperbark Forest isolated on a plateau within the headwaters of Dry Creek; and

- River Oak/Redgum Riparian woodland, with the largest stand occurring at the confluence of Growee River and the Bylong River.

Groundwater modelling indicates that the predicted drawdown in surface aquifers at most of the potential GDE sites is generally less than 2 m. Drawdown greater than 2 m is predicted by the model adjacent to the Eastern Open Cut (Blakely's Red Gum), in the lower reaches of Dry Creek (Blakely's Red Gum) and in the area adjacent to the proposed borefield pumping (River Oak).

All of these sites occur immediately adjacent to surface water courses and are likely to partially rely on the surface water. **Section 7.2.4** provides further discussion on the possible effects of groundwater impacts to ecology.

EcoLogical Australia Pty Ltd conducted a stygofauna impact assessment for the Project, a summary of which is provided in **Section 7.19**. No material impacts on stygofauna are anticipated as a result of the Project.

Post-Mining Surplus Water Management

A compartment within the void of the Eastern Open Cut Mining Area will be used to store any excess water removed from the underground mine for use within the water management system. The Surface Water Impact Assessment (as discussed in **Section 7.4**) has estimated that under extreme wet conditions, up to 2,542 ML of excess water will be stored within this compartment at the end of underground mining activities.

In the circumstance where no approvals are sought for further mining, it is proposed that the excess water remaining within the void at the end of the mine life will be pumped into the underground mining area to facilitate the final rehabilitation of the open cut mining landform.

The groundwater model simulated the reinjection of excess water into the groundwater system post-mining. The water was pumped into the underground mine at two points in the north-western section of the main headings. This was adjacent to the last panels to be mined, allowing the excess water to flood the abandoned workings. The model simulated the reinjection at a constant rate of some 7 ML/day to the Coggan Seam for a period of one year.

Post-Mining Recovery of Groundwater Levels

At the cessation of mining, there will be a relatively steep hydraulic gradient between the underground mine and surrounding aquifers, which will result in relatively rapid seepages. As the underground mining area slowly floods, the hydraulic gradient reduces and the rate of groundwater inflow will slow. Eventually, steady state equilibrium will occur where inputs are balanced by outputs and the water levels will stabilise.

The rate of recovery of groundwater levels in the aquifers will depend on rainfall. Years of below average rainfall will likely extend the recovery period with above average rainfall resulting in a reduced time for reaching equilibrium. Following the final rehabilitation of the open cut mining areas, there will be no final void, so there will be no permanent loss of water after the groundwater system reaches equilibrium.

Post-mining impacts were investigated with a recovery model, commencing from the end of mining and run for 1,000 years. The recovery model indicates mining results in a permanent change in shape of the water table surface, with water levels generally mounding within the spoil areas due to the change in hydraulic properties and recharge rates. The results indicate a decrease in water levels above the mined longwall area, which is the result of changes to the hydraulic conductivity in the goafed zone. The permanent drawdown in water levels is largely confined to the footprint of the Underground Extraction Area.

Modelling indicates the groundwater system essentially reaches equilibrium within 100 years of mining ceasing. Beyond 100 years there is a marginal increase (5 ML/Year) in the flow from the Permian aquifer to the alluvium due to enhanced recharge through the overburden materials.

Cumulative Impacts

Other existing mines within the Western Coalfield such as Moolarben Mine, Wilpinjong Mine and Ulan Mine are located well beyond the predicted zone of influence generated by the mining and as a consequence, there are unlikely to be any cumulative impacts on groundwater.

Aquifer Interference Policy

The AIP requires proponents to hold water licences to account for all water taken from groundwater and surface water sources as a result of the Project. **Section 7.6.4** summarises the predicted water take due to the Project and describes the water licences for the Project.

There are two levels of minimal impact considerations specified in the AIP. If the predicted impacts are less than the Level 1 minimal impact considerations, then these impacts will be considered as acceptable. Where the predicted impacts are greater than the Level 1 minimal impact considerations then the AIP requires additional studies to fully assess these predicted impacts. If this assessment shows that the predicted impacts do not prevent the long term viability of the relevant water-dependent assets, then the impacts will be considered to be acceptable.

The “*minimal impact considerations*” for the Project are discussed below:

- **AIP Requirement** - For both highly and less productive groundwater sources, changes in pressures and water tables due to the Project should not induce a decline of more than 2 m at any water supply work (i.e. a privately owned bore or well):
 - KEPCO has secured a large landholding surrounding the mine and substantial volume of water entitlements for the Bylong River water source. This creates an extensive buffer around the Project, meaning that impacts on private users are unlikely. There are no bores on privately owned land where the drawdown is predicted by the numerical model to be greater than 0.1 m at any time throughout the life of the Project.
 - There are no high priority GDEs or high priority culturally significant sites listed in the Hunter Unregulated WSP located within the zone of depressurisation and therefore the criteria set out in the AIP for GDEs and culturally significant sites have been satisfied.
- **AIP Requirement** - The AIP minimal impact considerations protect water quality by requiring “*any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40m from the activity*”.
 - The salinity balance indicates the potential for a slight increase in salinity post-mining, but it is not of sufficient magnitude to affect the environmental value and beneficial use of the water within the alluvium and interconnected surface waters as a result of the Project.

- **AIP Requirement** - The AIP requires “no increase of more than 1% per activity in the long term average salinity in a highly connected surface water source at the nearest point to the activity”.

- Throughout the life of Project, groundwater will flow into the mining areas and water will be managed within the mine water management system. Accordingly, it is not anticipated that there will be any changes to the surface waters as a result of the Project throughout the mine life. The pools in the Bylong River adjacent to and north of the proposed open cut mining areas are considered the most sensitive to the predicted seepage given the flow paths predicted post-mining. In these areas, there is potential for an increase in salinity of 12% within the alluvium and the connected surface waters of Bylong River and Lee Creek when no rainfall runoff occurs. Despite this potential, the salinity balance suggests the environmental value, and beneficial use of the water within the alluvium and interconnected surface water would not change due to the Project.
- The surface water impact assessment concluded the total salt load (surface runoff plus baseflow) could increase by about 1%. A 1% change in salinity is considered to be well within the range for natural variation, based on the data that has been collected within the system to date.

- **AIP Requirement** - The AIP provides set back distances for mining activities from a highly connected water source that is defined as a reliable water supply. The AIP states “no mining activity to be below the ground surface within 200m laterally from the top of high bank or 100m vertically beneath (or the three dimensional extent of the alluvial water source – whichever is the lesser distance) of a highly connected surface water source that is defined as a reliable water supply.”

- The proposed open cut and underground mining footprints complies with this requirement.

- **AIP Requirement** - The AIP also limits the amount of alluvial material that can be excavated by an activity by requiring “not more than 10% cumulatively of the three dimensional extent of the alluvial material in this water source to be excavated by mining activities...”

- No mining of alluvial material is proposed and therefore the Project complies with this requirement.

Non-Discretionary Development Standards for Mining

Clause 12AB of the SEPP Mining provides various non-discretionary development standards for mining that if complied with, prevents the consent authority from requiring more onerous standards for those matters. Specific to groundwater, Clause 12AB (7) states:

“Any interference with an aquifer caused by the development does not exceed the respective water table, water pressure and water quality requirements specified for item 1 in columns 2, 3 and 4 of Table 1 of the Aquifer Interference Policy for each relevant water source listed in column 1 of that Table.

Note. The taking of water from all water sources must be authorised by way of licences or exemptions under the relevant water legislation.”

Predictive modelling indicates that the requirements of 12AB (7) of the SEPP Mining may not be complied with in the Bylong River Water Source in the longer term in the absence of appropriate mitigation measures. Native vegetation protection and restoration over extensive areas within the catchment of the Bylong River Water Source is proposed to mitigate any such effects (see **Section 7.3**).

Peer Review

A Peer Review of the Groundwater Impact Assessment was undertaken by Heritage Computing in accordance with the Murray-Darling Basin Commission’s (MDBC’s) *Flow Modelling Guideline* (MDBC, 2001) and the *Australian Groundwater Modelling Guidelines* (Barnett, et al, 2012). A copy of the Peer Review report is provided in **Appendix N**.

The Peer Review concluded that the “model underpinning the groundwater assessment is ‘fit for purpose’, where the primary purpose of the model is the prediction of environmental impacts in the context of the Aquifer Interference Policy, and estimation of water takes for licensing. A very thorough analysis of the uncertainty in the estimates has been conducted.”

7.6.4 Mitigation and Management

A Water Management Plan will be prepared to outline the program of monitoring required to validate the predictions of the EIS and groundwater modelling. The Water Management Plan will ensure that the predicted impacts to water resources are appropriately monitored, validated, recorded and licenced throughout the life of the Project. The Water Management Plan will be prepared in consideration of the following mitigation, management and monitoring measures below.

Monitoring Program

The existing groundwater monitoring network will continue to be utilised to monitor water depths, pressures and qualities. Additional monitoring bores will be progressively installed (where required) within the predicted zone of depressurisation to monitor the regional groundwater regime and to provide for comparison against the modelling predictions. Monitoring of water levels and flows from key private bores within, and adjacent to the zone of depressurisation will also be considered.

The Water Management Plan and the locations for additional monitoring sites (if required) will be developed in consultation with NOW. Trigger levels will be established within the monitoring program to identify trends departing from historical or predicted values.

The Water Management Plan will also consider the optimal sites for monitoring of groundwater quality and water levels during the life of the Project. Yearly audits of the performance of the monitoring network will be included as part of the Annual Review.

Mine Water Seepage

Monitoring of mine water seepage will be undertaken, particularly to identify seepage rates and quality. The seepage monitoring program will be described within the Water Management Plan and will comprise:

- Recording of the time, location and estimated volume of any unexpected increased groundwater outflow from the highwall, endwall, of the open cut mines, or underground mine;
- Measurement of water pumped into and out of the mining areas using flow meters or other suitable gauging apparatus;
- Monitoring quality of water pumped from the mining areas (same analytical suite as groundwater);

- Correlation of rainfall records (and catchments) with mining area seepage records so groundwater and surface water can be separated; and
- Monitoring of coal moisture content and underground mine ventilation.

Borefield Design and Layout

The proposed borefield requires high volumes of water to be extracted from a relatively thin aquifer system. The groundwater model assumes a component of this water is derived from a consistent surface water influx. Sensitivity analysis of the possible climatic scenarios concluded that the proposed borefield will not be able to meet the Project requirements if extraordinarily dry periods coincide with high water volume requirements. In such an event it would be necessary to either seek approval to expand the borefield or modify mining operations to reduce water demand.

A testing program is proposed prior to the construction of the borefield to determine an optimal design for the borefield that will minimise impacts on the aquifers and streams. This will likely include test pumping bores and modelling to optimise the bore locations.

Management of Existing Groundwater Users

There are no bores on privately owned land where the drawdown is predicted by the numerical model to be greater than 0.1 m at any time. Should monitoring indicate the changes in groundwater levels and quality, and surface water flow and quality are more extensive or significant than predicted at any privately owned bore, mitigation measures will be considered.

Water Licensing

KEPCO will seek an appropriate water licence under the Water Act for its predicted water takes from the Permian units as shown in **Table 50**.

KEPCO has secured 2,535 units of water allocation from the Bylong Water Source under the Hunter Unregulated WSP. KEPCO may also secure additional water allocations from the Bylong River water source as the Project progresses, if necessary.

KEPCO holds entitlements to account for its groundwater take from the Bylong River Water Source even if the available water determination (AWD) reduces to less than 80%.

TABLE 50 Project Water Licensing Requirements

Geological Unit	Source of Water Take	Licence Regime	Average Take (ML/Year)	Maximum Take (ML/Year)
Permian	Open cut	Water Act	138	354
Permian	Underground	Water Act	1,248	2,093
Total at Any One Year	Project	Water Act	1,200	2,109
Quaternary alluvium	Borefield	WM Act	338	1,172
Quaternary alluvium	Reduced flow from Permian	WM Act	153	295
Total at Any One Year	Project	WM Act	491	1,149

7.7 AIR QUALITY

7.7.1 Background

An Air Quality and Greenhouse Gas Impact Assessment was undertaken for the Project by Pacific Environment Limited (PEL) and is presented in **Appendix O**. The purpose of the assessment was to quantitatively predict and assess the air quality impacts at receivers in the vicinity of the Project and to recommend measures to account for and manage any potential impacts above the applicable criteria. The assessment comprised of an evaluation of potential air quality impacts of the Project in accordance with the SEARs, including:

- Consideration of meteorological and climatic conditions and the existing air quality conditions within the region;
- Application of the relevant air quality criteria to the Project;
- Prediction of the annual dust emissions for selected future years, representing key stages over the life of the Project;
- Prediction of dust dispersion patterns due to emissions from the Project and cumulative impacts from other sources in the region;
- An assessment of the predicted dust concentration and deposition levels with air quality criteria relevant to the Project;
- Prediction of blast fume emission patterns due to emissions from the Project;
- Prediction of dust dispersion patterns from rail transport for the Project;

- Prediction of diesel emissions resulting from the Project; and
- Recommended management and mitigation measures to be implemented for the Project.

The greenhouse gas impact assessment for the Project is discussed separately in **Section 7.8**.

Air quality modelling for the assessment was carried out in accordance with the '*Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*' (Approved Methods) (DEC, 2005). The Approved Methods is referred to within the SEARs for the Project and are the most contemporary guidelines in NSW for the modelling and assessment of air pollution sources using dispersion models.

Jacobs Group (Australia) Pty Limited (Jacobs) was engaged to complete an independent peer review of the Air Quality and Greenhouse Gas Impact Assessment. The Peer Review was completed throughout the preparation of the Air Quality and greenhouse Gas Impact Assessment from the initial development of the model assumptions through until the final report. The Jacobs peer review letter is included within **Appendix P**.

Air Pollutants

Particulate matter is the air pollutant that is generated in the greatest quantity by mining operations. Particulate matter from mining predominantly consists of dust particles of varying sizes and compositions. Total Suspended Particulate (TSP) is the total mass of all particles suspended in the atmosphere. The upper limit of the size range for TSP is generally taken to be 30 micrometres (µm) in aerodynamic diameter, since particles larger than 30 to 50 µm will settle out of the atmosphere too quickly to be regarded as air pollutants.

TSP is commonly divided into two sub-components, namely PM₁₀ and PM_{2.5}. The PM₁₀ sub-component includes all particles with aerodynamic diameters of 10 µm or less. Similarly, the PM_{2.5} sub-component includes all particulate matter with an aerodynamic diameter of 2.5 µm or less. Deposited dust is comprised of all particulate matter that settles out of the atmosphere onto a dust deposition gauge.

In addition to particulate matter derived from dust particles, the combustion of diesel fuel in mining equipment results in emissions of fine particulate matter, nitrogen dioxide (NO₂), carbon monoxide (CO), sulphur dioxide (SO₂) and organic hydrocarbons. Emissions of particles from diesel combustion is accounted for in the estimates of fugitive emissions of particles (see **Section 7.8**), which include diesel particles as well as particles derived from the materials being handled. NO_x emissions from diesel combustion (and blasting) are also considered below.

Assessment Criteria

Air quality criteria are benchmarks set by the NSW Government to protect the health and amenity of the community. The air quality assessment criteria for particulate matter are presented in **Table 51**. These criteria are prescribed by the Approved Methods (DEC, 2005) and are thresholds for the cumulative dust generated by all sources, as opposed to dust generated by the Project alone. As a result, background levels need to be considered when using these criteria to assess potential impacts.

The criteria adopted by DP&E are identical to the Approved Methods criteria, except for the PM₁₀ 24 hour (hr) criterion. DP&E has adopted a PM₁₀ 24-hr criterion of 50 micrograms per cubic metre (µg/m³) for the Project alone.

In addition to possible health impacts, airborne dust also has the potential to cause nuisance impacts by depositing on surfaces. The criteria for dust deposition levels are imposed to protect against nuisance dust deposition impacts on a cumulative basis from all dust sources. The dust deposition criteria prescribed by the Approved Methods are presented in **Table 52**. The maximum acceptable increase in dust deposition over background dust levels is 2 grams per square metre per month (g/m²/month). This is the maximum allowable dust deposition that can be generated by the Project alone (incremental). The maximum allowable dust deposition from all sources (cumulative) is 4 g/m²/month.

The NSW Environment Protection Authority (EPA) criteria are generally consistent with the National Environment Protection Measures (NEPM) for ambient air quality. In 2003, the National Environment Protection Council (NEPC) amended the NEPM (NEPC, 2003) to include advisory reporting standards for PM_{2.5}. The advisory reporting standards for PM_{2.5} are 25 µg/m³ 24-hr average and 8 µg/m³ annual average. These advisory reporting standards under the NEPM have not been adopted by the NSW Government as impact assessment criteria. However, in the absence of any other relevant standard/goal, the advisory reporting standards have been used in this report for comparison against dispersion modelling results.

In December 2014, the DP&E released the *Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum Production and Extractive Industry Developments* (VLAM Policy) (DP&E, 2014) which outlines the land acquisition and mitigation and management criteria for air quality and noise.

TABLE 51 Air Quality Particulate Matter Assessment Criteria

Pollutant	Criterion (µg/m ³)	Averaging Period	Agency
TSP	90	Annual average	National Health and Medical Research Council
PM ₁₀	50	Maximum 24-hr average	EPA
	30	Annual average	EPA
PM _{2.5}	25	Maximum 24-hr average	NEPM Advisory Reporting Standards (NEPC, 2003)
	8	Annual average	NEPM Advisory Reporting Standards (NEPC, 2003)

Source: DEC, 2005

TABLE 52 Air Quality Dust Deposition Assessment Criteria

Pollutant	Averaging Period	Maximum Increase in Deposited Dust Levels (g/m ² /month)	Maximum Total Deposited Dust Levels (g/m ² /month)
Deposited Dust	Annual average	2	4

Source: DEC, 2005

The VLAM Policy (DP&E, 2014) sets out voluntary mitigation and land acquisition rights where it is not possible to comply with the EPA impact assessment criteria, even with the implementation of all reasonable and feasible avoidance and/or mitigation measures. The Project has been assessed against these criteria, in addition to the assessment criteria described above.

The Project may also generate emissions of other air pollutants, including CO, NO₂ and SO₂. The sources of these emissions are most likely to be diesel powered equipment used onsite and blasting activities. The Approved Methods impact assessment criteria for CO and NO₂ are presented in **Table 53**.

Meteorological Conditions

Baseline meteorological data has been collected for the Project since August 2011 in accordance with the 'Approved Methods for the Sampling and Analysis of Air Pollutants in NSW' (EPA, 2007). The location of the Bylong AWS is illustrated on **Figure 16**.

The meteorological monitoring results indicate that wind patterns are generally aligned along a north-west to east south-east axis, reflected in the general alignment of surrounding terrain features relative to the positioning of the AWS. The pattern is reflected across all seasons with more frequent east south-east winds in summer and north-west winds in winter. The mean hourly wind speed is comparable for each period presented. The percentage occurrence of calm conditions (≤ 0.5 m/s) is relatively high, ranging from 20% - 30%.

Background Air Quality

Baseline air quality data has been collected for the Project since August 2011 in accordance with the 'Approved Methods for the Sampling and Analysis of Air Pollutants in NSW' (EPA, 2007). The air quality monitoring network established for the Project is illustrated in **Figure 16**.

The main sources of particulate matter in the wider area of the Project are related to agricultural activities and emissions associated with local anthropogenic activities.

A detailed review of existing monitoring data was undertaken to determine the existing background particulate matter concentrations and dust deposition levels in the surrounding area.

A detailed review of the available background monitoring data is provided in **Appendix O**. Over the period of data used in the assessment, the average PM₁₀ concentration was 12.9 µg/m³ and the average PM_{2.5} concentration was 6.5 µg/m³. There were a number of exceedances of the criteria for PM₁₀ and PM_{2.5}, all of which occurred in October/November 2013 and January 2014 when extensive bushfire activity occurred across much of NSW, including the Blue Mountains, Lithgow and Bathurst areas.

Data gathered by the Project monitoring network was also compared to the closest NSW OEH monitoring site at Merriwa, located 45 km to the north-east of the Project Boundary. Monitoring of PM₁₀ concentrations commenced at Merriwa in February 2012. The period average from February 2012 to June 2014 at Merriwa for PM₁₀ concentration is 14.7 µg/m³.

Whilst the Merriwa data has been recorded over different periods, this average is similar to the period average of 12.9 µg/m³ for PM₁₀ concentrations recorded for the Project.

TABLE 53 Air Pollutants Assessment Criteria

Pollutant	Averaging Period	Criterion
Carbon monoxide (CO)	15 min	100 mg/m ³
	1 hr	30 mg/m ³
	8 hr	10 mg/m ³
Nitrogen dioxide (NO ₂)	1 hr	246 µg/m ³
	Annual	62 µg/m ³

Source: DEC, 2005

The following background air quality levels have been assumed for all existing sources to which the Project will contribute for the purposes of the cumulative assessment:

- Annual median PM₁₀ concentration of 10.2 µg/m³;
- Annual median PM_{2.5} concentration of 4.7 µg/m³;
- Annual average TSP concentration of 32.0 µg/m³; and
- Annual average dust depositional of 0.8 g/m²/month.

Estimates of annual average TSP concentrations were made by assuming that 40% of the TSP consists of PM₁₀. Applying this relationship to the background PM₁₀ average concentration of 12.9 µg/m³ for the Project gives an average TSP concentration of approximately 32 µg/m³.

7.7.2 Methodology

The CALMET/CALPUFF modelling system was used for the air quality assessment as it is considered by the EPA to be appropriate for locations with complex terrain such as that of the Project (EPA, 2005).

CALMET is a meteorological pre-processor that includes a wind field generator containing objective analysis and parameterised treatments of slope flows, terrain effects and terrain blocking effects. The pre-processor produces fields of wind components, air temperature, relative humidity, mixing height and other micro-meteorological variables to produce the 3-dimensional (3D) meteorological fields that are utilised in the CALPUFF dispersion model.

CALPUFF is a multi-layer, multi-species non-steady state puff dispersion model that is capable of simulating the effects of time and space varying meteorological conditions on pollutant transport, transformation and removal (Scire *et al.*, 2000). In March 2011, generic guidance and optional settings for the CALPUFF modelling system were published for inclusion in the Approved Methods (TRC, 2011). The model set up for the Air Quality and Greenhouse Gas Impact Assessment has been conducted in consideration of these guidelines.

Meteorological Modelling

CALMET was run for a grid domain of 25 km x 30 km at a 200 m resolution. Observed hourly surface data were incorporated from the Project weather station. In addition, cloud amount and height were sourced from the closest available BoM hourly observations (at Merriwa).

Upper air information was incorporated through the use of prognostic 3D data extracted from The Air Pollution Model (TAPM). TAPM was also used to fill in any gaps in the observational data. The weather station data, land use and terrain data were used as inputs to the meteorological modelling to produce a 3D, hourly varying wind field of the entire area for a full year. This wind field was used in the subsequent air dispersion modelling.

It should be noted that the western end of the CALMET/CALPUFF domain is flush with the western end of the 3 km TAPM domain. These domains were chosen as such because the CALMET/CALPUFF model would not run with a larger domain to the west as it crossed over two map zones (Zone 55 and Zone 56). It is noted however that mining operations lie approximately 13 km away from the boundary and the closest receivers are approximately 4.5 km away. It is therefore considered that receivers would not be affected by model boundary conditions and that the domains chosen for modelling are acceptable.

Further detail on the meteorological modelling methodology used is provided in **Appendix O**.

Air Quality Modelling

Dispersion models are used to predict concentrations of key pollutants at ground level receivers. The air quality and greenhouse gas impact assessment employed the CALPUFF modelling package, which is approved by EPA.

Three modelling scenarios were considered in this assessment. The mine plans for PYs 3, 5 and 9 were selected to represent the progression of the Project. These years were selected as those in which the worst case impacts are likely to occur due to the location of operations and the potential to generate air quality impacts.

In addition to the staging of open cut operations, an emissions inventory was prepared to represent the emissions for Underground only (PY 18) operations. The emissions inventory indicated that total estimated emissions are less than 17% of the TSP emissions estimated to occur during operation of the Project in PY 9 and therefore modelling was not considered necessary. The selected modelling scenarios are considered to represent the range of potential impacts over the life of the Project.

For each of the modelling scenarios, dust emission estimates were calculated by analysing the types of dust generating activities taking place and applying suitable emissions factors. The emission factors were sourced from both local and United States Environmental Protection Agency (US EPA) documentation. These factors are considered the most applicable and representative factors for determining dust generation rates for the proposed activities (including drilling, blasting, hauling, handling, emplacing and grading of overburden, topsoil, rejects and/or product coal).

The effect of dust management measures have been considered in the calculation of dust emissions. The proposed dust controls for the Project are based on the recommendations of the *NSW Coal Mining Benchmarking Study: International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining* (the Best Practice Report) (Donnelly *et al.*, 2011), a study that was commissioned by the NSW EPA.

A summary of the dust management measures adopted for the Project and detailed emissions calculations are provided in **Appendix O**.

Construction Phase Emissions

During the construction of the Project's surface infrastructure, fugitive dust emissions can be expected from activities including:

- Vegetation clearing/stripping;
- Bulk earthworks and material handling;
- Hauling along unsealed surfaces; and
- Wind erosion on exposed areas.

The total estimated emissions are less than 20% of the TSP emissions estimated to occur during operations in PY 5 (see **Section 7.7.3**) and therefore further assessment for construction was not considered necessary by PEL.

While the full modelling assessment of construction phase air quality impacts was not undertaken, KEPCO will implement a range of dust mitigation measures during the construction phase of the Project to ensure that dust emissions are kept to a minimum, especially during adverse meteorological conditions. These mitigation measures are discussed in **Section 7.7.4**.

Assessment of Diesel Emissions

Generators are proposed to be used at the Project for varying lengths of time. The generators will be used in the following areas of the mine:

- WAF - generator of 1.2 MW and in operation during PYs 1 and 2 of the Project (construction phase) and will then become standby units. The generator will be relocated to the MIAs for emergency use only following decommissioning of the WAF by PY 6 of the Project;
- Underground MIA – generators of 750 kW and 1 MW for emergency use only; and
- Ventilation Fan Facility – generator of 1 MW for emergency use only.

Due to the small size of the generators and the fact that they will be used for short, intermittent periods, emissions from these sources will be low and as such any air quality impacts are considered to be negligible.

Assessment of Diesel Fume Emissions

The diesel fume assessment reviewed predicted emissions of NO₂ concentrations, as this is considered to be the main pollutant of concern from vehicle emissions. Emissions of CO, and SO₂ will occur from diesel-powered equipment used onsite, however these emissions are typically minor and too widely dispersed to give rise to significant concentrations at sensitive locations offsite (PEL, 2015).

Estimates for diesel exhaust emissions were based on the Project's estimated diesel consumption for PY 5, which represents the highest equal diesel consumption and the year where mining activities will be closest to private receivers in Bylong Village. The US EPA Tier 2 NO_x emissions standard of 30.36 kg/kL for non-road diesel was applied.

Assessment of Blast Fume Emissions

Fume emission factors for blasting were determined using the available data from a Commonwealth Scientific and Industrial Research Organisation (CSIRO) study into blasting in the Hunter Valley (Attalla *et al.*, 2008). Dispersion modelling was undertaken using the CALPUFF modelling package. Blasting was simulated for a full year in what was considered to be the 'worst case year' (PY 5) at the ten most representative private receivers.

Assessment of Emissions due to Coal Haulage

Studies conducted by Katestone Environmental (2012) determined the particulate emissions factors for an uncovered train wagon. Even if the mitigation measures committed to by KEPCO for the Train Load-Out Facility were not taken into account, modelling emissions from Project coal trains would only approximate 250 kg/Year of TSP, which constitutes less than 0.01% of the total annual emissions for the worst case operational year (PY 5), as discussed below in **Section 7.7.3**. Any emissions from Project's coal trains would also be spread across a large area between Bylong and the Port of Newcastle.

PEL (2015) therefore concluded that any resulting ground level concentrations and any impacts to residences in the vicinity of the rail corridors due to rail haulage of product coal from the Project site would be negligible.

It should also be noted that dust emissions associated with the operation of the Rail Loop and Load-out Facilities were included as part of the modelling assessment of Project mining operations, as discussed below in **Section 7.7.3**.

7.7.3 Impact Assessment

Predicted Air Quality Impacts

Figure 54 illustrates the predicted worst case air quality contours for the representative staged mining years for the Project. **Figure 54** illustrates the maximum extents of the cumulative annual average TSP, PM₁₀ and depositional dust contours, along with the Project alone maximum 24-hr average PM₁₀ concentrations relative to neighbouring private receivers.

These contours represent the worst case air quality impacts over the Project life and were produced by consolidating the air quality contours for all the modelled years. **Figure 54** therefore shows the extent of air quality impacts from the Project relative to neighbouring private receivers.

The results of the dispersion modelling indicates that the Project is not predicted to contribute to exceedances of the relevant air quality criteria at any private receivers (either due to the Project alone, or cumulatively). Predicted impacts to all receivers for the "worst case" modelled PYs 3, 5 and 9 (including those receivers owned by KEPCO) are presented in full in **Appendix O**.

Diesel Fume Emissions

Modelling of NO₂ emissions conservatively included background contributions from OEH monitoring data gathered at Wallsend (closest relevant reference point). The modelling indicated that there are no predicted exceedances for the impact assessment criteria for 1-hour average (246 µg/m³) and annual average (62 µg/m³) at any private or mine-owned receiver.

Blast Fume Emissions

The assessment of maximum NO₂ emissions from blasting activities in PY 5 (considered to be the "worst case" year) predicted that no receivers would experience NO₂ concentrations above the 1-hour impact assessment criterion of 246 µg/m³. The results also demonstrate that at most receivers, there is no contribution from the Project. This confirms that the background concentration is the dominant factor in the cumulative analysis.

Non-Discretionary Development Standards for Mining

In accordance with Clause 12AB (4) of the SEPP Mining, the air quality modelling completed for the Project has not predicted any exceedances of the cumulative annual average PM₁₀ criteria (30 µg/m³) at any privately owned residence.

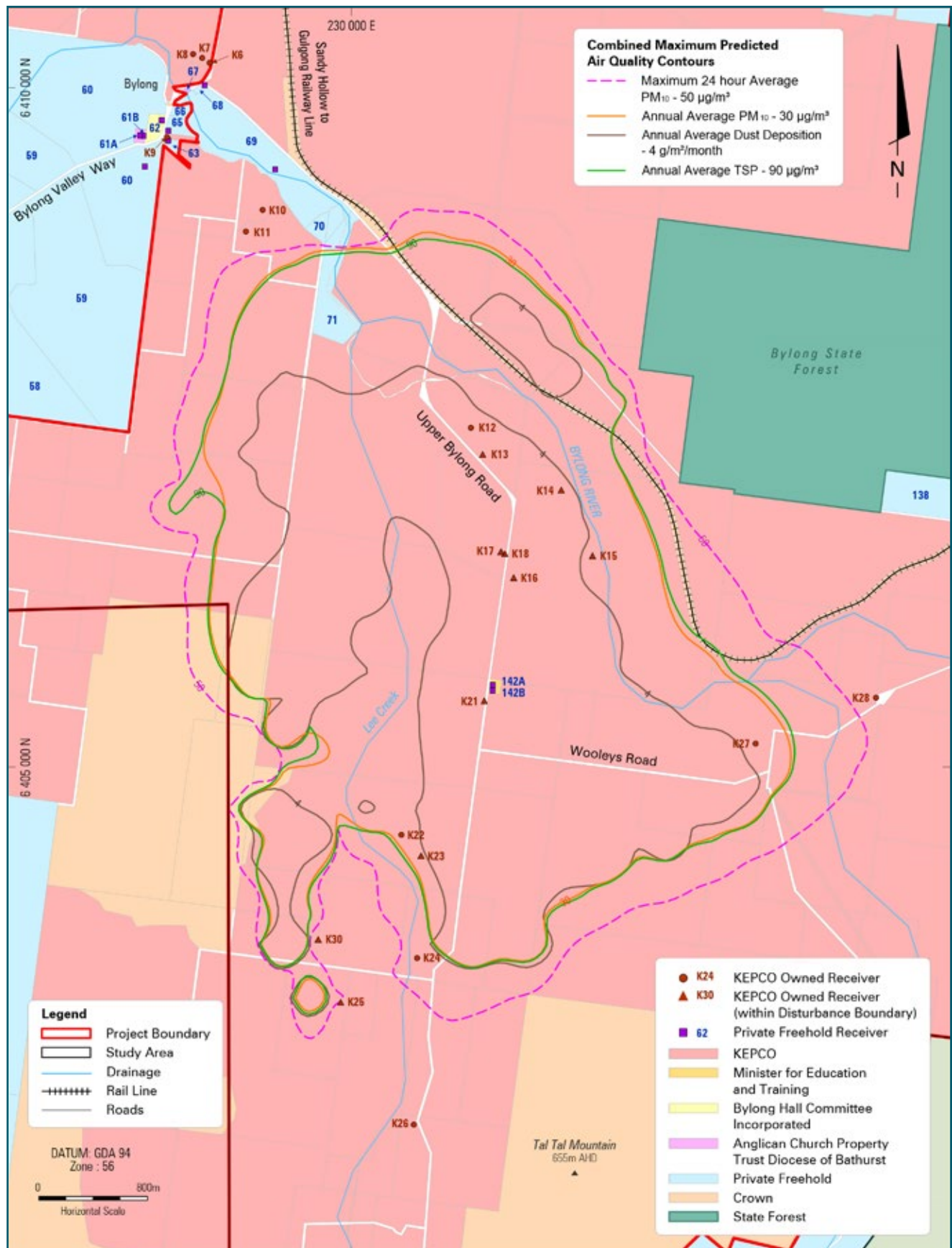
7.7.4 Mitigation and Management

Construction Dust Management

KEPCO will adopt a number of measures to manage its activities to minimise dust emissions during the construction phase, including:

- The modification of working practices to limit excavation during periods of high winds, as required;
- Limiting the extent of clearing of vegetation and topsoil to the designated footprint required for construction activities and to stage any clearing to minimise the total exposed area at any one time, where possible;
- Progressive rehabilitation of any exposed areas no longer required following the completion of construction works;
- Use of water carts on exposed surfaces and haulage routes, particularly during unfavourable weather conditions;
- Operation of equipment on designated areas and routes only, with speed limits enforced on internal roads to reduce road generated dust emissions; and
- Clearing of dirt/dust tracked onto public sealed roads/surfaces as soon as practicable.

FIGURE 54 Worst Case (All Years) Predicted Air Quality Contours



Operational Dust Management

The air quality management, controls and commitments adopted by KEPCO for the Project are based on recommendations of the Best Practice Report (Donnelly *et al.*, 2011), a study that was commissioned by the NSW EPA. Best practice operational management measures for the Project will include:

- Use of speed control signage, water carts and/or suppressants to control emissions from haul roads and other trafficked areas;
- Adoption of the largest truck size practicable within the constraints of the active mining areas of the conceptual mine plans;
- Minimisation, to the extent practicable, the drop heights from equipment associated with loading and dumping operations for coal and overburden;
- Minimisation of areas disturbed at any one time, with progressive rehabilitation (and temporary rehabilitation) undertaken following the completion of mining to reduce total exposed areas;
- Modification/cessation of mining operations in areas of the site during adverse/unfavourable weather conditions where generation of visible dust leaves the site;
- Delay of blasts in unfavourable weather conditions to avoid potential for elevated dust and blast fume emissions;
- Enclosure of conveyors and transfers points, where operationally practicable and safe to do so;
- Use of water sprays/injection during drilling activities;
- Use of water sprays on coal stockpiles;
- Design and construction of a partially enclosed ROM coal system;
- Profiling and orientation of coal stockpiles along prevailing wind axis; and
- Profiling of train loading and water sprays to minimise dust emissions.

Air Quality Monitoring

KEPCO currently conducts air quality monitoring at the locations shown in **Figure 16**. The existing monitoring network will be reviewed and augmented as required for the operation of the Project to ensure that compliance with relevant air quality criteria can be determined at representative private receivers.

Upgrades to the existing network will include at least the relocation of the existing TEOM and (at least) one additional continuous monitor in Bylong Village with the capability to be used as a real-time dust management tool.

KEPCO is committed to leading practice dust management for the Project through the use of a real-time proactive dust management system. This would enable the mine operators to pro-actively manage any short term impacts of the Project and prevent or minimise adverse dust impacts at privately-owned receivers to the greatest practical extent. The real-time dust management system would also incorporate a meteorological and air quality forecasting system to predict, in advance, what the meteorological conditions and air quality impacts will be. This will allow the appropriate personnel to proactively manage the intensity of activities for that day and increase controls or limit activity to various areas of the Project.

The Project air quality monitoring network and dust management system will be detailed within an Air Quality Management Plan.

Blast Management System

Measures to minimise or avoid imperfect blasts will be implemented in accordance with *Code of Good Practice: Prevention and Management of Blast Generated NOx Gases in Surface Blasting* (AEISG, 2011). These measures will be incorporated into a Blast Management Plan. The potential for fume emissions from Project blasting will be controlled via:

- Formulation of appropriate explosive products to reduce the likelihood of fumes;
- Reviewing geological conditions in the development of blast designs;
- Reviewing ground conditions (e.g. presence of clay or loose/broken ground);
- Minimising the time between drilling and loading, and loading and shooting of the blast; and
- Reviewing forecast meteorological conditions during blast planning, to avoid blasting in unfavourable conditions, where practical.

Air Quality Management Plan

KEPCO will develop an Air Quality Management Plan for the construction and operational activities for the Project. The Air Quality Management Plan shall incorporate the feasible and reasonable air quality controls described above and will also include procedures for the development and ongoing management of the Project air quality monitoring network.

7.8 GREENHOUSE GAS

7.8.1 Background

PEL conducted an Air Quality and Greenhouse Gas Impact Assessment for the Project, which is presented in full in **Appendix O**. The purpose of the assessment, in part, was to estimate the greenhouse gas emissions generated by the Project and recommend measures to mitigate and manage these emissions.

7.8.2 Methodology

Greenhouse gas emissions have been estimated based on the methods outlined in the following documents:

- The World Resources Institute / World Business Council for Sustainable Development 'Greenhouse Gas Protocol' (WRI/WBCSD, 2004);
- The 'National Greenhouse and Energy Reporting (Measurement) Amendment Determination 2014' (No. 1); and
- DoE's 'National Greenhouse Accounts (NGA) Factors 2014' (DoE, 2014).

Three "scopes" of emissions (scope 1, scope 2 and scope 3) are defined for greenhouse gas accounting and reporting purposes. This terminology and classification of emissions used in the greenhouse gas assessment for the Project is consistent with the Australian greenhouse reporting and measurement methods and has been employed in this assessment.

Scope 1 and Scope 2 emissions encompass the direct sources of emissions from the Project. For the Project, Scope 1 greenhouse gas emissions include the onsite combustion of diesel fuel during construction and mining operations and fugitive emissions of methane from the exposed coal seams during and post-mining.

Scope 2 emissions for the Project include indirect emissions associated with purchased electricity brought into the Project Boundary to supply operations onsite.

Scope 3 emissions occur due to the indirect sources from the Project including emissions associated with the production and transport of fuels, the transportation of product coal from the site to its final destination and the end use of product coal.

Greenhouse gas emission factors are generally standardised and expressed as carbon dioxide equivalent (CO₂-e) which is calculated by multiplying the individual gas emission factor by its respective Global Warming Potential. To quantify the amount of CO₂-e generated by the Project, specific emission factors were adopted from the DoE (2014) for each of the major greenhouse gas generating activities (see **Appendix O**).

These estimated greenhouse gas emissions generated in all three scopes defined are based on approximated qualities of materials and where applicable, generic emission factors. Therefore the estimated emissions for the Project are considered conservative.

7.8.3 Impact Assessment

The main sources of greenhouse gas emissions from the extraction and processing of coal for the Project were identified as resulting from diesel usage, explosives usage, electricity consumption, fugitive emissions of carbon dioxide and methane and the transportation and end use of product coal.

The total greenhouse gas emissions predicted for the Project from these sources are detailed in **Appendix O** and summarised in **Table 54**. Over the life of the Project, the annual average greenhouse gas emissions were predicted as 8,119,155 t CO₂-e.

The estimated Scope 1 greenhouse gas emissions intensity of the Project is approximately 0.02 t CO₂-e/t saleable coal. The estimated emissions intensity of the Project are at the lower end of emissions intensity of open cut and underground coal mines in Australia (Deslandes, 1999).

The estimated Scope 1, Scope 2 and Scope 3 greenhouse gas emission intensity of the Project is approximately 2.29 t CO₂-e/t saleable coal, of which approximately 2.26 t CO₂-e/t saleable coal (or 98.3%) is attributable to the end use of product coal.

The Project's contribution greenhouse gas levels would be in proportion with its contribution to global emissions. Average annual scope 1 emissions from the Project (0.09 Mt CO₂-e) would represent approximately 0.02% of Australia's commitment under the Kyoto Protocol (591.5 Mt CO₂-e) and a very small portion of global greenhouse emissions, given that Australia contributed approximately 1.25% of global greenhouse gas emissions in 2012 (PBL Netherlands Environmental Assessment Agency, 2013). A comparison of predicted annual greenhouse gas emissions from the Project with global, Australian and NSW emissions inventories is presented in **Appendix O**.

TABLE 54 Summary of Total Predicted Greenhouse Gas Emissions for the Project

Activity	Emissions (t CO ₂ -e)
SCOPE 1	
Fuel consumption (including diesel generators and mobile equipment) during construction, operation and decommissioning – Scope 1	674,284
Explosives consumption – Scope 1	7,051
Fugitive emissions – Scope 1	1,546,689
Scope 1 Emissions Sub Total	2,228,023
SCOPE 2	
Electricity consumption – Scope 2	1,286,419
Scope 2 Emissions Sub Total	1,286,419
SCOPE 3	
Transport of product coal – Scope 3 (including combustion of diesel, electricity use and rail transport)	499,608
End use of product coal – Scope 3	202,479,277
Scope 3 Emissions Sub Total	202,978,885
PROJECT TOTAL	206,493,327

7.8.4 Mitigation and Management

Mitigation and management measures that will be implemented to minimise greenhouse gas emissions generated as a result of the Project include:

- Consideration of energy efficiency in the mine planning process (i.e. minimising haul distances, fuel usage);
- Investigation of options for capture and treatment of fugitive methane emissions from underground mine ventilation;
- Sealing of underground mining panels to reduce methane emissions from the goaf;
- Use of ventilation control devices in sections of the mine not in active use enabling them not to be ventilated (unless required for safety purposes), thereby reducing fugitive emissions;
- Use of real-time gas (methane and carbon dioxide), temperature, pressure and associated volumetric flow monitoring at the ventilation shaft site to allow accurate measurement of ventilation (including methane and carbon dioxide) emissions, which will then allow further feasibility assessment of reuse options;
- Ensuring maintenance, calibration and record keeping is undertaken on the main ventilation shaft and fans to allow for the calculation of greenhouse gas emissions;
- Maintaining records for monthly electricity and diesel use and monthly ROM coal production to allow for the calculation of greenhouse gas emissions; and
- Completing energy use audits at various stages throughout the life of the Project to evaluate the operations and to consider the feasibility of applying potential energy use savings to the operations.

These mitigation measures will be included in the Energy and Greenhouse Gas Management Plan, which will describe a number of reasonable and feasible measures to be implemented to minimise greenhouse gas emissions from the Project.

7.9 NOISE

7.9.1 Background

A Noise and Blasting Impact Assessment for the Project was completed by PEL and is presented in full in **Appendix Q**. The Noise and Blasting Impact Assessment included quantitative consideration of construction noise, operational mining noise, offsite road and rail noise, sleep disturbance, low frequency noise and cumulative noise impacts. It also assessed blasting impacts on people, livestock and property. The assessment of Project blast impacts is addressed below in **Section 7.10**.

The Noise and Blasting Impact Assessment is summarised below and has been undertaken in accordance with the following policies and guidelines:

- The 'NSW Industrial Noise Policy' (INP) (EPA, 2000) to determine background noise levels, Project specific noise criteria, predicted noise levels and recommended negotiation options;
- The 'NSW Road Noise Policy' (RNP) (DECCW, 2011) for road traffic noise and sleep disturbance criteria outside the Project Boundary;
- The 'Noise Criteria Guideline' (NCG) (RMS, 2014) for road traffic noise impacts;
- The 'Rail Infrastructure Noise Guideline' (RING) (EPA, 2013) provides criteria and methods to assess noise from train movements on publicly owned rail lines;
- The 'Interim Construction Noise Guideline' (ICNG) (DECC, 2009) provides criteria, recommended hours and methods for assessing noise from construction activities; and
- The VLAM Policy (DP&E, 2014) for reference in the review and characterisation of noise impacts to private receivers.

Bridges Acoustics was engaged to complete an independent peer review of the Noise and Blasting Impact Assessment. The Peer Review was completed throughout the preparation of the Noise and Blasting Impact Assessment from the initial development of the model assumptions through until the final report. The Bridges Acoustics peer review letter is included within **Appendix R**.

7.9.2 Methodology

Introduction

Predicted noise levels at receivers for the Project have been assessed using a comprehensive site model using the CadnaA 4.3 acoustic modelling package and associated algorithms:

- 'ISO 9613 Acoustics – Attenuation of sound during propagation outdoors' (ISO, 1996); and
- 'Special Task Forces in Noise Propagation' (CONCAWE, 1981).

The CadnaA 4.3 acoustic modelling package is capable of considering a number of factors for each scenario. The modelling package considers the sound power levels of the proposed site operations, activities and equipment, and is able to apply adjustments for noise attenuation resulting from geometric spreading, acoustic shielding from intervening ground topography, ground effects, meteorological effects and atmospheric absorption.

The modelling has assumed a conservative 15 minute scenario representative of a mining year, operating 24 hours a day, seven days a week.

Noise levels for the Project have been modelled for four scenarios representative of the operations, time periods and weather conditions. The indicative years selected for modelling represent the periods most likely to generate worst case noise levels and include:

- PY 3 – Open cut mining in the Eastern and Western Open Cuts, with CHPP activities and the Project rail loop in operation;
- PY 5 – Open cut mining in the Eastern and Western Open Cuts, with CHPP activities and the Project rail loop in operation;
- PY 7 – Open cut mining in the Eastern Open Cut and underground mining operations, with CHPP activities and the Project rail loop in operation; and
- PY 11 and beyond – Underground mining operations, with the CHPP and Project rail loop in operation.

All operational scenarios include the normal mining activities, coal handling and processing activities, operation of the rail loading facility, locomotives on the rail loop, and the operation of the various conveyors within the CHPP and beyond.

The predicted noise levels for the construction and operational activities have assumed the implementation of various noise management and mitigation measures. Reasonable and feasible noise mitigation and management measures have been developed for the Project following an investigation of 18 scenarios and include fitting mobile equipment and fixed plant with various noise attenuation controls and making operational changes during adverse weather conditions (see **Section 7.9.4**).

The modelling has predicted the worst case noise levels by assuming that all equipment is operating under noise enhancing weather conditions. Although the situations modelled may occur occasionally, noise levels at receivers will generally be lower than the predicted levels.

Background Noise Levels

Results from eight periods of background noise monitoring undertaken between autumn (May) 2012 and summer (February) 2014 were utilised to determine the existing ambient noise levels and appropriate background noise levels for the Project. For the duration of each background noise monitoring period, weather conditions were recorded at the Bylong AWS. Where weather conditions were unsuitable for noise monitoring (as defined in the INP) the monitoring data was filtered accordingly. Data was also excluded for identified extraneous noise events (i.e. frog or insect noise).

Unattended background monitoring was conducted at five representative locations in the vicinity of the Project Boundary. These locations are shown on **Figure 16** and all are situated in a rural setting with no appreciable existing industrial noise sources in their vicinity. BG01 and BG02 are located on farmland while BG04 and BG05 are located within the grounds of residential dwellings. BG03 is located on a farm in the vicinity of the residential buildings.

The background monitoring results demonstrated that where Rating Background Levels (RBLs) were not affected by fauna noise, the minimum and median measured RBLs were 30 dB(A) or less at all locations. In accordance with **Section 3.1.2** of the INP, the RBL was set at 30 dB(A) for all locations.

Receivers

The Project is proposed in a rural setting, with a small number of residential receivers located on agricultural properties within and surrounding the Project Boundary. The residences within the Project Boundary are predominantly owned by KEPCO, with surrounding private residences located in the north-west, south and in the Bylong Village. The locations of the private receivers within and surrounding the Project Boundary and considered in the noise impact assessment are shown on **Figure 12a**.

Meteorology

A representative meteorological data set was produced based on detailed weather records from the Bylong AWS. Meteorological features in the vicinity of the Project were determined in accordance with the INP to identify the likelihood of weather conditions which may increase noise levels at neighbouring sensitive receivers. The prevailing meteorological conditions which were included in the noise model are shown in **Table 55**.

Dominant wind directions were identified by considering the total percentage occurrence of adding adjacent wind directions. Dominant winds were identified during the day period from east south-east to the south. During the evening period, dominant winds were identified between east south-east and west south-west. Dominant winds during the night period were identified to occur between south-east and west south-west.

The potential for drainage flows is considered likely due to the location of the sources and receivers within the Bylong Valley. Based on the local topography, a drainage flow has been considered flowing down the Bylong Valley from the south south-east towards the Bylong Village.

The potential for temperature inversions was considered, where they occur for 30% or more of the time during the evening and night time periods (6:00 pm - 7:00 am) in the winter months (June, July and August).

TABLE 55 Meteorological Noise Modelling Conditions

No.	Period	Meteorological Condition	Modelling Parameters			
			Wind	Pasquil-Gifford Stability Class	Relative Humidity	Air Temperature
1	Day	Neutral	No Wind	D	70%	20°C
2	Day	Gradient Wind	3 m/s ESE	D	70%	20°C
3	Day	Gradient Wind	3 m/s S	D	70%	20°C
4	Day	Gradient Wind	3 m/s WSW	D	70%	20°C
5	Evening/Night	Neutral	No Wind	D	90%	10°C
6	Evening/Night	Gradient Wind	3 m/s S	D	90%	10°C
7	Evening/Night	Gradient Wind	3 m/s SE	D	90%	10°C
8	Evening/Night	Gradient Wind	3 m/s WSW	D	90%	10°C
9	Evening/Night	Temperature Inversion	No Wind	F	90%	10°C
10	Evening/Night	Temperature Inversion and Drainage Flow	2 m/s SSE	F	90%	10°C

Noise Criteria

Project Operational Noise

The INP recommends two separate noise criteria for operational noise:

- Intrusive Criteria - designed to limit the relative audibility of the Project; and
- Amenity Criteria - designed to limit the total or cumulative level of industrial noise from all industrial sources in the area.

Intrusive Criteria are set at 5 dB(A) above the RBL. The assessment considered modifying factors such as tonality, impulsiveness, intermittency or dominant low frequency content to adjust noise levels where required.

The Amenity Noise Criterion require that the maximum ambient L_{Aeq} noise level from industrial sources within the day, evening and night assessment period should not exceed the “acceptable noise levels” as published in the INP. For the Project, all residential receivers were considered as “rural”, as the noise environment identified during background noise monitoring was dominated by natural sounds and is generally characterised by having low background noise levels.

The intrusive noise criteria (based on the adopted background noise levels of 30 dB(A)) were adopted as the Project Specific Noise Level (PSNL) for residential receivers. The PSNL for the Project are provided below in **Table 56**.

The INP recommends amenity criteria designed to limit the total or cumulative noise impacts. Background noise monitoring confirmed that there is currently no significant industrial noise sources present within in the vicinity of the Project.

Construction Noise

Construction noise levels have been assessed under the ICNG. In general, these criteria require that construction noise should not exceed the background noise level by more than 10 dB(A) during standard construction hours (as explained in **Section 3.10**), and by more than 5 dB(A) outside of standard construction hours. The Project specific construction noise management levels are summarised in **Table 57**.

Sleep Disturbance

Sleep disturbance can occur when a short, sharp noise is clearly audible over the background noise level within a bedroom. The RNP acknowledges that the effects of noise on sleep disturbance have not yet been conclusively determined.

However, in lieu of the availability of other more definitive research into sleep disturbance, a screening criterion of $RBL + 15 \text{ dB } L_{A1,1\text{min}}$ dB(A) was adopted for the Project.

Based on the Project RBL (30 dB(A)), the sleep disturbance screening criterion for all residential receivers is $L_{A1,1\text{min}}$ 45 dB(A).

TABLE 56 Operational Project Specific Noise Levels

Receiver / Land Use	Descriptor	Operational Noise Criteria (dB(A)) ¹		
		Day	Evening	Night
Residential	$L_{Aeq,15\text{min}}$	35	35	35
Places of Worship (external) (when in use)	$L_{Aeq,period}$	50 (when in use)	50 (when in use)	50 (when in use)
Area specifically reserved for passive recreation ² (when in use)	$L_{Aeq,period}$	50	50	50
Active recreation area (when in use)	$L_{Aeq,period}$	55 (when in use)	55 (when in use)	55 (when in use)
Commercial premises	$L_{Aeq,period}$	65	65	65
Industrial premises	$L_{Aeq,period}$	70	70	70

¹ Day (7.00am-6.00pm Monday to Saturday and 8.00am-6.00pm Sundays and Public Holidays), Evening (6.00pm-10.00pm), Night (10.00pm-7.00am, unless preceding a Sunday or Public Holiday).

² Noise criteria specified in the INP as internal limits are assessed using an external limit based on an outside to inside correction of 10 dB as specified in Section 2.2.1 of the INP.

TABLE 57 Project Specific Construction Noise Management Level

Land Use	Construction Noise Management Level, $L_{Aeq,15\text{min}}$ dB(A)			
	Standard Hours Monday - Friday 7 am to 6 pm, Saturday 8 am to 1 pm	Outside of Standard Hours		
		Day Saturday 7 am to 8 am, 1 pm to 6 pm, Sunday 8 am to 4 pm	Evening Monday - Sunday 6 pm to 10 pm	Night time Monday to Saturday 10 pm to 7 am Sunday & Public Holidays 10 pm to 8 am
Residential	40	35	35	35
Active Recreation Area	65	65	65	65
Passive Recreation Area	60	60	60	60
Places of Worship ¹	55	55	55	55
Commercial	65	65	65	65
Industrial	70	70	70	70

Notes: External noise level based on an outside to inside correction of 10 dB(A), in accordance with the INP

Road Traffic Noise

The construction and operational activities proposed for the Project has the potential to generate traffic on Bylong Valley Way, Wollar Road and Upper Bylong Road. Due to the function of each providing connections between local roads and carrying through traffic, these roads would be classified in the collector or sub-arterial categories under the RNP. Recommended road traffic noise assessment criteria under the RNP for such roads are listed in **Table 58**.

Rail Traffic Noise

Rail traffic noise criteria are sourced from the RING, which is used to assess rail noise impacts at sensitive receivers from rail bound vehicles on new, existing and redeveloped tracks and also where additional traffic is generated by land use developments.

The RING and ARTC's EPL recommend consistent criteria for rail noise impact assessment of $65 L_{Aeq,15hr}$ during the day, $60 L_{Aeq,9hr}$ during the night and $85 L_{Amax}$ from existing rail lines at 1 m from the facade of affected residential premises.

Low Frequency Noise

Section 4 of the INP recommends low frequency noise levels considered in the normal operational noise criteria by the addition of a "modifying factor" to either a source sound power level or a received noise level. Any modifying factors that are relevant to the assessment, including low frequency penalties, have been applied to the adopted sound power levels for mining and transportation equipment.

A low frequency noise criteria of 60 dB(C) was adopted for the noise impact assessment.

7.9.3 Impact Assessment

Project Operational Noise

Figure 55 presents the combined worst case predicted noise levels for all operational modelled scenarios for the Project. A summary of the predicted worst case modelled noise levels Project operations at private receivers is presented in **Table 59**. A full assessment of Project operational noise levels including key assumptions utilised for the purposes of modelling and detailed predicted noise levels for all receivers (including KEPCO owned receivers) are presented in **Appendix Q**.

The VLAM Policy (DP&E, 2014) was used to determine the significance of predicted operational noise levels at private receivers. The classifications and suggested mitigation treatments from the VLAM Policy are summarised in **Table 60**.

All reasonable and feasible noise mitigation measures (as discussed in **Section 7.9.4**) have been applied to the Project and were incorporated in the modelling results presented below.

Receivers

The predicted noise levels for the Project in **Table 59** indicate that three receivers will experience significant noise impacts (Landowner IDs 60, 63 and 69), six will experience moderate impacts (Landowner IDs 58, 65A, 68, 141, 151 and 158) and negligible impacts will be experienced at three receivers (Landowner IDs 56, 57A and 57C).

TABLE 58 Road Traffic Noise Criteria for Residential Land Uses

Road Category	Type of Project / Land Use	Assessment Criteria (dB(A))	
		Day (7.00 am to 10.00 pm)	Night (10.00 pm to 7.00 am)
Freeway/arterial/ sub-arterial	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{Aeq,15hour}$ 60 (external)	$L_{Aeq,15hour}$ 55 (external)

FIGURE 55 Worst Case (All Years) Predicted Noise Contours

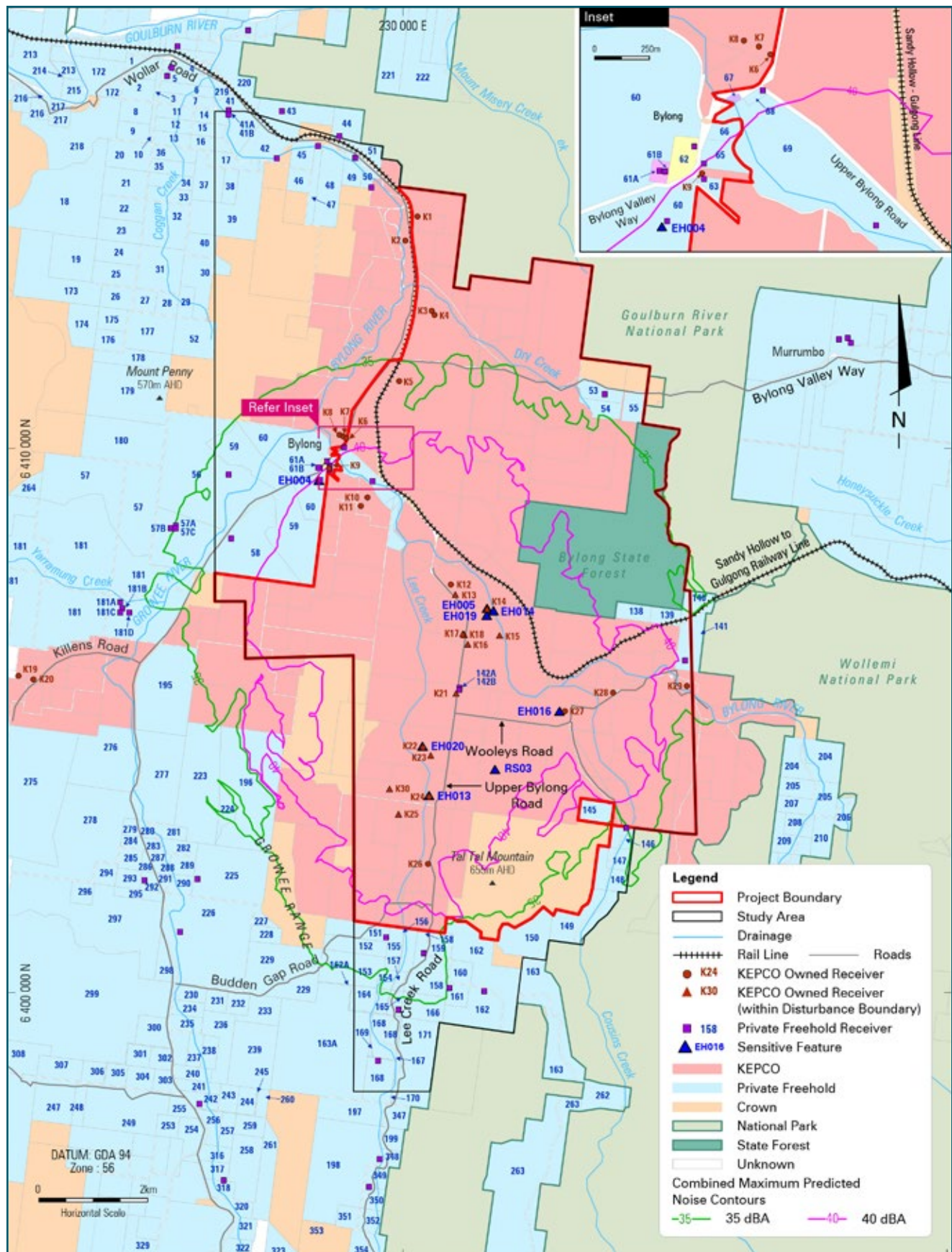


TABLE 59 Predicted Noise Levels in Exceedance of PSNL at Private Receivers

Landowner ID	Landowner	Predicted Noise Level (LA _{eq, 15 min} dB(A))							
		PY 3		PY 5		PY 7		UG	
		Day	Evening / Night	Day	Evening / Night	Day	Evening / Night	Day	Evening / Night
56	Locaway Pty Ltd	-	37	-	36	-	-	-	-
57A	Locaway Pty Ltd	-	-	-	36	-	-	-	-
57C	Locaway Pty Ltd	-	-	-	36	-	-	-	-
58	J Mead	37	38	36	38	-	-	-	-
60	Jarvet Pty Limited	40	41	38	40	36	38	-	36
65A	JB Watson	39	40	38	39	36	38	-	36
63	TA Rixon	40	41	38	40	36	38	-	36
68	RNK Wright	39	40	37	39	36	38	-	-
69	RNK Wright	42	43	40	42	39	41	37	39
141	Brown & Bonarius	-	36	36	38	38	40	-	-
151	PR Grieve	-	-	-	39	-	39	-	-
158	PR Grieve	-	-	-	38	-	37	-	-

Dashed result indicates no exceedance of PSNL predicted under that scenario

Green shading – Negligible operational noise impacts predicted

Blue shading – Moderate operational noise impacts predicted

Red shading – Significant operational noise impacts predicted

TABLE 60 Characterisation of Noise Impacts and Potential Treatments

Residual Noise Exceeds INP Criteria By	Characterisation of Impacts	Potential Treatment
0-2 dB(A) above the PSNL	Impacts are considered to be negligible	The exceedances would not be discernible by the average listener and therefore would not warrant receiver based treatments or controls
3-5 dB(A) above the PSNL in the INP but the development would contribute less than 1dB to the total industrial noise level	Impacts are considered to be marginal	Provide mechanical ventilation / comfort condition systems to enable windows to be closed without compromising internal air quality / amenity.
3-5 dB(A) above the PSNL in the INP and the development would contribute more than 1dB to the total industrial noise level	Impacts are considered to be moderate	As for marginal impacts but also upgraded façade elements like windows, doors, roof insulation etc. to further increase the ability of the building façade to reduce noise levels.
>5 dB(A) above the PSNL in the INP	Impacts are considered to be significant	Provide mitigation as for moderate impacts and see voluntary land acquisition provisions below.

Source: DP&E, 2014

Contiguous Land (No Residence)

Operational noise impacts on privately owned land were also assessed. In accordance with VLAM Policy (DP&E, 2014), voluntary land acquisition rights were considered to apply where more than 25% of adjacent continuous blocks owned by the same landholder were predicted to experience operational noise levels of more than the recommended maximum amenity impact levels.

Based on the predicted noise levels, voluntary acquisition rights should be applied to Landowner ID 69, which is also predicted to experience significant noise impacts at the residence.

Cumulative Operational Noise

The potential for noise generation from existing industrial sources was considered for private receivers and compared to the noise amenity criteria. Apart from the Bylong Quarry (Landowner IDs 53 - 55 on **Figure 12**), there are no other mining operations or industrial facilities present or proposed in the vicinity of the Project.

Bylong Quarry is located in the north-east of the Project Boundary and is distant from the proposed surface facilities and open cut mining areas proposed for the Project. Therefore cumulative noise impacts from the Bylong Quarry operations are not expected to occur.

No cumulative noise assessment was therefore considered necessary as part of the Noise and Blasting Impact Assessment.

Construction Noise

Phase 1 of the Project's construction is expected to occur over a period of approximately two years. Noise levels for the worst case construction impact scenarios were assessed. Noise levels for the worst case components of the construction phase 1 have been calculated using the noise model and the indicative construction schedule presented in **Section 3.2.1**.

The most significant noise-generating components of the construction phase are:

- Bulk earthworks for and construction of the rail loop;
- Installation and construction of the MIAs and CHPP;
- The upgrade and realignment of Upper Bylong Road; and
- Establishment of open cut mining areas, clearing and stockpiling activities.

The modelled noise impacts for the Project construction phase 1 show that the one receiver (Landowner ID 69) is predicted to experience moderate noise impacts as a result of the earthworks required to construct the Project rail loop. A further three receivers (Landowner IDs 53, 60 and 65A) are predicted to experience negligible noise impacts.

During the upgrade of Upper Bylong Road, exceedances of the construction noise management criteria are predicted at up to five receivers (Landowner IDs 60, 63, 65A, 68 and 69) when works are at their closest to Bylong Village.

Modelling indicates that noise levels for construction activities associated with development of the open cut mining area would comply with INP goals under neutral conditions during the day and night. However, under adverse conditions during the day, moderate impacts are predicted at receivers 60 and 69. Under adverse conditions during the night, significant impacts are predicted at receiver 69 and moderate impacts at receivers 60, 65A, 63 and 68. These impacts are similar to those predicted during operational noise modelling for PY 3.

Predicted noise levels for all receivers and each construction scenario modelled is presented in **Appendix Q**.

Sleep Disturbance

The predicted maximum noise levels indicated impacts above the sleep disturbance criteria of 45 $L_{A1,1min}$ for Landowner ID 69 during PY 3. Results for other receivers were below the sleep disturbance criteria in all modelled scenarios.

Road Traffic Noise

The Project is expected to generate additional vehicles on the existing roads in the area. As part of the Project, roads are expected to be upgraded or realigned. The primary road works include:

- Upgrade to Upper Bylong Road from the Bylong Valley Way intersection to the Open Cut MIA; and
- Realignment of Upper Bylong Road from the mine entrance to Wally's Road to provide access to properties to the east of the Project.

Consistent with the Traffic and Transport Impact Assessment (see **Section 7.18**), Project related traffic is expected to primarily travel to and from the Project along Wollar Road, accessing the Project from Wollar Road on to Bylong Valley Way and then Upper Bylong Road. Other access routes are expected to be from the east and south along Bylong Valley Way.

During the construction phase, a WAF is proposed on the Bylong Station property owned by KEPCO. The WAF will utilise an existing intersection with Bylong Valley Way, to the east of the Wollar Road intersection and crossing with Sandy Hollow to Gulgong Railway line (see **Figure 18**).

The potentially most affected private receivers were identified in the vicinity of the Project related roads. Where compliance is achieved at these receivers, compliance would be expected at receivers further from the road. These receivers and their offset from the roads are:

- Receiver 44 – Wollar Road (100 m);
- Receiver 65 – Bylong Valley Way and Upper Bylong Road (17 m and 420 m, respectively);
- Receiver 68 – Bylong Valley Way and Upper Bylong Road (23 m and 34 m, respectively);
- Receiver 69 – Upper Bylong Road (144 m);
- 5036 Bylong Valley Way, Growee – Bylong Valley Way south (30 m); and
- 2272 Bylong Valley Way, Widden – Bylong Valley Way east (22 m).

The largest predicted noise increases are expected at receiver 44 on Wollar Road, receiver 68 at the intersection with Upper Bylong Road and Bylong Valley Way and receiver 69 on Upper Bylong Road. These receivers are located on the roads where the largest traffic increases are expected. During PY 2, the largest increases in noise level are expected to be up to 8 dB at receiver 69 during the day and up to 6 dB at receiver 44 during the night. This represents the largest potential increase as a result of the Project as this scenario contains the most site generated traffic as construction activities are still ongoing at that time.

Whilst traffic noise levels on Wollar Road, Bylong Valley Way and Upper Bylong Road are predicted to increase, the predicted increase in noise is less than the relevant criteria (i.e. an increase greater than 12 dB). The noise levels from the road traffic are also expected to be within the 60 dB(A) $L_{Aeq,15hr}$ and 55 dB(A) $L_{Aeq,9hr}$ RNP criteria at the nearest sensitive receivers.

Rail Traffic Noise

Project related train movements and calculated noise levels produced by existing train movements on the existing government owned rail network were assessed against the 65 $L_{Aeq,15hr}$ day, 60 $L_{Aeq,9hr}$ night and 85 L_{Amax} noise criteria. It is predicted that maximum noise levels would not change as a result of the Project, as coal trains associated with the Project are assumed to produce similar maximum noise levels as the existing coal trains on the Sandy Hollow to Gulgong Railway Line between the Project site and the junction with the Main Northern Railway line in Muswellbrook.

Rail noise for existing contracted and approved movements is expected to exceed the criteria at distances of up to 50 m from the track. The addition of the Project related movements is not expected to cause a noticeable increase in the day or night rail noise levels and no addition receivers are expected to be affected.

As a result of the predicted increases expected to exceed 65 dB(A) $L_{Aeq,15hr}$ and 60 dB(A) $L_{Aeq,9hr}$ and increase rail noise levels by more than 0.5 dB of noise from rail operations as a result of additional rail traffic from the Project, noise management measures are recommended. These are discussed further in **Section 7.9.4**, however the requirement and provision to provide mitigation is not generally borne from one user of the track and would be subject to further investigation and consideration by ARTC.

Low Frequency Noise

The C-weighted noise levels were calculated using the mitigated noise model for all privately owned receivers for modelled PYs 3, 5, 7 and for the underground only scenario. This assessment indicated that low frequency noise levels are below the 60 dB(C) criterion for all receivers.

7.9.4 Mitigation and Management

Reasonable and Feasible Noise Controls

Noise modelling investigations involving the consideration of 18 separate scenarios were undertaken during the preparation of the Noise and Blasting Impact Assessment for the Project. The investigations considered various operational scenarios, the application of reasonable and feasible noise management controls and mitigation measures in order to determine measures that could be put in place by KEPCO minimise adverse noise impacts to private receivers. Each scenario is described in full in **Appendix Q**.

The noise management and mitigation controls that were adopted for the Project following the assessment of potential noise impacts from the nominated scenarios and mine plans include:

- Development of a Construction Noise and Vibration Management Plan for the Project construction phase. This document will include the following controls for construction activities:
 - Mitigation of specific noise sources or operational areas using portable temporary screens, where possible;
 - Maximising the offset distance between noisy plant items and sensitive receivers and orienting equipment away from sensitive receivers;
 - Using noise source controls, such as the use of residential class mufflers, to reduce noise from plant and equipment including cranes, excavators and trucks;
 - Using lower powered or reduced size equipment, where practical;
 - Using spotters, smart or broadband reversing alarms in place of traditional tonal reversing alarms;
 - Operating machinery in a manner which reduces maximum noise level event including excavators and dozers; and
 - Turning off machinery when not in use.
- Relocating the areas proposed for activities such as waste emplacement and haul roads from mining areas to minimise noise propagation. In particular, the following measures were adopted for PY 3:
 - Diversion of the Western Open Cut waste haul route and supporting plant to the South Western OEA during day time adverse weather conditions; and
 - Diversion of Western and Eastern Open Cut waste haul routes and supporting equipment to the South Western OEA during evening and night time adverse weather conditions.
- Fitting fixed and mobile plant with additional noise attenuation to achieve the lowest sound power levels that can reasonably be achieved and maintained. This will include:
 - Full noise attenuation kits on haul trucks, water cart, FEL's, LHD; and
 - Mitigation of fixed plant including the CHPP, transfer towers, sizers and crushers, ventilation fans and underground compressors.
- Periodic noise monitoring to ensure that mobile plant continues to operate at the modelled sound power levels;
- Regular maintenance of plant and equipment as required to ensure noise controls are working effectively;
- Operational responses to limit noise generating activities in potentially sensitive areas or under adverse weather conditions, particularly for the North Western OEA;
- Training for staff and contractors with regard to noise management as part of training and induction programs. This will include training in good practice protocols identified for the operation of machinery to minimise potential noise events, including:
 - Haul trucks;
 - Dozers;
 - Extraction of waste and coal from open cut mining areas;
 - OEAs;
 - Operation of the CHPP, conveyors, rail loader, stockpiles, ROM pad and crusher; and
 - Operation of trains on the rail loop.
- At-property noise mitigation or acquisition for significantly impacted receivers (Landowner IDs 60, 63 and 69) and at property noise mitigation for moderately impacted receivers (Landowner IDs 58, 65A, 68, 141, 151 and 158). At-property mitigation measures would be investigated upon KEPCO receiving a written request from the landowner of the above properties. For all other privately owned receivers not listed in **Table 59**, proactive and reactive noise minimisation practices will be implemented to ensure that the Project does not exceed the intrusive noise criteria; and
- Operational planning to take into account potential for adverse noise impacts under certain meteorological conditions.

Negotiated Agreements

KEPCO has commenced discussions with landowners as shown in **Table 59** that are predicted to experience moderate and/or significant noise emissions from Project related activities at some time during the life of the Project. KEPCO will endeavour to establish negotiated agreements with each landholder prior to the predicted worst case noise levels from the Project's activities being experienced at the receiver.

For those receivers who have been predicted to experience moderate noise impacts from the Project (Landowner IDs 58, 65A, 68, 141, 151 and 158), KEPCO has offered the installation of various noise mitigation and management measures at their property (such as air conditioning or double glazed windows, etc) and/or other appropriate compensations. For the three receivers who have been predicted to experience significant noise impacts (Landowner IDs 60, 63 and 69), KEPCO has offered the installation of noise mitigation and management measures at their property and/or other appropriate compensations or the potential acquisition of the property. It should be noted that receivers 68 and 69 are located on the same property. Accordingly, this landholder will be afforded the mitigation measures proposed for significantly impacted receivers for both residences.

KEPCO has commenced discussions with these relevant landholders as part of an ongoing process in establishing the appropriate negotiated agreements. To this end, KEPCO has recently written to each landholder confirming consultations to date and the various measures that have been offered during these discussions. KEPCO will keep the relevant parties informed in relation to the status of these agreements throughout the NSW Government's assessment of the Project.

Mitigation of Rail Traffic Noise

ARTC manages the rail network that will be used to deliver coal from the Project to market. Noise emissions from ARTC operated rail lines are regulated under their EPL 3142, which includes a requirement to prepare a Pollution Reduction Program to minimise noise emissions. In accordance with EPL 3142, ARTC is required to monitor locomotive noise levels, audit noise performance of locomotives, maintain an environmental hotline and implement all reasonable and feasible noise mitigation and management measures to reduce rail noise impacts.

KEPCO will continue to consult with ARTC in regard to the proposed rail movements for the Project, the status of its Pollution Reduction Program and the implementation of leading practice noise control measures.

Noise Monitoring Program

A noise monitoring program will be undertaken to monitor the construction and operational noise levels for the Project. KEPCO will implement a noise monitoring network, which is representative of the closest receivers and include:

- A weather prediction system to identify potentially noise enhancing weather conditions;
- A noise prediction system utilising the weather prediction system, to provide advanced warning of adverse conditions to allow operational responses to be put in place;
- Real-time noise monitors representative of private receivers will be put in place to enable ongoing noise management. Data from the real-time noise monitors will be transmitted to an onsite office or control room for use as a noise management tool. A Trigger Action Response Plan (TARP) will also be developed and implemented as part of the noise monitoring program to allow the proactive management of noise impacts and guide any actions required to minimise Project noise. Such responses may include modifying, suspending or ceasing operations under certain conditions or times of the day, or preferentially using equipment in specific areas; and
- Regular operator attended noise monitoring will occur at a minimum of four locations during normal mining operations to confirm Project noise levels. The monitoring locations will vary from time to time as the mine progresses and will be reviewed annually. Noise surveys will include two non-consecutive 15 minute noise measurements, and associated observations to identify and quantify dominant sources of noise during the day, evening and night at each location.

Results from real-time noise monitoring and quarterly noise surveys will be reported annually in the Annual Review.

Noise Management Plan

KEPCO will develop a Noise Management Plan for the Project, which will include all operational noise management strategies and responses required to minimise noise from mining operations.

The document will include:

- A description of all reasonable and feasible noise controls adopted to minimise Project noise impacts, as described above. This will include a summary of specific equipment attenuation commitments, operational controls and mine plan design;
- Management measures for the Project meteorological and noise monitoring program and a summary of responses to minimise noise impacts;
- Procedures for investigating noise monitoring results to confirm compliance with relevant impact criteria, if required; and
- Noise incident, complaint and reporting protocols for regulatory agencies and the local community.

The Noise Management Plan will be reviewed on a regular basis to ensure that the document incorporates any additional noise management measures put in place onsite over the life of the Project.

7.10 BLASTING

7.10.1 Background

A Noise and Blasting Impact Assessment for the Project was completed by PEL and is presented in full in **Appendix Q**. The blasting component of the assessment predicted the potential impacts of blasting activities on receivers and sensitive features in the vicinity of the Project and to recommend measures to manage and mitigate these impacts.

7.10.2 Methodology

The assessment was undertaken in accordance with the following policies and guidelines:

- The *'Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration'* (ANZECC, 1990);
- *'Assessing Vibration – a Technical Guide'* (DEC, 2006); and
- *'Australian Standard AS 2187: Part 2 – 2006 Explosives – Storage and Use'* (AS 2187) (Standards Australia, 2006).

The assessment calculated the likely ground vibration and overpressure levels generated by blasting required for the Project for each of the nearby receivers and sensitive features, for comparison with the relevant impact criteria.

As described in **Section 3.3.1**, the Project is likely to require a maximum of 6 blasts per week during the operational phase. Blasting will generally be undertaken during the hours of 7:00 am to 5:00 pm Monday to Saturday (excluding public holidays). Blasting effects to receivers or sensitive features depend on a number of interacting factors, including:

- Ground conditions including rock types, groundwater and strata layers;
- Distance from the blasting site;
- Maximum Instantaneous Charge (MIC) for the blast event;
- Topography between the blasting site and receivers or sensitive feature; and
- Atmospheric conditions at the time of blasting including wind speed, wind direction and vertical temperature gradient.

Overpressure and ground vibration levels for the Project were calculated based on a set of conservative site laws. This conservative approach assumed MICs of 410 kg, 1,000 kg and 3,500 kg as blasting has not previously been undertaken within the Project Boundary.

Blasting Criteria

Residential noise and vibration criteria associated with blasting are recommended in the *'Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration'* (ANZECC, 1990).

The blasting assessment identified a number of blast sensitive features and receivers where no specific criteria exist to assess impacts from blasting vibration and overpressure.

Where such features were identified, the most stringent criteria from AS 2187 for structural damage was used in consideration that further monitoring, condition inspection and trial blasts would be carried out to determine appropriate guideline limits.

7.10.3 Impact Assessment

Table 61 provides a summary of the predictions for selected private receivers. This table indicates that no exceedances of the ANZECC criteria are predicted for private receivers. Further detail on the blasting assessment on receivers is provided in **Appendix Q**.

TABLE 61 Blasting Impact Predictions for Private Residential Receivers

ID	Approx. Distance to Open Cut Mining Areas (m)	Vibration, mm/s				Overpressure, dB(L)			
		Criteria	MIC 410 kg	MIC 1,000 kg	MIC 3,500 kg	Criteria	MIC 410 kg	MIC 1,000 kg	MIC 3,500 kg
53	4,764	5	0.18	0.37	1.02	133	97	100	104
56	4,080	5	0.23	0.48	1.30	133	99	102	106
57A	4,346	5	0.21	0.43	1.18	133	98	101	105
57B	4,409	5	0.21	0.42	1.15	133	98	101	105
57C	4,324	5	0.21	0.44	1.19	133	98	101	105
58	3,331	5	0.32	0.66	1.80	133	101	104	108
60	3,004	5	0.38	0.78	2.13	115	102	105	109
61A	3,273	5	0.33	0.68	1.85	115	101	104	108
61B	3,261	5	0.34	0.68	1.87	115	101	104	108
65A	3,230	5	0.34	0.70	1.89	115	101	104	108
63	3,117	5	0.36	0.74	2.01	115	101	105	109
68	3,427	5	0.31	0.63	1.72	115	100	104	108
69	2,724	5	0.45	0.91	2.49	115	103	106	110
141	2,667	5	0.46	0.94	2.57	115	103	106	110
146	2,298	5	0.59	1.20	3.27	115	105	108	112
151	3,138	5	0.36	0.73	1.98	115	101	104	109
158	3,141	5	0.36	0.73	1.98	115	101	104	109
161	3,684	5	0.28	0.56	1.53	115	100	103	107
162	3,734	5	0.27	0.55	1.50	115	100	103	107
165	4,271	5	0.22	0.44	1.21	115	98	101	106
181A	4,950	5	0.17	0.35	0.96	115	97	100	104
181B	4,909	5	0.17	0.36	0.97	115	97	100	104
181C	4,937	5	0.17	0.35	0.96	115	97	100	104
181D	4,771	5	0.18	0.37	1.01	115	97	100	104
225	4,971	5	0.17	0.35	0.95	115	97	100	104
Bylong Oval	3,198	5	0.35	0.71	1.92	115	101	104	109
Bylong Community Hall	3,291	5	0.33	0.67	1.84	115	101	104	108

Table 62 presents a summary of sensitive features (including the heritage items) where exceedances of the blast impact criteria are predicted (bolded values indicate predicted exceedances).

Table 62 indicates that vibration levels at boulder RS03 are predicted to exceed the guideline limits. As the criteria are guideline levels only, additional condition inspection, monitoring and trial blasts will be undertaken to establish safe blasting limits.

The blast impact assessment predictions also indicate that three Historic heritage sites (Tarwyn Park, Harley Hill Cottage and Swiss Cottage) will potentially exceed the vibration and overpressure limits due to proximity of these sites to the proposed Eastern Open Cut. The significance of historic heritage sites in the vicinity of the Project and proposed management measures proposed are discussed further in **Section 7.12**.

The closest significant rock features were selected for the blasting assessment to provide an indicative calculation of blasting overpressure and vibration levels. A full list of results for all sensitive features is presented in **Appendix Q**.

For rock features in the local area, the blast impact assessment predicted overpressure levels of up to 129 dB(L) and ground vibration levels of up to 42 mm/s (assuming an MIC of 3,500 kg).

As there are no defined guideline limits to prevent rock falls from rock features as a result of blasting, detailed measures for the management of blast impacts to the rock features will be considered as part of the Blast Management Plan.

7.10.4 Mitigation and Management

KEPCO will develop a Blast Management Plan for the Project which will include appropriate management and mitigation measures to ensure that landform stability is maintained and that the relevant criteria are met for all private residential receivers. Further assessment will be undertaken where the nominated criteria are predicted to be exceeded at sensitive features. Here, further reductions in MIC may be required or blast damage remedied following the completion of blasting in close proximity.

TABLE 62 Blasting Impact Predictions for Sensitive Features

ID	Description	Approx. Distance (m)	Vibration (mm/s)*				Overpressure dB(L)*			
			Criteria	MIC (410 kg)	MIC (1,000 kg)	MIC- (3,500 kg)	Criteria	MIC (410 kg)	MIC (1,000 kg)	MIC (3,500 kg)
RS03	Boulder	85	50	114.8	243.3	638.4	133	139	142	146
EH005	Tarwyn Park	190	15	31.7	64.7	176.3	133	131	134	138
EH013	Harley Hill Cottage Remains	180	15	34.6	70.5	192.0	133	131	134	139
EH014	Tarwyn Park Potential Archaeological Deposit	248	15	20.7	42.2	115.1	133	128	131	135
EH016	Swiss Cottage	133	15	56.1	114.5	311.9	133	134	137	142
EH019	Tarwyn Park Stables	107	15	79.5	162.1	441.7	133	137	140	144
EH020	Potential Archaeological Deposit 3 (Chimney remains)	340	15	12.5	25.5	69.5	133	124	128	132

* **Bold** results indicate predicted exceedance of blast impact criteria under modelled MIC

A Blast Management Plan will be prepared to include the following management measures:

- Restriction of blast events to occur outside of adverse weather conditions, where possible;
- Commitment to complete dilapidation/condition surveys of private residences (on request), sensitive heritage sites, rock features and sensitive infrastructure prior to Project blasting. This will be undertaken to establish a baseline condition level and procedures for regular follow-up surveys;
- Undertaking smaller “trial blasts” to assist in the development of site specific “site laws” with regard to protecting sensitive features for the Project;
- Protocols for complaint’s response, property inspections and investigation;
- Protocols for road closures, community consultation and the establishment of blast exclusion zones of at least 500 m from public roads and private property;
- Development of a blast monitoring program which will include:
 - Detail on required blast monitoring procedures, including the use of a predictive meteorological element to guide the timing and design of blast events;
 - Ongoing monitoring of overpressure and ground vibration at representative private receivers and sensitive features (including heritage items) to ensure compliance with the relevant blast impact criteria;
 - Consideration of specific mitigation measures for the sensitive features, including utilising suitable MIC to meet predicted vibration limits, blast monitoring, and ongoing dilapidation/condition surveys for sensitive features;
 - Procedure for the review of blast fume generation; and
 - Regular review of blast design and recording of blast performance under different operational parameters (e.g. MIC, delay interval, burden and spacing, stemming, direction of initiation, charge depth and confinement) to minimise blast impacts.

7.11 ABORIGINAL ARCHAEOLOGY AND CULTURAL HERITAGE

7.11.1 Background

An Aboriginal Archaeological and Cultural Heritage Impact Assessment (AACHIA) was undertaken by RPS Australia East Pty Ltd (RPS) and is provided in full in **Appendix S**.

The purpose of the assessment was to identify and assess the potential impacts of the Project to Aboriginal archaeology and cultural heritage values and to recommend measures to mitigate and manage these impacts.

7.11.2 Methodology

Desktop Assessment

A comprehensive desktop assessment was undertaken which included:

- A review of previous archaeological and ethno historic information relevant to the regional and local area to assess the current status of Aboriginal archaeology and cultural heritage;
- A search of the OEH Aboriginal Heritage Information Management System (AHIMS) databases for all registered archaeological sites within the Study Area; and
- Development of a predictive model for Aboriginal archaeological sites within the Study Area.

Previous Aboriginal archaeological studies undertaken within the Project Boundary and its immediate vicinity were reviewed to gain an understanding of the Aboriginal archaeology and cultural heritage values of the area and to provide a basis for developing the predictive model. These studies included:

- Archaeological due diligence assessments completed by RPS (2011, 2012 and 2013) for a number of boreholes constructed within the Project Boundary;
- Surveys of approximately 64 ha for archaeological sites ahead of a proposed quarry extension located at Lots 53, 55 and 56 DP755420 Bylong Valley Way, Bylong, conducted by Archaeological Survey and Reports (2011). A total of 31 artefacts were identified in the survey, as at 2 March 2015 these sites and locations were not registered with AHIMS;

- Salvage and excavation of an archaeological site at Widden Creek Bridge conducted by RPS (2011). 3,000 artefacts were identified consisting mainly of mudstone. Artefact analyses demonstrated a variety of lithic technologies including formal tools with evidence of retouch and usewear indicating that the site was likely a procurement site;
- A Review of Environmental Factors (REF) prepared by Sinclair Knight Mertz (2008) for the proposed improvement works to the Bylong crossing loop along the Sandy Hollow to Gulgong Railway Line. An archaeological survey was completed on foot identifying one Aboriginal archaeological site, a moderate density scatter consisting of less than 50 artefacts. A potential archaeological deposit (PAD) was recorded in the same location;
- A draft heritage assessment conducted by HLA (2003) for eight borehole exploration sites located in A287. The assessment identified two isolated artefacts sites consisting of retouched fine-grained siliceous flake and silicate flake; and
- An Aboriginal Cultural Heritage Assessment conducted by Mudgee Local Aboriginal Land Council (2008) for the laying of an optical fibre cable 9 km from Bylong to Coggan Creek. The assessment identified a core and several flakes were identified within the optical fibre route. There is no information as to exact location of these objects.

The AHIMS database search identified a total of 21 registered archaeological sites within the Project Boundary, comprised of 12 isolated finds (55%), eight artefact scatters (40%) and one PAD (5%).

Aboriginal Stakeholder Consultation

Aboriginal stakeholder consultation was conducted in accordance with the *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (DECCW, 2010a) and the *Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (DEC 2005). Details of the consultation program are presented in **Section 5.6**.

Aboriginal Heritage Field Survey

In total, five weeks were spent in the field with all potential impact areas within the Study Area covered, including the Subsidence Study Area and the Project Disturbance Boundary. The field team consisted of two RPS archaeologists and 20 RAP organisations. The aims of the archaeological survey were to:

- Comprehensively survey for Aboriginal archaeological sites, by pedestrian transects and landform targeting within the Study Area;
- Identify Aboriginal Cultural Features present in the Study Area;
- Inspect where appropriate areas of known or potential Aboriginal cultural value, including AHIMS sites and areas identified by RAP representatives; and
- Provide sufficient data to facilitate the development of appropriate management and mitigation measures for Aboriginal sites, Aboriginal Cultural Features and areas of archaeological sensitivity.

A comprehensive archaeological survey methodology was adopted whereby pedestrian transects were undertaken within landforms identified over the Study Area. Each transect was recorded using a handheld GPS. The recording of survey units was undertaken using representative digital photographs and field notes which included observations of soils, ground surface exposure and visibility, vegetation cover, rock outcrops, levels of ground surface disturbance, erosion and any other relevant information. Landscape, soils and surface exposure characteristics along transects were recorded through descriptive notes and photographs.

All archaeological sites identified during the survey were recorded to a standard comparable to that required by the '*Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW*' (DECCW, 2010b).

A sampling strategy was adopted for the assessment, the Study Area was divided into discrete landforms based areas for the purpose of site description and analysis. Landform elements in the Study Area are provided in **Table 63**.

7.11.3 Impact Assessment

Archaeological Resource

The archaeological resources within the Study Area identified during the field study included 239 Aboriginal archaeological sites and cultural features (inclusive of the 21 previously registered with AHIMS) (see **Table 64** and **Table 65**).

Sites identified within the Study Area during the site survey (see **Figure 56**) included isolated finds, artefact scatters, rockshelters, grinding grooves, modified trees, PADs and an Ochre Quarry.

TABLE 63 Landform Elements Identified in the Study Area

Landform Element	Description
Cliff Lines	Outcropping sandstone and very steep slopes
Mid to Upper Slope – Jointed Sandstone	Mid to upper slopes under cliff lines containing outcropping sandstone with large talus boulders and rock fall
Stepped Creeks and Terraces	Creek lines that were formed with outcropping sandstone along the banks
Interlocking Spurs and Creek Lines	Interlocking spurs and creek lines along the middle catchment area of Dry Creek
Steep Slopes and Rolling Hills	Gentle and moderate slopes. Associated with the western tributaries of Dry Creek.
Cobbled Creeks and Flat Terraces	Cobbled creek lines. Associated with flat creek terraces adjacent to the main channel of Dry Creek.
Alluvial Plains	Relative level landform with extremely low relief, valley floor.
Volcanic Capped Hills	Undulating hill slopes.
Footslopes	Transition between the ridgeline and alluvial plains.
Incised V-Shaped Creek Lines and Slopes	Steep sloped landform with deeply incised V-shaped creek lines.
Flats and Slopes Adjacent to Major Channels	Flats and slopes adjacent to major channels.

TABLE 64 Summary of AHIMS Sites Within the Study Area

Site Type	Number	Percent
Isolated Find	12	55%
Artefact Scatter	8	40%
PAD	1	5%
TOTAL	21	100%

TABLE 65 Summary of Archaeological Aboriginal Sites Identified during the Survey

Site Type	Number	Percent
Isolated Find	104	47.71%
Artefact Scatter	91	41.75%
Rockshelter	13	5.96%
Grinding Groove	4	1.83%
Modified Tree	3	1.38%
Artefact Scatter + PAD	2	0.92%
Ochre Quarry	1	0.46%
TOTAL	218	100%

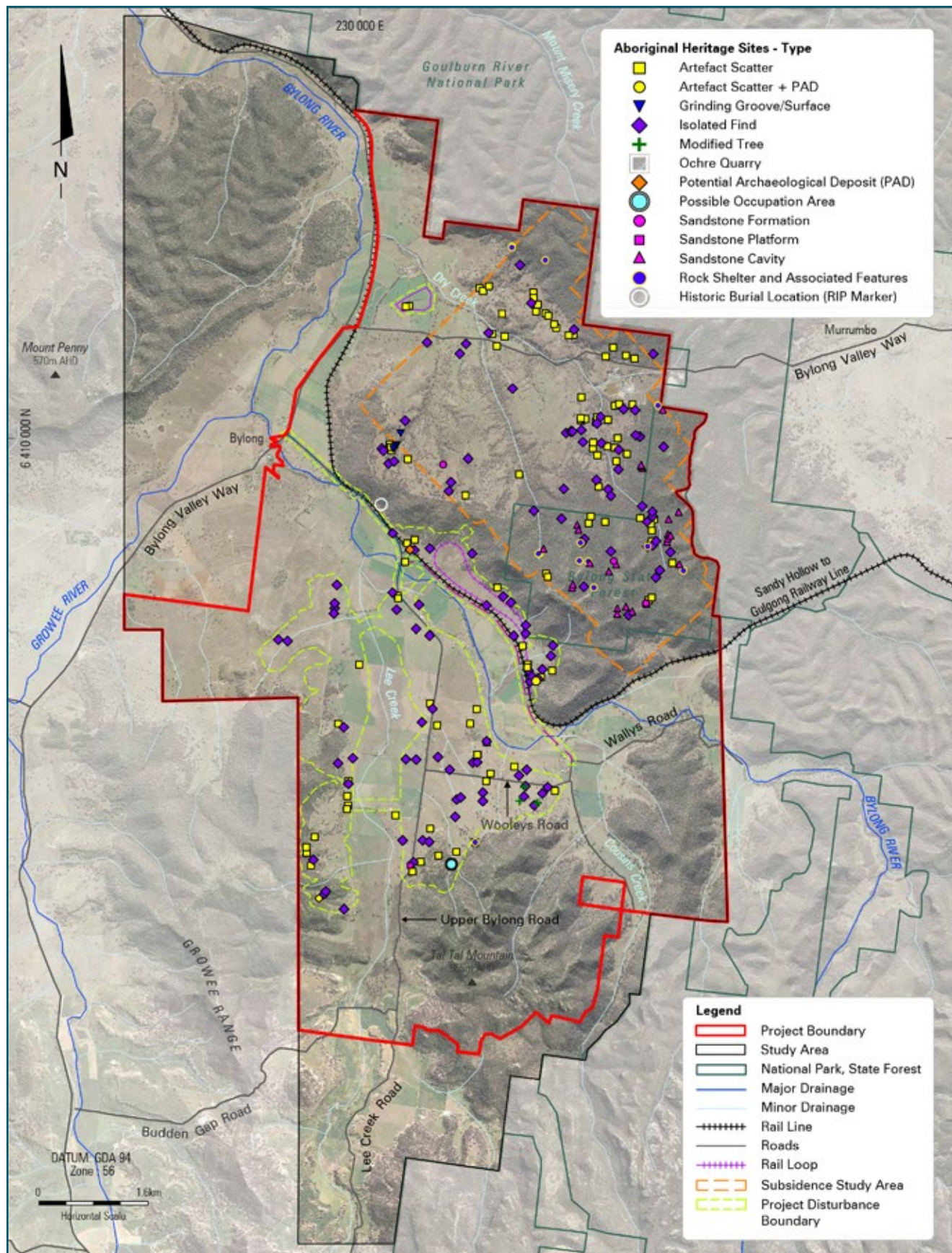
FIGURE 56 Aboriginal Heritage Sites

Figure 57 illustrates the 144 archaeological sites and cultural features identified as being at risk from the Project. Of the total 144 sites at risk of impact, 42 are identified as being at risk of indirect impacts (due to subsidence and blasting) and 102 are at risk of direct impacts (within the Project Disturbance Boundary). All remaining sites within and outside the Study Area will not be impacted.

Indirect Impacts

Potential indirect impacts include that of mine subsidence associated with the underground mining area and mine blasting associated with open cut mining operations. Of the 42 sites identified as being at risk of indirect impacts, 12 are archaeological sites and 30 are cultural features. The archaeological sites are inclusive of an ochre quarry, a grinding groove site and ten rockshelters.

Direct Impacts

Direct impacts of the Project are a result of the construction of open cut mining areas, development of OEAs and associated infrastructure. 102 sites were identified as being at risk of direct impacts. These sites consisted of surface artefact sites (95), artefact scatter with PAD (1), PAD (1), modified trees (3) and cultural features (2).

Significance Assessment

In Australia, the primary guide to the assessment of cultural significance is the Burra Charter, which defines “*cultural significance*” as the “*aesthetic, historic, scientific, social or spiritual value for past, present or future generations*” of a site or place. The significance of Aboriginal archaeological and cultural heritage sites and places can be determined through two avenues:

- The assessment of scientific significance by archaeologists; and
- The assessment of cultural or social significance by Aboriginal people.

Cultural Significance

The social and/or cultural significance determined by the RAPs is reflected in their responses to the assessment. Due to sensitivities, the responses received from RAPs are not included in the published AACHIA. The responses from the RAPs are summarised within **Appendix S**. Of the 27 RAPs, 16 provided a response to the Draft AACHIA. A summary of the cultural significance is provided below.

These responses, as well as information provided by RAPs during the cultural values assessment and discussion sessions determined that a high level of cultural significance should be ascribed to the ochre quarry, modified trees and grinding grooves present within the Study Area. Not all RAPs agreed unanimously on the significance of the sites. As such the level of cultural value is seen as a general consensus.

Archaeological (Scientific) Significance

Scientific value refers to the contribution that the heritage resource (i.e. an Aboriginal archaeological site or distribution) can make to knowledge and understanding of the past. A heritage resource is assessed according to four criteria; rarity, representativeness, research potential and educational potential. The degree to which it can contribute to knowledge is denoted by a significance rating.

A total of 25 sites were assessed to be of “*high local*” significance, nine were determined to be of “*moderate*” significance and 184 were determined to be of “*low*” significance. Of the 25 sites of “*high local*” significance, only seven were of high regional significance equating to less than 4% of total number of sites. Archaeological Aboriginal sites of high regional significance included the ochre quarry (OQ001), three grinding grooves (GG001-GG003) and three rockshelters with PAD (RS003, RS007 and RS013). The above listed sites are valued at both a local and regional level due to their individual rarity, representativeness, research and/or educational potential.

Table 66 lists the scientific significance rating associated with each archaeological site identified to be impacted in the Study Area.

Cumulative Impacts

A search of the AHIMS database for a 75,000 ha area centred on the Study Area provides a method of assessing the cumulative impact of the Project on the existing Aboriginal heritage resource of the Study Area. A search of the AHIMS database was undertaken for the AACHIA returned 168 records of current valid Aboriginal records. These comprised 79 surface artefacts, 44 surface artefacts containing PADs, two grinding grooves, 13 PADs and 30 rockshelters. Only 6,000 ha of the cumulative impact study area had been archaeologically surveyed thus if 100% of the area had been surveyed we would expect 2,100 sites to be present.

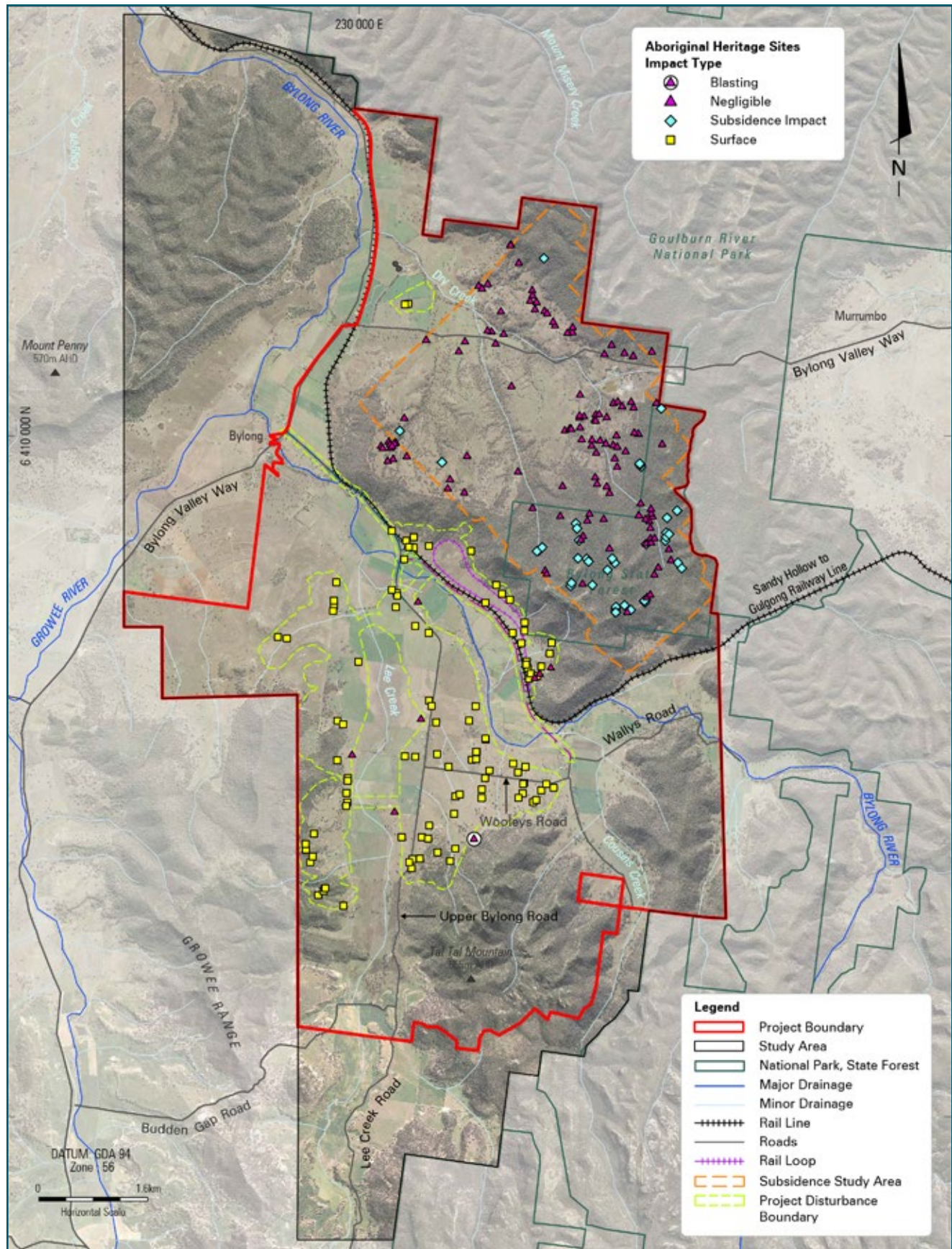
FIGURE 57 Aboriginal Heritage Site Impacts

TABLE 66 Indirectly Impacted Aboriginal Archaeology Sites and Management

Site ID	Site Type	Potential Impact	Regional Significance	Pre-Mining Mitigation	Post-Mining Mitigation
OQ001	Ochre Quarry	Cracking / Rock fall	High	Archival Recording	Monitoring
GG001, GG002, GG003	Grinding Groove	None	Low	Archival Recording	None Required
GG004	Grinding Groove	Cracking	Moderate	Archival Recording	Monitoring
RS001, RS006, RS007, RS009, RS011, RS013	Rockshelter	Cracking	Low	Test Excavation	Mitigation post-mining dependant on results of pre-mining test excavation
RS002	Rockshelter	Negligible	Low	Archival Recording	None Required
RS008, RS010, RS012	Rockshelter	Cracking	Moderate	Test Excavation	Mitigation post-mining dependant on results of pre-mining test excavation
RS003	Rockshelter	Blasting	High	Archival Recording	Inspections
CUL004, CUL007	Cultural Feature	Cracking / Rock fall	N/A	Archival Recording	Monitoring
CUL001, CUL002, CUL003, CUL005, CUL006, CUL008, CUL009, CUL012, CUL013, CUL015, CUL016, CUL017, CUL018, CUL019, CUL020, CUL021, CUL022, CUL023, CUL024, CUL025, CUL026, CUL027, CUL028, CUL029, CUL030, CUL031, CUL032, CUL033	Cultural Feature	Cracking	N/A	Inspection and Archival Recording	Monitoring

The Project will result in potential impact to 144 archaeological sites both within and outside the Subsidence Study Area and Project Disturbance Boundary. This produces a cumulative impact of less than 7% against the predicted 2,100 sites within the cumulative impact study area. Of the sites to be impacted, 4.9% are of high archaeological significance.

The majority of sites to be impacted are surface artefacts with low archaeological significance. Based on the projected total number of sites located within the cumulative impact study area, the cumulative impact of the Project to sites of high significance is less than 0.3%.

7.11.4 Mitigation and Management

To mitigate and manage impacts to Aboriginal archaeology and cultural heritage items, an AACHMP will be developed in consultation with the relevant regulators. The AACHMP will include:

- Detailed pre-mining and post-mining mitigation strategies for all Aboriginal archaeological sites and cultural features;
- A detailed research design for salvage methodologies;
- Detailed salvage methodologies to be carried out, including:
 - Surface collection of select archaeological sites;
 - Combined surface collection and excavation of select archaeological sites;

- Detailed management strategy for items identified to be impacted by subsidence inclusive of:
 - Full archival recording;
 - Engineering solutions to prevent rock fall and cracking if impact is unavoidable at the identified ochre quarry;
 - Regular inspection schedule;
- Specific mitigation and management measures will be developed to minimise any impacts on the ochre quarry (OQ01). These management and mitigation measures will include reasonable and feasible actions to reduce the potential for rockfalls or cracking of this site. Prior to the commencement of any works or actions that have the potential to impact OQ01, an archival recording and site specific management plan will be prepared;
- A staged Aboriginal heritage clearance process for all areas to be disturbed;
- Provision for all archaeological salvage work to be undertaken by, or under the supervision of qualified archaeologists and RAPs;
- Protection and conservation of archaeological sites that are not impacted by the Project by means of fencing and signage;
- Identification of the storage location (keeping place) and procedure for the care of salvaged artefacts in accordance with the '*Code of Practice for Archaeological Investigation for Aboriginal Objects in New South Wales*' (DECCW, 2010);
- Provision for modified trees to be removed in consultation with RAPs and a qualified arborist;
- Provision for the discovery of human remains;
- Provisions to facilitate continuing access to non-salvaged Aboriginal archaeological sites within and outside of the Project Disturbance Boundary for archaeological research purposes; and
- Periodic review of the AACHMP.

As part of the implementation of the AACHMP, Aboriginal Site Impact Recording Forms (ASIR Forms) will be completed.

Indirect Impacts

In order to mitigate indirect impacts of the Project, full archival recordings will be completed pre-mining at sites predicted to be indirectly impacted. Regular monitoring of these sites post-mining will identify any potential impacts at which point all reasonable and feasible measures will be investigated and implemented to prevent further impact.

Direct Impacts

To mitigate the Project's direct impacts on archaeological sites a surface collection will be undertaken for sites within the Project Disturbance Boundary (including artefact scatters, isolated finds and modified trees). The surface collection process may be staged in conjunction with the commencement of ground disturbing works within the area of surface artefacts.

Test Excavation and Salvage Excavation

It is recognised that the complete archaeological resource within the Study Area is not identifiable by surface surveys alone. Therefore, a program of subsurface test excavation and salvage excavation will be undertaken for select sites to obtain a more detailed understanding of the nature and extent of Aboriginal archaeology within the Study Area.

The program will include a geomorphological assessment, followed by test excavation and then a salvage excavation. The program will be developed in consultation with RAPs and will be informed by the relevant technical specialists to ensure practicality. The program will include salvage excavation of the archaeological sites impacted by the Project that are of high significance. Further, the program will utilise the results of the archaeological field survey, including identified PAD sites and areas of archaeological sensitivity, to develop an appropriate scientific research methodology.

Conservation and Management

Conservation and management activities will be undertaken for all archaeological sites within the Project Boundary that are not anticipated to be impacted by the Project. These sites will be identified on onsite plans to avoid accidental disturbance and included in the AACHMP. Where mining activities will occur in close proximity to recorded archaeological sites, fencing will be erected.

Table 66 and **Table 67** lists the mitigation and management measures associated with each archaeological site identified to be indirectly and directly impacted in the Study Area, respectively.

TABLE 67 Directly Impacted Aboriginal Archaeology Sites and Management

Site ID	Site Type	Potential Impact	Regional Significance	Mitigation
Bylong River PAD 1	PAD	Surface Impact	Moderate	Excavation
AS077	PAD + Artefacts	Surface Impact	Moderate	Excavation
MT005, MT007, MT008	Modified Tree	Surface Impact	High	Conservation by controlled removal
CUL010, CUL011	Cultural Feature	Surface Impact	N/A	Archival Recording
AS005, AS007, AS011, AS012, AS013, AS014, AS035, AS041, AS043, AS044, AS045, AS046, AS047, AS048, AS049, AS050, AS051, AS052, AS053, AS054, AS055, AS056, AS057, AS058, AS059, AS064, AS067, AS069, AS070, AS071, AS072, AS073, AS074, AS075, AS076, AS092, AS093	Artefact Scatter	Surface Impact	Low	Salvage
RPS Bylong AS10	Artefact Scatter	Surface Impact	Low	Salvage
BE-IF-01, BE-IF-02, BE-IF-03	Isolated Find	Surface Impact	Low	Salvage
RPS Bylong River 1, RPS Bylong IF3, RPS Bylong IF6	Isolated Find	Surface Impact	Low	Collection
IF003, IF004, IF006, IF007, IF008, IF029, IF030, IF032, IF038, IF039, IF040, IF041, IF043, IF044, IF045, IF046, IF047, IF056, IF057, IF058, IF059, IF060, IF066, IF068, IF069, IF070, IF071, IF072, IF073, IF074, IF076, IF077, IF078, IF079, IF080, IF081, IF090, IF091, IF092, IF093, IF094, IF095, IF096, IF097, IF098, IF099, IF100, IF101, IF102, IF103, IF104, IF105, IF106, IF109	Isolated Find	Surface Impact	Low	Collection

7.12 HISTORIC HERITAGE

7.12.1 Background

A Historic Heritage Impact Assessment (HHIA) was undertaken by AECOM Australia Pty Ltd (AECOM) and is provided in **Appendix T**. The purpose of the assessment was to identify and determine the impacts on historic heritage items and areas of archaeological potential within the Study Area and to recommend measures to mitigate and manage these impacts, as required.

Settlement

William Lawson and James Blackman are likely to have been the first Europeans to explore the Bylong district. In 1822 they headed north-eastward from Bathurst towards the Goulburn River with Lawson describing the country as *"interspersed with plains here and there of the best of land, the grass excellent, very thick with herbs and vines intermixed, watered by innumerable fine runs of water. This is a beautiful country for sheep"*.

For much of its early history, land within the Bylong Valley was occupied by a handful of pioneering families. The two earliest and most significant landholders were the Lee and Tindale families. Historical records suggest that the Bylong Valley was first explored in detail and settled by William Lee between 1823 and 1824. By 1828 the Lee family received title to approximately 2,000 acres of the best pasture land in the Bylong Valley on which they ran approximately 2,700 sheep, 320 cattle and 15 horses. The original Lee Homestead *"Homestation"*, built on the 2,000 acre plot, was the first stone house built in Bylong and dates to 1848. In 1829 John Tindale, an associate of William Lee was officially granted title to a 2,000 acre plot of land to the south-west of the Lee property on the opposite side of the Bylong River which he named "Bylong".

After the initial settlement of the area by the Lees and Tindales in the 1820s and 1830s, the 1840s saw John Davis arrive in the valley and settle north of Dry Creek. John Mead was also an early settler in the area, arriving in the 1850s taking up properties to the north of Bylong Township over the Mt Penny Ranges and down to the banks of the Bylong River.

The Bylong Valley has several links to known bushrangers including Frederick Wandsworth Ward (aka Captain Thunderbolt), Elizabeth “Jesse” Hickman (the Lady Bushranger) and Henry Arthur “Harry” Readford (Captain Starlight) who are suspected to have used the rugged sandstone cliffs and caves above the Bylong Valley as hideouts.

Land Use History

Historically land use within the Bylong Valley can be characterised as pastoral, with a focus on breeding cattle and thoroughbred horses. Throughout the nineteenth century, the Lee and Tindale families in Bylong were heavily involved in horse breeding for the burgeoning racing industry in Sydney. Numerous historical sources attest to the Valley’s fame, during both the nineteenth and twentieth centuries, for the production of high quality cattle and thoroughbred horses. In addition, Bylong Valley was well known for the production of crops such as lucerne, rye, prairie and English grasses.

The small township of Bylong developed slowly throughout the nineteenth and twentieth centuries, and has generally never comprised more than a few centrally located community buildings, churches and stores which are thought to have developed around the adjacent Tindale property “Sunnyside”. Prior to the 1880s, Bylong was a district of isolated farmsteads with a small local population and few community facilities.

With the exception of the operation of a Cheese Factory during the early part of the twentieth century, the Bylong Quarry (1940s), and various general stores, commercial developments in Bylong have been limited. The construction of civic buildings has likewise been limited, having been confined to churches, public halls and schools. Approval for a railway line passing through Bylong was granted in 1927 however was abandoned in the 1950’s and work did not recommence until the 1980s for the purpose of a heavy-haul railway line to the Ulan Coal Mine. **Table 68** provides a summary of key historical developments within the Bylong Valley.

7.12.2 Methodology

The HHIA was undertaken in accordance with the *NSW Heritage Manual* (NSW Heritage Office & NSW Department of Urban Affairs and Planning, 1996) and with reference to the Burra Charter (the Australia ICOMOS Charter for Places of Cultural Significance, 2013). The methodology for the assessment consisted of several components to ensure that all relevant historic heritage items that had a potential to be impacted by the Project were identified.

These items were assessed for their conservation values and the potential impacts that may occur as a result of the Project and recommended mitigation measures to manage these potential impacts. This included:

- Background research of land within the Project Boundary so as to identify historic heritage items, including areas of archaeological sensitivity;
- Review of the relevant historic heritage registers and lists to identify any known heritage items of significance that may have the potential to be impacted by the Project including:
 - Register of the National Estate (non-statutory);
 - National Heritage List;
 - Commonwealth Heritage List;
 - NSW State Heritage Register;
 - National Trust of Australia; and
 - Schedule 5 of the Mid-Western Regional LEP.
- Discussions with the local historic societies to identify historic heritage items including areas of archaeological sensitivity;
- Meetings with local landowners in order to prepare oral histories for the local area: and
- A targeted archaeological survey of land within the Project Disturbance Boundary over a six-day period in May 2014.

The following guidelines have been adopted for this assessment:

- *NSW Heritage Manual* (NSW Heritage Office and NSW Department of Urban Affairs and Planning, 1996a);
- Burra Charter (the Australia ICOMOS Charter for Places of Cultural Significance) (ICOMOS (Australia), 2013);
- NSW Heritage Branch’s Guidelines: *Assessing Heritage Significance* (NSW Heritage Office, 2001);
- *Levels of Heritage Significance* (NSW Heritage Office, 2008); and
- NSW Heritage Branch’s guidelines: *Statements of Heritage Impact* (NSW Heritage Office, 2002).

TABLE 68 Key Historical Developments Timeline

Date	Key Historical Development	Date	Key Historical Development
Pre-1820s	Occupation by the Wiradjuri speaking Aboriginal people	1908	Bylong Estate listed for sale, bought and subdivided
c.1823	William Lee first explores and settles in Bylong Valley	1910-1926	Cheese factory operational
c.1823	John Tindale settles in Bylong and Widden Valley	1911	"Bylong Station" listed for sale
1840s	John Lee, William's son takes over the Bylong properties	1912	"Swiss Cottage" constructed
1840s	Cattle replaces sheep within the valley	1915	Bylong Post Office constructed
1840s	Thoroughbred horse breeding begins in the valley	1915	Sacred Heart Catholic Church Bylong constructed
1840s	Davis family arrives in the valley	1921	Bylong Hall constructed
1848	Construction of first stone building "Homestation"	1920s	Bylong Upper Hall constructed
1850s	John Mead settles in the valley	1920s	Elizabeth "Jesse" Hickman (the Lady Bushranger) active in the area
1860s	Captain Thunderbolt active in the area	1926	Tarwyn Park House constructed
1864	Tindale homestead "Sunnyside" constructed	1927	Bylong Upper School constructed
1866	Bylong (horse) wins the Great Metropolitan Handicap at Randwick	1936	Railway construction begins
1876	St Stephens Anglican Church constructed	1940s	Quarrying begins at Bylong
1880-1920s	Several schools operating	1951	Railway construction stopped
1890s	The Lees property holdings begin to diminish	1980	Railway construction restarted
1898	"Harley Hill" farm complex established	1982	Railway completed
		2010	Coal exploration begins in Bylong

7.12.3 Impact Assessment

A total of 18 sites were identified within and directly adjacent to the Study Area. Of these three are listed on the non-government organisation National Trust (NSW) Register and an additional 15 historical heritage items or complexes are considered to be of local heritage significance (see **Figure 58**).

There are no heritage items or sites within the Project Boundary listed on statutory UNESCO, Commonwealth or NSW State or Local Government Lists, Registers or Schedules.

An overview of each site and its associated local historical significance is provided in **Table 69**. The development of the Project will result in direct impacts (i.e. removal) to seven historic heritage sites identified within the Project Disturbance Boundary and partially impact on an additional five sites as listed in **Table 69**.

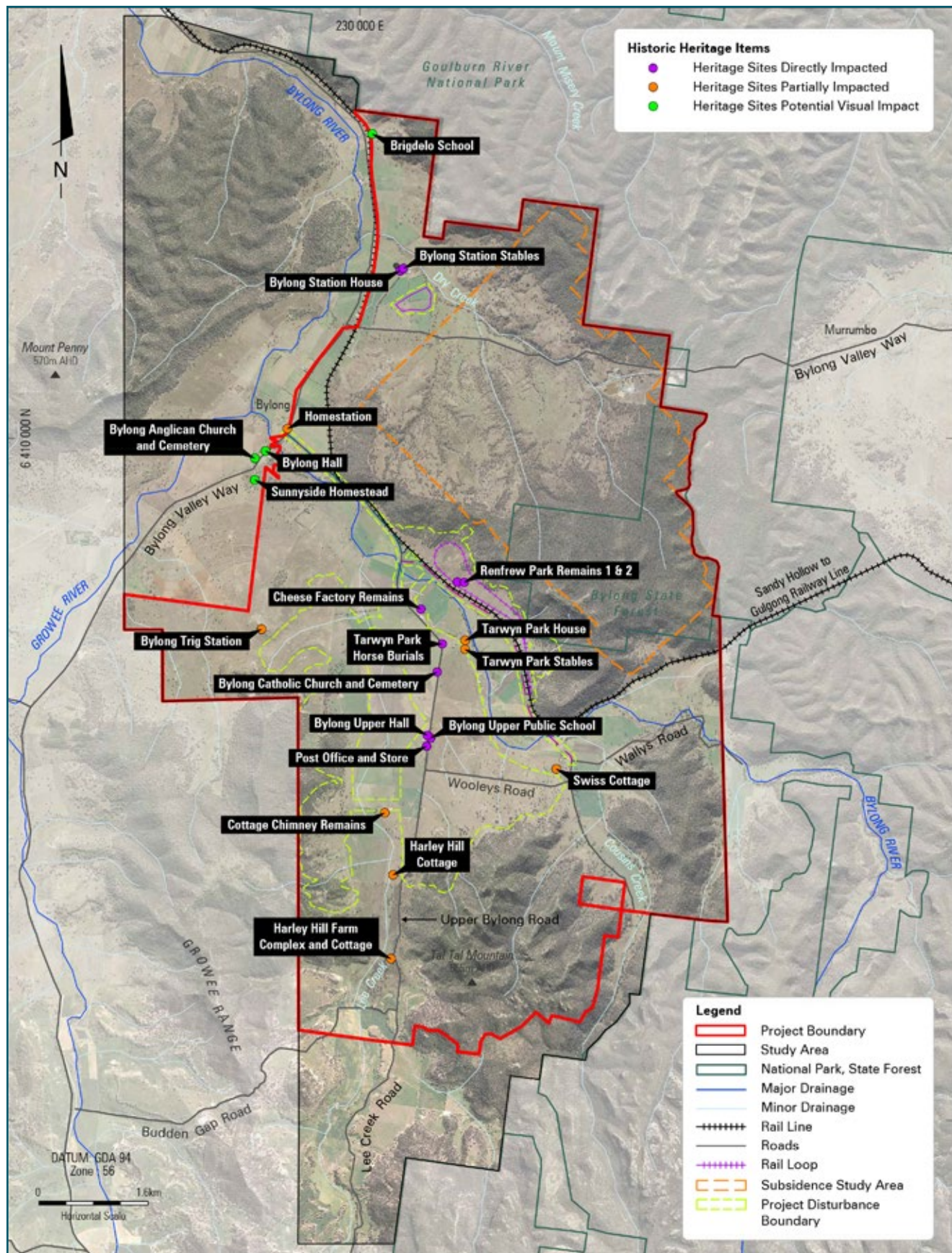
FIGURE 58 Historic Heritage Sites of Local Significance

TABLE 69 Historic Heritage Sites

Site	Description	Significance	Impact
ITEMS DIRECTLY IMPACTED TO BE DEMOLISHED			
BUPS	The school consists of two detached buildings and associated grounds. The original Bylong Upper Public School was built in 1912 and was moved to its current location in 1927 with the second building constructed in 1975.	Local	Direct/Whole Demolition
Cheese Factory Remains	Remnants of the cheese factory include broken sandstone, channels, and an air flow vent. The Cheese Factory was established in Bylong in 1910 and was the first major commercial operation in the Bylong Valley operating for 14 years before its closure in 1926.	Local	Direct/Whole Destroyed
Our Lady of the Sacred Heart Catholic Church and Cemetery	The former Catholic Church site, which opened in 1915, comprises a church building and four marked graves. The church building is a simple Carpenter Gothic style representative of vernacular timber rural churches in Australia.	Local	Direct/Whole Demolition
Renfrew Park Remains 1 & 2	The building has been demolished with sandstone blocks heaped together and sandstone footings only visible through thick vegetation.	Local	Direct/Whole Destroyed
Upper Bylong Post Office and Store	The Bylong Post Office was established on the Chapman property known as Almeria in 1915. It is a single storey detached structure with a verandah, timber framed floors, walls and roof with brick masonry foundation footing.	Local	Direct/Whole Demolition
Bylong Upper Hall	The hall consists of a simple timber framed rectangular structure built in the 1920s and was used for a number of functions including movie nights in the 1950s.	Local	Direct/Whole Demolition
ITEMS PARTIALLY OR INDIRECTLY IMPACTED			
Homestation	Homestation consists of a single square sandstone brick structure in Victorian style and was the first stone building built in Bylong in 1848. The building is in poor condition with only the brick walls and foundation stones of the building currently remaining.	Local	Potential Low Visual
Bylong Station Farm Complex	The complex consists of the Bylong Station House, stables and a number of farm buildings. The farm complex was known historically, as was its owner John Lee, as a producer of some of the best cattle and thoroughbred horses in Australia throughout the mid to late nineteenth century and early twentieth century.	Local	Direct / Visual
Sunnyside	Based on local interviews the Sunnyside homestead built in 1864 was demolished during the last 20 years.	Local	Potential Low Visual
Bylong St Stephens Anglican Church and Cemetery	The complex consists of a simple sandstone and rendered brick Early English Gothic Revival style church and cemetery. The cemetery contains 44 graves and churchyard monuments from the late nineteenth and twentieth centuries.	Local	Potential Low Visual
Harley Hill Farm Complex and Cottage	The complex consists of a modern farmhouse, cottage remains, blacksmith shed, shearing shed, a number of farm buildings and a rubbish mound containing materials from the original homestead. The farm complex is representative of an early twentieth century rural pastoral station in NSW which has survived in its original layout.	Local	Visual / Vibration
Bylong Trig Station	Consists of a plinth with square concrete base and vertical concrete square column with metal cylindrical mounting typical of stations constructed from the 1870s onwards. The vane, which should be mounted on the metal cylinder, is missing.	Local	Visual

Site	Description	Significance	Impact
Swiss Cottage	The cottage is part of the Helvetia farm and comprises a simple rectangular building demonstrative of an early twentieth century rural farm building.	Local	Visual / Vibration
Bylong Hall	The hall opened in 1921 and consists of a simple timber framed rectangular structure.	Local	Potential Low Visual
Tarwyn Park Farm Complex	The complex consists of the homestead constructed in 1926, stables, various farm buildings, rubbish mound containing antique bottles and racehorse burial sites (Rain Lover and Eloisa). The area is also the location where the Natural Sequence Farming (NSF) was first developed and practiced.	Local	Direct / Visual / Vibration
Cottage Chimney Remains	The remains consist of a standing layered sandstone brick chimney and attached fireplace in poor condition.	Local	Visual / Vibration
Bylong Valley Cultural Landscape	The Bylong Valley Cultural Landscape reflects the physical and cultural character of its use by both Aboriginal and European people. The valley, comprising a number of natural elements, is of distinctive aesthetic value. The area has a rich cultural history as a geographically isolated frontier style settlement that develops into a vibrant pastoral centre known Australia-wide throughout the late nineteenth and twentieth centuries for its rich, fertile pastoral lands and breeding of high quality cattle and thoroughbred horse. The landscape has a distinct pastoral character which is reflected in its natural and man-made features.	Local	Direct / Visual
Bylong Landscape Conservation Area	The Bylong Landscape Conservation Area includes the valley and pasture landscapes beside the Bylong Valley Way, the valleys adjoining the Wollar Road westwards to Razorback Ridge, the valleys of the Growee River and Sawyers and Jumper Creeks, the valley of Cousins Creek, the valley of Kerrabee Creek and the valley of Baerami Creek. The Bylong Valley has been home to numerous horse studs. The champion racehorse and sire Heroic was born in the area. Much of Bylong Valley Way is nestled between the Wollemi and Goulburn River National Parks. The area has significance as prime agricultural land with a rural landscape of exceptional scenic value.	Local	Direct / Visual

Blasting Impacts

Ground vibrations and overpressure associated with blasting have the potential to indirectly impact the structural integrity of the identified historic heritage sites. A blasting assessment undertaken for all historic heritage items within the Study Area (see **Section 7.10**) predicted that vibration and overpressure impact levels may exceed assumed limits (i.e. 15 mm/s) for the following structures (with MIC of 410 kg):

- Tarwyn Park Homestead (31.7 mm/s);
- Tarwyn Park Stables (79.5 mm/s);
- Harley Hill Cottage Remains (34.6 mm/s); and
- Swiss Cottage (56.1 mm/s).

Visual Impacts

The carrying out of the Project, including development of open cut mining areas, OEAs and associated mine infrastructure will modify the existing visual environment and potentially the visual aesthetics of the surrounding heritage sites. The Visual Impact Assessment undertaken by JVP Visual Planning and Design describes the likely visual impacts associated with the Project on sensitive receivers in the surrounding area (see **Section 7.17**). A list of visually impacted or potentially visually impacted heritage items and landscape areas is provided in **Table 69**.

The recommended Rehabilitation Strategy, proposed final landform, revegetation strategy and other visual mitigation strategies will ensure that a landscape of high visual diversity is realised in the long term.

Subsidence

A subsidence assessment was completed for the Project by MSEC (**Section 7.1**). The assessment found that no built items would be impacted as a result of longwall extraction related subsidence.

7.12.4 Mitigation and Management

The development of the Project will result in direct impacts to seven historic sites within the Project Disturbance Boundary. These sites will need to be removed prior to disturbance subject to the following measures being implemented at each site, where appropriate:

- Archival recordings, including scaled drawings and photographs, prepared in accordance with *How to Prepare Archival Records of Heritage Items* (Heritage Office, 1998) and *Photographic Recording of Heritage Items using Film or Digital Capture* (Heritage Office, 2006);
- Test excavation, and salvage excavation (as determined by testing);
- Excavation and exhumation in accordance with legislative, regulatory and statutory requirements and consultation with descendants and relatives; and
- Documentation, including photographic record.

Blast Management

To ensure blast vibration and overpressure are managed to minimise impacts to adjacent historic sites, KEPCO will prepare a Blast Management Plan as described in **Section 7.10.4**.

The following management will be undertaken for each item:

- A dilapidation assessment will be completed for each item prior to potential impact from vibration caused by construction or operation activities;
- During both construction and mining operations, KEPCO will design blasting operations with due consideration of vibration impacts at each item avoids, where practicable exceeding the levels predicted in the EIS Noise and Blasting Impact Assessment (Pacific Environment Limited, 2015) when blasting in closest proximity assuming a MIC of 410 kg;

- At the site of each item identified above, where proposed vibration will exceed 15 mm/s, an assessment will be undertaken by a suitably qualified structural engineer to determine whether, on the basis of the maximum predicted vibration, mitigation measures such as temporary bracing should be put in place to reduce any possibility of mine blast related damage. Further, a site specific monitoring program will be instigated to ensure any damage from mine blasting is readily identified; and
- Once open cut mining operations have been completed, any damage identified from the monitoring program will be assessed and a targeted works program will be implemented with the aim of restoring the item to a structurally stable state similar to that of its pre-existing condition.

Visual Impact Management

Several mitigation measures to reduce visual impacts at sensitive viewing locations, including historic heritage sites, have been incorporated into the design and operation of the Project, including:

- Onsite treatments include progressive rehabilitation of disturbed landforms; and
- Viewer location (offsite) treatments including a range of treatments to screen views or filter views as required.

Historic Heritage Management Plan

As part of the EMS for the Project, KEPCO will prepare a Historic Heritage Management Plan, which will include:

- A list and map indicating the location of historic heritage sites identified within the Project Boundary;
- A final significance assessment and Statement of Significance for each historic heritage site;
- Procedures for archival recording of impacted heritage items in accordance with Heritage Branch Guidelines *How to Prepare Archival Records of Heritage Items* (1998) and *Photographic Recording of Heritage Items using Film or Digital Capture* (2006).
- Management procedures, including dilapidation reports, impact prevention measures, and remediation strategies for potentially impacted heritage items;
- Details and procedures, including research design, for carrying out test and salvage excavations (if required) for the Cheese Factory Remains; and
- Unexpected finds procedure, including a specific procedure for human remains.

Conservation Management Plans

Conservation Management Plans will be included as appendices to the Historic Heritage Management Plan in accordance with the principles of Kerr's *Conservation Plan* (2013) and the Burra Charter. Conservation Management Plans will be prepared to guide the conservation of Tarwyn Park Farm Complex, Bylong Station Farm Complex and Homestation.

7.13 HISTORIC BURIALS

7.13.1 Background

An Archaeological Assessment for Historical Burials was undertaken by Edward Higginbotham and Associates Pty Ltd within the Study Area and is provided in full in **Appendix U**.

The objectives of the Archaeological Assessment for Historical Burials were to:

- Identify potential historical burials within the Study Area;
- Assess the cultural significance and surviving condition of any identified historical burials; and
- Make recommendations to the management and protocols relating to any identified historical burials arising from the development of the Project.

This assessment was undertaken in association with the HHIA prepared by AECOM as discussed in **Section 7.12**.

Location of the Site

The former Catholic Church and Cemetery of Our Lady of the Sacred Heart (the former Catholic Church) is located on the western side of Upper Bylong Road, in Upper Bylong (see **Figure 58**). The former Catholic Church comprises a church building and associated graves located on an approximate 4,000 m² plot of land.

The Catholic Diocese of Bathurst purchased the site and constructed the church in 1915. The use of the church continued until 2000 when it was closed. The Catholic Diocese of Bathurst sold the site in 2008 to Mr Beaumont Kingsley Ward and Ms Belinda Susan Sullivan. A Deed Poll was entered into between the Trustees of the Catholic Diocese of Bathurst and Mr Ward and Ms Sullivan stating a number of obligations relating to the maintenance and access to the Cemetery for representatives of the Catholic Diocese of Bathurst, direct descendants of those buried there and persons undertaking legitimate historical research.

The site was purchased by the Wallings Pastoral Company in about 2010. The Wallings Pastoral Company was acquired by KEPCO in February 2014. KEPCO has continued to satisfy the maintenance and access obligations regarding the Cemetery.

If development consent is granted in relation to the Project, KEPCO understands that the Deed Poll shall no longer apply by operation of section 28 of the EP&A Act and clause 1.9A of the Mid-Western Regional LEP. Together, these provisions operate so as to enable KEPCO to carry out the Project despite the restrictions contained in the Deed Poll, if development consent is granted for the Project. In light of this position, KEPCO has commenced consultation with the beneficiaries of the Deed Poll and will continue to do so throughout the assessment of the Development Application for the Project.

Four marked graves are located within the Cemetery. Evidence is also available to suggest that there is a number of potential unmarked burials on this land.

Another potential burial has been identified on the Renfrew Park property owned by KEPCO, on the northern side of the Sandy Hollow to Gulgong Railway Line. The site at Renfrew Park includes a timber fenced burial enclosure with a stone marker.

The Archaeological Assessment for Historic Burials did not include consideration of the potential for Aboriginal burials. This matter has been addressed within the AACHIA (**Appendix S**).

7.13.2 Methodology

The Archaeological Assessment for Historic Burials was prepared in accordance with the *NSW Heritage Manual (as revised)* (Heritage Office and Department of Urban Affairs and Planning, 1996). The methodology for the Archaeological Assessment for Historic Burials is discussed below and included:

- Site surveys;
- Historical research; and
- Assessment of archaeological significance.

Site Survey

A site inspection of the former Catholic Church was completed by Edward Higginbotham and Associates Pty Ltd on 11 February 2014. A preliminary Ground Penetrating Radar (GPR) survey was completed by Suresearch on 9 April 2014. The preliminary GPR survey confirmed the four marked burials and identified up to eighteen other disturbance areas potentially indicating graves.

A second and more detailed GPR survey was carried out by GBG Australia on 26 and 27 June 2014, which provided high resolution reflection images of the subsurface to a depth of 2 m. The GBG Australia report (see **Appendix U**) identified only three probable grave sites and five locations of disturbed ground at depths varying from 0.5 m to 1.0 m each of which could possibly be a burial site.

Site survey at Renfrew Park has been unable to confirm whether the site marks the burial of a human or animal. Consultation with local landholders suggests the site may be the grave of a rail construction worker.

Historical Research

Edward Higginbotham and Associates Pty Ltd commissioned an historian, Dr. Terry Kass, to research and prepare historical biographies of those individuals known to be buried in the former Catholic Church Cemetery. The four marked burials in the Cemetery have been identified as:

- John Gerald Burke died on 24 April 1932, aged 62 years;
- Hugh Francis Cobrey, born County Mayo, Ireland 1843, died 2 January 1929, aged 86 years;
- Susan Alenia [Helena] Cecelia Cobrey, died 22 November 1946, aged 76 years; and
- Ethel Kate Readford died 1 June 1937, aged 58 years.

Of the eight potential unmarked burial sites described in the GBG Australia report, only one has been identified. This is the burial site of Gerard William Campbell who died at birth on 12 January 1931 and was buried on 13 January 1931.

In order to attempt to identify the other potential burials at the site and the person potentially buried at Renfrew Park, a search continues to be undertaken by the Registrar General for Death Certificates recorded at Rylstone and Mudgee, relating to burials within the vicinity of the Bylong Village. As of August 2015, no further identifications have been made.

Archaeological Significance

As discussed in **Section 7.12**, there are no heritage listings on the State Heritage Register, State Heritage Inventory or on Schedule 5 Environmental Heritage to Mid-Western Regional LEP for the former church, nor for the burial on private land. The former Church and Cemetery was classified by a non-government organisation, the National Trust of Australia (NSW) on 24 September 2013.

As indicated in **Section 7.12**, the Statement of Significance prepared as part of the HHIA identified the former Catholic Church to be of local, historical, social, contributory and representative significance. The Statement of Significance is expanded in the Archaeological Assessment for Historic Burials to include the Cemetery. By including the Cemetery the site is also assessed to be of aesthetic, scientific and representative significance.

The surviving headstones indicate a range of monumental masonry, principally derived from workshops in Mudgee. The coffins and grave furnishings may reveal aspects of traditional technology, styles and fashions. The Cemetery and burials may contribute to a number of research themes in historical archaeology and are typical of a small rural church and community.

There is very limited historical documentation in relation to the Renfrew Park site.

7.13.3 Impact Assessment

The former Catholic Church and Cemetery is located within the Project Disturbance Boundary. Burial sites within the Cemetery will need to be exhumed and relocated following consultation with various stakeholders and the receipt of the necessary approvals.

The burial enclosure at Renfrew Park will not be impacted by the Project as it is located outside of the Project Disturbance Boundary to the north-west of the Underground MIA and rail loop.

7.13.4 Mitigation and Management

Commitments to mitigation and management strategies for the former Catholic Church and Cemetery are set out in the HHIA and summarised in **Section 7.12**.

In order to complete the archaeological investigation and exhumation of the burials located within the former Catholic Church Cemetery and complete the reburial of the remains at an alternative location(s) having regard to the views of descendants and the relevant regulations and guidelines, KEPCO will:

- Seek to identify and make contact with all descendants through public notifications in National State and relevant Regional and Local newspapers and the Journal of the Genealogical Society;
- Conduct consultations with all known descendants;
- Seek the statutory permits and approvals for the exhumation and depending on the management practices of the place of reinterment re-erection of the grave markers;
- Stakeholders in the exhumation and relocation process may include:
 - KEPCO;
 - Relatives and descendants;
 - Community members;
 - The Catholic Church and possibly other denominations; and
 - Relevant consent/approving authorities;
- Develop a Burials Management Plan to outline the process for obtaining all relevant approvals, procedures and reporting necessary to the exhumation and reburial of the remains. The Burials Management Plan will detail the following:
 - Applications for Exhumation for each burial recorded in the former Catholic Church Cemetery, signed in accordance with the provisions of the *Public Health Regulation 2012*;
 - Community liaison plans and procedures;
 - Procedures for the exhumation, relocation and reburial;
 - Location and requirements for forensic analysis and storage of skeletal material, prior to reburial;
 - Procedure for accidental discovery of human remains;

- Recommendations for selecting a suitable location for the relocation and reburial; and
- Appendices including:
 - Procedures for archaeological investigation and forensic analysis; and
 - Conditions for approval for exhumation, under the *Public Health Regulation 2012*.

The International Council on Monuments and Sites (ICOMOS) Burra Charter (2013) is the guideline accepted by the heritage and archaeological professions as setting the standard for professional practice in this industry. Article 30 states that “*competent direction and supervision should be maintained at all stages, and any changes should be implemented by people with appropriate knowledge and skills.*”

The exhumation of burials is a sensitive issue for any community. For this reason, persons with appropriate expertise will be responsible for each part of the process.

7.14 SOILS AND LAND CAPABILITY

7.14.1 Background

A Soil, Land Capability and Strategic Agricultural Land Assessment was undertaken for the Project by SLR Consulting and is provided in full as **Appendix V**. The purpose of the assessment was to:

- Classify and define the soil types present within the Study Area;
- Provide a description and mapping of the pre and post-mining land capability within the Study Area;
- Assess the potential impacts of the Project on soils and land capability;
- Assess and quantify the potential impacts of the Project on verified BSAL (using a risk based approach) with the specific intention to inform the BSAL Reinstatement Plan (further detailed in **Section 7.15.2**);
- Determine the topsoil availability, stability and suitability for ongoing disturbance management and post-mining rehabilitation; and
- Provide topsoil and subsoil management recommendations.

7.14.2 Methodology

Project Domains

The various Project components have been categorised into eight major Project domains. Impact on the existing land resource differs between each domain. Project domains are identified in **Section 7.14.3**.

Desktop Assessment

A desktop review was undertaken to gain an initial understanding of the different soil and landscape types across the Study Area. This involved a review of aerial photography, topographic maps and reference information from previous soil studies in the region.

This review, along with consideration of the relevant regulatory guidelines (detailed in full in **Appendix V**), informed the level of survey effort undertaken during the field survey component of the assessment.

Risk Assessment

A risk assessment was undertaken in accordance with the *Interim Protocol for Site Verification and Mapping of Biophysical Strategic Agricultural Land – V7* (OEI & DPI-OASFS, 2013b) to determine the risk on soil resources and consequently agricultural activities in each Project domain. The risk ranking associated with each Project domain was used to develop an appropriate survey methodology and soil sampling density (survey scale) across the Study Area.

It was determined that the risk of impact to different soil resources ranged from low to high, depending on the impacts associated with each activity. For the majority of Project domains identified as having a high risk of impacting soil resources, the associated land was targeted for a sampling density scale of 1:25,000. For the remaining Project domains identified as having a medium to low risk of impacting soil resources, the associated land was subject to a sampling density scale of 1:50,000 to 1:250,000.

Soil Sampling Program

Extensive fieldwork has been conducted across the Study Area over a one and a half year period, commencing in November 2011 and finishing in April 2013. The field sampling program for the Project was undertaken over two survey periods. The initial field surveys of 2011 and 2012 were an integrated qualitative survey conducted in accordance with the *Guidelines for Surveying Soil and Land Resources* (NCST, 2008). The methodology for the second phase of field survey conducted in 2013 was revised to be consistent with the requirements of the *Draft Interim Protocol – 1st Release and 2nd Release* and included a random grid sampling pattern. Stratification of known soil landscape units was also taken into account during these surveys.

Soil profiles recorded during field surveys were assessed in accordance with the *Australian Soil and Land Survey Field Handbook* (NCST, 2009). Approximately 257 detailed profile descriptions were undertaken across the Study Area over both survey periods. Each soil-profile exposure was excavated by a soil corer to the required depth of 1.2 m or to bedrock. After assessment was completed, soil cores were backfilled with the remaining excavated soil. Descriptions of each soil profile were developed by recording a range of parameters for each site (detailed in **Appendix V**).

Mapping observations (or check sites) were also executed to confirm mapping boundaries, soil unit distributions and any other characteristics being mapped in the survey. The mapping observations consisted of exposed cuttings (such as cut slopes), topsoil exposures of up to 0.4 m (using a spade), vegetation cover associations, and rock outcrops. In total approximately 302 mapping observations were undertaken across the Study Area over both survey periods.

Soil samples from representative sites were included in the laboratory testing program. In total, approximately 350 samples were subjected to laboratory analysis. These analyses were undertaken to assist with:

- Classification of soil taxonomic classes and soil suitability for reuse in rehabilitation activities;
- Assessment of Land and Soil Class Classification; and
- Assessment of BSAL.

Land and Soil Capability

Assessment of the land and soil capability (LSC) of the Study Area was undertaken in accordance with *The land and soil capability assessment scheme: second approximation – A general rural land evaluation system for NSW* (OEH, 2012) (LSC Guideline).

The LSC classes within the Study Area were determined by assessment of the biophysical features of the land against a number of general hazards in accordance with the methodology provided by the LSC Guideline.

The eight hazards considered for the assessment of LSC include: water erosion, wind erosion, soil structure decline, soil acidification, salinity, water logging, shallow soils and rockiness and mass movement.

Definitions for the LSC classes from the LSC Guideline are reproduced in **Table 70**.

TABLE 70 Land and Soil Capability Class Definition

LSC Class	General Definition	
Land capable of a wide variety of land uses (cropping, grazing, horticulture forestry, conservation, nature conservation)		
1	<i>Extremely high capability land</i> No limitations	No special land management practices required. Land capable of all rural land uses and land management practices.
2	<i>Very high capability land</i> Slight limitations	Limitations can be managed by readily available, easily implemented management practices. Land is capable of most land uses and land management practices, including intensive cropping with cultivation.
3	<i>High capability land</i> Moderate limitations	Is capable of sustaining high-impact land uses, such as cropping with cultivation using more intensive and widely accepted management practices. However careful management of the limitations is required for cropping and intensive grazing to avoid land and environmental degradation.
Land capable of a variety of land uses (cropping with restricted cultivation, pasture cropping, grazing, some horticulture forestry, nature conservation)		
4	<i>Moderate capability land</i> Moderate to high limitations for high-impact land uses	Limitations will restrict land management options for regular high-impact land uses such as cropping, high-intensity grazing and horticulture. These limitations can only be managed by specialised management practices with a high level of knowledge, expertise, inputs, investment and technology.
5	<i>Moderate-low capability land</i> High limitations for high-impact land uses	Limitations will restrict land use to grazing, some horticulture (orchards), forestry and nature conservation. The limitations need to be carefully managed to prevent long term degradation.
Land capable of a for a limited set of land uses (grazing, forestry and nature conservation, some horticulture)		
6	<i>Low capability land</i> Very high limitations for high-impact land uses	Land restricted to low-impact land uses such as grazing, forestry and nature conservation. Careful management of limitations is required to prevent severe land and environmental degradation.
Land generally incapable of agricultural land use (selective forestry and nature conservation)		
7	<i>Very low capability land</i> <i>Severe limitations that restrict most land uses</i>	Limitations generally cannot be overcome. Onsite and offsite impacts of land management practices can be extremely severe if limitations are not managed. There should be minimal disturbance of native vegetation.
8	<i>Extremely low capability land</i>	Limitations are so severe that the land is incapable of sustaining any land use apart from nature conservation. There should be no disturbance of native vegetation.

BSAL Assessment

The Upper Hunter SRLUP mapping indicates broadly where BSAL will potentially occur at a regional scale. The regional scale mapping was used to provide an indication of areas that would potentially have strategically significant agricultural value.

An assessment in accordance with the requirements of the Interim Protocol was undertaken to verify the occurrence of BSAL within the Study Area. As required by the Interim Protocol, a two-phase verification process was utilised, which included:

- Confirmation of access to reliable water supply. For the Upper Hunter SRLUP, the Interim Protocol states that reliable water supply has been verified for the area (phase 1); and
- Assessment of the land against BSAL Criteria (phase 2). This requires consideration of the 12 site verification criteria from the Interim Protocol to verify the presence of BSAL.

7.14.3 Impact Assessment

Soil Types

Forty soil units and 14 soil-phases have been identified within the Study Area. **Table 71** provides an overview and a quantitative distribution of each identified soil type. **Figure 59** provides an illustration of the spatial distribution of each soil type.

Bald Hill

The Bald Hill Soil Landscape Unit is associated with low hillocks and basalt or dolerite caps and is present mainly in the north-east of the Study Area. It occurs on the Tertiary basalt geological unit and the parent rock is olivine basalt and dolerite. Elevations range from 240 m to 1,000 m and slope gradients are between 5-50%.

In the Study Area, the Bald Hill Soil Landscape Unit is a major unit covering a large area of elevated land in the north-east, and smaller pockets of land in the western and southern parts of the Study Area. This soil landscape unit is typically suited to grazing enterprises.

Benjang

The Benjang Soil Landscape Unit is associated with rounded rolling hills with large open valleys and some sandstone cliffs and occurs beside the more rugged Lees Pinch soil landscape in the east of the Study Area. It occurs on the Illawarra Coal Measures geological unit and the parent rock is shale, sandstone, conglomerate, mudstone, coal, tuff and some basalt.

The rolling hills range in elevation from 240 m to 440 m and are generally rounded with frequent outcrops of sandstone or conglomerate on the summits. The landform slopes are 10-25%.

The Benjang Soil Landscape Unit is a minor unit covering the lower slopes surrounding the Bald Hill Soil Landscape Unit in the north-eastern part of the Study Area. Soils on the steeper benched country have hard rocks and near horizontal bedding that has resulted in poor soil drainage. This soil landscape unit is typically suited to grazing enterprises.

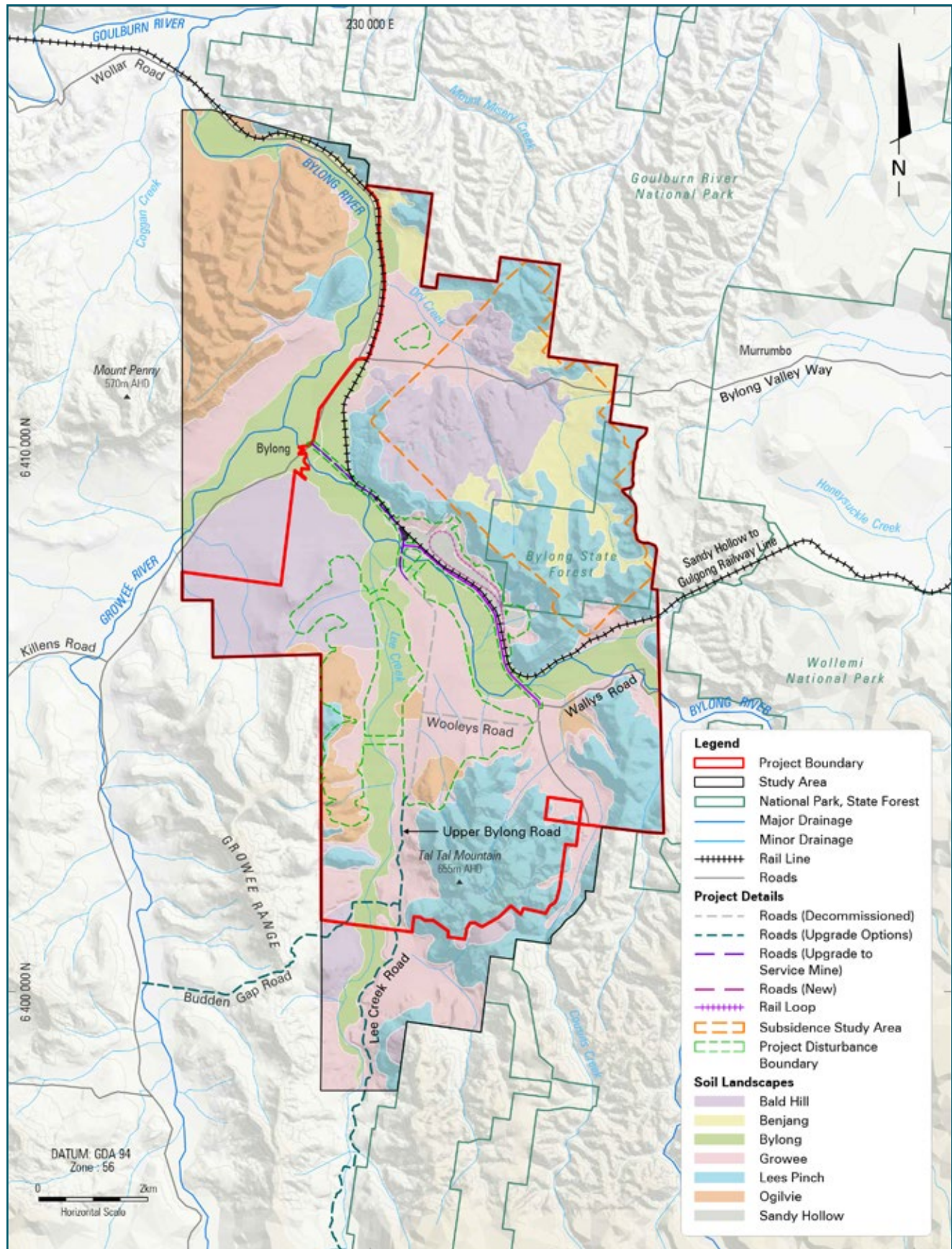
TABLE 71 Soil Unit Distribution Summary

Soil Unit		Study Area		Project Boundary	
		ha	%	ha	%
Bald Hill Soil Landscape					
BH1	Eutrophic Red Dermosol; deep	729.6	7.1	443.4	6.3
BH1-P1: Shallow Phase	Red Chromosol; shallow	317.1	3.1	191.4	2.8
BH1-P2: Moderate Phase	Eutrophic Red Chromosol; moderate	24.6	0.2	6.4	0.1
BH2	Eutrophic Red Dermosol; deep	211.1	2.0	211.1	3.1
BH2-P1: Moderate Phase	Red Dermosol; moderate	62.6	0.6	62.5	0.9
BH2-P2: Shallow Phase	Red Chromosol; shallow	436.8	4.2	436.7	6.3
Total		1,781.8	17.2	1,351.5	19.5

Soil Unit		Study Area		Project Boundary	
		ha	%	ha	%
Benjang Soil Landscape					
BJ1	Eutrophic Brown Chromosol; deep	354.9	3.4	355.4	5.1
BJ2	Self-mulching Brown Vertosol; shallow	47.1	0.5	47.0	0.7
BJ3	Subnatric Yellow Sodosol; deep	80.8	0.8	75.3	1.1
BJ3-P1: Shallow Phase	Subnatric Yellow Sodosol; shallow	34.7	0.3	24.0	0.3
Total		517.5	5.0	501.7	7.2
Bylong Soil Landscape					
B01	Eutrophic Black Dermosol overlying Stratic Rudosol	341.9	3.3	341.9	4.9
B02	Eutrophic Black Dermosol; deep	54.8	0.5	54.7	0.8
B03	Eutrophic Black Dermosol; deep	149.6	1.5	148.8	2.1
B03-P1: Saline Phase	Eutrophic Black Dermosol; saline	574.4	5.6	31.3	0.5
B04	Black Dermosol; moderate	39.9	0.4	Nil	Nil
B05	Brown-Orthic Tenosol	71	0.7	70.9	0.9
B06	Eutrophic Black Dermosol overlying Stratic Rudosol	228.2	2.2	187.4	2.7
B06-P1: Saline Phase	Eutrophic Black Dermosol overlying Stratic Rudosol; saline	34.7	0.3	32.4	0.5
B07	Chernic-leptic Tenosol	24.8	0.2	Nil	Nil
B08	Eutrophic Grey Dermosol overlying Stratic Rudosol	78.4	0.8	78.3	1.1
B09	Black Dermosol	19.9	0.2	Nil	Nil
B10	Leptic Tenosol	7.9	0.1	Nil	Nil
B11	Eutrophic Brown Kandosol	10	0.1	Nil	Nil
B12	Stratic Rudosol overlying Black Dermosol	28.7	0.3	28.8	0.5
Total		1,664.2	16.2	974.5	14.0
Growee Soil Landscape					
G01	Eutrophic Red Chromosol; moderate	249.8	2.4	77.1	1.1
G02	Eutrophic Red Chromosol; deep	89.7	0.9	Nil	Nil
G03	Lithic Rudosol	86.9	0.8	39.5	0.5
G04	Mesotrophic Brown Chromosol; moderate	40.2	0.4	40.2	0.6
G04-P1	Mesotrophic Red Chromosol; shallow	368.3	3.6	325.8	4.7
G05	Eutrophic Red Chromosol; moderate	419.3	4.1	208.9	3.1
G05-P1: Shallow Phase	Red Chromosol; shallow	82.8	0.8	Nil	Nil
G06	Eutrophic Red Chromosol; moderate	90.8	0.9	76.8	1.1
G06-P1: Shallow Phase	Red Chromosol; shallow	14.1	0.1	14.1	0.2

Soil Unit		Study Area		Project Boundary	
		ha	%	ha	%
G07	Eutrophic Red Chromosol; deep	23.2	0.2	23.2	0.3
G07-P1: Gravelly Phase	Eutrophic Red Chromosol; gravelly	17.1	0.2	17.2	0.3
G08	Eutrophic Red Dermosol; shallow	37.1	0.4	37.1	0.5
G09	Eutrophic Brown Chromosol; moderate	76.5	0.7	76.5	1.1
G10	Eutrophic Black Kandosol	16.9	0.2	10.9	0.1
G11	Stratic Rudosol	80.7	0.8	66.3	1.0
G12	Black Dermosol; deep	47.8	0.5	47.8	0.6
G13	Black-Orthic Tenosol; light sandy textured	17.8	0.2	17.8	0.2
G14	Eutrophic Brown Chromosol; deep	72.6	0.7	72.4	1.1
G14-P1	Brown Chromosol; shallow	25.9	0.2	25.9	0.4
G15	Subnatric Brown Sodosol	84.2	0.8	84.1	1.1
G16	Stratic Rudosol	9.9	0.1	Nil	Nil
G17	Eutrophic Red Chromosol; deep	117.7	1.1	102.4	1.5
G17-P1: Moderate Phase	Eutrophic Red Chromosol; moderate	171.3	1.7	171.3	2.4
G18	Mesonatric Yellow Sodosol; deep	29.4	0.3	0.4	<0.1
G19	Brown Chromosol*; moderate	28.0	0.3	Nil	Nil
Total		2,298.0	22.4	1,535.7	21.9
Lees Pinch Soil Landscape					
L1	Clastic Rudosol	577	5.6	578.7	8.4
L1-P1: Shallow Phase	Clastic Rudosol; very shallow	1,964.2	19	1,577.5	22.7
Total		2,541.2	24.6	2,156.2	31.1
Ogilvie Soil Landscape					
O1	Mesonatric Brown Sodosol; moderate	159.4	1.5	35.7	0.5
O1-P1: Shallow Phase	Subnatric Brown Sodosol; shallow	950.8	9.2	Nil	Nil
O2	Clastic Rudosol; deep	77.0	0.7	76.7	1.2
O2-P1: Moderate Phase	Clastic Rudosol; moderate	195	1.9	193.6	2.8
Total		1,382.2	13.3	306	4.5
Sandy Hollow Soil Landscape					
SH1	Subnatric Red Sodosol; deep	132.1	1.3	132.1	1.8
Total		132.1	1.3	132.1	1.8
TOTAL		10,317.0	100.0	6,957.7	100.0

Notes: Discrepancies may be present in totals due to rounding

FIGURE 59 Soil Unit Types

Bylong

The Bylong Soil Landscape Unit is associated with alluvial flats and low terraces of the Bylong River and the Growee River in the vicinity of the Bylong Village. It occurs on the Quaternary alluvium geological unit and the parent material is alluvium.

Elevations range from 260 m to 320 m and the landform consists of low (<10 m) alluvial terraces with swampy hollows and abandoned channels. This soil landform provides a stable landscape with little erosion except for stream bank erosion along main drainage channels.

The Bylong Soil Landscape Unit in the Study Area is a major unit covering the alluvial flats around the two main watercourses, which run in a north-south and east-west direction through the centre of the Study Area. This soil landscape unit is typically suited to cropping and grazing enterprises.

Growee

The Growee Soil Landscape Unit is associated with undulating rises and low hills, with broad, widely spaced shallow valleys. The small, closely spaced valleys occur in the areas of undulating low rises. The main valleys often have terraced alluvium near the drainage lines.

This unit occurs throughout the Study Area primarily adjacent to the Bylong soil landscape unit. It occurs on the Illawarra Coal Measures geological unit and parent rock is shale, sandstone, conglomerate, coal, tuff and clay.

The Growee Soil Landscape Unit is a major unit within the Study Area covering the low hills and valleys surrounding the alluvial flats and is associated with the Bylong soil landscape unit. The slopes are generally less than 10% throughout the area and this soil landscape unit is typically suited to grazing enterprises.

Lees Pinch

The Lees Pinch Soil Landscape Unit is associated with rolling hills to steep mountains and generally covers the steep sections and rocky features of the Great Dividing Range that surround the Bylong Valley. Summits are rounded or edged by sandstone cliffs, large sandstone outcrops occur on many hills, with occasional small plateaus, and narrow inaccessible valleys and gorges are common. It occurs on the Narrabeen Group geological unit and parent rock is lithic and quartz sandstone, conglomerate, green and red claystone, shale and siltstone. The slopes are up to 90%.

The Lees Pinch Soil Landscape Unit is the dominant unit in the Study Area covering elevated regions with steeper slopes in the north-west, eastern and southern parts of the Study Area. This soil landscape unit is marginally suited to grazing enterprises or best left protected with green timber.

Ogilvie

The Ogilvie Soil Landscape Unit is associated with steep hills and escarpments with sandstone and conglomerate outcrops forming cliffs. The landscape is also characterised by deep ravines with sandstone rubble and is present as isolated pockets in the Study Area. It occurs on the Narrabeen Group geological unit and parent rock is sandstone, shale and conglomerate. The landform elevation ranges from 180 m to 620 m, with slopes between 15 to 60%.

The Ogilvie Soil Landscape Unit is a minor unit covering smaller areas of land in the north-west, eastern and southern parts of the Study Area and is usually associated with the Lees Pinch soil landscape unit. This soil landscape unit is marginally suited to grazing enterprises or not suitable for agriculture.

Sandy Hollow

The Sandy Hollow Soil Landscape Unit occurs within undulating terrain with smooth and gentle rises. It is associated with the Ogilvie and Lees Pinch soil landscape units. It grades into Lees Pinch on the steep slopes with cliffs and into Ogilvie on and Lees Pinch Soil Landscape Units. It is located on Quaternary colluvium derived from the Narrabeen Group and the parent rock is sandstone, shale and conglomerate. Slopes are generally less than 10% with lengths ranging from 100 m to 250 m. There are some outcrops of sandstone and also narrow flat benches on the sandstone with small broken scarps.

The Sandy Hollow Soil Landscape Unit is a very minor unit covering a small area in the central and eastern part of the Study Area that grades into the Lees Pinch soil landscape unit. It is typically a slightly saline and sodic soil landscape. This soil landscape unit is typically suited to grazing enterprises.

Topsoil and Subsoil Balance

The Project disturbance footprint (which includes the Project Disturbance Boundary and Subsidence Study Area) covers approximately 2,875 ha of land within the Study Area.

Table 72 estimates the area of disturbance to soil resources as a result of each component of the Project and ranks the risk of impact to each. It should be noted that rehabilitation commitments for each Project component have been considered in the risk category and therefore there are different outcomes between the two assessments (risk / impact).

Indirect and temporary impacts are defined as impacts that do not directly disturb the land's surface and are temporary. Direct and temporary impacts are defined as impacts which directly disturb the land's surface, however, are short term in nature with the area to be rehabilitated to pre-mining status. Direct and permanent impacts are defined as impacts which will directly disturb the land's surface and the area will not be rehabilitated consistent with the pre-mining status.

TABLE 72 Project Component Impacts on Soil Resources

Impact Category by Project Domain	Risk Category	Ha	%
Indirect and Temporary Impacts (1,714.3 ha, 59.6%)			
Subsidence Study Area	Low	1,714.3	59.6
Direct and Temporary Impacts (240.9 ha, 8.4%)			
Haul Roads	Medium	118.3	4.1
Mine Infrastructure Area	Medium	85.0	3.0
Stockpile Area	Low	11.1	0.4
Water Storage Facilities	High	26.5	0.9
Direct and Permanent Impacts (919.5 ha, 32.0%)			
Internal Roads	Medium	73.5	2.6
Open Cut Mining Area	High	532.7	18.5
OEAs	High	225.0	7.8
Rail Loop	High	88.3	3.1
TOTAL		2,874.7	100.0

Soil stripping activities will be undertaken on areas totalling approximately 1,160 ha. These areas of land will be subject to direct temporary and direct permanent impacts. Land indirectly impacted upon is not subject to stripping activities and is therefore excluded from the topsoil and subsoil balance. Rehabilitation of disturbed mining land requires adequate soil resources be available for rehabilitation works. The suitability of relevant soils for reuse as a topsoil resource (primary growth media) or subsoil resource (secondary growth media) has been assessed within the Project Disturbance Boundary.

The quantity of soil that can be salvaged from the Project Disturbance Boundary for reuse in rehabilitation works as a primary or secondary media is based on the recommended soil stripping depths per soil unit horizon and the area to be disturbed. All directly impacted areas are proposed to be rehabilitated, with the exclusion of the internal roads and rail loop which will remain as infrastructure at closure.

The soil suitability assessment determined that a total of 5.51 Million cubic metres (MCM) of soil is available for conservation across the areas of land which are proposed to be directly and permanently impacted. This exceeds the 4.73 MCM required for rehabilitation. **Table 73** lists the volume of topsoil and subsoil material required to achieve targeted LSC classes in the rehabilitated post-mining landform.

TABLE 73 Soil Balance for Land Capability Targets

Growth Media Class	Soil Volume Mass Balance (MCM)		
	Volume Available	Volume Required	Difference
Topsoil (Primary LSC 3/BSAL)	0.61	0.57	0.04
Topsoil (Primary LSC 4 and 5)	0.8	0.76	0.04
Topsoil (Primary LSC 6 and 7)	0.24	0.03	0.21
Subsoil (Secondary LSC 3 and 4)	2.98	2.42	0.56
Subsoil (Secondary LSC 5, 6 and 7)	0.88	0.95	-0.07
TOTAL	5.51	4.73	0.78

Biophysical Strategic Agricultural Land

Upper Hunter SRLUP mapping indicates approximately 1,610 ha of BSAL is potentially present within the Study Area. The property scale field verification assessment has identified approximately 2,366 ha of verified BSAL within the Study Area and 1,676 ha within the Project Boundary (see **Figure 60**).

Generally BSAL in the Study Area is associated with the alluvial influenced deep non-saline Black Dermosol soil units on very gently inclined land. Some basaltic influenced Red Dermosols on elevated gently inclined land and some deep Red Chromosols on the sedimentary derived Growee Soil Landscape Unit were also assessed as BSAL. The remainder of the Study Area which has been assessed as non-BSAL includes moderately to steeply inclined land, poorly developed or shallow soils, low fertility soils and soils with chemical constraints such as sodicity and salinity.

TABLE 74 Project Impacts to BSAL by Category

Project Domain and Impact Category	ha	%
Indirect and Temporary Impacts	171.8	39.0
Subsidence Study Area	171.8	39.0
Direct and Temporary Impacts	62.7	14.2
Haul Roads	48.5	11.0
Mine Infrastructure Area	4.7	1.1
Stockpile Area	8.1	1.8
Water Storage Facilities	1.4	0.3
Direct and Permanent Impacts	206.3	46.8
Internal Roads	27.9	6.3
Open Cut Mining Area	116.2	26.4
OEAs	62.2	14.1
TOTAL	440.8	100.0

Notes: Discrepancies may be present in totals due to rounding

The Project has been designed to avoid and minimise disturbance of BSAL where possible. Of the potential 2,875 ha of land to be impacted by the Project, approximately 85% is situated on non-BSAL and approximately 15% (440 ha) is located on land verified as BSAL. Of the land to be impacted by the Project and verified as BSAL, approximately 39% will be indirectly and temporarily impacted. The level of impact of each component of the Project on land that has been verified as BSAL is summarised in **Table 74**. BSAL in each impacted category includes:

- 39% (172 ha) of the verified BSAL within the Project disturbance footprint will be indirectly and temporarily impacted by the Subsidence Study Area;
- 14% (63 ha) of the verified BSAL within the Project disturbance footprint will be directly (however only temporarily) impacted by the development of hauls roads, mine infrastructure, stockpile area and water storage facilities; and
- 47% (206 ha) of the verified BSAL within the Project disturbance footprint will be directly and permanently impacted by internal roads, open cut mining areas and OEAs.

No BSAL is predicted to be disturbed as a result of construction of the rail loop which is intended to remain following completion of the Project.

KEPCO has committed to minimising the Projects impacts on BSAL. The quantity of BSAL that will be directly and permanently impacted (206 ha) will be reinstated to mitigate Project impacts. Following rehabilitation, there will be no reduction in the quantity of BSAL, however the spatial distribution of BSAL will differ from the pre-mining landscape. Additionally, KEPCO will aim to reinstate an area of BSAL 10% greater than is predicted to be disturbed as a conservative approach to achieving the rehabilitation objective.

BSAL will be reinstated on land which meets LSC Class 3 criteria with slopes preferably less than 3%, but may be reinstated on land up to 10% slope. Where practical, the reinstatement of BSAL will occur in areas adjacent to or in the vicinity of existing undisturbed BSAL.

Further details regarding the rehabilitation and reinstatement of BSAL and compensatory measures are provided in **Section 7.15.2**.

Land and Soil Capability

The *Land and Soil Capability Assessment Scheme* (OEH, 2012) was applied to assess the inherent physical capacity of the land to sustain a range of land uses and management practices. The LSC classes for the Study Area ranged from Class 3 to Class 7 and are shown on **Figure 61**.

As described in **Table 70**, Class 3 lands are capable of high impact land uses and are suitable for a range of intensive agricultural activities such as cropping with cultivation. Class 4 land is moderately capable land suitable for some rotational cropping and good quality grazing. Class 5 lands are moderate to low capability land that is largely restricted to grazing, some horticulture and forestry. Classes 6 and 7 are low to very low capability land suited to light grazing.

Impacts to the land as a result of the Project will remain within the Project disturbance footprint. All five LSC Classes are present within the Project Disturbance Boundary. The dominant land capability category within the footprint is low capability land (Classes 6 and 7; 43%), followed by moderate capability land (Classes 4 and 5; 33%) and then high capability land (Class 3; 24%).

Following the completion of mining, LSC classes within the Project disturbance footprint are predicted to remain within the same pre-mining capability range (Class 3 to Class 7). This will provide a post-mining landform capable of both cropping (Class 3) and grazing (Classes 4 and 5) enterprises along with some land that can be lightly grazed but is best revegetated with trees and shrubs for erosion control (Classes 6 and 7). The post-mining landform will also contain areas not suitable for any agricultural enterprise (Class U) as the infrastructure will be retained for future use.

Land temporarily impacted upon, both directly and indirectly, will be returned to pre-mining condition and will not experience any changes in LSC classes. All infrastructure elements contained within the MIAs, water storage facilities and haul roads domains will be removed and the pre-mining landform and LSC class reinstated.

The post-mining LSC classes within the open cut mining areas and OEAs will contain a similar mix of LSC classes to that of pre-mining. A total of approximately 162 ha of infrastructure including internal roads and the rail loop will remain post-mining and therefore is not designated a LSC Class, rather it has been designated a state land capability code of U for Urban. The predicted change in LSC between the pre and post-mining case within the land predicted to be directly and permanently impacted upon is presented below in **Table 75**.

TABLE 75 Pre and Post-Mining LSC Class for Directly and Permanently Impacted Lands

LSC Class	Pre-Mining		Post-Mining		Difference	
	ha	%	ha	%	ha	%
Rehabilitated Landform						
3	141.9	15.5	227.0	24.8	85.1	9.3
4	194.7	21.1	264.8	28.8	70.1	7.7
5	441.0	48.0	232.3	25.2	-208.7	-22.8
6	127.7	13.9	11.0	1.2	-116.7	-12.7
7	14.2	1.6	22.6	2.4	8.4	0.8
Non-Rehabilitated Infrastructure						
Urban	Nil	Nil	161.8	2.3	161.8	17.6
TOTAL	919.5	100.0	919.5	100.0	-	-

Notes: Discrepancies may be present in totals due to rounding

7.14.4 Mitigation and Management

Appropriate management of the soils onsite is vital to facilitating the long term success of the Projects rehabilitation strategy (described in detail in **Section 7.15**). KEPCO's overarching post-mining land use goals (rehabilitation goals) for the Project include:

- Where practical, returning the land to its pre-mining land capability and land use;
- Limit impacts on BSAL and minimise the total quantity of BSAL disturbed within the Project Boundary;
- Return land subject to temporary disturbance to pre-mining condition; and
- Return a similar quantity of good quality land, (including BSAL) for land directly and permanently impacted by mining related activities.

In order to achieve the Project's rehabilitation goals, the following soil-handling techniques will be implemented for the Project to prevent impacts to soil resources:

- Soil material will be stripped to the depths provided in **Appendix V**, subject to ongoing inspections;
- Soil will be maintained in a slightly moist condition during stripping. Material will not be stripped in either excessively dry or wet conditions;
- Place stripped material directly onto area to be rehabilitated and spread immediately (if mining sequences, equipment scheduling and weather conditions permit) to reduce the requirement for stockpiling;
- Grade or push soil into windrows with graders or dozers for later collection by open bowl scrapers or for loading into rear dump trucks by front-end loaders. This will minimise compression effects of the heavy equipment that is often necessary for economical transport of soil material. These techniques are examples of preferential less aggressive soil handling systems;
- Soil transported by dump trucks may be placed directly into storage. Soil transported by scrapers is best pushed to form stockpiles by other equipment (e.g. dozer) to avoid tracking over previously laid soil;
- The surface of soil stockpiles should be left in a coarsely structured condition in order to promote infiltration and minimise erosion until vegetation is established, and to prevent anaerobic zones forming;

- As a general rule, maintain a maximum stockpile height of 3 m for subsoil (or 2 m for topsoils). Clay soils should be stored in lower stockpiles for shorter periods of time compared to coarser textured sandy soils;
- If long term stockpiling is planned (i.e. greater than 12 months), stockpiles should be seeded and fertilised as soon as possible after placement. An annual cover crop species that produce sterile florets or seeds (e.g. oats) will be sown. A rapid growing and healthy annual pasture sward provides sufficient competition to minimise the emergence of undesirable weed species. The annual pasture species will not persist in the rehabilitation areas but will provide sufficient competition for emerging weed species and enhance the desirable micro-organism activity in the soil;
- An inventory of available soil resources will be maintained to ensure adequate topsoil and subsoil materials are available for planned rehabilitation activities;
- Subsoil and topdressing materials will be spread to depths dependent on target land capability and as stated in **Section 7.15**; and
- Where possible, suitable subsoil/topsoil will be re-spread directly onto reshaped areas. Topsoil will be spread, treated with fertiliser and seeded in one consecutive operation, to reduce the potential for topsoil loss to wind and water erosion.

KEPCO will develop a Soil Resource Management Plan prior to the commencement of construction works for the Project. This plan will provide detailed management measures to minimise impacts to soil resources during stripping, stockpiling and emplacement activities.

7.15 REHABILITATION, FINAL LANDFORM AND MINE CLOSURE

7.15.1 Background

A Rehabilitation Strategy and BSAL Reinstatement Strategy (Rehabilitation Strategy) has been developed for the Project and is presented in **Appendix W**. The objective of the Rehabilitation Strategy was to create stable, non-polluting post-mining landforms that are cognisant of site constraints and allow the achievement of the agreed post-mining land uses.

The rehabilitation strategies described in the following sections have been developed in consideration of relevant technical studies, including:

- The Ecological Impact Assessment summarised in **Section 7.2** and presented in full in **Appendix J**;
- The Soil, Land Capability and Strategic Agricultural Land Assessment summarised in **Section 7.14** and presented in full in **Appendix V**; and
- The Agricultural Impact Statement summarised in **Section 7.16** and presented in full in **Appendix X**.

7.15.2 Rehabilitation Goals, Objectives and Strategic Framework

This section outlines the rehabilitation goals, objectives and relevant strategic framework for the Project.

Rehabilitation Goals

KEPCOs overarching post-mining land use goals for the Project include:

- Where practical, return the land to its pre-mining land capability and land use;
- Return land subject to temporary disturbance to pre-mining condition;
- Return a similar quantity of existing productive agricultural land back to that purpose; and
- Return a similar quantity of permanently disturbed land classified as BSAL back to that classification.

Rehabilitation Objectives

In order to ensure achievement of the Project's rehabilitation goals, short term rehabilitation objectives were developed which include:

- Reducing the extent of clearing and/or vegetation disturbance (consistent with operational requirements);
- Scheduling of operations, including overburden / interburden emplacement, shaping and revegetation;
- Timely rehabilitation of the disturbed areas, being no longer required for mining-related operations;
- Application of topdressing material (topsoil/subsoil) to the final landform based on soil availability and post-mining LSC classification targets (see **Table 78**);

- Stabilisation of all earthworks, drainage lines and disturbed areas in order to minimise erosion and sedimentation; and
- Control of vermin, feral animals and noxious weeds on KEPCO owned land, including the rehabilitation areas.

Overall, long term mine rehabilitation objectives are to provide a landform that is safe, low maintenance, and geotechnically stable that blends in with the surrounding topography. Land use will provide for a mixture of rehabilitated native vegetation, pastoral land and cropping areas. The Project's specific long term rehabilitation objectives include:

- Re-establishment of cropping land, pastoral land or native vegetation in the areas disturbed by the Project;
- Limit direct impacts on BSAL and minimise the total quantity of BSAL that is degraded within the Project Boundary;
- Reinstate pre-mining land uses and LSC classes where Project impacts are temporary;
- Reinstate an equivalent amount of BSAL on the rehabilitated landform to mitigate the long term impact of mining activities on good quality agricultural lands;
- Reinstate an equivalent amount of LSC Class 3 and 4 land on the rehabilitated landform to mitigate the long term impact of mining activities on the better quality agricultural lands;
- Appropriately recover, store and re-handle suitable soil resources for future rehabilitation;
- Establish healthy and self-sustaining soil profiles and vegetation cover on rehabilitated lands to meet the nominated post-mining LSC class and land use commitments;
- Establish healthy and self-sustaining soil profiles and vegetation cover on lands to meet the nominated post-mining BSAL reinstatement commitments;
- Undertake progressive rehabilitation as soon as areas become available for practical rehabilitation;
- Monitoring of rehabilitation success in terms of physical, chemical and biological parameters;
- Conduct maintenance (e.g. weed control, follow-up fertiliser, reseeding, erosion repair etc.) until rehabilitation is sustainable;

- Monitor and manage rehabilitation areas to facilitate the process of achieving sign-off on pre-determined success criteria;
- Long term conservation of remnant and degraded native vegetation and/or habitat corridors on the mine site;
- Development and implementation of a long term and regionally integrated BOS;
- Ensuring that the quality of runoff water from rehabilitation areas that is released from the site will not cause environmental harm; and
- Ensuring that the water quality of any residual water bodies post-mining is suitable for the nominated use and does not have the potential to cause environmental harm.

Strategic Framework

The Rehabilitation Strategy for the Project has been developed generally in accordance with the relevant strategic land use planning and resource management plans and policies including:

- *Strategic Framework for Mine Closure* (ANZMEC, 2000);
- *ESG3: Mining Operations Plan Guidelines* (ESG Guidelines) (Department of Trade and Investment, Regional Infrastructure and Services – Division of Resources and Energy (DTIRIS);
- *EDG03 – Guidelines to the Mining, Rehabilitation & Environmental Management Process* (DTIRIS, 2012);
- Interim Protocol (OEH and DPI-OAS&FS, 2013);
- *The Land and Soil Capability Assessment Scheme* (OEH, 2012) was applied to provide rehabilitation success criteria for each post-mining LSC class of land; and
- Department of Environment and Climate Change (2008) *Managing Urban Stormwater: Soils and Construction – Volume 2E Mines and Quarries*. Applied to assist with erosion control measures.

Additionally, identified initiatives and relevant planning instruments which have been considered include:

- Great Eastern Ranges Initiative (Anon, 2015): Bylong is located just to the west of the ranges, abutting the Wollemi National Park, and close to the Goulburn River National Park and several State Forests;

- Central Tablelands Local Land Services – *Catchment Action Plan* (Anon, 2013): This is a multi – catchment management plan including creeks and rivers found within the immediate vicinity of Bylong;
- Upper Hunter SRLUP (NSW DP&I, 2012): Recommendations extend to the Bylong and Mudgee mining districts;
- ESG Guidelines: Emphasises integration of post-mining landforms with local environment and catchment management plans;
- MWRC – *Roadside Corridor Management Project* (Applied Ecology, 2010): This project is conducted across the MWRC LGA, including Bylong; and
- Watershed Landcare – a local Landcare initiative covering Mudgee, Bylong, Gulgong and surrounds (Anon, 2009).

7.15.3 Rehabilitation Management

Progressive rehabilitation will be an integral component of the Project. The Project disturbance footprint will be progressively rehabilitated, excluding the Rail Loop and Internal roads, which will remain as infrastructure post-mining.

The Project features that will directly and permanently disturb the landscape are associated with Open Cut Mining and the two OEAs which will be developed from PY 2 to PY 10. Underground mining operations will then occur for the remainder of the Project life. The final Project year or “closure period” is PY 25.

As is demonstrated in **Figure 19** to **Figure 22**, progressive rehabilitation of the open cut mining areas and OEAs will largely occur in the first eight years of operations, with the residual void associated with the Eastern Open Cut backfilled over time using fine reject materials from the underground mining operation.

The rehabilitation program for the Project involves the progressive rehabilitation of open cut mining areas and OEAs, the establishment of an integrated stable final landform, soil management and translocation, implementation of erosion and sediment controls, revegetation and relevant maintenance and monitoring to achieve a successful and self-sustaining final landscape.

Landform Establishment

Rehabilitation has been designed to achieve a stable final landform compatible with the surrounding environment. All finished slopes are designed to a safe, geotechnical maximum angle. This will involve shaping the completed OEAs, where practical, to achieve slopes of less than 10 degrees. Where slopes exceed 10 degrees, additional drainage and revegetation works will be carried out to aid groundcover establishment and enhance erosion and sediment control.

Disturbed areas will generally be reshaped within one year of overburden placement and then rehabilitated to the target LSC classes, with BSAL reinstatement a priority where practical (see further discussion on BSAL reinstatement below). This will ensure that areas where mining or overburden placement is completed are promptly shaped, topsoiled and vegetated to provide a stable landform. The progressive formation of the post-mining landform and the re-establishment of vegetative cover will reduce the amount of disturbed land at any one time and also reduce the visibility of mine-related activities from surrounding properties and roads.

Soil Management

Topsoil and intermediate soil layers will be stripped to the recommended depth detailed in **Appendix V** and in accordance with the soil stripping and handling procedures outlined in **Appendix W**. Where possible (i.e. if mining sequences, equipment scheduling and weather conditions permit), stripped materials will be placed directly onto the area to be rehabilitated and spread immediately to avoid the requirement for stockpiling. Where stockpiling is required, the stockpiling and stripping guidelines outlined in **Appendix W** will be adhered to. Indicative stockpile locations are identified in **Figure 19** to **Figure 22**.

The stockpile areas will have contour drains built around the perimeter to divert water away. This water will be drained into existing mine sedimentation dams. Where possible, stockpiles will be located in areas remote from the floodplain or flow lines.

Prior to stripping and placement of soils, inspections will be carried out to identify if any weed control measures are required to be implemented. Completed topsoil and subsoil stockpiles will be sown and pasture established. Regular inspections of the stockpile areas will be undertaken, particularly after significant rainfall events.

Reinstated LSC Classes

Within the Project disturbance footprint, all land within areas to be temporarily disturbed, whether indirectly or directly, will be returned to its pre-mining land use (refer **Section 7.14.3**).

Of the 920 ha to be directly and permanently disturbed (see **Table 75**), land associated with Internal Roads and the Rail Loop will not be returned to a pre-mining land use and will remain as non-rehabilitated infrastructure.

For the remaining land (758 ha), land suitable for cropping will be established on rehabilitated LSC Class 3 land and will cover around 227 ha. Grazing land will be established on land associated with LSC Classes 4 and 5, covering approximately 497 ha. Woodland will be used for the remaining land which is LSC Class 6 and 7 due to their association with moderately steep to steeply inclined land (see **Figure 59**). **Table 76** summarises the post-mining land uses for land predicted to be directly and permanently impacted which is illustrated on **Figure 62**.

Reinstated BSAL

As discussed in **Section 7.14.3**, the Project will directly and permanently disturb a total of 206 ha of the verified BSAL within the Project Disturbance Boundary. The Project is committed to reinstating all verified BSAL that will be directly and permanently disturbed.

An assessment to identify appropriate areas for BSAL reinstatement was undertaken as part of the Rehabilitation Strategy which concluded that there is an inadequate area of land suitable for BSAL reinstatement within the Project Boundary and external to the Project disturbance footprint. However, there is a suitable quantity of land available for BSAL reinstatement within the rehabilitated landform.

Figure 63 shows the location of the proposed BSAL reinstatement on the rehabilitated landform. This correlates with the post-mining LSC Class 3 land. **Table 76** demonstrates that a total of approximately 227 ha of BSAL will be reinstated over the life of the Project.

The successful establishment of BSAL is dependent upon the execution of a detailed BSAL Reinstatement Plan which will outline specific soil handling and replacement techniques and strict rehabilitation monitoring protocols. Should the monitoring trends indicate that the BSAL establishment trajectory is unfavourable, TARP's developed for potential hazards will be implemented (see **Appendix W**) to rectify the situation and ensure that the proposed rehabilitation objectives are met. BSAL monitoring commitments and success criteria are detailed in the relevant sections below.

TABLE 76 Post-Mining Land Use for Directly and Permanently Disturbed Land

Land Use	Associated LSC Class	Post-mining	
		ha	%
Rehabilitated Land			
Cropping	Class 3	227.0	24.8
Grazing	Class 4 and 5	497.1	54.0
Woodland	Class 6 and 7	33.6	3.6
Subtotal		757.7	82.4
Non-Rehabilitated Infrastructure			
Industrial	N/A	161.8	17.6
TOTAL		919.5	100.0

Reinstated Land Uses within Mapped Equine CIC

Mapped Equine CIC is located within the land being directly and permanently impacted upon by the Project (specifically Domains 1 and 2) (Scott Barnett & Associates, 2015). This area of Equine CIC (pre-mining) is associated with LSC Classes 3 through to 7, inclusive. The dominant pre-mining LSC Classes are the grazing LSC Classes 4 and 5.

The Project's Rehabilitation Strategy commits to returning the land to LSC Classes within the same pre-mining range (i.e. Classes 3 through to 7, inclusive). The dominant post-mining LSC Classes are 3 and 5, which would be suitable for equine land uses post-mining. On this basis there is no impediment for future landholders should they wish to implement equine related activities on the rehabilitated landform.

A full assessment of the potential impacts of the Project on CIC is provided in **Section 7.16**.

Rehabilitation Completion Criteria

The Project has committed to rehabilitating land to LSC Classes 3, 4, 5, 6 and 7 on the landform that is to be directly and permanently disturbed. In addition, within these areas, the LSC Class 3 will be rehabilitated to meet BSAL criteria. The appropriate closure criteria have therefore been taken directly from the LSC Guideline and the Interim Protocol as these guidelines provide prescriptive criteria to measure rehabilitation success against. Performance indicators and TARPs will be developed in conjunction with the MOP.

LSC Class 3 and BSAL Closure Criteria

LSC Class 3 land includes flat to sloping land that is capable of sustaining cultivation on a rotational basis. This land should be capable of supporting a range of crops including cereals, oilseeds and legumes. Productivity will vary with soil fertility. BSAL is land that, in addition to water supply requirements, meets the BSAL criteria of the Interim Protocol. Inherent soil fertility for BSAL can vary from moderate to high fertility. Preliminary success criteria for the development of LSC Class 3 and BSAL land is provided in **Table 77**.

LSC Class 4, 5, 6 and 7 Closure Criteria

LSC Class 4 land includes land that is generally used for grazing and is suitable for pasture improvement. Class 4 land can be cultivated occasionally for sowing of pastures and crops, however; it has cropping limitations due to chemical and/or physical factors.

LSC Class 5 land has severe limitations for high impact land management uses such as cropping. This land is therefore generally more suitable to grazing. Preliminary success criteria for the development of LSC Class 5 land will be based on the LSC Guideline.

LSC Class 6 land has very severe limitations for a wide range of land management uses. This land is therefore generally only suited to grazing. Given the location of the LSC Class 6 post-mining land, its nominated land use is woodland. However, the key LSC capability criteria will still apply.

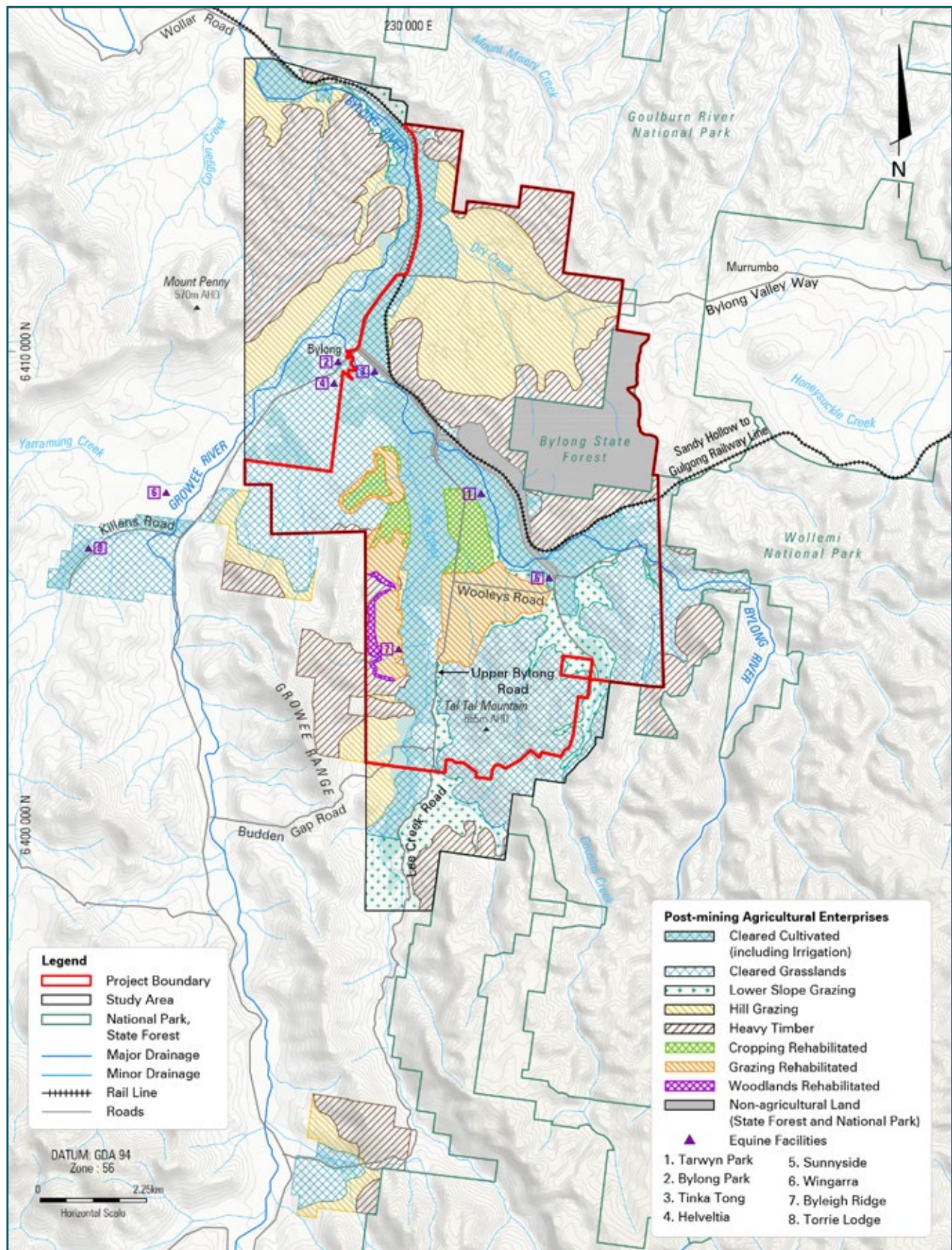
FIGURE 62 Post-Mining Land Use

FIGURE 63 Proposed Reinstatement of Biophysical Strategic Agricultural Land

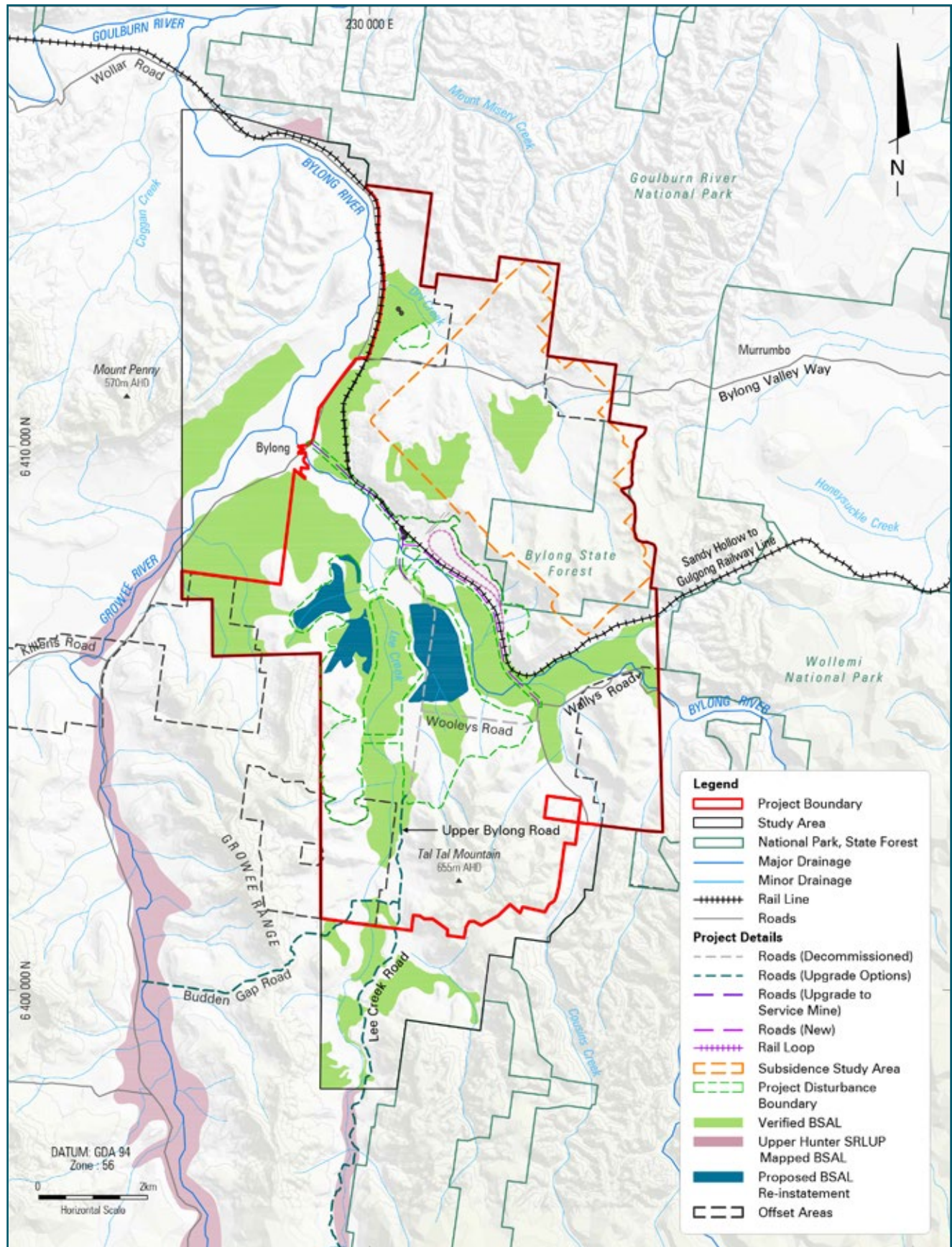


TABLE 77 LSC Class 3 and BSAL Closure Criteria

Criteria	Relevance to Interim Protocol & LSC Guideline	BSAL	LSC Class 3 Criteria
Slope	BSAL Criteria 1 LSC Hazard 1	Slope less than 10%	Slope < 10% or < 3% if slope is > 500 m in length
Rock outcrop	BSAL Criteria 2 LSC Hazard 7	Rock outcrop less than 30%	Rock outcrop less than 30%
Surface Rockiness	BSAL Criteria 3	Less than 20% of the area has unattached rock fragments greater than 60 mm diameter	N/A
Gilgai	BSAL Criteria 4	Less than 50% of the area has gilgai depression that are deeper than 500 mm	N/A
Slope, relative soil fertility class and rock outcrop	BSAL Criteria 5, 6, 7 LSC Hazard 1	Moderate fertility and <5% slope and nil rock outcrop OR Moderately high or high fertility and <5% slope and <30% rock outcrop OR Moderately high or high fertility and 5-10% slope and <30% rock outcrop	N/A
Physical Barrier	BSAL Criteria 8 LSC Hazard 7	Effective rooting depth to a physical barrier (i.e. bedrock, gravel layer) is greater than or equal to 750 mm	Soil depth is > 75 cm
Soil Drainage	BSAL Criteria 9 LSC Hazard 6	Soil drainage is better than poor	Imperfectly drained soil (waterlogging is 1-8 weeks duration)
pH	BSAL Criteria 10 LSC Hazard 4	pH within range of 5.0 to 8.9 within upper 600 mm of soil profile	Moderate or higher surface soil buffering capacity and pH >5.5 or low surface soil buffering capacity and pH 6.7-8.0
Soil Salinity	BSAL Criteria 11 LSC Hazard 5	ECe less than or equal to 4 dS/m or if gypsum is present, chlorides less than 800 mg/kg within upper 600 mm of soil profile	low salt store OR low discharge potential and moderate salt store
Chemical Barrier	BSAL Criteria 12	Effective rooting depth to a chemical barrier is greater than or equal to 750 mm Chemical barrier includes: ▪ pH <5.0 or >8.9; ▪ ECe > 4 dS/m or if gypsum is present, chlorides >800 mg/kg ▪ ESP > 15% ▪ Ca:Mg ratio <0.1	N/A
Wind Erosion	LSC Hazard 2	N/A	Selected site to be a site that has low exposure to wind
Soil Structure Decline	LSC Hazard 3	N/A	Surface soil texture a sandy loam OR fine sandy loam with <60% silt and very fine sand and <5% ESP (hazard 3) OR normal loam/clay loam OR friable/ferric or weakly self-mulching clay.
Mass Movement	LSC Hazard 8	N/A	No mass movement

LSC Class 7 land has extremely severe limitations for a wide range of land management uses. This land is therefore unsuitable for any type of grazing or cropping due to the severity of the limitations. Given the location of the LSC Class 7 post-mining land, its nominated land use is woodland.

The LSC Class hazard and closure criteria are provided in **Table 78**. The refinement of these criteria will be developed in conjunction with the preparation of the MOP whereby reference sites will be selected and analysed for relevant site-specific parameters for each success criteria. Measurement of rehabilitation effectiveness for post-mining LSC Class and additional criteria will be developed as appropriate.

Rehabilitation Maintenance

Maintenance activities will be initiated if rehabilitation efforts do not meet the relevant success criteria. These may include reseeding and, where necessary, applying additional topsoil and/or applying specialised treatments (such as composted mulch) to areas with insufficient vegetation establishment. Tree guards will be placed around tube stock if grazing by native animals is found to be excessive.

If drainage controls are found to be inadequate or are compromised by grazing stock or wildlife they will be repaired and/or temporary fences installed to exclude animals. Should areas of excessive erosion or sedimentation be identified, remedial works such as the importation of additional fill, subsoil or topsoil material or the redesigning of water management structures to address erosion will be implemented.

No time limit has been placed on post-mining rehabilitation maintenance. Rather, maintenance will continue until such time as the completion criteria are met, although it is generally accepted that it will be at least five years beyond closure. Maintenance at rehabilitated areas will include, but not be limited to:

- Weeds and pest animal control;
- Minor earthworks to remediate any significant erosion features, including contour banks and diversion channels;
- Infill planting and/or seeding to meet vegetation community requirements; and
- Maintaining erosion and sediment controls.

Rehabilitation Trials and Research

A key component of successful rehabilitation is to regularly review performance and to identify areas for continuous improvement. In this regard, KEPCO will actively participate in trials and research to improve mine site rehabilitation techniques and enhance performance outcomes. The following sections detail the rehabilitation trials and research programs to which KEPCO is committed.

Grazing Land

It is proposed to establish a small trial area within the Class 4 and 5 rehabilitated lands to investigate the benefits of soil hydrology techniques that has been previously pioneered in the locality. This trial will be conducted in conjunction with local farming experience and expertise and may involve other organisations such as the Tom Farrell Institute (centred at the University of Newcastle) and the Outcomes Australia Soils for Life Program. KEPCO has held discussions with both organisations to discuss this trial.

Cropping Land

It is proposed that a trial plot for BSAL/LSC Class 3 land is established within or proximal to the Project Boundary. The plot will be an approximate 50 m x 100 m and simulate LSC Class 3 land.

The plot will be used to assess the acceptability of the soil profile depths proposed for LSC Class 3 land rehabilitation and to assess yields and to establish the effect of handling techniques and deep ripping.

Woodland

While there are numerous examples of rehabilitation using native vegetation, local conditions will be carefully assessed to inform the wider rehabilitation. Trials will be undertaken as soon as the first re-contoured and topsoiled areas become available for revegetation to confirm:

- Extent of Weeds – the extent of weed emergence on the different respread topsoil types across the mine is currently unknown. The purpose of this trial will be to assess the nature and level of weed emergence, as well as its effect on native species. It will assist in the development of strategies to reduce the competitive effects of weeds on sown/planted native species;

TABLE 78 LSC Class 4, 5, 6 and 7 Closure Criteria

Criteria	Relevance to LSC Guideline	LSC Class 4	LSC Class 5	LSC Class 6	LSC Class 7
Water Erosion	LSC Hazard 1	Slope < 20%	Slope < 20%	Slope < 33%	Slope < 50%
Wind Erosion	LSC Hazard 2	Surface texture with no more than moderate erodibility where in a highly exposure position	N/A – due to average rainfall and low wind erosive power	N/A – due to average rainfall and low wind erosive power	N/A – due to average rainfall and low wind erosive power
Soil Structure Decline	LSC Hazard 3	Surface soil texture with <8% ESP	Surface soil texture with <15% ESP	Surface soil texture with <15% ESP	N/A
Soil Acidification	LSC Hazard 4	Moderate or higher surface soil buffering capacity and pH >4.7 or low surface soil buffering capacity and pH 5.5-8.0	Low or higher surface soil buffering capacity if pH <4.7. All other soil surface pH is suitable	N/A	N/A
Salinity	LSC Hazard 5	Moderate salt store	Moderate salt store	Moderate to high salt store	N/A
Waterlogging	LSC Hazard 6	Imperfectly drained soil (waterlogging is 8-12 weeks duration every 2-3 years)	Imperfectly drained soil (waterlogging is 8-12 weeks duration every year)	Poorly drained soil (waterlogging is >12 weeks duration per year but not almost permanently)	Poorly drained soil (waterlogging is >12 weeks duration per year but not almost permanently)
Soil Depth (rock outcrop)	LSC Hazard 7	<30% rock outcrop and soil depth >50cm or 30-50% rock outcrop and soil depth >100cm	<30% rock outcrop and soil depth >50cm or 30-50% rock outcrop and soil depth >75cm	<50% rock outcrop and soil depth >25cm or 50-70% rock outcrop and soil depth >50 cm	<70% rock outcrop and soil depth of maximum 25 cm
Mass Movement	LSC Hazard 8	No mass movement	No mass movement	No mass movement	No mass movement
Vegetation	N/A	Land is useable as a functioning agricultural system with yield similar or exceeding known yield of local Class 4 agricultural enterprises	N/A	N/A	N/A
Soil fauna	N/A	Representation of a range of soil species such as earthworms, springtails and fungi relative to the control site	N/A	N/A	N/A

- Germination and Establishment of Native Seed - There is no history of mine site revegetation in the Bylong area. In particular, many of the understorey species have complex dormancy mechanisms which need to be overcome before wide-spread use of this seed is possible. Trials on different topsoil materials will examine the germination and suitability of different species both singularly and in combination with other species in direct seeding programs;
- Species Proportions and Densities - Various ratios of sown and planted seedlings will be tested in order to assess the optimum ratios for each community;
- Re-emergence of Native Grasses - The emergence and persistence of native grasses (occurring naturally in topsoil) will be examined over time as well as its success when artificially sown. This will provide guidance as to the extent to which native grasses will need to be incorporated into the original sowing mix;
- Fertiliser Alternatives and Soil Amelioration - The extent of weed reinvasion will determine whether fertiliser alternatives (e.g. kitty litter) will be needed to reduce weed competition. At this time, it is not proposed to use fertiliser when direct seeding native species due to likely enhancement of weed competition. Similarly, the benefits of different soil ameliorants such as gypsum and mulched timber will also be tested for their potential to enhance preferred community establishment and stability; and
- Mulching of Felled Timber – At this point in time it is proposed to mulch approximately 30% of standing timber and incorporate and blend the mulch with topsoil in the stripping process. However, it is also planned to investigate the option of separately collecting, stockpiling and composting mulch prior to resspreading onto top-dressed rehabilitation areas. There are benefits in both methods. The ratio of timber mulched, compared to that left and reused as coarse timber, will also be examined.

7.15.4 Conceptual Final Landform

Landform design and planning takes into account three main components:

- Landform stability;
- Erosion minimisation; and
- Landform compatibility with the surrounding environment.

Rehabilitation has been designed to achieve a stable final landform compatible with the surrounding environment. All finished slopes are designed to a safe, geotechnical maximum angle. The final landform will incorporate contour and graded banks installed during the progressive rehabilitation process. The spacing and ultimate dimensions of these banks will be a function of the final slope and catchment area. On the slopes exceeding 18% (or 10 degrees), linear contour bank spacing will generally range between 50 m and 80 m.

The final landform will not contain any voids. The two open cut mining areas will be backfilled to surface level in accordance with the final landform design. The void associated with the Western Open Cut will be backfilled with overburden at the completion of open cut mining operations. A portion of the void associated with the Eastern Open Cut will remain open for the storage of coarse and fine reject materials for the longer term underground mining operations. This void will be filled over the life of the Project and will be capped and rehabilitated at the end of the mine life, so that no final void remains. The void will be capped with overburden material from the South Western OEA and/or the OEAs within the Eastern Open Cut.

Figure 23 presents the conceptual final landform for the Project.

7.15.5 Mine Closure

A Mine Closure Plan will be developed for the Project five years prior to closure, which will consider contemporary expectations including changes to the final mine plan, regulatory requirements, new technologies and stakeholder expectations.

Decommissioning and removal of mine site infrastructure items will take place, if that infrastructure is not required post-mining or sold on for other industrial purposes. Any infrastructure including dams, roads and buildings which are beneficial for future use by post-mine landowners, will be left in place in accordance with the relevant stakeholder or landowner agreements. Land in the vicinity of the mine site facilities will undergo remediation of any land contamination, ripping, topsoiling and seeding as necessary.

7.16 AGRICULTURE

7.16.1 Background

An Agriculture Impact Assessment (AIS) was undertaken by Scott Barnett and Associates and is provided in **Appendix X**. The purpose of the assessment was to:

- Describe the agricultural resources and enterprises in the general locality, including identifying any State Significant agricultural resources;
- Identify the agricultural domains of the land within the assessment areas;
- Assess the current and maximum agricultural potential for each domain in terms of quantum, gross and net value of agricultural production;
- Assess the loss of agricultural production from within the assessment areas during the life of the Project in terms of value of agricultural production and downstream activities within the value chain and support activities;
- Assess the use of the unregulated water supply for the Project in comparison to it being used for agricultural purposes within the unregulated system;
- Assess the impact of the Project on SAL including Equine CIC and BSAL; and
- Provide recommendations for appropriate mitigation and management measures for any impacts identified.

The AIS considered the agricultural productivity of all land within the Study Area and the Biodiversity Offset Areas (as described in **Section 7.3**) (Agricultural Assessment Area). This ensured that all land affected by the Project (either via direct disturbance, indirect (e.g. subsidence) or biodiversity offsets) is considered.

7.16.2 Regional Setting

Surrounding Locality

The Project is located within the Bylong Valley in the eastern portion of the MWRC LGA. The MWRC LGA is located at the eastern extent of the Central West region, adjacent to the western boundary of the Upper Hunter region of NSW (see **Figure 4**).

The dominant land use within the MWRC LGA is agriculture. Native vegetation and reserves cover the majority of the remaining areas of land within the MWRC LGA.

The Bylong Valley has a long history of rural land use, involving a variety of agricultural activities, including sheep and cattle grazing, horse breeding, and various cropping enterprises. The Goulburn River National Park and the Wollemi National Park border the eastern boundaries of the Project.

In general, current and historical agricultural activities in the surrounding locality include:

- Beef Cattle grazing;
- Fodder Cropping;
- Improved Pastures;
- Irrigated cropping; and
- Equine activities (Australian Stock Horse, pleasure and performance horses).

Agricultural Assessment Area

The Agricultural Assessment Area comprises the land within the Study Area, the proposed Biodiversity Offset Areas (some of which fall within Study Area) and land within 10 km of the Project Boundary. The Agriculture Assessment Area contains cleared agricultural land with native vegetation, a section of the Bylong State Forest and other portions of Crown Land. The predominant enterprise is beef cattle grazing supported by fodder cropping (oats, lucerne, millet and forage sorghum) and improved pastures on the better quality land and larger holdings. This typically reflects the enterprises found in the northern end of the Bylong Valley (where the Project is located), which is generally representative of cattle breeding with a lesser emphasis on lucerne hay production and fodder cropping.

Two categories of SAL under the SRLUP (DP&I, September 2012) have been identified as occurring within the Study Area and surrounding locality, including:

- BSAL – Land with a rare combination of natural resources highly suitable for agriculture; and
- CIC – Government mapped localised concentrations of interrelated productive industries based on an agricultural product that provides significant employment opportunities and contributes to the identity of the region. Only Equine CIC is present within the Study Area.

As part of the Soils Impact Assessment, a total of 2,366 ha of BSAL was verified and mapped within the Study Area (**Section 7.14.3**). Approximately 1,933 ha of mapped Equine CIC occurs within the Study Area and 584 ha within the Biodiversity Offset Areas.

7.16.3 Methodology

Field Assessment

A field assessment was undertaken between 10 and 11 June 2014 as part of the AIS to inspect KEPCO owned land and the land within the Biodiversity Offset Areas.

The purpose the field assessment was to assess the existing and potential agricultural production of the land. Interviews were also conducted with property managers of KEPCO owned land and private land surrounding the Project Boundary to ascertain details of the agricultural enterprises currently in operation and potential levels of agricultural production.

Desktop Assessment

Using the information gathered during the field assessment for the AIS, the Soil, Land Capability and Strategic Agricultural Land Assessment (see **Section 7.14** and **Appendix V**) and the Ecological Impact Assessment (see **Section 7.2** and **Appendix J**), agricultural domains were developed for the land within the Study Area and Biodiversity Offset Areas (see **Figure 64**). Agricultural domains were developed to reflect the current land practices as they align to the various land classification systems within the limitations of individual land manager's management style and choices and the variance between individual land managers.

The current and maximum value of each agricultural enterprise was then calculated by domain using the Gross Margin Budgets prepared by DPI (2012). These values were then reviewed against the regional, state and national agricultural production outputs to understand the total contribution of each enterprise.

The assessment of the potential impacts was undertaken in consideration of the Upper Hunter SRLUP, the *Strategic Regional Land Use Policy Guideline for Agricultural Impact Statements* (DP&I, October 2012) and *Agricultural Impact Statement Technical Notes - A Companion to the Agricultural Impact Statement Guideline* released (DP&I, April 2013). Issues and concerns identified throughout the stakeholder consultation program for the Project were also included.

Inputs from various impact assessments undertaken for the EIS were used to draw conclusions regarding the impact of the Project on agriculture (particularly BSAL) including:

- The Soil, Land Capability and Strategic Agricultural Land Assessment (**Appendix V** and **Section 7.14**);
- The Rehabilitation Strategy and BSAL Reinstatement Strategy (**Appendix W** and **Section 7.15**);
- The Subsidence Impact Assessment (**Appendix H** and **Section 7.1**);
- The Ecological Impact Assessment (**Appendix J** and **Section 7.2**);
- The Biodiversity Offsets Strategy (**Appendix K** and **Section 7.3**);
- The Surface Water Impact Assessment (**Appendix L** and **Sections 7.4** and **7.5**);
- The Groundwater Impact Assessment (**Appendix M** and **Section 7.6**);
- The Air Quality and Greenhouse Gas Impact Assessment (**Appendix O** and **Sections 7.7** and **7.8**);
- The Noise and Blasting Impact Assessment (**Appendix Q** and **Sections 7.9** and **7.10**);
- The Visual Impact Assessment (**Appendix Y** and **Section 7.17**);
- The Traffic and Transport Impact Assessment (**Appendix Z** and **Section 7.18**);
- The Social Impact Assessment (**Appendix AC** and **Section 7.21**);
- The Mine Plan Justification Report (**Appendix E** and **Section 3.17**); and
- The Economic Impact Assessment (**Appendix AD** and **Section 7.22**).

As part of the AIS, Gillespie Economics also undertook an assessment of the potential economic implications of the Project on agricultural resources. This assessment provided a comparison of the economic efficiencies of coal mining and the agricultural industry, including a consideration of the use of land and resources.

7.16.4 Existing Agricultural Domains, Production and Value

This section presents the existing quantum and value of the agricultural production from the Study Area and Biodiversity Offset Areas. Agricultural Domains within the Study Area and Biodiversity Offset Areas is illustrated in **Figure 64**.

Study Area

Land within the Study Area was dissected into four agricultural domains (see **Table 79**), which were confirmed through site verification as part of the soils assessment.

Table 79 also presents the domain areas as relevant to the Project Disturbance Boundary. The LSC classes within the Study Area range from Class 3 to Class 7 (see **Section 7.14**). **Table 79** indicates that the majority of the Study Area is composed of agricultural Domain A and B. Agricultural Domain A is the most abundant (3,975 ha or 39%) and is the highest quality agricultural land within the Study Area. This land is suited to fodder cropping and/or cultivation to establish improved pasture. It is not suited to continuous (annual) cultivation due to the underlying soil types. This land primarily coincides with the LSC Classes 3 and 4.

The agricultural enterprises that are currently operating within the Study Area are provided in **Table 80** and the value of agricultural production from each of these enterprises is summarised in **Table 81**. The predominant enterprise within the Study Area is beef cattle grazing supported by fodder cropping (oats, lucerne, millet and forage sorghum) and improved pastures on the better quality land and larger holdings. **Table 81** shows that the existing gross value of agriculture production within the Study Area, based on the current land use, is approximately \$5.3 Million per annum.

Biodiversity Offset Areas

The Biodiversity Offsets Strategy, broad-scale soils mapping, broad-scale land capability mapping and observations from land managers in the region have been used to delineate the Agricultural Domain distribution where it occurs outside the Study Area.

Of the Biodiversity Offset Areas, 2,226 ha are located within the Study Area and an additional 1,856 ha outside.

All areas within the offset properties that are currently cultivated and contain exotic monoculture will specifically be excluded from the proposed conservation mechanism and continue to remain available for agricultural production.

TABLE 79 Agricultural Domain Distribution Within the Study Area and Project Disturbance Boundary

Agricultural Domains	Description	Study Area		Project Disturbance Boundary	
		(ha)	(%)	(ha)	(%)
A	Arable land – Land suitable for high impact land uses such as cropping including; irrigated cropping; fodder cropping; and improved pastures for grazing. Careful management of limitations is still required for intensive cropping and grazing to avoid environmental degradation.	3,975	39	451	39
B	Extensive Grazing Land – lower slopes and hill grazing, suitable for grazing activities. Some occasional cultivation for fodder and improved pasture establishment may be undertaken on the lower slopes. Not suitable for high intensity agricultural activities such as regular cropping. Specialised management practices required to prevent long term degradation.	3,805	37	694	60
C	Heavily Timbered – Low carrying capacity, dense vegetation, steep slope and stoniness limit agricultural activities. Domain has limited agricultural value and is generally suited to nature conservation.	1,919	19	15	1
D	Non-agricultural use	618	6	0	0
TOTAL		10,317	100	1,160	100

FIGURE 64 Agricultural Domains

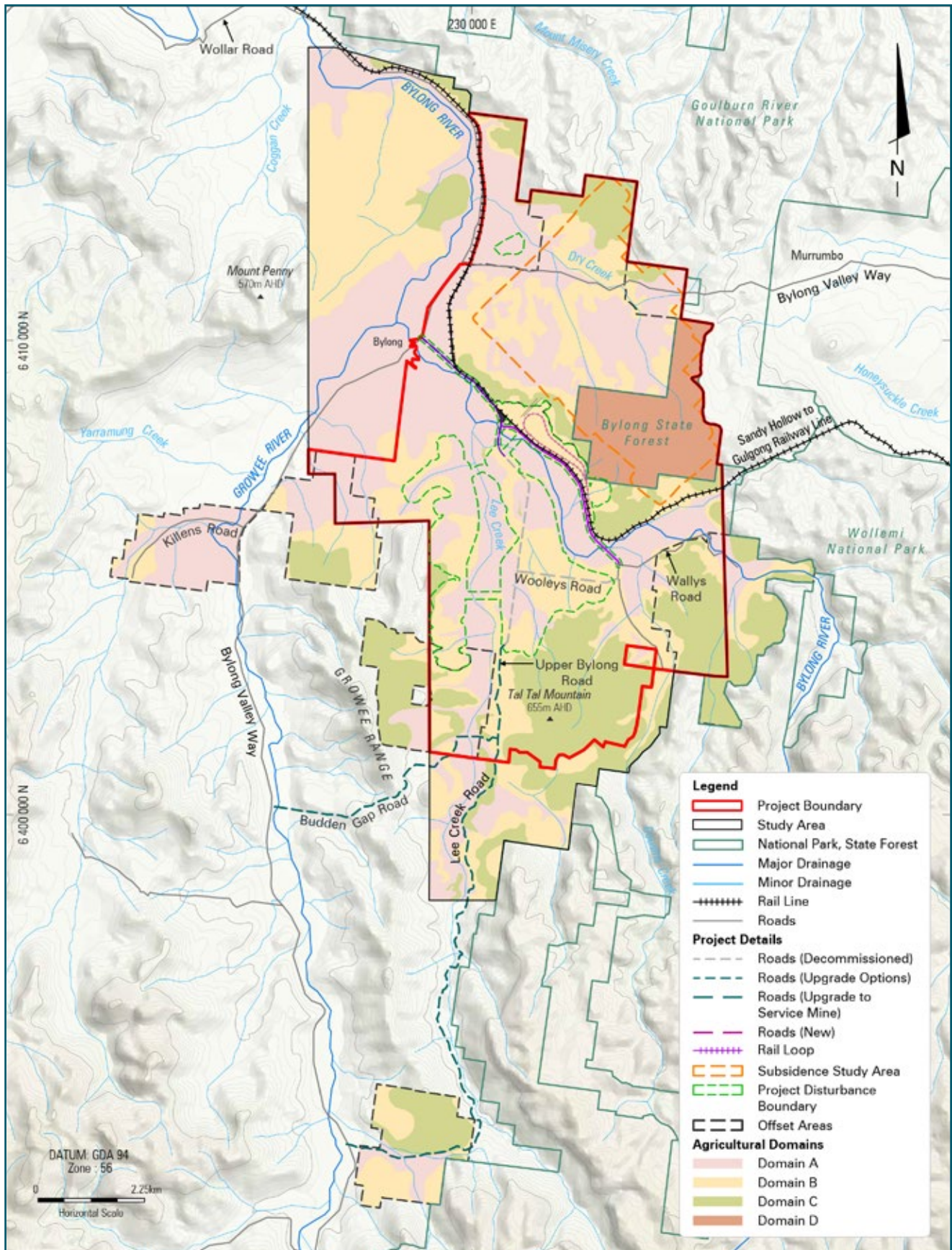


TABLE 80 Current Enterprises Within the Study Area

Enterprise	Average Stocking Rate (ha/Head)	Average Carrying Capacity / Yield*	Agricultural Domain
LIVESTOCK			
Young Cattle (15 – 20 Months)	5.54	6.63 DSE/ha	A, B and C
Custom Young Cattle (15 – 20 Months)	5.18	6.19 DSE/ha	A, B and C
Steers (240 – 460kg)	2.29	7.13 DSE/ha	A, B and C
Steers (in 240 kg out 420 kg)	2.94	4.62 DSE/ha	A, B and C
In 200 – 350 kg out 680 kg (Jap OX Market)	2.36	5.59 DSE/ha	A and B
Breeders (Inland weaners)	3.23	7.29 DSE/ha	A, B and C
EU Custom Steers (240 – 460 kg)	1.23	15.45 DSE/ha	A and B
Bulls	12.30	10.25 DSE/ha	A and B
Semen and embryos	Semen and embryos imported from overseas and sold. Approximately 200 straws of semen and 41 embryos annually.		
CROPPING			
Lucerne Dry Land	0.25	4.00 t/ha	A
Lucerne Irrigated	0.08	12.86 t/ha	A
Oaten/Cereal Hay	0.25	4.00 t/ha	A
EQUINE			
Stockhorse Stud	1.6	15.52 DSE/ha	A

* DSE – Dry Sheep Equivalent. The equivalent daily energy requirement of a 50 kg wether not losing or gaining weight.

TABLE 81 Quantum and Value of Agricultural Production from Within the Study Area

Domain	Crop Production (Tonnes)	Animals Sold (Head)*	Gross Value of Production (per annum)	Net Value of Production (per annum)
Domain A	5,454	3,022	\$4,251,681	\$1,961,737
Domain B	0	991	\$901,597	\$440,674
Domain C	0	224	\$127,785	\$55,086
Domain D	0	0	\$0	\$0
TOTAL	5,454	4,237	\$5,281,063	\$2,457,497

*Note this includes horses from the stockhorse stud.

FIGURE 65 Equine CIC Relevant to the Study Area

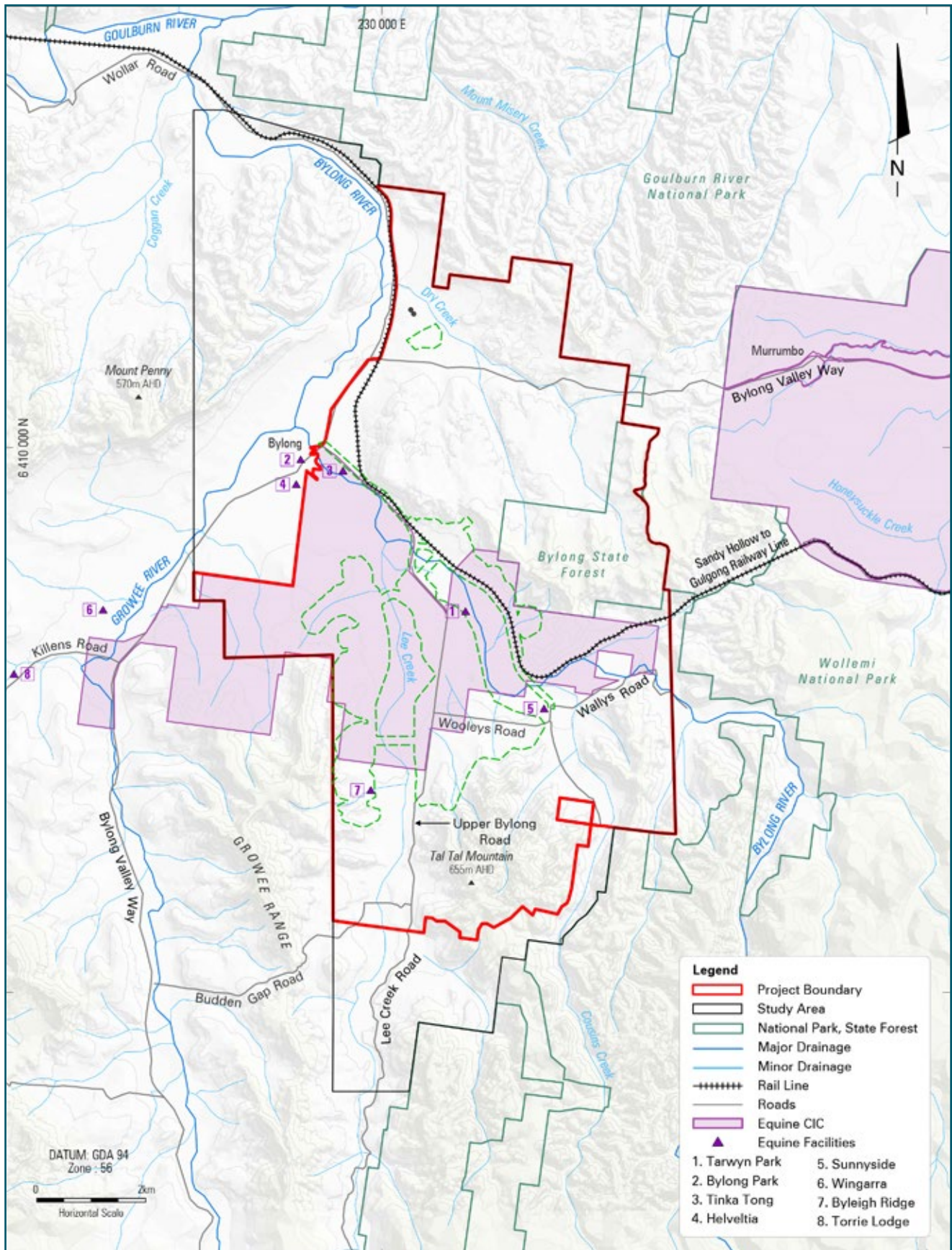


Table 82 indicates that the majority of the Biodiversity Offset Areas to be managed for conservation purposes is composed of Agricultural Domain C. Agricultural Domain C is the most abundant (1,324 ha or 35%) and is the lowest quality agricultural land within the Agricultural Assessment Area. Due to the limitations of the domain including dense vegetation, slope and rockiness it is unsuitable for cultivation and only capable of a low carrying capacity and is therefore best suited to nature conservation.

The agricultural enterprises that are currently operating within the Biodiversity Offset Areas are described in **Table 83** and the value of agricultural production from these enterprises is summarised in **Table 84**. The areas currently cultivated comprising exotic monoculture has not been included, as they will remain available for agricultural production. **Table 84** shows that the existing gross value of agriculture production based on the current land use is \$1.4 Million per annum.

Potential Value of Equine CIC

There is approximately 1,933 ha of mapped Equine CIC within the Study Area (**Figure 65**). Of note there are no thoroughbred breeding activities currently occurring within 10 km of the Project Boundary. Therefore a representative land use scenario was developed for land mapped as Equine CIC to determine its maximum potential value to the Upper Hunter Equine Industry. It has been assumed that the two best practice land uses to contribute to the Upper Hunter Equine CIC would include:

- Lucerne production to be sold to the industry; and
- Broodmare farm.

The Agricultural Domain mapping, interviews with relevant landowners and knowledge of the existing agricultural enterprises was used to develop this theoretical optimum equine land use scenario for modelling purposes. Using the Equine CIC land use scenario, it has been determined that a broodmare farm (incorporating both broodmares owned, and dry and wet mare agistment during thoroughbred breeding season as demand dictates), would be a suitable alternative to a beef grazing operation. This enterprise would potentially agist mares following a 'walk on walk off' service at thoroughbred breeding studs from within the Upper Hunter region.

The potential value of each Agricultural Domain for the Equine CIC land use scenario has been assessed assuming the average DSE rating for a thoroughbred horse is approximately 14 DSE. However, unlike cattle who generally graze evenly across an area, horses are naturally wasteful grazers due to their selective grazing. Therefore in similar broodmare operations, cattle are utilised to ensure even grazing and help manage feed wastage and ground cover.

The average operational income and variable costs were obtained from a survey of broodmare farms (Scott Barnett & Associates, 2011, unpublished data). The value of the potential equine land use scenario is summarised in **Table 85**.

Value of Agricultural Water

KEPCO has secured 2,535 units of water allocation for the Bylong Water Source under the *Hunter Unregulated and Alluvial WSP*. This water allocation entitles extraction of up to 2,535 ML of water in periods where the AWD remains at 100%. The Project's water demand from the Bylong River Water Source is discussed in **Section 7.4**.

To conservatively quantify the potential agricultural production (quantum and value) of the water, it is assumed that the water would be used for cash crops, namely lucerne for hay production. A 100% water allocation was assumed (i.e. 2,535 ML used per year over the 443 ha of suitable land).

DTIRIS (2011) farm budgets for summer irrigated crops and dryland crops for the Hunter NSW irrigation region have been utilised to determine agricultural water values for the Project. **Table 86** summarises the gross value (per ML) of irrigation water for lucerne grown in the locality assuming all approximately 443 ha of suitable land within KEPCO ownership was being utilised. **Table 86** shows that the potential gross and net values of production per ML of water are \$550 and \$146, respectively.

Whilst there is potential for the above area and water quantities to be irrigated on KEPCO land, in the recent past it has been estimated that approximately 750 ML per annum was typically utilised for irrigation purposes. The 750 ML of water currently utilised under KEPCO's water allocation has the potential to produce a gross value production of \$412,778 from the production of 1,241 tonnes of lucerne hay and 276 tonnes of Maize grain.

TABLE 82 Agricultural Domain Distribution Within the Biodiversity Offset Areas

Agricultural Domains*	Description	Biodiversity Offset Areas		Total Offset Area managed for Biodiversity Value	
		(ha)	(%)	(ha)	(%)
A	Arable land - Land suitable for high impact land uses such as cropping including; irrigated cropping; fodder cropping; and improved pastures for grazing. Careful management of limitations is still required for intensive cropping and grazing to avoid environmental degradation.	1,440	35	1,158	30
B	Extensive Grazing Land - lower slopes and hill grazing, suitable for grazing activities. Some occasional cultivation for fodder and improved pasture establishment may be undertaken on the lower slopes. Not suitable for high intensity agricultural activities such as regular cropping. Specialised management practices required to prevent long term degradation	1,318	32	1,318	35
C	Heavily Timbered - Low carrying capacity, dense vegetation, steep slope and stoniness limit agricultural activities. Domain has limited agricultural value and is generally suited to nature conservation.	1,324	32	1,324	35
TOTAL		4,082	100	3,800	100

* Denotes areas of land to be managed for biodiversity value (i.e. does not include the areas that are currently cultivated exotic monoculture).

TABLE 83 Current Enterprises per Agricultural Domain Within the Biodiversity Offset Areas*

Enterprise	Stocking Rate (ha/Head)	Average Carrying Capacity/Yield**	Agricultural Domain*
LIVESTOCK			
Young Cattle (15 – 20 months)	5.54	6.63 DSE/ha	A, B and C
Custom Young Cattle (15 – 20 months)	5.18	6.19 DSE/ha	A, B and C
Steers (240 – 460 kg)	2.29	7.13 DSE/ha	A, B and C
Steers (in 240 kg out 420 kg)	2.94	4.62 DSE/ha	A, B and C
In 200 – 350 kg out 680 kg (Jap OX Market)	2.36	5.59 DSE/ha	A and B
Breeders (Inland weaners)	3.23	7.29 DSE/ha	A, B and C
EU Custom Steers (240 – 460 kg)	1.23	15.45 DSE/ha	A and B
Bulls	12.30	10.25 DSE/ha	A and B
Semen and embryos	Semen and embryos imported from overseas and sold. Approximately 200 straws of semen and 41 embryos annually.		

* Denotes areas of land to be managed for biodiversity value (i.e. does not include the areas that are currently cultivated exotic monoculture).

** DSE – Dry Sheep Equivalent. The equivalent daily energy requirement of a 50 kg wether not losing or gaining weight.

TABLE 84 Quantum and Value of Agricultural Production Within the Biodiversity Offset Areas

Domain*	Animals Sold (Head)	Gross Value of Production (per annum)	Net Value of Production (per annum)
Domain A	1,057	\$1,032,847	\$566,531
Domain B	372	\$312,301	\$152,644
Domain C	124	\$88,165	\$38,006
Domain D	0	\$0	\$0
TOTAL	1,553	\$1,433,313	\$757,181

* Denotes areas of land to be managed for biodiversity value (i.e. does not include the areas that are currently cultivated exotic monoculture).

TABLE 85 Maximum Quantum and Value of Equine CIC Land Use Scenario

Domain	Crop Production (t)	Number Horses (Head)	Gross Value of Production (per annum)	Net Value of Production (per annum)
A	2,040	680	\$6,500,820	\$3,184,666
B	0	158	\$1,359,800	\$698,331
C	0	0	\$7,860,620	\$3,882,997
TOTAL	2,040	837	\$6,500,820	\$3,184,666

TABLE 86 Potential Production from KEPCO Water Allocation

Crop Grown	Lucerne	Maize	Total	Value/ML
Years Grown	5	2	7	-
ML/ha	8.0	7.2	-	-
Weight average ML/ha	5.7	2.1	-	-
Ha grown	231.2	94.6	326.2	-
Yield (t)	4,194.0	932.0	-	-
Gross Value	\$1,145,419	\$249,772	\$1,395,191	\$550
Net Value	\$265,168	\$104,695	\$369,863	\$146

Potential production from an alternative dryland cropping scenario (detailed in full in **Appendix X**) estimated a gross value production of \$343,903 from the production of 932 tonnes of lucerne hay and 419 tonnes of sorghum. The potential gross value of agricultural water per ML removed is \$415 and the net value is \$101.

Potential Agricultural Production

With superior management practices and/or capital investment such as pasture improvement and paddock subdivision to allow for more intense grazing management, the total potential agricultural production within the Study Area could be increased to approximately \$7.6 Million per annum and the net value to approximately \$2.9 Million per annum.

7.16.5 Impact Assessment

This section assesses the potential impacts on agricultural land within the Project Disturbance Boundary, Subsidence Study Area, Biodiversity Offset Areas and water resources removed from agriculture as a result of the Project. This section also includes an assessment of impacts to the Equine CIC utilising the "optimum equine land use scenario".

Project Disturbance Boundary

Any agricultural land that is situated within the Project Disturbance Boundary will be removed from production for approximately five years following completion of open cut mining operations and subsequent rehabilitation. It is estimated that the following areas of the identified agricultural domains will be affected:

- Domain A 451 ha;
- Domain B 694 ha; and
- Domain C 15 ha.

An additional 33 ha outside of the Project Disturbance Boundary and within Domain A will cease to be irrigated due to the removal of the irrigation infrastructure as a result of its proximity to the Project Disturbance Boundary and has been conservatively included in the assessment. **Table 87** provides an estimate of the annual agricultural production that will be impacted within the Project Disturbance Boundary.

If it were to be assumed that agricultural production from the entire Project Disturbance Boundary ceases at the commencement of the Project in perpetuity, the present value of the gross value of production foregone is \$12.4 Million (using a 7% discount rate) and the present value of the net value of agricultural production foregone is \$5.3 Million (using a 7% discount rate) (Gillespie Economics, 2015). These values are developed as a conservative worst case scenario as the mitigation measures and proposed rehabilitation strategy ensures the present value of agricultural production will be forgone for as little time as practicable.

This loss will be mitigated by the Project's long term rehabilitation objective to provide a stable rehabilitated landform with either a self-sustaining vegetation cover or of adequate stability conducive to agricultural activities. Specific landscape objectives seek to return the rehabilitated land to its pre-mining land use or similar (where practical) and to enhance biodiversity values where possible.

Sustainable farming practices will continue in available areas owned by KEPCO not required as biodiversity offsets outside of the Project Disturbance Boundary throughout the life of the Project. The Project's Farm Management Plan will ensure the best agricultural use of adjacent non-mine lands to maximise this integration and to provide opportunities for private farmers to use these through long term leases.

TABLE 87 Quantum and Value of Agricultural Production Impacted Within the Project Disturbance Boundary

Domain	Crop Production (Tonnes)	Animals Sold (Head)	Gross Value of Production (per annum)	Net Value of Production (per annum)
A	1,043	343	\$654,422	\$271,122
B	0	237	\$164,444	\$80,375
C	0	2	\$999	\$431
TOTAL	1,043	582	\$819,865	\$351,928

Subsidence Study Area

The Soils Assessment and Subsidence Impact Assessment confirmed that land indirectly and temporarily impacted by the Subsidence Study Area will experience localised short term changes in soil and landscape characteristics. Given the nature of underground mining it is unlikely these impacts would be to an extent that the land and associated agricultural productivity is significantly impacted and cannot proceed without remediation.

Surface remediation will be investigated to ensure soil and landscape characteristics are not significantly impacted from its pre-mining condition. Upon progressive settlement of each subsided longwall panel, it is expected that the land will be able to retain its pre-mining land capability characteristics and, where it is the intended post-mining land use, continue current agricultural production.

Biodiversity Offset Areas

Pending further land management arrangements upon development and approval of the Biodiversity Offset Management Plan, the properties selected as Biodiversity Offset Areas for the Project will be managed for agricultural purposes, in conjunction with the conservation of ecological values. All areas within the offset properties that are currently cultivated and contain exotic monoculture will specifically be excluded from the proposed conservation mechanism and continue to remain available for agricultural production. The agricultural enterprises that are currently operating within the Biodiversity Offset Areas are listed in **Table 83** and the value of agricultural production from these enterprises is summarised in **Table 84**.

Conservatively assuming that agricultural production from the onsite biodiversity offset areas ceases at the commencement of the Project in perpetuity, the present value of the gross value of production foregone is \$21.7 Million (using a 7% discount rate) and the present value of the net value of agricultural production foregone is \$11.5 Million (using a 7% discount rate).

Water Resources

It is predicted that pumping will be required from a borefield constructed within the alluvium throughout the life of the Project in order to supplement water supplies within the water management system for the continued operation of the CHPP (see **Section 7.6**). The annual total water take from the alluvial groundwater systems due to mining, averages 153 ML/Year (peak of 295 ML/Year) with a total of 3,829 ML take estimated over the life of the Project (AGE, 2015).

Predicted average water usage requirements for the mining operations are presented in **Table 88**. Throughout the Project, where this water is not used for mining related activities it will be available for use in agricultural activities on KEPCO owned land. The surface water and groundwater impact assessments have confirmed that the Project will be operated so as to not adversely impact upon any neighbouring private groundwater bores.

As presented in **Table 86**, the potential gross value of agricultural water per ML removed is \$415 and the net value is \$101. The maximum gross value lost from agriculture due to Project water requirements is \$410,562 per annum and the maximum net value lost is \$99,956 per annum during open cut operations (PYs 3 to 6). During underground only operations there is predicted to be no loss of water from agriculture.

TABLE 88 Quantum and Value of Water Potentially lost from Agriculture

Project Year	Borefield Water Requirements (ML/Year)*	Water Available for Agriculture (ML/Year)*	Gross Value of Water Lost from Agriculture per annum	Net Value of Water Lost from Agriculture per annum
PY 3 – 6 (open cut only operations)	990	1,605	\$410,562	\$99,956
PY 11 – 25 (underground only operations)	0	2,065	\$0	\$0
PY 7 – 10 (combined mining operations)	500	1,815	\$207,355	\$50,483

* Based on the median borefield water demand plus predicted average alluvial groundwater seepage

If it were to be assumed that the predicted maximum loss of water from agriculture under median conditions due to Project water requirements is removed in perpetuity, the present value of the gross value of production foregone is \$5.4 Million (using a 7% discount rate) and the present value of the net value of agricultural production foregone is \$1.3 Million (using a 7% discount rate) (Gillespie Economics, 2015).

Table 88 presents a worst case value from loss of agricultural water when compared to the utilisation of the entire KEPCO held water allocation. In reality the loss is far less as the actual quantity of water utilised for agriculture is approximately 30% of that available under KEPCO held water allocations. The predicted quantum of water which will remain available for agricultural land use between PYs 3 and 6 remains greater than the currently utilised 750 ML under average conditions.

Total Combined Agricultural Production

Table 89 presents a comparison of annual value of agricultural production affected by the Project to the annual value of agricultural production within MWRC LGA, NSW and Australia. The combined gross value of production from the agricultural land and water impacted by the Project is \$2.66 Million per annum. This represents 4.12% of the total agricultural production of the MWRC LGA, 0.02% of NSW and 0.005% of Australia's agricultural production.

In total, foregone gross value and net value of agricultural production from land and water resources required for the Project is estimated at a present value of \$5.4 Million and \$1.3 Million, respectively (using a 7% discount rate).

As the overall agricultural contribution of the land within Project Disturbance Boundary and the Biodiversity Offset Areas is small when compared to the total agricultural production on a regional, state and national scale, the reduced availability and productivity of this land will have a negligible impact on the agricultural industry.

Regional Impacts of Agriculture Foregone

The regional impacts of the level of annual agricultural production foregone as a result of the Project were estimated from the sectors in the Upper Hunter regional input-output table by Gillespie Economics. **Table 90** compares the annual regional production and economic impacts associated with the Project with the level of annual agricultural production that would be foregone as a result of the Project.

The direct annual output of the Project is estimated at \$469 Million per annum. In contrast, the direct annual output of future use of agricultural lands that would be utilised by the Project is estimated at \$3 Million per annum.

Gillespie Economics (2015) also undertook a benefit cost analysis which included an estimation of the present value of production costs and benefits of the Project over a 25 year period. The present value of net production benefits of the Project to Australia is estimated at \$596 Million (7% discount rate) with this estimate already including foregone agricultural production as an economic cost. In contrast, the present value of future use of agricultural lands that would be utilised by the Project is estimated at \$16.8 Million (7% discount rate).

TABLE 89 Comparison of Annual Value of Agricultural Production

Resource	Project Impact (per annum)	MWRC LGA (per annum)	NSW (per annum)	Australia (per annum)
Land	\$ 2,253,176*	-	-	-
Water	\$ 410,5620	-	-	-
TOTAL AGRICULTURAL PRODUCTION	\$ 2,663,738	\$64.70 M	\$12,128.20 M	\$ 48,048.00 M

Source: ABS, 2008; ABS 2011, ABS 2014

* Project Impact to land includes both the Project Disturbance Boundary and the Biodiversity Offset Areas

TABLE 90 Annual Regional Production and Economic Impacts

Aspect	Agriculture ¹	Project
PRODUCTION TYPE	BEEF AND CROPPING	COAL
Direct Output Value (\$ Million)	2	469
Direct Value Added (\$ Million)	1	305
Direct Income (\$ Million)	0	41
Direct Employment (average no.)	14	290
Direct and Indirect Output Value (\$ Million)	4	624
Direct and Indirect Value Added (\$ Million)	2	378
Direct and Indirect Income (\$ Million)	1	72
Direct and Indirect Employment (no.)	19	830

¹ This is the area of agricultural land that would be impacted in perpetuity by the Project

Impact to Biophysical Strategic Agricultural Land

Project Disturbance Boundary

As described in **Section 7.14**, there is a total of approximately 441 ha of verified BSAL within the Project disturbance footprint (Project Disturbance Boundary and Subsidence Study Area). This represents 26% of the total verified BSAL within the Project Boundary (approximately 1,676 ha). The Project has been designed to avoid BSAL where possible. Of the potential approximately 2,875 ha of land to be impacted by the Project, approximately 15% is located on land verified as BSAL.

In order to minimise the impacts to BSAL, KEPCO has committed to avoiding where practicable any impacts on BSAL. KEPCO's objective is to return all lands disturbed except that associated with the rail loop and public roads back to at least or better than the original land formation.

The quantity of BSAL that experiences direct and long term impacts (206 ha) is proposed to be reinstated to mitigate Project impacts. There will be no reduction in the quantity of BSAL, however, as per the LSC classes, the spatial distribution of BSAL will differ from the pre-mining landscape. Additionally, KEPCO will aim to reinstate 10% greater area of BSAL than is predicted to be disturbed as a conservative and practical objective for rehabilitation.

Further details regarding the rehabilitation of this land and compensatory measures are provided in Project's Rehabilitation Strategy (**Section 7.15**).

Biodiversity Offset Areas

The Upper Hunter SRLUP mapping and site verified BSAL indicates that 486 ha of BSAL is likely to occur within the Biodiversity Offset Areas. The BOS has proposed that agricultural activities will continue in areas, which have previously been used for cultivation. Therefore 109 ha of BSAL which currently lies within areas of cultivated land will continue to be utilised for agricultural purposes. A further 245 ha of BSAL lies within areas of CEEC/EEC. The Project is proposing to utilise these areas for ecological conservation purposes by excluding agricultural activities. Actively regenerating and preserving the areas relevant to native woodland and grassland is considered a priority land use for preservation of native biodiversity in the region.

As such, the Biodiversity Offset Areas will experience some changes in land use as a result of the Project; however the inherent agricultural productivity of the land will not be reduced. No land within the Biodiversity Offset Areas will be subject to significant direct or permanent disturbance nor will there be impacts to soil fertility, rooting depth, soil profile materials, soil thickness, surface microrelief and/or soil salinity. Therefore, the Project will not significantly reduce the agricultural productivity of potential BSAL within the Biodiversity Offset Areas, but rather modify the land use in some areas of native vegetation.

Impact to Equine Critical Industry Cluster

The area of Equine CIC mapped as occurring within the Bylong Valley is located on the south-western most extremity of the mapped Equine CIC. The Upper Hunter SRLUP identifies that the relevant equine industry is focused in the Upper Hunter Valley surrounding the township of Scone. **Figure 65** illustrates the isolated location of the mapped Equine CIC within the Study Area in relation to the key equine breeding facilities and related infrastructure surrounding Scone as identified within the Upper Hunter SRLUP.

A total of 700 ha of mapped Equine CIC is located within the Project Disturbance Boundary (29% of the total mapped Equine CIC within the Study Area) and will be directly disturbed as a consequence of the Project. There is an additional 584 ha of mapped Equine CIC within the Biodiversity Offset Areas, 69 ha of which falls within areas of cultivated land and as such will remain for agricultural activities which could include equine husbandry.

The impacts in relation to the entire Upper Hunter Equine CIC have been identified as minimal. This is due to the location of the mapped Equine CIC as an isolated pocket located at the absolute extremity of the mapped Equine CIC, approximately 1½ hours' drive from the equine centre of Scone.

Project Disturbance Boundary

The AIS estimated the maximum potential value of the mapped Equine CIC land within the Project Disturbance Boundary and Biodiversity Offset Areas, should the land be utilised for a purpose which contributes to the equine industry. Total direct disturbance of 700 ha of mapped Equine CIC is predicted as a result of the Project. This constitutes a total of 0.27% of the total mapped Equine CIC in the Upper Hunter.

Under the theoretical best practice equine land use scenario, the annual Net Value of Production potentially lost as a result of the direct disturbance within areas of mapped Equine CIC is approximately \$1.2 Million.

Should, as an absolute worst case, the mapped Equine CIC within the Project Disturbance Boundary be lost in perpetuity, the present value of the gross value of production foregone is approximately \$37 Million (using a 7% discount rate). The land within the Project Disturbance Boundary will be returned to agricultural land use as soon as practical after achieving relevant rehabilitation goals, and will not be lost in perpetuity.

Biodiversity Offset Areas

There is 584 ha of mapped Equine CIC within the Biodiversity Offset Areas. Of this 69 ha falls within areas of cultivated land and as such will remain for agricultural activities such as equine husbandry. Of the remaining 515 ha of mapped Equine CIC, 100 ha is classed as Agricultural Domain C and would be utilised as part of the cattle grazing program. Therefore it has been assumed that 415 ha of mapped Equine CIC will be removed from agricultural production for the purposes of biodiversity value. The management of the native vegetation areas adjacent to these farm lands will enhance the farmlands both by improving the aesthetics and providing shelter belts for valuable livestock.

Under the best practice equine land use scenario described above the annual Net Value of Production potentially lost as a result of the Biodiversity Offsets Areas within areas of mapped Equine CIC is \$869,804.

Should the mapped Equine CIC within the Biodiversity Offsets Area be lost for perpetuity, the present value of the gross value of production foregone is \$25.6 Million (using a 7% discount rate) and the present value of the net value of agricultural production foregone is \$15.4 Million (using a 7% discount rate).

Assessment of Indirect Impacts on Agricultural Enterprises

A review of the assessment of environmental and social impacts of the Project on agricultural land use has been completed for the AIS. Environmental and social impacts reviewed included groundwater, surface water, air quality, noise and vibration, visual, traffic and labour supply.

With the environmental and social mitigation and management measures described throughout this EIS, no substantial impact to the agricultural industry in the Bylong Valley or MWRC LGA is predicted as a result of the Project outside the Agricultural Assessment Areas discussed above.

7.16.6 Mitigation and Management

As the overall agricultural contribution of the Project disturbance footprint is small when compared to the total agricultural production on a regional, state and national scale, the reduced availability and productivity of this land will have a minimal impact to the agricultural industry. In addition, the Project will not reduce the availability of land for agricultural purposes or affect the productivity of existing agricultural land outside of KEPCO owned land within the locality.

The area of agricultural land disturbed by the Project at any one time will be minimised to ensure agricultural uses can continue where practicable. KEPCO has appointed a Farm Manager to ensure available agricultural land will continue to be used for Agricultural enterprises where practicable. The Farm Manager will also help to develop and implement the Farm Management Plan for all KEPCO owned land not required for mining purposes. This will ensure the continued productivity of agricultural land not directly impacted by the Project.

Other potential impacts on agricultural resources and enterprises in the locality, including air quality, noise, water usage, traffic and transport, and labour supply have been assessed as having minimal effect.

To maintain and where possible enhance the agricultural productivity of KEPCO owned land outside the Project Disturbance Boundary and Biodiversity Offset Areas, as part of the Farm Management Plan being developed by the Farm Manager and Rehabilitation Strategy (as appropriate) KEPCO will:

- Develop and implement a weed and pest management plan to control the distribution of invasive species and feral animals over KEPCO owned land;
- Minimise the time that disturbed areas are removed from agricultural production by progressively rehabilitating disturbed areas as soon as practical;
- Implement sustainable farming practices and management of land situated outside the Project Disturbance Boundary and Biodiversity Offset Areas on all KEPCO owned agricultural land;
- Consolidation of previously disparate agricultural properties under a single management strategy to maximise economies of scale;
- Continue employing a dedicated Farm Manager to ensure the long term productivity of KEPCO owned agricultural lands; and
- Expand existing environmental monitoring network within the Project Boundary and in the locality to ensure that no unforeseen environmental impacts occur that may deleteriously affect agricultural activities adjacent to the Project Boundary.

7.17 VISUAL

7.17.1 Background

A Visual Impact Assessment for the Project was undertaken by JVP Visual Planning and Design and is provided in full as **Appendix Y**. The purpose of the study was to identify the character of the existing visual landscape in the area and determine the potential visual and lighting impacts associated with the key stages in the development of the Project.

Mine Planning

The sensitive scenic setting within which the Project is located has been given specific consideration to minimising the visual impacts of the Project on sensitive viewing locations in the mine planning and design phases of the Project (discussed further in **Section 3.17**). Specific mine planning decisions made in consideration of minimising visual impacts include:

- A reduction as far as practicable of the open cut mining footprint and limiting the duration of open cut mining activities;
- The siting of the MIA between existing topographic features to achieve screening from many sensitive external view locations, especially the main valley along the Growee River;
- Implementation of progressive OEA rehabilitation during mining operations to reduce visual effect levels of these features; and
- Retention of iconic high topographic points in the local landscape setting.

7.17.2 Methodology

The methodology to determine the level of visual impact of the Project on the scenic and landscape values of the locality and wider region involved the following stages:

- Consideration of the existing visual environment. This stage included a field review of existing landscape settings and how they are seen from various viewing locations. This process determined the visual character of the landscape and the visual sensitivity of the key viewing locations surrounding the Project;
- Determination of the visual effect and visual sensitivity of the Project. Visual effect and visual sensitivity was assessed by considering the visual characteristics of the Project in the context of the existing landscape within which it is seen;

- A combined consideration of both visual sensitivity and visual effect to identify Project impacts at specific locations and confirm the specific mitigation strategies required. The overall visual impact of the Project was then determined by assessing the interaction between visual sensitivity and visual effects; and
- Consideration of the impact on landscape values based on the total perception of landscape. Evaluation of these values included a consideration of the landscape of the locality and region and how landscapes affected by the Project may be perceived in the broader context of perceptions of the Bylong region.

Visual Sensitivity

Visual sensitivity is a measure of how critically a change to the existing landscape is viewed from different land use areas in the vicinity of a development.

In this regard, residential, tourist and/or recreation areas generally have a higher visual sensitivity than other land use areas including industrial, agricultural or transport corridors.

This is because land uses with a higher visual sensitivity, such as residential, use the scenic amenity values of the surrounding landscape and may be used as part of a leisure experience and often over extended viewing periods (such as the Bylong Valley Way which is part of a regional designated tourist drive).

The visual sensitivity of individual viewing locations may range from high to low, depending on a number of factors including viewing distance to Project elements, the level of screening provided by intervening topography and vegetation and the general orientation of views (from residences, roads, etc.) toward the Project. For any area to be given a sensitivity ranking, it must have views to the Project. This visibility was determined based on field assessment, evaluation and computer analysis of topographic and vegetation data.

Visual Effect

Visual effect is a measure of the level of a Project's visual contrast and integration with the existing landscape.

The degree to which the visual characteristics and elements of a Project contrast with the existing landscape may determine the level of visual effect. For example, a new mining development will have a higher visual effect due to strong contrast with the existing visual environment. Extensions to the operations of an existing mine could have a lesser visual effect due to elements of the development being present in the landscape. The successful completion of rehabilitation would be likely to have a low visual effect due to limited contrast with the existing landscape.

In a similar way, a development is considered to be integrated with the existing landscape based on issues of scale, position in the landscape and contrast with the surrounding environment. High visual integration is achieved if a development is dominated by the existing landscape, is of small scale and/or of limited contrast.

Visual Impact

The visual impact of a project is assessed using a qualitative assessment of the visual sensitivity of the viewing locations and the visual effect caused by activities associated with the Project. The relationship between visual sensitivity, visual effect and visual impact is depicted in **Table 91**.

Existing Visual Landscape

The landscape setting of a Project is defined in terms of topography, vegetation, hydrology and land use features. These elements define the existing visual character of the landscape that the Project is located within and that it visually interacts with.

TABLE 91 Visual Impact Assessment Matrix

Visual Sensitivity	Visual Effect			
	High	Moderate	Low	Very Low
High	High Impact	High/Moderate Impact	Moderate/Low Impact	Low Impact
Moderate	High/Moderate Impact	Moderate Impact	Moderate/Low Impact	Very Low Impact
Low	Moderate/Low Impact	Moderate/Low Impact	Low Impact	Very Low Impact

The Primary Visual Catchment (PVC) represents this area where the majority of critical views of the Project may be experienced and was the focus of the Visual Impact Assessment (see **Figure 66**). Within any landscape there are areas of similar visual features that are defined as a Landscape Character Unit (LCU). Characterising the landscape within the PVC in terms of these units assists in understanding the visual character of the landscape as a whole.

LCUs within the PVC included the:

- **Forested hills and ridgelines LCU.** This LCU is the most visually dominant within the PVC, and generally defines the boundary of the areas with views of the Project. The LCU is also significant in that these elevated features also provide screening of views to the Project;
- **Undulating pastoral lands LCU.** Lands within this LCU are characterised by dry grassland and areas of scattered trees. These undulating slopes lie between flat valley floors and the steeper wooded slopes of the ridgelines and hills and cover the majority of more elevated areas that are not occupied by forest and woodland;
- **Flat pastoral lands LCU.** This LCU is characterised by flat land within the creek and river valleys that has been cleared of trees and is used for broad paddock grazing, with no evidence of more intensive operations such as irrigated cropping. The flat pastoral lands also support a number of rural residences on various sized rural holdings;
- **Irrigated grazing/agricultural lands LCU.** The irrigated pastoral/agricultural LCU closely follows the creek and river alluvial valley floors in a patterned landscape of textured rectilinear fields. There are few trees within this LCU as this land is reserved for cropping or irrigated pastoral land uses;
- **Creeks and rivers LCU.** This LCU is usually evident by a thin linear band of trees and shrubs marking the margins of the main watercourses in the PVC; and
- **Bylong Village LCU.** This LCU includes the village of Bylong and the immediately surrounding areas.

Representative Viewing Locations

The PVC was divided into four distinct viewing sectors as shown on **Figure 67** which included:

- North View Sector;
- East View Sector;
- South View Sector; and
- West View Sector.

Based on the analysis of the existing landscape and sensitive receiver positions, a range of key viewing locations were assessed to determine the level of impact associated with views of the Project. Computer-generated photomontage models were used to assist in the determination of visual effect of the existing view and key stages of the Project relevant to the visual impact assessment (PYs 3, 5, 7, 9 and 25).

The models enabled accurate views of the Project to be generated from representative viewing locations, taking into account screening of views by natural topography and vegetation. To illustrate worst case views of the Project from external locations, six viewing locations representative of key residential areas and public roads were selected for photomontage analysis:

- Wooleys Road – Photomontage location 1;
- Upper Bylong Road – Photomontage location 2;
- Bylong Village/Sunnyside – Photomontage location 3;
- Bylong Valley Way South – Photomontage location 4;
- Bylong Valley Way North – Photomontage location 5; and
- WAF – Photomontage location 7.

Photomontage locations are illustrated on **Figure 67** and discussed below in **Section 7.17.3**.

Lighting

Lighting impacts were evaluated qualitatively. There are two types of lighting effects which could be experienced from the Project. The first effect is where the light source is directly visible, and will be experienced if there is a direct line of sight between a viewing location and the light source. The second effect relates to the general night-glow (diffuse light) that results from light of sufficient strength being reflected into the atmosphere. This type of lighting effect will create a strong local focal point and the effect will vary with distance and atmospheric conditions such as fog, low cloud and/or dust particles which all reflect light.

The visual effect of lighting on sensitive receivers will vary as a result of the location and height of operations onsite, the relative level at which the viewing location is situated and the presence of any barriers to lighting effects such as OEAs, offsite topographic features and/or vegetation.

FIGURE 66 Visual Character Units

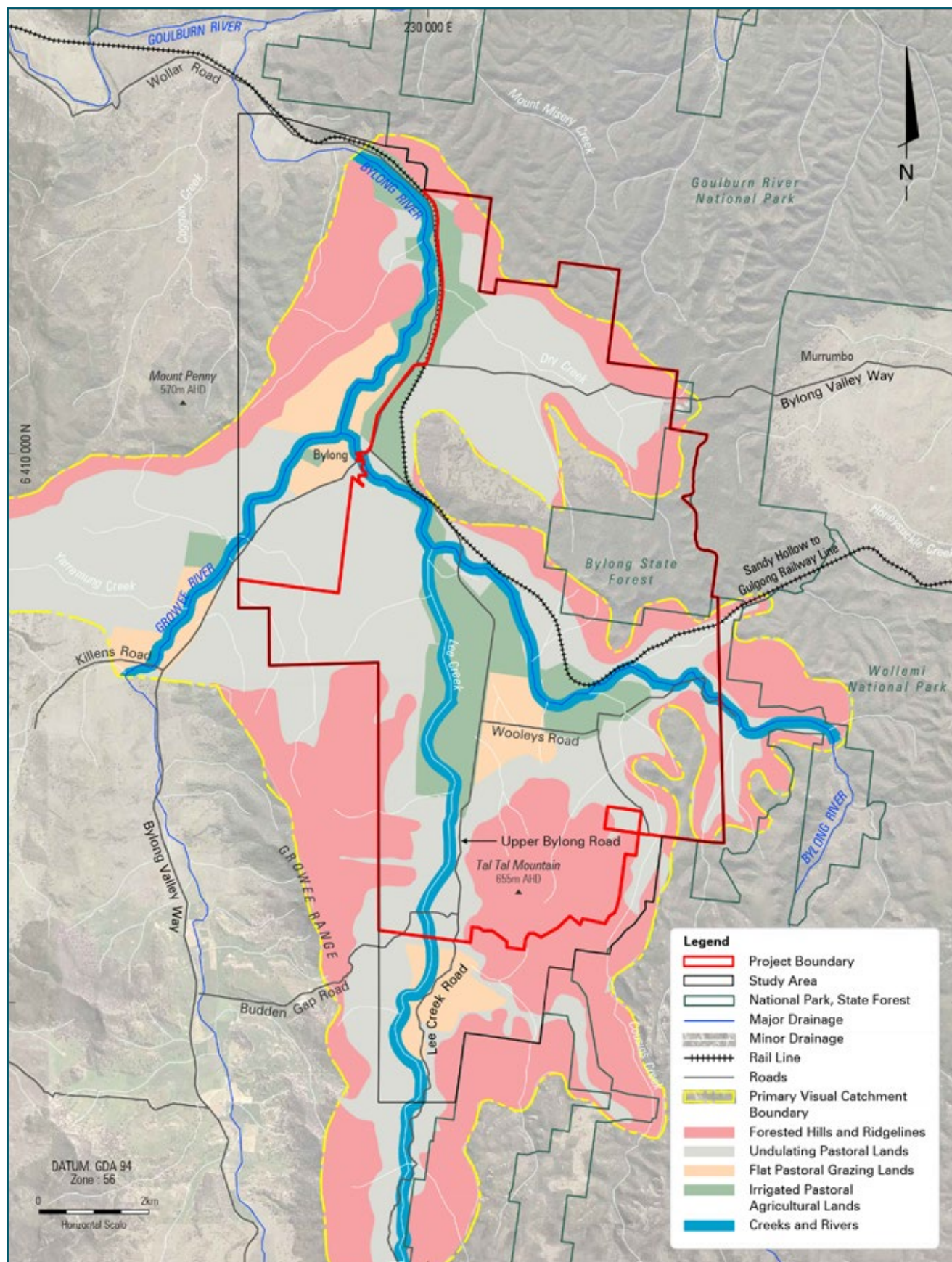
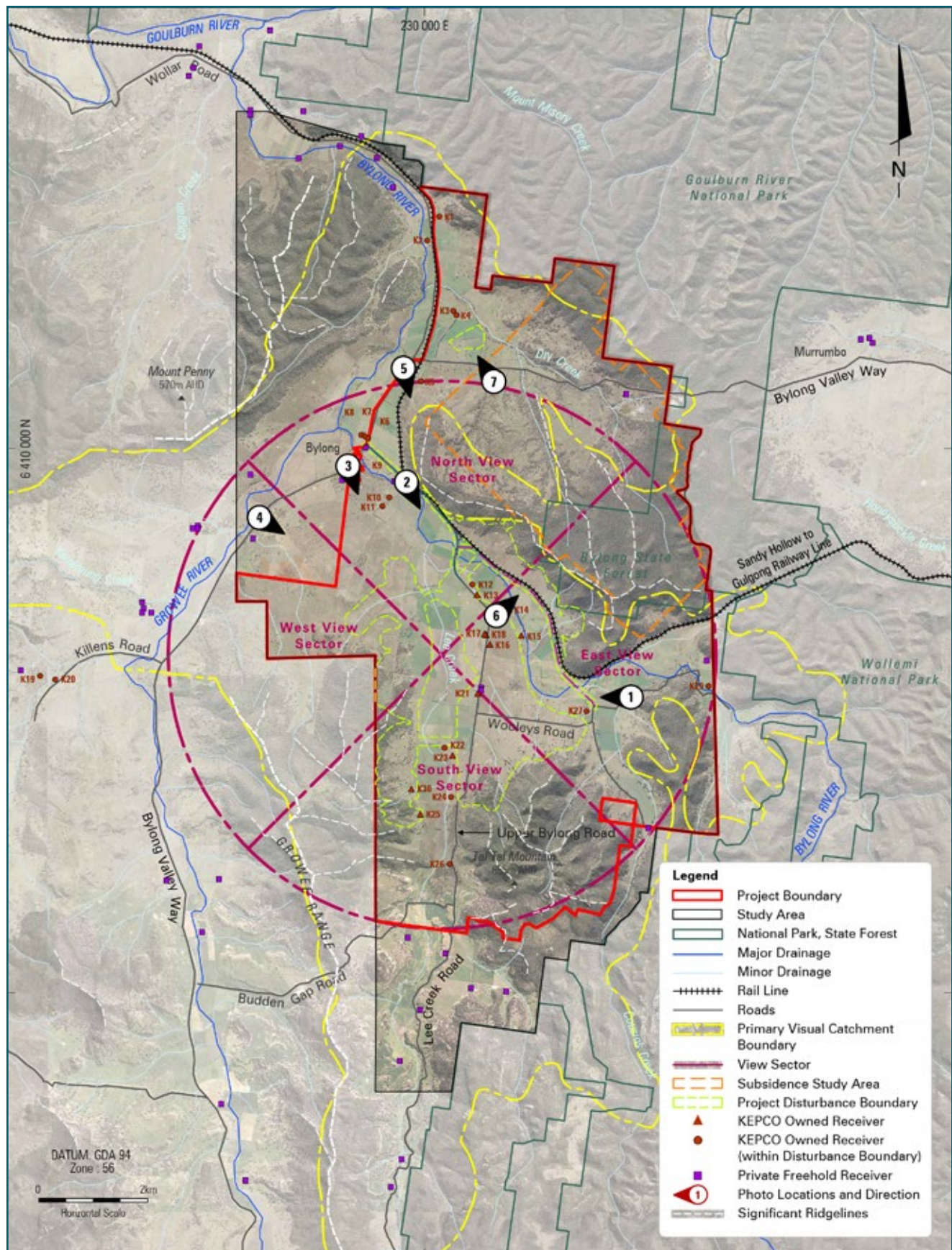


FIGURE 67 Visual Assessment Locations

Cliffs

An assessment of the visibility of potentially impacted upon prominent cliffs was undertaken. It included development of cross sections to determine the potential visual impacts to sensitive receivers.

7.17.3 Impact Assessment

The Project will result in a number of visual impacts, which will vary in each view sector over the life of the Project. A review of the staged Project mine plans, aerial photography and the photomontages developed for representative viewing locations was used to determine the visual impacts discussed below.

North View Sector

The majority of the North View Sector contains flat to gently undulating pastoral lands with a northern backdrop of forested ridgelines (see **Figure 67**). Potentially sensitive receivers located within this sector include:

- Bylong Village which has a high visual sensitivity;
- Rural residences which have a high visual sensitivity;
- Bylong Valley Way and Wollar Road which have high visual sensitivity;
- Upper Bylong Road which has a moderate to low sensitivity;
- Rural land which have a low visual sensitivity;
- Sandy Hollow to Gulgong Railway Line which has a low sensitivity; and
- Mapped Equine CIC which has a high visual sensitivity.

Representative viewing locations in the North View Sector where photomontage analysis was undertaken to illustrate visual effects are shown on **Figure 67** and includes:

- **Photomontage location 2 – Upper Bylong Road.** Existing views from this location are to the south and south-east across open pastoral lands. As shown on **Figure 68** to **Figure 70**, views of the developing North Western OEA (after PY 3) will be available from this location. The OEAs both contrast with the colour, form and texture of the existing views and a reduction in this effect is only achieved through the establishment of rehabilitation on the OEAs.

This reduction in visual contrast with pastoral lands in the foreground of this view will occur from approximately PY 9 as woodland trees start to mature on the rehabilitated OEAs.

- **Photomontage location 3 – Bylong Village.** Views are to the south-south-east from the edge of Bylong Village towards the North Western OEA. As shown on **Figure 71**, visible elements of the Project in this direction are partially screened from the viewing location by open woodland vegetation. There are no perceptible views of the Project elements (including the northern face of the North Western OEA) through intervening vegetation and topography. This is typical of many western viewing locations within the Growee Valley.

- **Photomontage location 5 – Bylong Valley Way (North).** The existing view from this location is of open fields with scattered trees and grassland, towards the gentle slopes in the background. This location is representative of views from Bylong Valley Way and for rural residences north of Bylong Village. As shown on **Figure 72**, there is no visible alteration to the existing vegetation, topography or landscape character as viewed from this location. There are no views to the Project elements from this location.

- **Photomontage location 7 – WAF.** This montage location has been chosen to represent the potential views of the WAF when travelling along Bylong Valley Way. There is approximately 1,450 m of road frontage where there are potential views of the WAF. The WAF will be constructed in PY 1 and decommissioned and removed at the end of PY 6.

As shown on **Figure 73** to **Figure 74**, views will be available to the WAF from Bylong Valley Way, however early roadside planting will assist to minimise the visual impacts.

The Bylong Village has high sensitivity to any views of the Project; however tree cover and topography screen views to Project elements from this location result in a low visual impact. One privately owned rural residence, situated at Photomontage Location 2 (Landowner ID 69) (see **Figure 67** and **Figure 12**) may be subject to views and will receive visual impacts prior to rehabilitation of the North-Western and Eastern OEAs.

Within the Northern View Sector, the visual impact on Bylong Valley Way by the open cut mining related Project components will be low due to topographic and vegetative screening. Views will be available to the WAF from Bylong Valley Way and Wollar Road. With the implementation of early roadside planting, visual impacts are minimised.

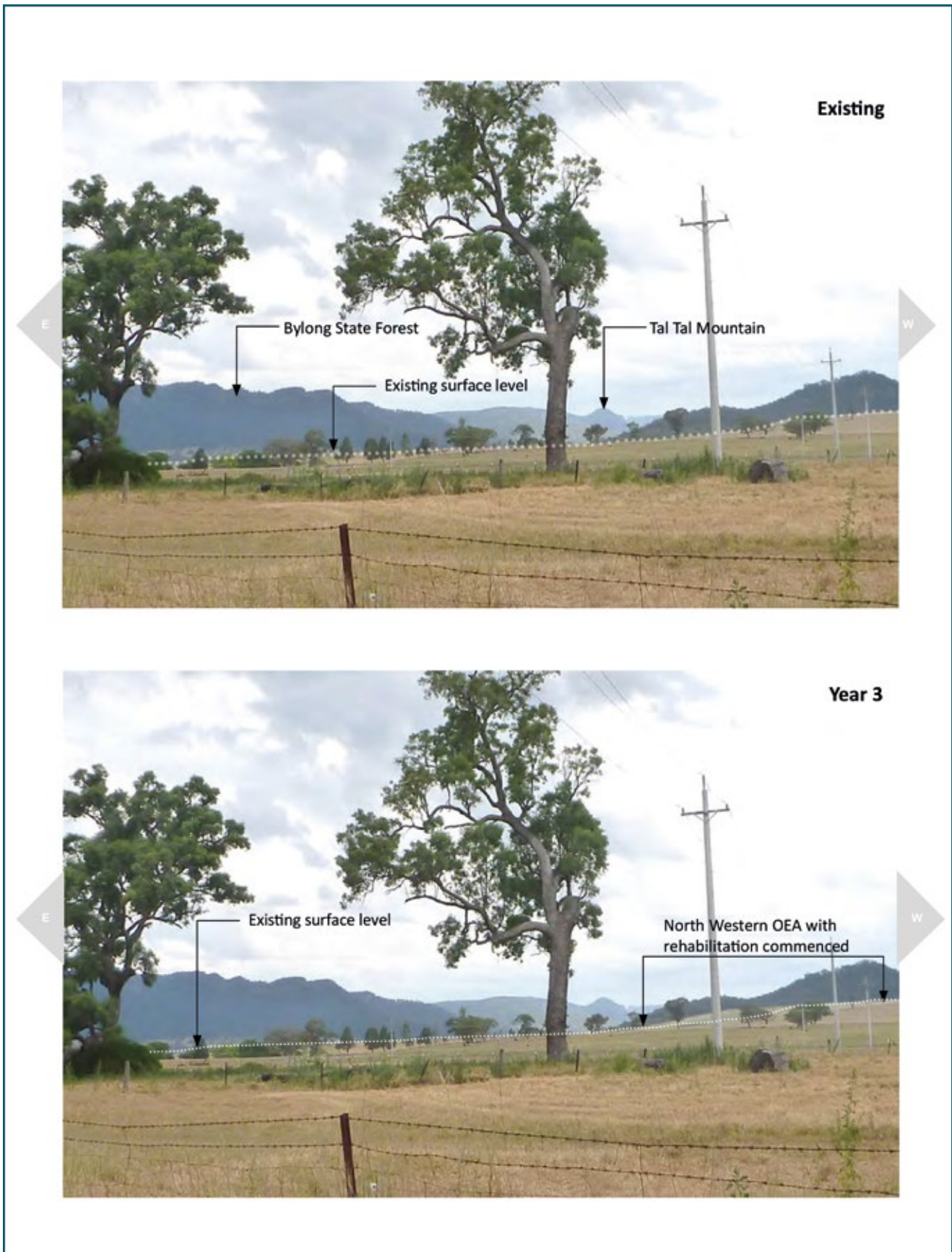
FIGURE 68 Photomontage Location 2 Upper Bylong Road (Existing and Year 3)

FIGURE 69 Photomontage Location 2 Upper Bylong Road (Year 5 and Year 7)

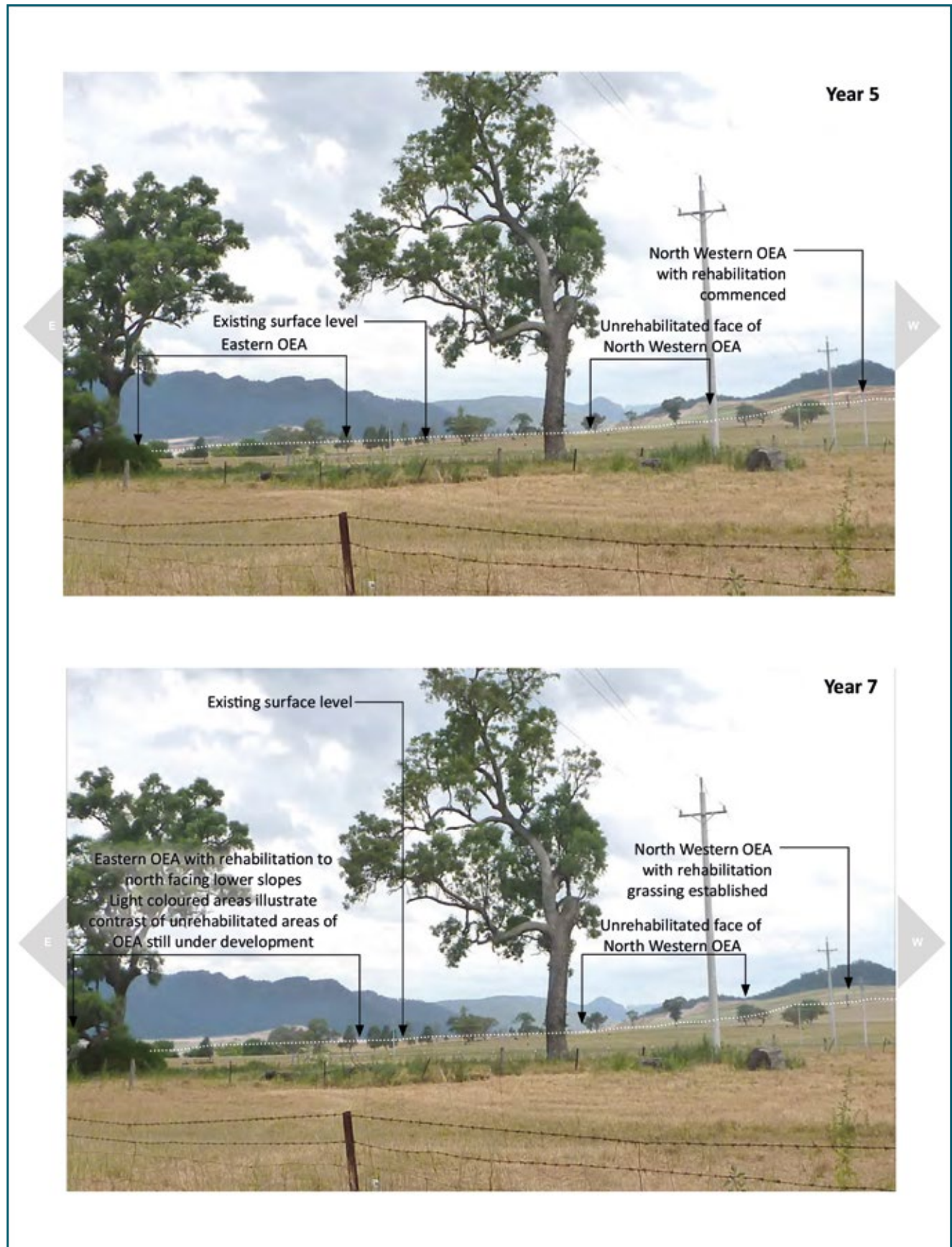


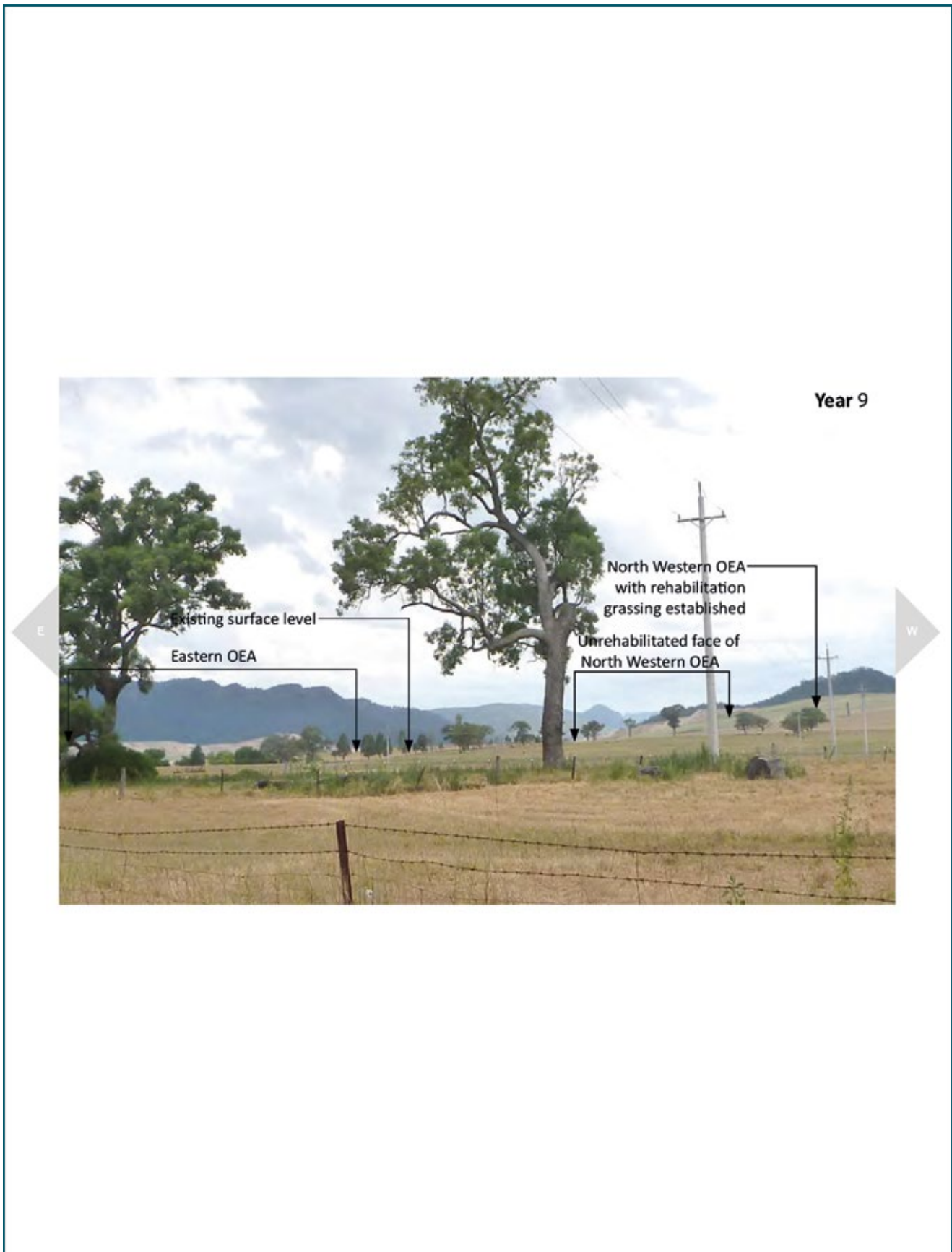
FIGURE 70 Photomontage Location 2 Upper Bylong Road (Year 9)

FIGURE 71 Photomontage Location 3 Bylong Village/Sunnyside (Existing and all Mine Years)

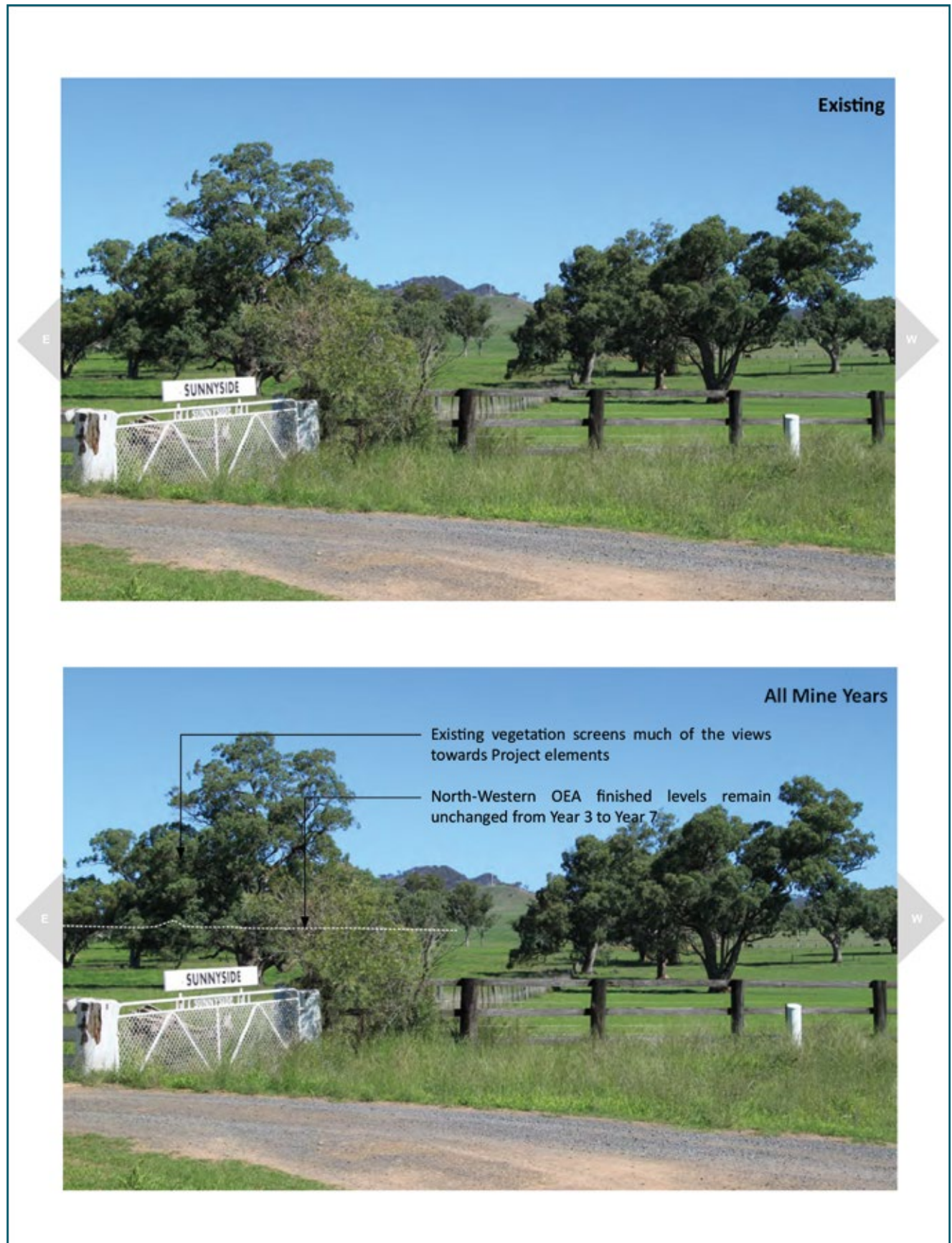


FIGURE 72 Photomontage Location 5 Bylong Valley Way (North) (Existing and all Mine Years)

FIGURE 73 Photomontage Location 7 Workforce Accommodation Facility
(Existing and all WAF Years)



FIGURE 74 Photomontage Location 7 Workforce Accommodation Facility (with roadside screening)



For Upper Bylong Road, visual impacts will be experienced for short periods of time when the visual effect of a pre-rehabilitated OEA is seen from the roadway. When rehabilitation is achieved, visual effects will be lowered and due to the moderate to low sensitivity of the road, impact will be reduced to moderate to low.

Rural land located within this sector has low sensitivity and will experience moderate to low impacts due to minimal direct views of Project components and progressive rehabilitation of the North-Western and Eastern OEAs.

Sandy Hollow to Gulgong Railway Line has a low sensitivity as the line is not utilised for passenger transport; however is subject to a high effect due to the direct views to the Eastern Open Cut. The visual impacts are therefore assessed as moderate to low.

Mapped Equine CIC properties located within the Northern View Sector comprise Tinka Tong, a portion of Tarwyn Park and a portion of the Wallings Pastoral Company. Tinka Tong may be subject to views of Project components and will receive visual impacts prior to rehabilitation of OEAs. The visual impact on the KEPCO owned Tarwyn Park and Wallings Pastoral Company would be high due to the close proximity and unobstructed views of Project components, had KEPCO not acquired these properties. KEPCO's purchase of these two properties significantly reduces the sensitivity of the land resulting in a low visual impact.

East View Sector

The East View Sector is divided between flat to gently undulating pastoral lands in the west and elevated ridgelines and hill country to the north and east. The upper section of the Bylong River also flows through this sector. From within this sector, views will be limited to the broader flat pastoral areas in the centre, east and south-east. Hills and ridgelines limit more distant views and external views across the sector from the north and east.

Potentially sensitive receivers located within this sector include:

- Rural residences which have a high visual sensitivity;
- Local roads including Upper Bylong Road, Wooleys Road and Wallys Road which have a moderate to low sensitivity;
- Rural land which have a low visual sensitivity;
- Sandy Hollow to Gulgong Railway Line which has a low sensitivity; and
- Mapped Equine CIC which has a high visual sensitivity.

Representative viewing locations in the East View Sector where photomontage analysis has been undertaken to illustrate visual effects are shown on **Figure 67**.

As shown on **Figure 75** to **Figure 77**, there will be views of the northern and eastern aspects of the Eastern Open Cut, Eastern OEA, haul roads and newly constructed access roads within the sector. There will be some views to MIAs, overland conveyor and ROM coal pad in the adjacent northern view sector. There will be views to the North Western OEA, but these will be limited to people accessing the mine, rail operators and the small number of local residents using the relocated portion of Upper Bylong Road.

For one private rural residence (Landowner ID 141 on **Figure 12**) near the eastern boundary with views to the mine operations, visual impact will be high up to 4 years from the commencement of open cut mining operations due to the visual effect of the pre-rehabilitated OEA. After PY 4, progressive rehabilitation will reduce the extent of high level visual effect areas. Visual integration and a further reduction in visual effect occurs as rehabilitation progresses southward behind the advancing open cut mine face. When the rehabilitated final landform is achieved, visual effects will be lowered resulting in impacts being reduced to moderate and low.

For local roads, moderate visual impacts will be experienced for short periods of time when the high visual effect of a pre-rehabilitated OEA and open cut operations is seen from the roadway. When rehabilitation is achieved, visual effects will be lowered and due to the moderate to low sensitivity of the road, impact will be reduced to moderate to low.

All rural lands will experience moderate to low visual impacts. The rehabilitation of OEAs will reduce such impacts to very low. The visual impact on the eastern view sector is low to moderate due to the limited number of high sensitivity receivers. The progression of rehabilitation of OEAs visible in this sector will reduce impacts to low.

Sandy Hollow to Gulgong Railway Line has a low sensitivity as the line is not utilised for passenger transport; however is subject to a high effect due to the direct views to the Eastern Open Cut. The visual impacts are therefore assessed as moderate to low.

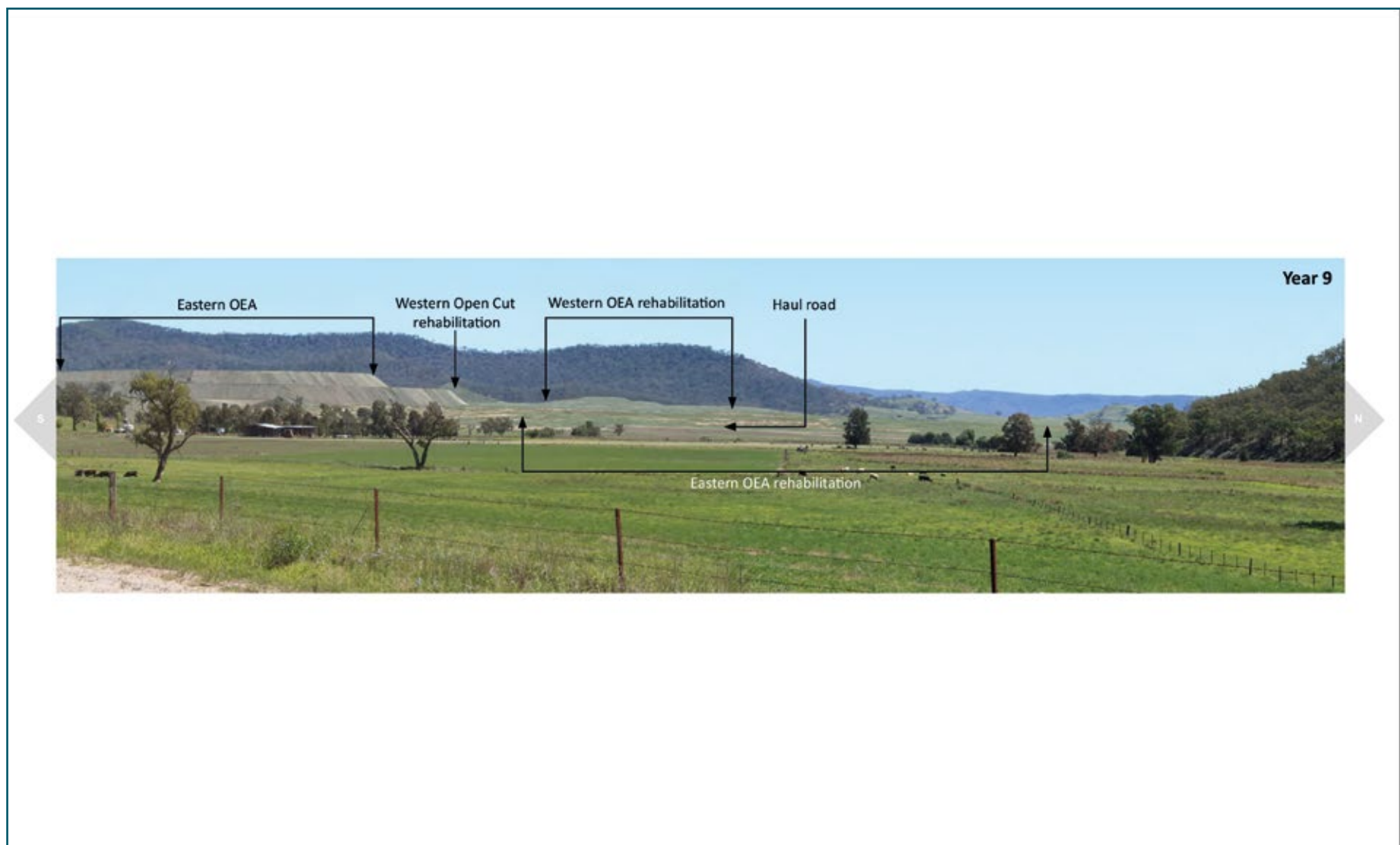
FIGURE 75 Photomontage Location 1 Wooleys Road (Existing and Year 3)



FIGURE 76 Photomontage Location 1 Wooleys Road (Year 5 and Year 7)



FIGURE 77 Photomontage Location 1 Wooleys Road (Year 9)



Properties mapped as Equine CIC located within the Eastern View Sector comprise Tarwyn Park and a portion of the Wallings Pastoral Company. The visual impact on Equine CIC lands would be high due to the close proximity and unobstructed views had KEPCO not acquired these properties. KEPCO's purchase of the land significantly reduces the sensitivity of the land resulting in a low visual impact.

South View Sector

The South View Sector is defined by elevated ridgelines and hill country to the east and west divided by flat to gently undulating pastoral lands and river valley. Lee Creek flows from south to north through this sector.

Potentially sensitive receivers located within this sector include:

- Rural residences which have a high visual sensitivity;
- Local roads including the southern reaches of Upper Bylong Road, Wooleys Road, Lee Creek Road and Budden Gap Road which have a moderate to low sensitivity;
- Rural land which have a low visual sensitivity; and
- Mapped Equine CIC which has a high visual sensitivity.

A number of rural residences are located within the South View Sector however the majority of these have been purchased by KEPCO. Localised screening by intervening topography and woodland vegetation will eliminate views of the South Western OEA and Eastern Open Cut from the private residences located further to the south ensuring moderate to low visual impacts.

During the initial years of the Project, the southern section of Upper Bylong Road and other local roads will experience moderate visual impacts. For all local roads, such impacts will be experienced up to PY 5 due to the effect of views of the active OEAs that will be visible from the roadways. Visual effects and impacts will be reduced to low following PY 5 due to the development of Project rehabilitation.

All rural lands will experience moderate to low visual impacts. The progressive rehabilitation of OEAs will reduce such impacts to very low as the mine progresses.

Equine CIC properties located within the Southern View Sector comprise a portion of the KEPCO owned Wallings Pastoral Company. The visual impact on Equine CIC would be high due to the close proximity and unobstructed views had KEPCO not acquired this property. KEPCO's purchase of the land significantly reduces the sensitivity of the land resulting in a low visual impact.

West View Sector

The majority of the West View Sector is comprised of broad flat pastoral lands that straddle the Bylong Valley Way which passes through this sector. The PVC boundary forms part of the south-western margin of this view sector.

Potentially sensitive receivers located within this sector include:

- Rural residences which have a high visual sensitivity;
- Bylong Valley Way which has high visual sensitivity;
- Rural land which has a low visual sensitivity; and
- Mapped Equine CIC which has a high visual sensitivity.

As shown on **Figure 78**, views of the North Western OEA will be screened by the existing topography within the sector.

Within the sector, there are privately owned residences located on Bylong Valley Way. These residences are screened from views of the Project by the existing ridgeline topography.

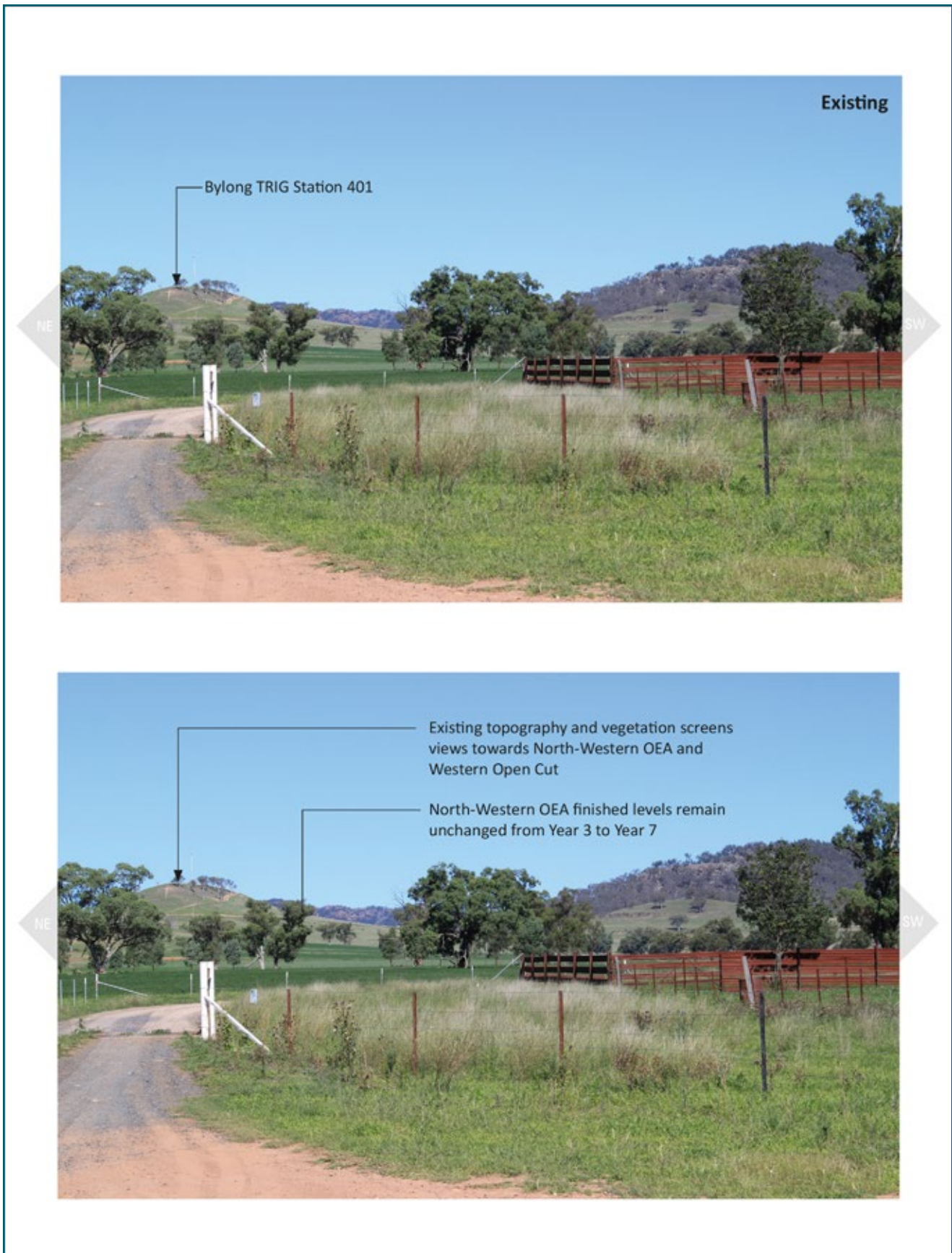
A section of Bylong Valley Way runs through the south-west of this view sector. There is a short stretch of this route where it is less than 2.5 km from the North Western OEA. This road will have a high sensitivity for this section. Limited stretches of the high sensitivity road areas may have high to moderate impact for short transient periods prior to establishment of rehabilitation.

Equine CIC properties located within the West View Sector comprise a portion of the Wallings Pastoral Company. The visual impact on Equine CIC lands would be moderate to low due to the screening of views by the existing topography had KEPCO not acquired these properties. KEPCO's purchase of the land significantly reduces the sensitivity of the land resulting in a low visual impact.

Landscape Impacts

The landscape of the Bylong Valley for the greater part is characterised by narrow pastoral flats adjacent to various creeks and rivers, adjoined by rolling topography dominated by grassland but also supporting scattered trees and woodland that is dominated by steep forested ridges and in parts rocky cliffs. The strong enclosure of the agricultural landscapes creates the character of the valley.

While it is possible to experience this character from a range of locations within it, by far the most significant experience of the wider landscape is from the roads, especially Bylong Valley Way that runs along the main valley floor.

FIGURE 78 Photomontage Location 4 Bylong Valley Way (South) (Existing and all Mine Years)

In this context, the Project will have a limited impact on the landscape of the Bylong Valley as experienced by the majority of residents and visitors to the valley. While the impact on the locality of the lower catchment of Bylong River and Lee Creek may be periodically high for up to ten years, the impact on the larger adjacent main valley will be limited as it is generally out of the visual experience (both static and sequential) of most view sheds. Beyond this time, with the Project infrastructure well screened and or integrated by the Project Rehabilitation Strategy, the impact on the landscape values of the region will be minimal.

Lighting Impacts

During the eight years of the Project open cut mining operations, night lighting from mobile equipment working on the outer faces of the OEAs may project direct lighting effects to the east. Areas to the north, south and west of active mining areas will be screened by existing topography. Lighting in the two MIAs will be located on a range of infrastructure including tall structures such as the CHPP, as well as loading ramps, conveyors, roadways, Rail Loop facilities and tunnel portals. With the exception of tall buildings and gantries, most of this lighting will be lower than 5 m from ground level for building and site illumination.

Visual impacts emanating from light sources are low for sensitive receivers primarily due to the influence of intervening topography. Mitigation measures in the form of landscape treatments and normal light management through directional lighting and hooding will further reduce diffuse light spillage from active work areas.

Equine CIC

The visual impacts on mapped Equine CIC lands have been assessed in the above sections. This section provides a summary of predicted impacts to the areas of mapped Equine CIC within the PVC.

Construction and operation of the open cut mining areas will be limited to ten years during which time progressive rehabilitation including ground shaping, grassing and the re-establishment of vegetation patterns and rural land uses, road side planting and other landscape treatments around homesteads will reinstate and in some cases improve on landscape patterns in this locality.

Beyond this 10 year period, mapped Equine CIC lands could to varying degrees, experience moderate to low visual impacts from infrastructure elements that depend on the various levels of visual integration of these elements as seen from view points in the mapped Equine CIC. Again these impacts will only be experienced during the life cycle of the Project.

Mapped Equine CIC lands within the Lee Creek and upper reaches of Bylong River catchments is not currently utilised for equine purposes and due to the proximity to the Project Disturbance Boundary, will not be utilised for equine purposes for (at least) the open cut operational period. As such, the impacts to the mapped Equine CIC will be low.

Due to the existing land uses on the mapped Equine CIC properties, the short term nature of the open cut mining operations phase, the Project Rehabilitation Strategy and the proximity of the Project to the central area of the Equine CIC, impact on the greater Equine CIC will be negligible.

Cliff lines

The EIS Subsidence Impact Assessment (**Appendix H**) has identified the following:

- Cliffs C1 (24279), C2 and C3 (24324), nearest Upper Bylong Valley Road and in line of sight have been assessed as “*to be substantially protected*” from mine induced subsidence because of the mine design;
- Cliff C4 (24278) is also generally protected from subsidence however is in closer proximity to the Subsidence Study Area than C1 to C3;
- Cliffs C5, C6 and C9 have highest potential for subsidence; and
- Cliffs C7 and C8 have potential for disturbances and perceptible impacts.

Cross sections have been developed to illustrate the potential for subsidence related impacts to prominent cliffs located within and in close proximity to the Subsidence Study Area, to create visual impacts at various viewing locations. Prominent cliffs and location of cross sections is illustrated on **Figure 76**, **Figure 77** and **Figure 78**.

The visual impact of potential cliff instability (rock falls) to sensitive receivers is determined to be a low due to the separation distances between sensitive receivers and potentially impacted cliffs or the topographic separation.

Cross Sections A, B and C demonstrate that the protected cliff lines associated with C1, C2, C3 and C4 provide topographic separation from the potentially impacted cliffs (see **Figure 79**). Therefore, from the potential viewing locations along the Upper Bylong Road realignment, the visual impact is determined to be low.

Cross Section D demonstrates that some cliff lines (such as C5, C6 and C9) may be visible when travelling along Bylong Valley Way at a distance of 3.2 km (see **Figure 79**). The sensitivity of Bylong Valley Way is assessed as high, whilst the visual effect is assessed as moderate to low due to the interrupted views through existing roadside trees, the angle at which the cliffs are located proximate to the direction of travel along Bylong Valley Way and the distance from the receiver location to the cliff. As such, the visual impact to Bylong Valley Way from potential subsidence to cliffs above the Subsidence Study Area is determined to be moderate.

Cross Section E demonstrates that the intervening topography between Landowner ID 146 and C7 will restrict views from the potentially impacted cliffs (see **Figure 79**). Therefore, from the potential viewing location at Landowner ID 146, the visual impact is determined to be low.

Cross Section F demonstrates that potential subsidence related impacts to C8 may be visible from Landowner ID 141, at a distance of 1.5 km (see **Figure 79**). The sensitivity of Landowner ID 141 is assessed as high and the visual effect is assessed as moderate due to the distance from the receiver location to the cliff. As such, the visual impact to Landowner ID 141 from potential subsidence to cliffs above the Subsidence Study Area is determined to be moderate to high.

Cross Section G demonstrates that potential subsidence related impacts to C8 may be visible from Wallys Road (most eastern section of Wooleys Road) at a distance of 1.5 km (see **Figure 79**). The sensitivity of Wallys Road is assessed as moderate to low and the visual effect is assessed as high due to the distance from the receiver location to the cliff. As such, the visual impact to Wallys Road from potential subsidence to cliffs above the Subsidence Study Area is determined to be moderate.

7.17.4 Mitigation and Management

A number of visual mitigation treatments will be established to further reduce visual impacts to receivers at key viewing locations. These include:

- Where possible, seeking to limit pre-rehabilitated OEA areas to less than 2.5% of the potential primary view zones of sensitive receivers, limiting times that high visual effects are experienced;
- Inclusion of visual landscape objectives in the rehabilitation strategy prepared for the Project, including measures to establish forest, woodland and scattered tree planting patterns. The objective of these plantings will be to emulate existing landscape patterns and create and texture continuums in the existing landscape for mine area rehabilitation, infrastructure areas and roadways;
- Retaining driveway and other plantings for the WAF site. Use existing vegetation to screen and integrate WAF structures with the surrounding landscape;
- Designing the form of OEAs consistent with storage and noise abatement requirements to achieve a natural fit with surrounding hills and avoid extensive 'flat top' development within the landscape;
- Designing drainage structures to complement natural landforms; and
- Constructing Project infrastructure in forest tones (i.e. green, grey, cream) to blend with the surrounding natural environment, as far as practical.

Offsite mitigation measures will also be implemented for the Project and will include the development of roadside tree screens and in consultation with local private landholders regarding the need for treatments at residences where views to the Project operations are available and would create high visual impacts as shown in **Figure 80**.

Residences and roadside locations where field assessments indicate additional treatments may be required are illustrated on **Figure 80**. The scale and nature of these treatments will be identified in a detailed Landscape Plan for the Project and finalised in consultation with the landholder or other relevant agencies.

FIGURE 79a Prominent Cliffs and Visual Cross Section Locations

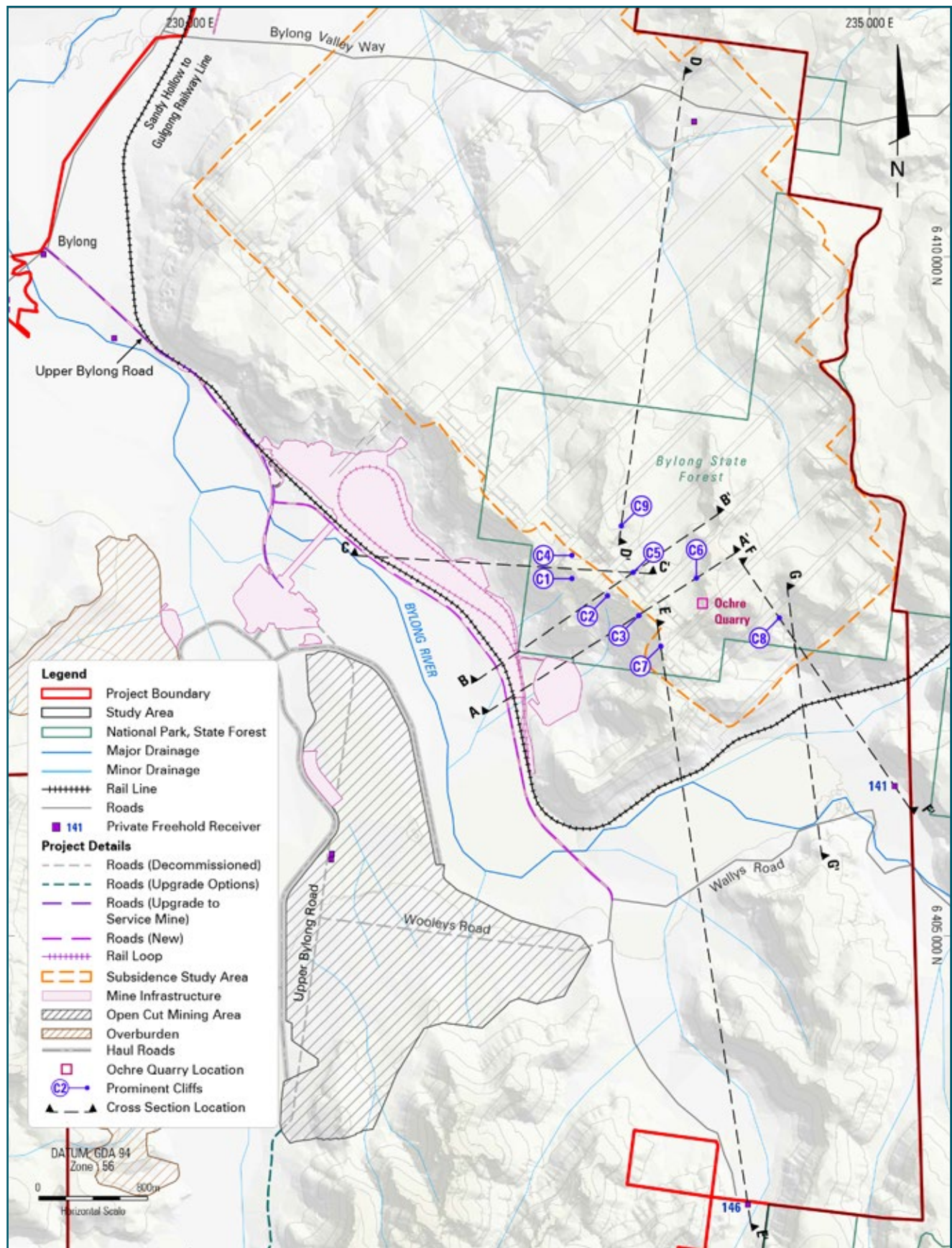


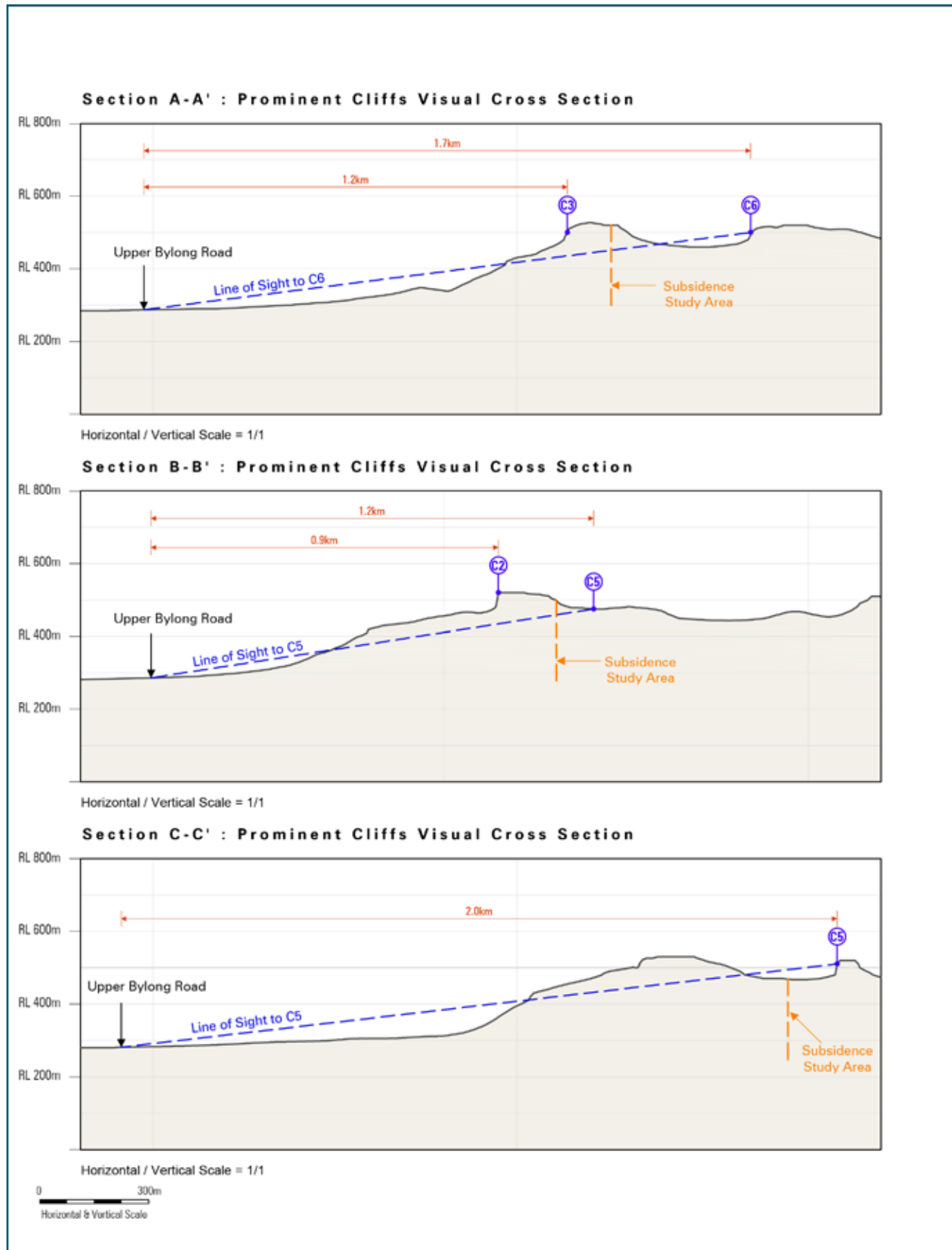
FIGURE 79b Visual Cross Sections From Upper Bylong Road

FIGURE 79c Visual Cross Sections From Other Key View Points

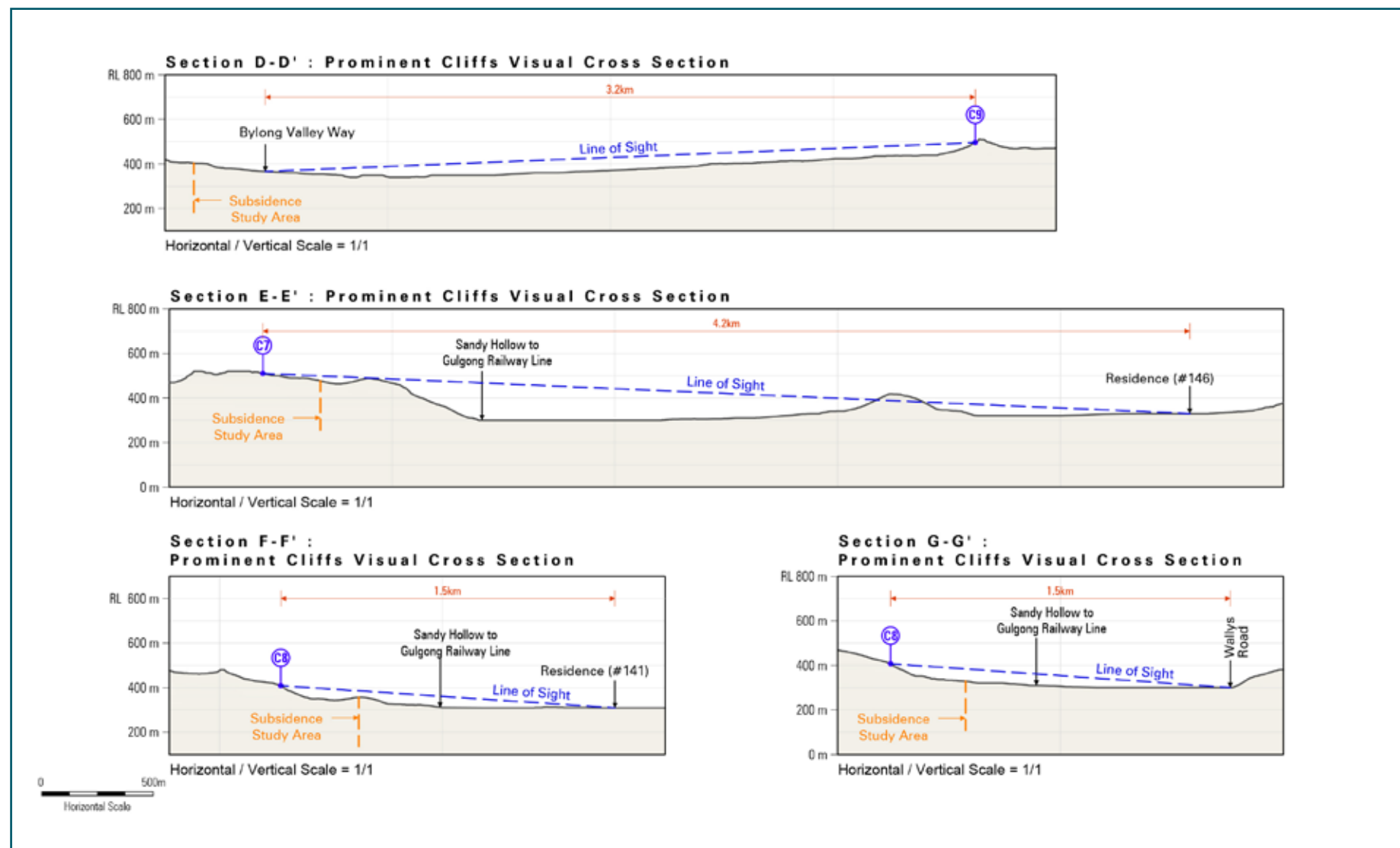
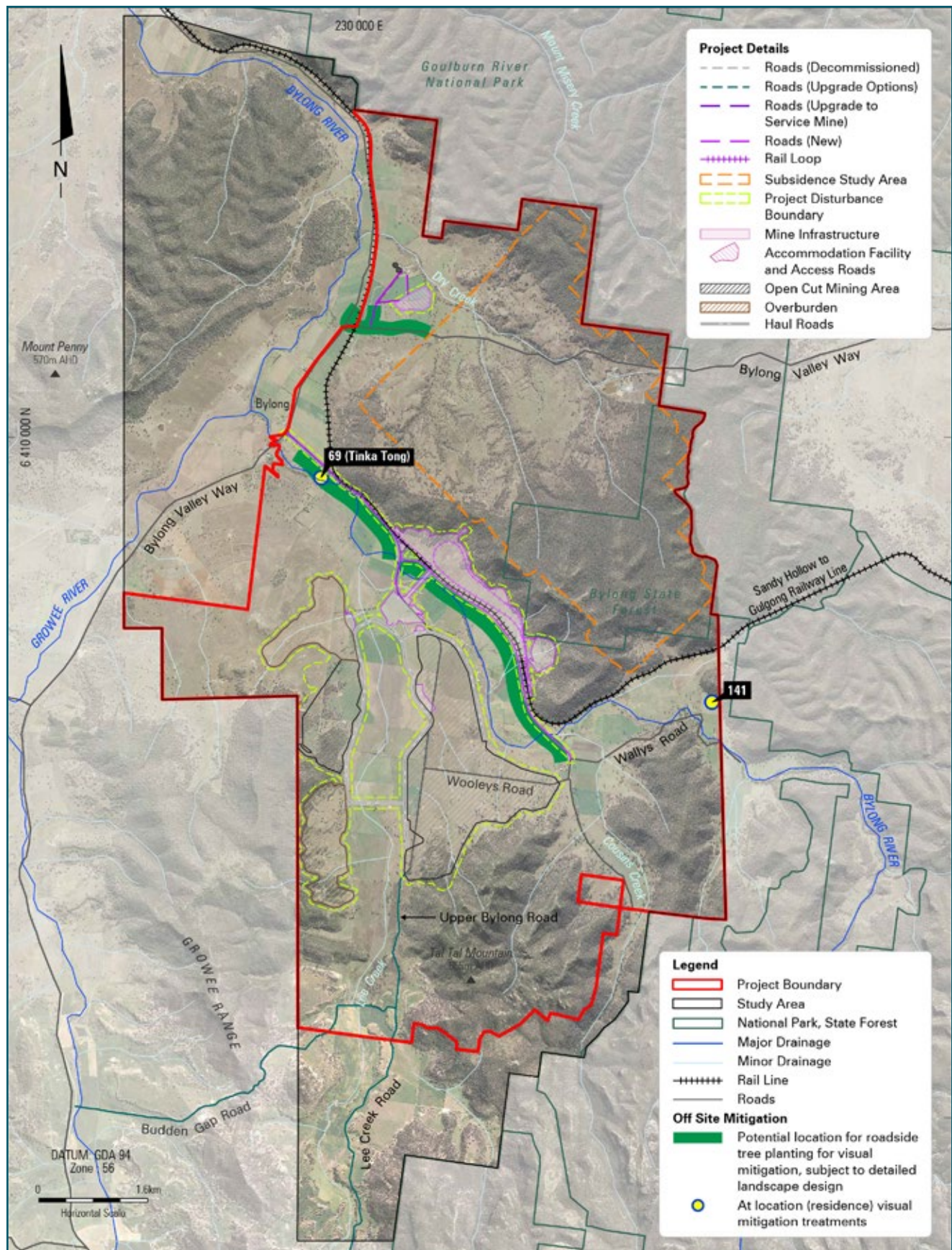


FIGURE 80 Visual Mitigation Measures

7.18 TRAFFIC AND TRANSPORT

7.18.1 Background

A Traffic and Transport Impact Assessment (TTIA) was undertaken by Parsons Brinckerhoff and is provided in full in **Appendix Z**. The objectives of the assessment were to:

- Quantify road and rail traffic generated by the Project;
- Assess the potential impacts of Project related traffic on the capacity, efficiency and safety of the road and rail network;
- Identify and assess temporary and permanent road closures as a result of the Project; and
- Recommend measures to mitigate and manage any identified impacts.

Existing Road Network

The local road network in the vicinity of the Project is shown on **Figure 33**. All relevant roads which are considered within the TTIA are under the jurisdiction of the MWRC.

The Bylong Valley Way is the main access into the Bylong Valley. Bylong Valley Way is a two lane sealed road with an approximate width of 7 m. The road links Bylong to the Golden Highway to the north and the Castlereagh Highway to the south. Within the Bylong Valley, it intersects with Wollar Road, Upper Bylong Road, Budden Gap Road and Lee Creek Road. Located on Bylong Valley Way just to the east of the intersection with Wollar Road is a level rail crossing over the Sandy Hollow to Gulgong Railway Line. At present this level crossing is passively controlled with signs and flashing lights.

Wollar Road is a two lane road which is unsealed for the first approximately 17 km from the Bylong Valley Way intersection. It is approximately 8 m wide and connects Bylong Valley Way north of Bylong Village to Wollar and other communities to the north and west of the Project where it intersects Ulan Road. There are two intermittent locations where Wollar Road is sealed for short sections.

The local road network (see **Figure 33**) surrounding the Project includes:

- Upper Bylong Road connects Bylong Valley Way to properties on the eastern side of the Growee Ranges which traverse through the middle of the Bylong Valley. Upper Bylong Road becomes Lee Creek Road to the south following the intersection with Budden Gap Road;

- Upper Bylong Road is sealed for approximately 7.7 km from its intersection with Bylong Valley Way and has been built to approximately 5 m wide on both the sealed and unsealed sections. The unsealed section of road is used primarily for private property access;
- Wooleys Road is an unsealed road approximately 4 m to 5 m wide which connects Upper Bylong Road to private properties located to the east of Project;
- Wallys Road is the name denoted to the most eastern section of Wooleys Road which is an unsealed road approximately 4 m wide and provides access to private properties to the east of the Project;
- Lee Creek Road is an unsealed road approximately 4 m wide, connecting Upper Bylong Road to the north with Bylong Valley Way to the south; and
- Budden Gap Road is an unsealed road, approximately 4 m in width and aligned in a general east-west direction connecting Upper Bylong Road and the Bylong Valley Way. It is currently gated through private properties and is only used intermittently.

Other roads of relevance to the Project are:

- Lue Road - a two lane sealed road with an approximate width of 7 m located south of the Project. Lue Road links Mudgee with the Bylong Valley Way; and
- Ulan Road - a two lane sealed road with an approximate width of 8 m. Ulan Road connects Mudgee with Ulan and Ulan with the Golden Highway.

Based on the workforce accommodation strategy presented in **Section 7.21**, the most critical intersections for accessing the Project are considered to be:

- Bylong Valley Way and Upper Bylong Road; and
- Bylong Valley Way and Wollar Road.

Existing Rail Network

The Sandy Hollow to Gulgong Railway Line is part of the ARTC's Hunter Valley Coal transport network and will be utilised to transport coal from the mine site to market. This rail line runs between Ulan and Muswellbrook, is a single track and has several passing loops along its 170 km length.

The Project is located approximately 230 km from Port Waratah Coal Service (PWCS) Kooragang Coal Terminal, the main coal export facility in the Port of Newcastle. The Hunter Valley rail network is shown on **Figure 81**.

This line is mainly utilised by coal trains, one or two country ore and grain trains per day and occasionally by interstate freight trains that are bypassing Sydney.

The current maximum train size used on the Sandy Hollow to Gulgong Railway Line is 91 x 120 t (gross) wagons with a total net payload of around 8,800 t and maximum overall length of 1,543 m. Capacity constraints which currently exist on the Sandy Hollow to Gulgong Railway Line are due to ventilation in the Bylong tunnel, with train spacing and track maintenance limited by the “purge times” for air in the tunnel. Minimum operating frequency of 20 minutes between trains is required to address this ventilation issue.

There is currently adequate capacity for all contracted volume on the rail network.

7.18.2 Methodology

The TTIA for the Project comprised of the following:

- A review of available existing traffic data, assessments and reports completed in the vicinity of the Project Boundary;
- Forecasts of the road and rail traffic volumes generated by the Project;
- Assessment of potential impacts of the Project on traffic conditions, Level of Service (LoS) and intersection operation during construction and operational phases;
- An assessment of the potential road safety issues of relevant parts of the road network surrounding the Project;
- A detailed assessment of the potential impacts on road and rail level crossings;
- An assessment of the cumulative impacts of future traffic, and increased rail movements due to increased coal production within the region; and
- Identification of any management and mitigation measures that may be necessary for the Project.

A review of the existing and proposed road and rail infrastructure was undertaken to assess any safety deficiencies in the network. This involved, in part, a review of crash data between 2008 and 2013, which is the latest five year period for which there is fully validated, non-provisional data.

Existing Road Network Conditions

To measure traffic volumes on local roads in the vicinity of the Project Boundary, intersection traffic surveys were undertaken by TTM Consulting on Wednesday, 9 April 2014 between 5:00 am and 8:00 pm in fine and dry weather conditions. These results were compared to the results of traffic surveys conducted for the Bylong Quarry Project (Wells Environmental, 2012). In the Bylong Quarry Project survey, weekly traffic count data was collected over a 24 hour 7 day period in October 2011 on each of Bylong Valley Way and Wollar Road.

A conservative estimate of 2% per year traffic growth has been applied to all traffic measurements.

A site inspection was undertaken by Parsons Brinckerhoff staff on Thursday, 10 April 2014 in fine and dry weather conditions. The purpose of the site inspection was to view the existing road network, intersection layouts, traffic conditions, access locations, road conditions, road restrictions, level railway crossings and general road safety. The inspection included traversing Bylong Valley Way, Upper Bylong Road, Lee Creek Road and Wollar Road.

Project Scenarios Assessed

Traffic volumes associated with the Project relate to employees' vehicles, visitors and heavy vehicle movements. Project related traffic volumes vary between the construction and operations phases.

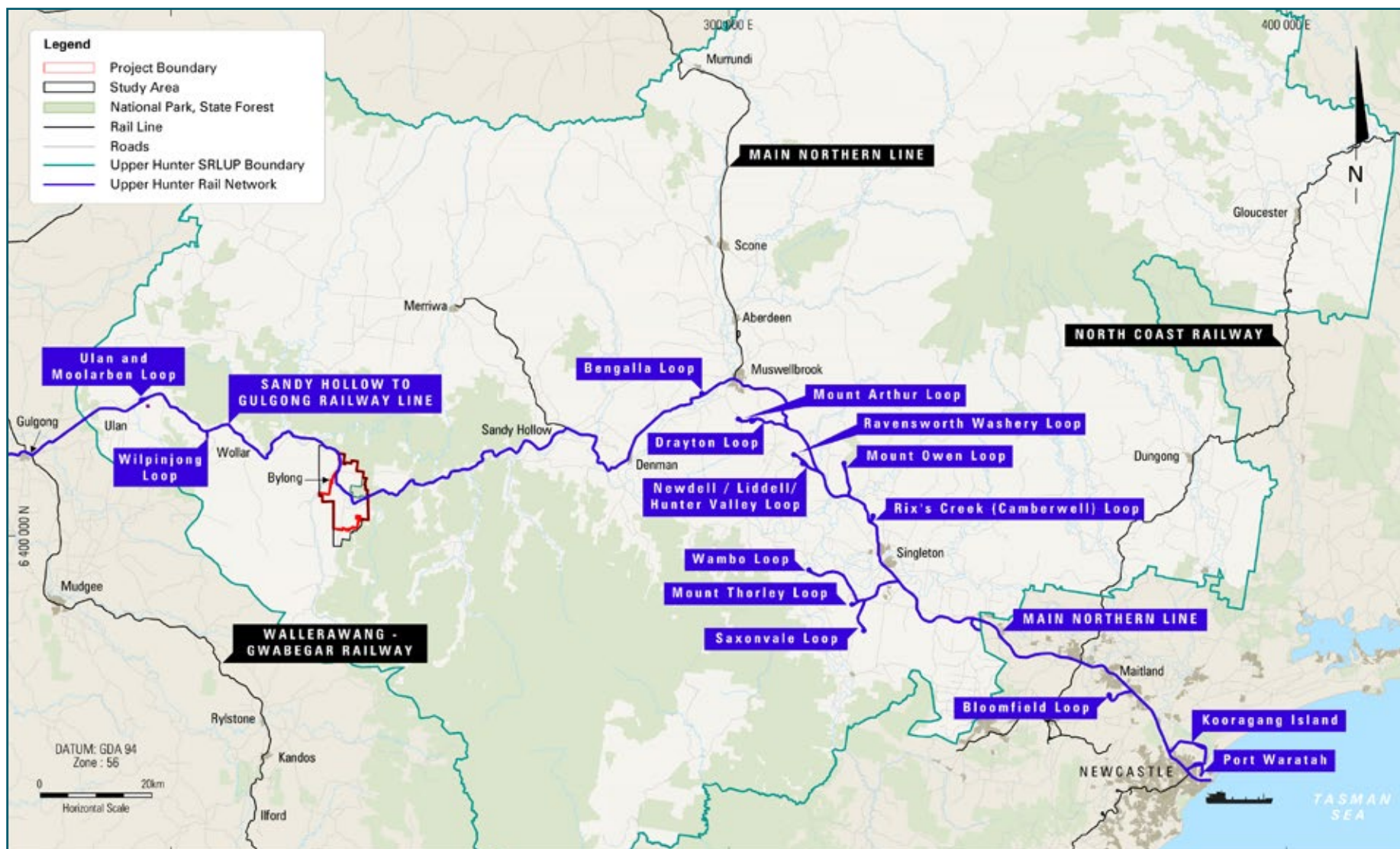
As such, the following representative years have been included in each of the future year scenarios:

- The peak construction activity year (2017/PY 2);
- The peak of dual mine operations (2024/PY 9) and
- Underground mine operation only (2028/PY 13).

For the purposes of the TTIA, the Local Area has been defined as areas within one hour drive of the Project (i.e. Mudgee, Wollar, Ulan, Rylstone, Kandos, Sandy Hollow and Denman), which is considered to be a safe commute time. This definition is based on the assumption that Wollar Road will be upgraded by the end of PY 1 and therefore Mudgee will be approximately 45 minutes via car from the Project.

At the peak of the construction phase 1 (PY 2), a total workforce of approximately 800 is anticipated. It is predicted that 650 will be accommodated in the WAF during this phase. It is assumed that the remaining 150 staff will reside in and travel from the Local Area.

FIGURE 81 Hunter Valley Rail Network



At the peak dual-operational period (PY 9), a total of 470 mine workers will be involved with the operation, working three shifts including day time office hours, day time mining and night time mining of the Project. None of these workers are assumed to be accommodated within the WAF. It is assumed that approximately 90% of the operational workforce will reside in the township of Mudgee with the remaining 10% residing at other locations within one hours commute to the Project.

During the underground only mine operation phase (PY 13), a total workforce of 275 is anticipated. It is assumed that approximately 90% of the operational workforce will reside in the township of Mudgee with the remaining 10% residing at other locations within one hours commute to the Project.

A set of “no-Project” scenarios have also been analysed to determine the comparable case in the absence of the Project.

The Preferred Operation scenario (as described in **Section 3.11**) is for the WAF to operate up to the end of underground construction activities in approximately PY 6 with Wollar Road being upgraded by the end of PY 1 in 2016.

The following three sensitivity options have been assessed within **Appendix Z**:

- **Sensitivity Option 1** – Wollar Road Upgrade by end of PY 1, WAF operational for PYs 1 and 2 only followed by the entire workforce being required to reside within the Local Area;
- **Sensitivity Option 2** – Wollar Road Upgrade by end of PY 1, WAF operational for PYs 1 to 10 followed by the entire workforce being required to reside within the Local Area; and
- **Sensitivity Option 3** – No upgrade of Wollar Road is completed and therefore Mudgee is outside the safe commute time and the WAF is required for the full Project life (PYs 1 to 25).

As the results of the above sensitivity options did not identify any significant differences in impacts on the local road network, they are not considered further below. Full assessment of the sensitivity options are presented in **Appendix Z**.

Road Network Assessment

A mid-block capacity assessment has been completed on Bylong Valley Way, Upper Bylong Road and Wollar Road to determine mid-block LoS based on two-way hourly vehicle flows and the percentage of heavy vehicles.

The mid-block traffic performance is the LoS along a mid-block section of road (between two intersections). The mid-block capacity has been based on the *Guide to Traffic Generating Developments* (RMS, 2002) and *Guide to Traffic Management Part 3: Traffic Studies and Analysis Guidelines* (Austroads, 2013). Mid-block capacities and LoS based on two-lane rural roads are shown in **Table 92**.

TABLE 92 Peak Hour Flow on Two-Lane Rural Roads

Terrain	LoS	Percent of Heavy Vehicles (Veh/h)			
		0%	5%	10%	15%
Level	B*	630	590	560	530
	C	1030	970	920	870
	D	1,630	1,550	1,480	1,410
	E	2,630	2,500	2,390	2,290

* Vehicles per hour less than those documented in the row assigned for Level of Service B indicate a Level of Service A performance
Source: RMS Guide to Traffic Generating Developments (2002)

The ability of intersections to cater for existing and future traffic forecasts was investigated using the SIDRA Intersection 6 modelling software package. The results of the SIDRA model provide an explanation of the key traffic performance indicators (including LoS), average delay and maximum queue length. The criteria for intersection performance are outlined in **Table 93**.

TABLE 93 Intersection Performance Criteria

Level of Service	Average Delay (Seconds per Vehicle)	Description
A	Less than 14	Good
B	15 to 28	Acceptable
C	29 to 42	Satisfactory
D	43 to 56	Near capacity
E	57 to 70	At capacity
F	Greater than 71	Unsatisfactory

Cumulative Impacts

A review of several developments surrounding the Project were undertaken to determine any cumulative traffic impacts on Bylong Valley Way, Upper Bylong Road and Wollar Road. The Bylong Quarry and Batching Plant expansion (approved in February 2014) will create an additional 94 heavy vehicles and 20 light vehicles on the local road network daily. This additional volume of traffic generated has been included in the future year traffic assessments.

The proportion of traffic from the existing Wilpinjong, Moolarben and Ulan coal mines travelling Wollar Road towards Bylong Valley Way (and Bylong town) is determined to be minimal, as the majority of mine traffic travels towards Ulan, Mudgee and Gulgong.

7.18.3 Impact Assessment

Road Traffic Generated by the Project

Construction Phase 1 (PY 2)

The estimated hourly construction traffic generated by the WAF and site construction activities for the preferred operation scenario is shown in **Table 94**.

Operation (PY 9 and PY 13)

Workers travelling from accommodation outside of Bylong are assumed to carpool when driving to and from site. It has been assumed that there will be a 30% reduction in the vehicle trips that would result from solely single-occupant journeys. A summary of the estimated hourly traffic generated by the site during dual operations (PY 9) and underground only (PY 13) is shown in **Table 95**.

Regional Road Impacts

The mid-block road capacity and LoS assessment has been completed for both the construction (PY 2) and dual mine operation under preferred operations (PY 9) as shown in **Table 96**. The results indicate that although there is a large percentage increase in daily traffic due to operation of the Project, the mid-block road capacity continues to operate at good LoS (Level A), with ample spare capacity.

Underground only operations (PY 13) will create a smaller increase in daily traffic than either PY 2 or PY 9 and therefore the mid-block road capacity during this operational phase will continue to operate at good LoS (Level A).

Pavement deterioration is expected due to increased vehicle movements, particularly from heavy vehicles.

TABLE 94 Estimated Hourly Vehicle Trips during Construction

Working hours	Direction of traffic	Trip type	Time	Operations Contributors*
Between 7:00 am and 7:00 pm	Inbound	Construction employee trip (light vehicles)	6:30 am to 7:30 am	34
	Inbound	Office workers (8.00 am to 4.00 pm shift)	7:00 am to 8:00 am	30
	Outbound		4:00 pm to 5:00 pm	30
	Inbound and outbound	Construction vehicle trip (heavy vehicles)	Throughout the day between 7:00 am and 7:00 pm	8
		Visitors and deliveries	Throughout the day between 7:00 am and 7:00 pm	20
	Outbound	Construction employee trip (light vehicles)	6:30 pm to 7:30 pm	34
Between 7:00 pm and 7:00 am	Inbound	Construction employee trip (light vehicles)	6:30 am to 7:30 am	34
	Outbound	Construction employee trip (light vehicles)	6:30 pm to 7:30 pm	34

*Modelling indicates outcomes are identical for the Option 1/2/3 contributors

TABLE 95 Inbound and Outbound Vehicle Trips at the Open Cut and Underground Mine

Time	Employee type	Direction of traffic	PY 9 Preferred Operations	PY 13 Preferred Operations
6:30 am to 7:00 am	Day shift mine operation (light vehicles)	Inbound	83	53
7:00 am to 7:30 am	Night shift mine operation (light vehicles)	Outbound	83	53
7:00 am to 8:00 am	Day time office (light vehicles)	Inbound	21	21
Throughout the day between 7:00 am and 7:00 pm	Contractors for delivery of materials and services (light vehicles)	Inbound and outbound	240	240
	(heavy vehicles)		20	20
4:00 pm to 5:00 pm	Day time office (light vehicles)	Outbound	21	21
6:30 pm to 7:00 pm	Night shift mine operation (light vehicles)	Inbound	83	53
7:00 pm to 7:30 pm	Day shift mine operation (light vehicles)	Outbound	83	53

TABLE 96 Mid-block Road Capacity and Level of Service

Road	Between	Daily# base flow (two-way vehicles)	Peak Construction (PY 2)			Peak Dual Mine Operation (PY 9)		
			Daily project vehicles (two-way)	Daily traffic increase (%)	Mid-Block LoS	Daily project vehicles (two-way)	Daily traffic increase (%)	Mid-Block LoS
Bylong Valley Way	Upper Bylong Road and Wollar Road	313	511	63%	A	511	63%	A
Upper Bylong Road	Bylong Valley Way and Project site	171	538	215%	A	640	274%	A
Wollar Road	North of Bylong Valley Way	140	457	227%	A	544	289%	A

Traffic counts undertaken between 5:00 am and 8:00 pm on a weekday (not a 24 hour full day count, although vehicle volumes outside of this time range over a 24 hour period is negligible)

Road Intersection Performance

Increased traffic volumes are anticipated at intersections due to Project traffic. **Table 97** provides the results of the SIDRA model forecast intersection performance for both the local traffic and Project traffic peak hours during PY 2, PY 9 and PY 13.

Table 97 demonstrates that intersections in the vicinity of the Project will continue to operate at good LoS (Level A) for all sensitivity options modelled.

Road Closures

Temporary

At various times throughout the open cut mining operations, public roads within 500 m of blasting activities, including Upper Bylong Road realignment, Wallys Road, and Lee Creek Road, will need to be temporarily closed.

TABLE 97 Intersection Performance for Construction and Operational Phases of the Project

Intersection	Control Type	Peak hour	Peak hour time	Peak Construction (PY 2)				Peak Dual Mine Operation (PY 9)				Underground Operations (PY 13)			
				DoS	Ave Delay (sec)	LoS	Queue (m)	DoS	Ave Delay (sec)	LoS	Queue (m)	DoS	Ave Delay (sec)	LoS	Queue (m)
Bylong Valley Way/ Wollar Road	Priority	Local traffic peak	10:45 am – 11:45 am	0.018	5.9	A	0.6	0.017	5.3	A	0.7	0.017	5.2	A	0.7
		Local traffic peak	2:30 pm – 3:30 pm	0.019	5.5	A	0.6	0.017	5.0	A	0.7	0.018	5.1	A	0.8
		Project traffic peak	6:30 am – 7:30 am	0.043	6.7	A	1.0	0.077	7.3	A	1.8	0.055	7.3	A	1.3
		Project traffic peak	6:30 pm – 7:30 pm	0.036	6.1	A	0.9	0.073	6.7	A	1.7	0.050	6.8	A	1.2
Bylong Valley Way/Upper Bylong Road	Priority	Local traffic peak	10:45 am – 11:45 am	0.020	3.2	A	0.6	0.017	5.3	A	0.7	0.019	2.8	A	0.6
		Local traffic peak	2:30 pm – 3:30 pm	0.023	3.2	A	0.6	0.020	2.9	A	0.6	0.020	2.9	A	0.6
		Project traffic peak	6:30 am – 7:30 am	0.045	4.7	A	1.2	0.082	4.7	A	1.9	0.055	4.6	A	1.3
		Project traffic peak	6:30 pm – 7:30 pm	0.045	4.5	A	1.2	0.083	4.5	A	2.0	0.056	4.4	A	1.3

Permanent

The southern reaches of Upper Bylong Road will be decommissioned to facilitate mining operations within the Eastern Open Cut. Two options are being considered in relation to maintaining a reasonable level of access to the Bylong Valley Way for neighbouring landholders positioned along the southern reaches of Upper Bylong Road.

These are either the upgrade of:

- Lee Creek Road, which intersects the Bylong Valley Way further to the south of the Project Boundary; or
- Budden Gap Road, which connects Lee Creek Road to the Bylong Valley Way 8 km to the north of the intersection of Lee Creek Road and Bylong Valley Way.

The preferred option will be selected as part of the detailed engineering design phase and in close consultation with the MWRC and the local landholders within this area. Further, it is proposed that the works associated with the selected option will be completed under a separate approval to be granted by MWRC and at the cost of KEPCO.

In the event that negotiated agreements are reached with all three of the relevant landholders (Landowner IDs 151, 161 and 165 as identified on **Figure 12**) over compensation for the resultant loss in optionality for land access and MWRC is in agreement that neither of the two road upgrades described above is required, then neither of these upgrades will be progressed.

The closure of Upper Bylong Road will increase travel times for the three properties listed above travelling to Bylong Village by approximately 30 minutes when compared with existing arrangements. Closure of the northern portion of Upper Bylong Road will also result in reduced accessibility for heavy vehicles to the three properties listed above. It is recognised that this could affect the supply of bulk goods to these properties and the transport of livestock. The potential upgrade of Lee Creek Road or Budden Gap Road would maintain heavy vehicle access and reduce the increased travel times to Bylong Village for these residents.

It is anticipated that with the upgrade of Lee Creek Road or Budden Gap Road, the increase in travel time for the three properties to the south of the Project to Bylong Village would increase by approximately 15 minutes or 7 minutes, respectively.

Rail Network

Based on the proposed product coal tonnages and a conservative 80% utilisation of the network (292 days of 365), the Project will require an average of up to 2.1 trains per day at peak operation, averaging 1.4 trains per day over the period of 2017 to 2027 (i.e. PYs 2 to 12). This assumes that standard 96 wagon trains (9,200 t payload) are used (i.e. the existing ventilation issues as discussed in **Section 7.18.1** are resolved). There is adequate capacity of the Sandy Hollow to Gulgong Railway Line to accommodate the Project as well as other mines in the MWRC LGA. KEPCO is currently in discussion with ARTC regarding a possible increase in train vehicle length to 100 cars and a gross payload of 9,750 t.

Proposed Rail Related Upgrades

The Project will require the construction of a rail loop that connects the Project to the Sandy Hollow to Gulgong Railway Line. The proposed rail loop will be excavated into the existing topography, generally at a higher elevation than the main line. The existing level railway crossing on Bylong Valley Way will be upgraded as part of the Bylong Valley Way and Wollar Road intersection works proposed by MWRC.

Impact Summary

Given the low amount of traffic generated by the Project over a daily and peak hourly period, and given the spare capacity within the road network, only minimal impacts are foreseen on the surrounding road network. Road mid-block capacities and intersection performance on Bylong Valley Way, Upper Bylong Road and Wollar Road will continue to perform well within capacity with the introduction of Project related traffic.

Further, the proposed intermittent road closures for mine blasting purposes should not be a major inconvenience to the relatively low number of traffic users on the affected roads.

7.18.4 Mitigation and Management

Results of the TTIA indicate that there will not be additional adverse impacts beyond the networks capacity on the surrounding road network as a result of the increased traffic associated with the construction and operation activities.

KEPCO will develop a Construction Traffic Management Plan for the Project, which will be prepared to ensure the traffic network can be safely and efficiently managed throughout the construction phases of the Project in accordance with the Roads and Traffic Authority (2010), *Traffic Control at Work Sites*, as well as relevant Australian Standards including AS1742.

Proposed Road and Intersection Changes/ Upgrades

Although the increases in traffic associated with the construction and operation of the Project are predicted to remain within the capacity of the existing network, KEPCO recognises that the Project will result in increased usage of key roads and intersections. As such, road and intersection upgrades (as detailed in **Section 3.14**) will occur during the initial construction of the Project, in consultation with and to the approval of MWRC as the roads authority.

Wollar Road

Discussions with the MWRC have confirmed that the 17 km section of Wollar Road between Bylong Valley Way and the Wollar village that is currently unsealed will be upgraded and sealed. The upgrade of Wollar Road will be funded by a \$14 Million grant which has been secured for the upgrade under the NSW Resources for Regions Grants Program.

These works will include upgrade of the road to include two 3.25 m travel lanes, 1 m sealed shoulders, road sealing, bridge widening, a new culvert, guard rails, as well as the upgrade of the level railway crossing and intersection of Wollar Road at Bylong Valley Way.

This intersection is proposed to be channelised to safely meet the requirements for the estimated future daily traffic.

Workforce Accommodation Facility

The existing driveway access to the WAF will be upgraded by KEPCO to accommodate increased vehicle volumes and turning movements by being widened at the throat of the intersection with Bylong Valley Way.

Upper Bylong Road and Adjoining Roads

Upper Bylong Road will be widened by KEPCO from Bylong Valley Way to the mine infrastructure areas to accommodate a two lane road. The open cut MIA will be accessed directly from Upper Bylong Road.

A private access road is to be constructed over the Sandy Hollow to Gulgong Railway Line to access the Underground MIA incorporating the existing level railway crossing facility. This road will commence with a priority controlled T-junction with Upper Bylong Road (with dedicated left and right turn lanes on Upper Bylong Road) and will extend on the southern side between the level railway crossing and Upper Bylong Road. Once built, the road access to the existing level railway crossing will be closed.

Realignment of the Upper Bylong Road along the southern side of the Sandy Hollow to Gulgong Railway Line will connect with Wallys Road to the east, providing continued access for private landholders to the east of the Project.

The potential upgrade options of Lee Creek Road or Budden Gap Road may also occur in the event negotiated agreements are not reached with landholders.

Speed and Fatigue

A review of the 2008-2013 crash data indicates the majority of crashes on Bylong Valley Way and Upper Bylong Road were non-intersection (13/15 accidents). One involved a fatality (5 km south of Bylong Village on Bylong Valley Way), with the majority involving curved roads and/or occurring during normal (fine) conditions. Nine crashes involved speed and/or fatigue which led to drivers losing control and running off the roadway.

KEPCO recognises that speed and fatigue management strategies are a key part of minimising the risk of crashes and thus the impact of Project traffic on the local road network. To this end, shuttle buses are proposed to transport workers between the WAF and the MIAs.

The provision of shuttle buses will reduce and limit the number of light vehicle movements to and from the mine sites as well as reduce the staff parking requirements onsite.

KEPCO will also investigate the provision of a bus service between Mudgee and the Project at shift change over. This would remove additional traffic from Wollar Road and Bylong Valley Way and reduce the hazards associated with speed and/or fatigued mine staff. KEPCO has engaged in discussions with the MWRC LGA regarding suitable locations for a park and ride facility. However, the sustainable provision of a bus service will ultimately be determined based on demand.

Over-dimensioned Loads

Prior to the transportation of over-dimensioned loads on State roads, the necessary approvals from RMS will be obtained. Similarly, required approvals from relevant local councils will be obtained prior to transportation of over-dimensioned loads on local roads.

Traffic Impacts on Road Pavement Serviceability

It is recognised that increased light and heavy vehicle movements as a result of the Project on the local road network will contribute to impacts on road pavement longevity and road maintenance issues. KEPCO will continue to consult with the MWRC as the relevant roads authority to assist in providing the appropriate funding for road maintenance activities on the key roads to be utilised by the Project (i.e. Bylong Valley Way, Wollar Road, Upper Bylong Road), commensurate with the Project-related impacts to these roads.

7.19 STYGOFAUNA

7.19.1 Background

A Stygofauna Impact Assessment for the Project was undertaken by Eco Logical Australia Pty Ltd and is provided in **Appendix AA**. The purpose of the assessment was to determine the potential impacts of the Project on stygofauna and to recommend measures to manage these impacts, where appropriate.

7.19.2 Methodology

Desktop Assessment

A desktop assessment was undertaken to determine the likelihood of stygofauna occurring in the alluvial aquifers within the Study Area and immediate surrounds. This involved a review of available hydrogeological, geological and water quality monitoring data and relevant previous stygofauna studies.

Previous stygofauna studies in the Hunter Valley region commenced in 2000 and investigated the presence of stygofauna in the hyporheic zone (an area of the river bed where groundwater and surface water mix) over a period of four years along the Hunter River, Goulburn River and Wollombi Brook. These surveys have confirmed the existence of a diverse array of stygofauna in the Hunter Valley region, including crustaceans, flat worms and aquatic worms.

Following the initial hyporheic survey, additional work was undertaken from 2004 to 2008 for bores in the Hunter River, Pages River, Dart Brook and Kingdon Ponds alluvial aquifers, which found additional species. The findings of the desktop assessment and the location of the Project in relation to the Hunter River alluvium suggested that stygofauna were likely to occur within the vicinity of the Project Boundary and as such, a field sampling program was conducted.

Sampling Program

A sampling program was developed to provide a selection of bores representative of likely stygofauna habitats and potential areas of impact proposed for the Project. Samples were collected from the sandstone and Coggan Seam aquifers, but most were collected from the Hunter River alluvial aquifer and the underlying Permian aquifer, where stygofauna were considered most likely to occur. EC was also considered during bore selection, with preference given to bores with favourable EC values for stygofauna occupation (i.e. $EC < 5,000 \mu S/cm$). Samples were collected using combined net and pump methods, which exceeds the minimum requirements of the *Sampling methods and survey considerations for subterranean fauna in Western Australia* (WA EPA, 2007).

A total of 20 bores were sampled in October 2012, with most of the survey effort placed in the alluvial aquifers as the desktop review indicated these aquifers are most likely to contain groundwater fauna. A second survey occurred in February 2014.

An additional 19 samples were collected during this survey, bringing the total number to 39 over the two survey rounds. Of the bores sampled during the second survey, 12 had been sampled previously, and seven were new.

The water level at each bore was recorded prior to sampling followed by the measurement of pH, EC, temperature and dissolved oxygen concentration after pumping 10 L, 50 L and then every 50 L thereafter.

All samples collected were subjected to laboratory analysis to identify the species present where possible and to quantify the numbers of each species present in each sample.

7.19.3 Impact Assessment

Species Present

Of the 32 bore locations sampled in 2012 and 2014, stygofauna were present in 18 bores (56.3%) within the Study Area. Of the bores found to contain stygofauna, 15 bores (83.3%) were sampled from the shallow alluvial aquifers, two bores (11.1%) from the deep alluvium, and one bore (5.6%) from the weathered Permian strata. Stygofauna appear to be distributed throughout the shallow alluvial aquifers of Lee Creek and Bylong River. Only one taxa of stygofauna was collected from the Growee Creek aquifer, from the one bore which was sampled within this system.

A total of ten stygofauna taxa were recorded during the sampling program, all of which are known to occur outside of the Study Area from previous stygofauna surveys undertaken in the region.

At a regional scale, fauna recorded in the Study Area appear to be spread throughout the Bylong River and Lee Creek alluvial aquifers and have distributions beyond the predicted groundwater drawdown area. Due to their wide distribution it is considered that there is no significant risk to existing stygofauna communities as a consequence of the Project.

Potential Stygofauna Impacts

Both open cut and underground mining activities have the potential to impact stygofauna communities. Groundwater modelling undertaken for the Project (see **Section 7.6**) indicates that the proposed mining will result in a lowering of the water level.

Potentially impacted stygofauna taxa are not endemic to the Study Area and as large areas of suitable habitat remain in the immediate vicinity of the Project, the current level of drawdown will have minimal impact on the stygofauna community.

7.19.4 Mitigation and Management

The aquifers within and adjacent to the Study Area were found to contain at least ten stygofauna taxa, with none of the taxa collected during the sampling found to be endemic to the Study Area. It is very unlikely that there will be endemic species whose distribution is confined solely to the narrow band of alluvium predicted to be dewatered by the Project.

As the Project is predicted to result in only very limited impacts to the stygofauna community present in the local alluvium, no additional surveys or management and mitigation measures are considered to be necessary.

7.20 GEOCHEMISTRY

7.20.1 Background

A Geochemical Impact Assessment has been undertaken for the Project by RGS Environmental Pty Ltd (RGS) and is provided in **Appendix AB**. The Geochemical Impact Assessment details the geochemical characterisation findings of the overburden and the coal reject material likely to be generated by the Project. The findings were developed utilising information from ongoing exploration activities and a sampling and geochemical testing program consistent with Australian and worldwide technical guidelines (as referred to in **Section 7.20**).

The purpose of the assessment was to:

- Characterise the overburden, interburden and coal rejects (including coarse rejects and fine rejects) associated with open cut mining of the targeted coal seams for the Project; and
- Develop and recommend any necessary environmental management measures related to overburden, interburden and coal reject emplacement and the Project's rehabilitation program.

The characterisation of the overburden, interburden and coal rejects has enabled an understanding of the anticipated water quality associated with runoff and seepage from coal stockpile areas, backfilled open cut voids and OEAs.

These findings have in turn been considered within the Surface Water and Flooding Impact Assessment and the Groundwater Impact Assessment (see **Appendix L** and **Appendix M**) to determine any potential impacts to surface water and groundwater quality as a result of runoff and seepage from mining areas.

7.20.2 Methodology

Desktop Assessment

A desktop assessment was undertaken to review the existing geological and water quality data associated with the Project to assist in the development of a suitable sampling and testing program for overburden, interburden and coal reject materials.

As there are no specific regulatory requirements regarding the number of samples required to be obtained and tested at coal mines in NSW, existing technical guidelines for the geochemical assessment of coal and mining waste materials in Australia (Australian Minerals Industry Research Association, 2002; Department of Industry, Tourism and Resources, 2007) and worldwide (International Network on Acid Prevention, 2009) were used by RGS as a framework for developing the sampling (and geochemical testing) program for the Project.

The sampling program focused on obtaining fresh representative samples for each of the Project coal and mine waste material types. An early site visit was undertaken by an RGS representative to ensure a sound sampling and testing methodology.

Sampling Program

Drill core materials were collected from 34 drill holes to assess the following:

- Overburden, interburden and minor uneconomic coal seams;
- Raw coal; and
- Potential coal rejects materials (including roof/parting/floor and coarse and fine rejects likely to be produced as part of the processing of coal).

A total of 251 representative sub samples of drill core (and some drill chips) were collected from the lithologies encountered throughout the stratigraphic profile. Samples were subjected to a series of static and kinetic leach column geochemical tests. The geochemical test program was designed to assess the degree of risk from the oxidation of pyrite, acid generation and the leaching of soluble materials, major ions and salts.

All of the samples collected were subjected to Acid Base Account (ABA) geochemical testing, standard soil parameters including pH, salinity (EC), exchangeable cations, major metal composition analysis and were tested for Acid Neutralising Capacity (ANC) and Net Acid Producing Potential (NAPP). Seventy-two of the 251 samples were also tested for Chromium Reducible Sulphur (Scr).

Following the review of the ABA tests, 24 individual and composite samples were prepared and subject to additional multi element testing on solid and soluble fractions of the pulverised composite samples.

Nine Kinetic Leach Columns (KLC) tests were completed on various composite materials (crushed material passing nominal 10 mm sieve size). KLC testing of four samples representing overburden, interburden, potential coal reject and coal materials from both the Ulan and Coggan Seams commenced in December 2012.

Testing of three samples, representing coarse reject from the Ulan and Coggan Seams commenced in May 2013 and a further two samples representing coarse reject from the Coggan Seam were KLC tested from April 2014. All leachate collected was subject to multi-element analysis. The sulphate generation obtained from the KLC tests was used to determine the rate of sulphide oxidation in materials represented by the samples.

7.20.3 Impact Assessment

Overburden

A total of 131 samples representing overburden, interburden, uneconomic coal seam and composite overburden materials (collectively termed 'overburden') were included in the geochemical assessment program (static and kinetic tests). The results of the assessment program demonstrate that the majority (98.5%) of overburden materials tested is Non-Acid Forming (NAF) and not Potentially Acid Forming (PAF).

Most of the overburden materials had very low sulphur content (less than the typical background concentration of 0.1% sulphur). These materials were classified as NAF-barren, and had a significant acid buffering capacity.

A very small portion (1.5%, a total of two samples) of the material tested was classified as 'Uncertain' and could potentially have a low capacity to generate acid. As the majority of the overburden was confirmed as NAF-barren with significant excess acid buffering capacity, bulk overburden materials will have a high factor of safety with respect to potential acid generation and are predicted to generate slightly alkaline leachate with relatively low salinity values upon contact with water.

Total metal/metalloid concentrations in overburden materials are relatively low and sparingly soluble in leachate, and are therefore unlikely to present a significant risk to rehabilitation activities and water quality at the Project.

Coal Reject and Coal

A total of 120 potential coal reject and coal samples generated from the target Ulan and Coggan Seams were included in the geochemical assessment program (static and kinetic tests). The results of the geochemical assessment indicate that approximately 80% of these materials are NAF and have a high factor of safety in respect to acid generation. The majority of these also have relatively low sulphur content and are classified as NAF-barren. Approximately 10% of the 120 samples were classified as "Uncertain" and may have a low acid forming capacity. The remaining 10% of the samples, which mainly comprised coarse and fine reject and floor samples from the Coggan Seam, are classified as PAF as they have some capacity to generate acidity.

As the majority of the potential coal reject and coal materials were confirmed as NAF-barren with significant excess acid buffering capacity, bulk coal reject materials are expected to have an elevated factor of safety with respect to potential acid generation and are predicted to generate pH neutral to slightly alkaline leachate with relatively low salinity values upon contact with water.

Due to the PAF classification of some of the floor material and coal reject materials from the Coggan Seam, there is some potential for parts of the underground mine workings and pit floor at the open cut operation, as well as some co-disposed coal reject materials to be a source of acidity. The implementation of appropriate mitigation and management measures, as described in **Section 7.20.4** will adequately control or neutralise any potential acidity that may be generated by these materials.

Total metal/metalloid concentrations in coal reject and coal materials are relatively low and sparingly soluble in pH neutral leachate. Therefore, provided that the mitigation and management measures described in **Section 7.20.4** are adopted, metals/metalloids are unlikely to present a significant risk to rehabilitation activities and water quality at the Project.

Seepage Water Quality

The risk of significant water quality impacts from NAF coal and mining waste material is low. Static and KLC geochemical test results have indicated that initial and ongoing surface runoff/seepage is likely to be pH neutral to slightly alkaline. Only some of the coal reject from the Coggan Seam has the potential to generate some acidity.

The salinity of surface runoff and seepage from overburden materials is likely to be relatively low. The salinity of surface runoff and seepage from coal reject materials and coal (from both open cut and underground mining) is also likely to be low, but may increase over time if the small portion of PAF material is exposed to oxidising conditions.

Trace metals/metalloids in seepage and runoff from coal reject and storage areas are likely to be low. However, materials generated from the Coggan Seam may generate higher levels of metal leachate and salinity, specifically if these materials are exposed to ongoing oxidising conditions.

Spontaneous Combustion

Spontaneous combustion typically occurs when pyrite (iron sulphide) oxidises in the presence of a combustible material, such as coal. Most overburden, interburden and coal rejects that are associated with the Project have low sulphur content and consequently a low propensity for spontaneous combustion. However, some of the coal and potential coal reject materials have elevated pyritic sulphur content, which could represent a potential risk for spontaneous combustion. As coal reject materials for the Project will be well mixed, the amount of coal rejects with high sulphur content will be diluted to produce a composite material thereby reducing the propensity for spontaneous combustion.

7.20.4 Mitigation and Management

The ongoing management of coal and mining waste materials at the Project will consider the geochemistry of these materials with respect to their potential risk to cause harm to the environment and their suitability for use in construction and revegetation.

To this end KEPCO will develop a Mine Waste Management Plan for the Project which will include:

- Confirmation of the occurrence and distribution of any PAF material via a sulphur grid / layered geological model with updated exploration data;
- Pre-stripping topsoil from areas to be disturbed and then utilise this in the final rehabilitation activities to limit the risk of dispersion and erosion of potentially sodic overburden;
- Selective handling and capping of PAF materials with NAF materials;
- Additional overburden testing as mining progresses to ensure the most appropriate rehabilitation options are considered during mine closure;

- Provisions for the treatment of potential acid water in underground workings or in the open cut workings (e.g. mobile lime dosing plant or the broadcast application of agricultural lime);
- Ongoing testing to confirm spontaneous combustion propensity of selected mine materials as they are generated to be detailed in a Spontaneous Combustion Monitoring and Management Plan; and
- Monitoring of runoff and seepage from overburden, interburden and coal rejects on a regular basis during the operations phase of the Project to ensure key water quality parameters, are maintained within relevant criteria as forecast.

7.21 SOCIAL

7.21.1 Background

A Social Impact Assessment (SIA) was completed for the Project by Hansen Bailey and is provided in **Appendix AC**. The SIA identifies the potential socio-economic impacts associated with the construction, operation and decommissioning of the Project and recommends mitigation and management measures to address these impacts.

7.21.2 Methodology

The methodology for the SIA included the following key components:

- Assessment of the Project workforce and workforce accommodation strategy;
- Identification of the SIA Study Area;
- Profiling the socio-economic environment of the SIA Study Area based on a review of existing information/ data and consultation with relevant stakeholders including consultation with Bylong Valley residents;
- Identification and assessment of potential socio-economic impacts; and
- Development of appropriate management commitments to address potential socio-economic impacts and to maximise potential community benefits.

Project Workforce

As described in **Section 3.10**, the Project will require the following full-time equivalent workforce:

- 800 people at peak construction (PY 2) for the development of the open cut mine and associated infrastructure;
- An annual average workforce of approximately 360 people during PY 3 and PY 12 including 100 people during construction phase 2 (PY 4 – PY 6);
- 470 people during peak operations (PY 9); and
- 275 people during underground only operations (PY 13 – PY 25).

The Project workforce will be recruited as a mixture of local hires (i.e. those currently residing within a one hour commute of the Project) and NLHs (i.e. those that are expected to be sourced from outside the one hour commute zone).

The majority of the workforce associated with both construction phases is expected to be NLHs. Approximately 85% of the operations phase workforce is expected to be NLHs. KEPCO is seeking to encourage all NLHs associated with the operations phase to relocate permanently to within a one hour commute of the Project Boundary. The majority (95%) of NLHs associated with the operations phase are anticipated to relocate to the MWRC LGA, with 85% of these people predicted to relocate to Mudgee township.

Workforce Accommodation Strategy

The Project workforce will be accommodated in a combination of:

- Temporary 650 bed WAF in PYs 1 and 2 and a 300 bed WAF from PYs 3 to 6;
- Existing KEPCO owned housing in the Bylong Valley;
- Private housing in the Local Area (i.e. within a one hour commute of the Project); and
- Short term accommodation options in the Local Area as necessary.

The WAF will operate during the construction phases of the Project (PY 1 to approximately PY 6) providing accommodation for all NLHs associated with the Project construction phase. The WAF may also provide short term accommodation for NLHs associated with the operations phase as an interim measure while employees secure longer term accommodation in the Local Area.

SIA Study Area

The SIA Study Area consists of the:

- Regional Study Area - Defined as the Lithgow - Mudgee Region;
- Sub Regional Study Area - Comprising the MWRC LGA; and
- Project Area - Defined as the Bylong Valley, including the Project Boundary and neighbouring landholders.

The Local Area has been defined as the geographical area within an approximate one hour commute of the Project Boundary (assuming the Wollar Road upgrade by MWRC). The above mentioned areas which comprise the SIA Study Area are illustrated on **Figure 4**.

Socio-economic Profile

Project Area

The Bylong Valley consists of a small, rural agricultural community of approximately 100 residents. Coal exploration has been occurring in the area for more than 15 years. Bylong Village is the focus of community activity in the Bylong Valley and has a small general store, a community hall and community sporting grounds, St Stephen's Anglican Church and the Bylong RFS.

The BUPs is a primary public school located on Upper Bylong Road approximately 1 km from Bylong Village. There are three houses in Bylong Village. At June 2015, Bylong Village had a population of seven persons.

Current community identity, values, aspirations and lifestyle were explored with residents of the Bylong Valley through targeted consultation. Bylong Valley residents identified a range of economic, social, physical, natural and cultural heritage values of importance in the Bylong Valley. The results of this consultation are summarised in **Section 5.5** and detailed in **Appendix AC**.

Sub Regional Study Area

The MWRC LGA includes the regional service centre of Mudgee, the smaller settlements of Gulgong, Kandos and Rylstone and 14 villages and other localities including Bylong, Wollar, Ulan and Lue. The estimated resident population (ERP) of the MWRC LGA was 23,843 in June 2013 (Australian Bureau of Statistics (ABS) 2014a).

The MWRC LGA is a popular tourist destination attracting more than 496,000 visitors each year (MWRC, 2014b). The MWRC LGA is large enough to provide for the full range of lifestyle conveniences such as shopping, sports, schools and medical facilities.

The majority of these services are centred in Mudgee. The MWRC LGA has a strong and diverse economic base supporting job opportunities in a range of industries including agriculture, viticulture, tourism and mining.

There are currently four mining operations located within the MWRC LGA: Wilpinjong Mine (Peabody Energy); Moolarben Coal Mine (Yancoal); Ulan Coal Mine (Glencore); and Charbon (Centennial Coal). The first three mines are centred around the village of Ulan. Charbon mine is located immediately south of Kandos and is scheduled to close in 2015.

The MWRC LGA exhibits the following key demographic characteristics:

- Population growth rate of 10.5% between 2006 and 2013 (NSW Ministry of Health 2015);
- Indigenous population equivalent to 3.9%, slightly higher than the NSW proportion of 2.5% (ABS, 2013a);
- Median age of 41, slightly higher than the NSW median age of 38 (ABS, 2013a);
- Household structure similar to those across NSW and dominated by family households; and
- Higher proportion of couples with children (43%) compared to NSW (37%) (ABS, 2012e).

Mudgee is the regional service centre for the MWRC LGA. Agriculture, viticulture, mining and tourism are important driving industries in the MWRC LGA that, together with Mudgee's expanding retail, service and commercial sectors, provide a growing employment base for a diverse economy.

The key economic characteristics of the MWRC LGA include:

- A strong reliance on mining as a key driver of economic growth;
- A high proportion of businesses in the agriculture, forestry and fishing sectors, consistent with the agricultural nature of the LGA;
- Significant growth in the mining, administrative and support services and financial and insurance services sectors between 2011 and 2013;
- Unemployment rate of 6.6% compared to 5.5% in NSW (December 2014);
- Labour force participation rate in 2011 lower than NSW (56% compared to 60%);

- High unemployment in the 15 - 19 year age cohort (15% for males and 12% for females) compared to other age cohorts; and
- Median income indicators lower than NSW average in 2011.

Consultation with MWRC representatives suggests that the economy of the LGA over the last 12 months has slowed in parallel with the slow-down in the mining industry, highlighting the need to protect existing economic diversity.

An assessment of the current housing and accommodation market in the Sub Regional Study Area, specifically Mudgee, shows that residential property prices between 2006 and 2014 increased substantially in line with population growth fuelled by expansion in the mining sector. Annual capital growth (medium value) in Mudgee was greatest in 2012 at the height of the mining boom. The slow-down in the mining industry from 2013 onwards and sustained efforts by the MWRC to deliver land to the market for development has resulted in a softening of the housing market in Mudgee in terms of price and availability.

An assessment of the temporary housing market shows that typical "tourist" accommodation was heavily used by the construction and resources sector during the mining boom in 2012-2013. Demands have since reduced significantly due to a slow-down in the mining sector.

The SIA includes an assessment of the current community facilities and services provided in the Sub Regional Study Area.

Infrastructure considered in the assessment includes education facilities, children's services, youth services and facilities, health services, emergency services, recreation, sporting and leisure services, cultural facilities and cultural development, social support services and community groups, commercial and retail services and public transport. The assessment highlighted existing servicing issues in Mudgee in the following areas:

- Children's services, namely child care and early childhood intervention services;
- Medical services and health facilities;
- Youth services;
- Further education opportunities including school based learning and vocational education opportunities;
- Emergency accommodation and crisis housing; and
- Volunteer based organisations including the NSW Rural Fire Service.

Additional child care services will be delivered in Mudgee over the course of the next 12 to 18 months. These services, which will be delivered through a combination of private sector and local government investment, will address some of the existing servicing issues.

7.21.3 Impact Assessment

Population and Demography

The construction phases of the Project will have little noticeable impact on the population size of the MWRC LGA as the majority of workers are anticipated to be NLHs who reside permanently outside of the MWRC LGA and will be accommodated in the WAF in Bylong Valley while on roster.

Project induced population growth over the life of the Project, is likely to be most significant in PY 3 with the commencement of the operations phase. In PY 3 up to approximately 460 new residents could potentially relocate to MWRC LGA, of which up to approximately 415 residents are anticipated to reside in Mudgee. This is equivalent to a 3.6% increase in the current estimated resident population of Mudgee and a 1.9% increase in the estimated resident population of MWRC LGA.

Between PY 3 and PY 9 a further and approximate 540 people could potentially relocate to the MWRC LGA, of which up to approximately 490 are predicted to reside in Mudgee. This is equal to a 4.3% increase in the current estimated resident population of Mudgee and a 2.3% increase in the estimated resident population of MWRC LGA.

The majority of the incoming population are predicted to be families of which 70% are anticipated to bring children. The Project therefore has the potential to result in an increase in the number of children aged 0-18 years in Mudgee and across the broader MWRC LGA.

The Project will also generate flow-on employment and subsequent population growth in the MWRC LGA during Project construction and operations.

Housing and Accommodation

Project induced population growth will have subsequent impacts on housing demand across the MWRC LGA and potential impacts on housing affordability in Mudgee. Direct Project induced population growth is estimated to generate the following demand for housing in the MWRC LGA:

- In PY 3, total demand for up to 174 dwellings; and
- In PY 9 (peak operations), total demand for up to 380 dwellings.

Dwelling demands generated by the Project workforce will reduce substantially between PY 9 and PY 13 as open cut operations cease. During this period the Mudgee housing market may be required to absorb the release of an average of approximately 35 dwellings per year back into the market as open cut mining ceases and employees transition to other projects which may necessitate relocation to areas outside the MWRC LGA.

The MWRC has confirmed that the broad housing demands anticipated to be generated by the Project have been considered in the preparation of the *Mudgee-Gulgong Urban Release Strategy* (HillPDA, 2014). Based on the findings of HillPDA (2014) it appears that the:

- Housing demands generated by the Project can be met without placing additional pressure on the existing housing market; and
- Anticipated release of 35 dwellings per year between PY 9 and P 13 can be absorbed without causing sustained impacts to the local housing market. The ability of the Mudgee housing market to absorb the release of houses between PY 9 and PY 13 will require forward planning by the MWRC in relation to land releases.

Economic Vitality

The Project will result in significant economic benefits for the MWRC LGA and NSW. This is further discussed in **Section 7.22.**

Labour Market Dynamics

A softening of the labour market has occurred with the slow-down in the mining industry. This is evident in unemployment rates across the MWRC LGA and adjoining LGAs (e.g. Muswellbrook LGA). The Project will result in the provision of new direct and indirect employment opportunities for local residents of the MWRC LGA. The labour pool of the MWRC LGA will be able to absorb a proportion of the jobs created by the Project. The capacity of the MWRC LGA labour force to absorb Project employment opportunities will be influenced by the number of major projects occurring in the LGA at the same time. The SIA has assumed a constrained local labour market for the assessment of Project impacts.

Stakeholders consulted for the SIA identified a number of potential labour market benefits associated with the Project including:

- The potential for increased employment and training opportunities for young people in the MWRC LGA;

- The generation of employment opportunities for existing residents of the Bylong Valley; and
- The provision of jobs, scholarships and training for locals.

The Project will increase the size of the labour force available in the MWRC LGA for the non-mining sector through the introduction of new residents associated with Project employees.

Community Infrastructure

The SIA includes an analysis of the expected impacts of the Project on community facilities and services in the Project Area and the Sub Regional Study Area.

The Project will not impact the operation of key facilities located in Bylong Village including the Bylong General Store, sports ground and St Stephen's Anglican Church.

KEPCO is in ongoing discussions with the DED in relation to the future of the BUPS, which is located within the Project Disturbance Boundary and was recently placed into recess due to no enrolments for 2015. KEPCO has committed to assist in the relocation of the BUPS to a location outside the Project Disturbance Boundary should the DED decide to recommission the BUPS following the current period of recess.

Most recent discussions with DED have suggested that it is considering the permanent closure of the BUPS as a result of a declining trend in enrolments for this facility in recent years (consistent with other similar schools across regional NSW). KEPCO has expressed its interest in the acquisition of the BUPS in the event that DED decide to permanently close this facility. A Memorandum of Understanding (MoU) which addresses both outcomes has been drafted and provided to DED for consideration.

The following community infrastructure and services in the MWRC LGA are predicted to experience impacts from the Project:

- Health services and facilities – During construction phase 1, the health facilities in Rylstone may experience an increase in demand from the construction workforce. Rylstone is the closest urban centre to the Bylong Valley and the proposed WAF. The operations phase workforce will generate demand for a range of health services in Mudgee, including general practitioner services and emergency care;
- Children's Services – Project induced population growth has the potential to increase demand for child care services and youth services in Mudgee;

- Education services – Project induced population growth has the potential to increase enrolments at primary and secondary schools in Mudgee necessitating additional service provision in the form of staffing and infrastructure; and
- Training and skill development – The workforces associated with all phases of the Project will increase demand for skills training in relevant fields of occupation in the MWRC LGA.

Discussions with service providers in Mudgee completed as part of the SIA consultation confirms that the majority of impacts on individual services including health services, children's services, and primary and secondary education services will generally be incremental and able to be absorbed by the "natural" growth of those services.

In the case of child care services the recent approval of a new child care centre and a new preschool centre in Mudgee will create additional service capacity that can cater for demand generated by future population growth, including Project related population growth.

Cooperation in monitoring and planning between the mining and resource companies in the Study Area, MWRC and relevant State government agencies and other stakeholders will be the key to ensuring that services are adequately able to plan for future growth.

Community Liveability

The SIA considers the impact of the Project on community liveability in the Bylong Valley. Bylong Valley residents who participated in SIA interviews raised concerns in relation to the potential impacts of the Project on rural character and amenity, community sustainability and long term cohesion, accessibility due to changed road conditions and increased traffic.

The Project (particularly the open cut operation) will impact on the rural character and amenity of Bylong Village and to a lesser extent the broader Bylong Valley. A number of measures have been integrated into the Project design to minimise the visual impact of the Project. Additional offsite treatments are also proposed to further reduce the impact of the open cut operations. The most significant visual impact will occur during the open cut operation and rehabilitation (PY 2 – PY 12). The underground mining operation will have a significantly smaller impact compared to the open cut mining operation.

Near neighbours expressed concern that the Project is likely to contribute to air quality impacts from dust, reducing residential amenity. Near neighbours perceive that blasting activities associated with the Project will impact on the amenity of properties in proximity to the open cut operation, particularly those properties in Bylong Village. Noise and blasting impacts are discussed in **Section 7.9** and **Section 7.10**.

During EIS consultation, residents of the Bylong Valley reported that the population of the Bylong Valley had experienced a steady decline since the early 1980s. EIS consultation with Bylong Valley residents highlighted a perception that the Project may result in the further decline of the Bylong Valley population and a loss of community members and leaders as a result of property acquisition and relocation. There is a perception that further population decline will result in a loss of social connection within the community. To date, Project related property acquisition has resulted in a net loss of eight residents, equal to approximately 8% of the estimated total population of the Bylong Valley. Future property acquisition may result in a further loss of up to six existing residents.

Some stakeholders were optimistic that the Project would attract new residents to the Bylong Valley, particularly if suitable accommodation was provided. These stakeholders suggested that any Project induced population growth in the Bylong Valley would have a positive impact on the local community in terms of enhancing social capital and long term community sustainability.

Population modelling for the SIA suggests that at peak operations (PY 9) up to approximately 20 employees with families could potentially relocate to the Bylong Valley with a resulting increase in population of approximately 50 people. This impact is positive and offsets the loss of population associated with property acquisition activities and the historical population decline experienced in the Bylong Valley.

During SIA interviews, concerns were raised by a number of residents of the Bylong Valley in relation to the decommissioning of the southern section of Upper Bylong Road.

The closure of Upper Bylong Road will increase travel times to the north of the Bylong Valley (towards Denman in the Muswellbrook Shire LGA) for all landholders residing within and adjoining the southern and south-eastern areas of the Project Boundary.

Proposed access arrangements for these residents is discussed in **Sections 3.13** and **3.14** and assessed in **Section 7.18**.

7.21.4 Mitigation and Management

The SIA includes a wide range of mitigation strategies which have been developed to address the social impacts of the Project. KEPCO is currently in negotiations with the MWRC in relation to the preparation of a VPA for the Project. The VPA is the primary mechanism for managing socio-economic impacts associated with the Project and enhancing positive benefits and opportunities.

Additional mechanisms will include, but are not limited to:

- Corporate Sponsorship and Donations Fund (SD Fund);
- Interim Community Investment Fund;
- Social Impact Management Plan (SIMP);
- Upgrade of Wollar Road by the MWRC; and
- Management strategies described in relevant EIS technical reports.

Voluntary Planning Agreement

KEPCO has made an offer to MWRC over a VPA in respect of the Project. A copy of the letter of offer for the VPA dated 26 June 2015 is provided in **Appendix AD**. The VPA offer to the MWRC includes a:

- \$2.75 Million contribution consisting of an initial payment of \$1.5 Million upon granting of development consent and KEPCO's approval to proceed and a further \$1.25 Million (to be CPI adjusted post 1 July 2017) at the commencement of the open cut mining operation; and
- Payment of \$0.05 (to be CPI adjusted post 1 July 2017) per railed tonne of coal for the life of the Project.

KEPCO is undertaking a "Community Needs Assessment" which includes consultation with key community groups and government agencies. The outcomes of the Community Needs Assessment will guide discussions with MWRC regarding the potential distribution of the VPA payments.

Corporate Sponsorship and Donations Fund

KEPCO has been supporting local community activities and will be continuing to support the community. The Corporate Sponsorship and Donations Fund (Corporate SD Fund) which has been developed will support small-scale investment across the MWRC LGA and will operate for the life of the Project. Investments under the Corporate SD Fund will be guided by the key priorities identified through the "Community Needs Assessment" to be conducted by KEPCO.

Interim Community Investment Fund

An Interim Community Investment Fund has been developed and will operate from 2015 to the commencement of Project construction phase, at which point in time the VPA will commence. Similar to the Corporate SD Fund, investments under the Interim Community Investment Fund will be guided by the key priorities identified through the Community Needs Assessment.

Social Impact Management Plan

KEPCO will develop a SIMP which will document the full suite of mitigation strategies proposed for the Project including the outcomes of the Community Needs Assessment and management arrangements for consulting with MWRC in relation to the distribution of VPA funding. The SIMP will also include a strategy for monitoring social impacts and the success of management strategies.

Upgrade of Wollar Road

The MWRC recently received Resources for Regions funding to the value of \$14 Million for the completion of an upgrade to Wollar Road from Bylong Valley Way to the town of Wollar. The upgrade of this road will significantly improve access for the Project workforce to Mudgee and in doing so increase the attractiveness of Mudgee as a potential permanent residential location for the workforce.

7.21.5 Summary of Management Measures

In addition to the key management commitments identified above, KEPCO proposes a number of additional actions to enhance the positive benefits of the Project and manage potential impacts. A summary of the proposed management commitments is provided in **Table 98**.

7.22 ECONOMIC

7.22.1 Background

An Economic Impact Assessment of the Project was undertaken by Gillespie Economics and is provided in **Appendix AE**. The purpose of the Economic Impact Assessment was to determine:

- The economic efficiency of the Project (i.e. consideration of economic costs and benefits); and
- The economic impacts of the Project (i.e. the economic stimulus that the Project will provide to the regional and State economies).

A Peer Review was completed of the Economic Impact Assessment by BDA Group's Mr Drew Collins who is a pre-eminent specialist economist with over 30 years' experience in economic assessment. The peer review is provided in **Appendix AF**.

The Peer Review of the Economic Impact Assessment endorsed the methodology and the findings of the assessment confirming that it is *"a generally sound report, employing methods and an approach to the presentation of results consistent with best practice economic assessment principles"*. Further the Peer Review confirmed that the report *"appropriately concludes that the Project offers net economic benefits to the region, State and more broadly to Australia, and is therefore desirable from an economic efficiency perspective"*.

7.22.2 Methodology

The Economic Impact Assessment was carried out in accordance with the SEARs and the *Guideline for the Use of Cost Benefit Analysis in Mining and Coal Seam Gas Proposals* (NSW Government (2012)) and the *NSW Government Guidelines for Economic Appraisal* (NSW Treasury (2007)).

The following analyses were prepared as part of the Economic Impact Assessment:

- A Benefit Cost Analysis (BCA) of the Project;
- An economic activity analysis of the Project, using input-output (IO) analysis;
- An assessment of fiscal impacts to NSW and Federal Governments; and
- An assessment against the economic heads of consideration included in the SEPP Mining.

TABLE 98 Summary of Management Commitments

Ref	Mitigation and Management Measures	Ref	Mitigation and Management Measures
POPULATION AND DEMOGRAPHICS			
1.	A WAF will be constructed in the Bylong Valley and operated from PY 1 to the end of underground construction in ~ PY 6. The WAF will accommodate all NLHs associated with the Project.	11.	KEPCO is developing a comprehensive Farm Management Plan to guide the use of all proponent owned land in the Bylong Valley. The Farm Management Plan identifies methods to generate an economic return from the agricultural land as KEPCO is committed to making a valued contribution to the agricultural economy in the MWRC LGA.
2.	KEPCO will support the MWRC in seeking that the NSW Government to produce population projections for the MWRC LGA that more reasonably reflect the mining resource development activities within the LGA. This could facilitate the MWRC in applying for further funding for physical and social infrastructure and potentially enable improved forward planning for the LGA.	12.	Through the Interim Community Investment Fund and/or the Corporate SD Fund, KEPCO will contribute to beautification and enhancement works at Bylong Village to enhance the attractiveness of the location as a tourist stopping point along the Bylong Valley Way.
3.	KEPCO will provide the MWRC with an annual workforce report for the Project for the years PY 1 to PY 13. The annual workforce report will detail the current and anticipated workforce numbers for the Project. This will enable the MWRC to plan proactively for anticipated population changes.	LABOUR MARKET DYNAMICS	
4.	KEPCO will assess which Project-owned houses in the Bylong Valley are of a standard suitable for habitation.	13.	In consultation with MWRC, KEPCO will encourage the provision of education and training opportunities in the non-mining sector through initiatives established under the VPA.
5.	KEPCO will make existing proponent owned housing in the Bylong Valley available to the workforce associated with the Project operations phase where residential amenity requirements can be met.	14.	KEPCO will monitor local labour supply and will investigate adjusting local labour recruitment practices and rates accordingly.
6.	KEPCO will consider developing and implementing an Employee Incentive Scheme (if needed) which will detail a range of incentives to encourage re-location to the Bylong Valley and Mudgee.	15.	As a component of the Community Needs Assessment KEPCO will engage with Kandos and Mudgee SHS and St Matthews Catholic School in Mudgee and the Cudgegong TTC to identify potential opportunities for supporting the delivery of existing training programs targeting open cut and underground mining skill sets and other non-mining related skill sets in demand in the MWRC LGA e.g. childcare.
7.	KEPCO will encourage all NLHs associated with the Project's operations phase to locate permanently with their families to Mudgee and other areas in the MWRC LGA.	16.	The Local Content and Project recruitment planning process will consider a workforce recruitment and training model that could potentially include the development of school based traineeship and apprenticeship opportunities at Kandos and Mudgee HS
ECONOMIC VITALITY		17.	KEPCO will prepare a targeted Recruitment and Training Plan for the Project which will include a range of employment and training options for the MWRC LGA residents.
8.	Projects that support the economic diversity of the MWRC LGA may be suitable for funding under the VPA Community Investment Fund, acknowledging the valuable contributions other industries in the MWRC LGA make to the economic stability of the LGA.	18.	The Project will seek to provide part-time and/or flexible employment opportunities to encourage a higher rate of labour force participation, particularly among disadvantaged groups. This will be done wherever possible based on an assessment of each position and its association with achieving 24/7 productions.
9.	KEPCO is committed to returning appropriate areas within the Project Disturbance Boundary to agricultural land use practices as soon as possible following achievement of rehabilitation goals.	19.	As a component of the VPA, KEPCO will encourage MWRC to establish an annual scholarship program offering financial support to local students seeking to study a university degree in a primary industry related course.
10.	KEPCO will retain the services of a professional Farm Manager to oversee the use and management of all KEPCO owned land in the Bylong Valley.		

Ref Mitigation and Management Measures

20. KEPCO will investigate opportunities for mentoring and career development services to secondary schools in MWRC LGA to promote:
- Employment in the mining industry;
 - Project specific pathways to employment; and
 - Employment opportunities for women.

HOUSING AND ACCOMMODATION

21. KEPCO will construct the WAF at the commencement of construction phase 1 and extend its operation to the end of construction phase 2 to minimise the impact of the construction phase workforces on short term accommodation provision in the MWRC LGA, particularly Mudgee.
22. KEPCO will encourage NLHs associated with the operations phase to use the WAF while they transition to permanent housing, if the local short term accommodation market is experiencing high demand due to the cumulative impacts of projects.
23. KEPCO will keep the MWRC informed of the Project schedule, any changes to the size of the Project workforce and anticipated recruitment periods. KEPCO will proactively engage with the MWRC both prior to the commencement of the construction phase and throughout the construction and operations phases to enable the MWRC to make informed decisions regarding land and housing availability to meet Project generated demand.
24. KEPCO will monitor housing affordability and availability in the MWRC LGA and report in the regulatory Annual Review.
25. KEPCO will seek to monitor workforce size, obtain information regarding the workforce's previous and current residential location (where possible), local housing demand and supply, housing prices and affordability.
26. Further engagement in relation to the provision of crisis housing will be conducted with key stakeholders such as Housing Plus, Barnardos and the MWRC as part of the preparation of a Community Needs Assessment
27. Actions to address the reported crisis housing deficit in the MWRC LGA will be discussed for funding as a component of the VPA, in consultation with MWRC.

COMMUNITY LIVEABILITY

28. KEPCO will encourage employees, through company policy, to remove their high-visibility mining work wear if they intend to visit public places in the towns and villages of the MWRC LGA before and after work.

Ref Mitigation and Management Measures

29. Through the Interim Community Investment Fund and/or the Corporate SD Fund, KEPCO will contribute to the beautification and enhancement works at Bylong Village to enhance the attractiveness of the location as a tourist stopping point along the Bylong Valley Way.
30. KEPCO will retain the services of a professional Farm Manager to oversee the use and management of all Proponent owned land in the Bylong Valley.
31. KEPCO will develop a comprehensive Farm Management Plan to guide the use of all KEPCO-owned land in the Bylong Valley to facilitate the land generating an economic return and KEPCO making a valued contribution to the agricultural economy in the MWRC LGA.
32. Employee policies that enable emergency services personnel to be released from duties to attend emergency calls and to perform crucial volunteer actions outside of the Project Boundary will be developed for all phases of the Project.
33. KEPCO will keep landholders in the Bylong Valley informed of decisions in relation to the timing of the closure of Upper Bylong Road and the proposed alternative access route.
34. KEPCO will work in collaboration with the MWRC and local residents within and adjoining the Project Boundary to ensure that property access is maintained where possible and that adequate roadway is provided for servicing properties.
35. KEPCO will assist new residents (employees) and families to integrate into their host community by collaborating with the MWRC LGA and industry in the region to source or provide various information, projects and policies.
36. Specifically in relation to Bylong Village assist new residents and families to integrate by:
- Holding community BBQs or similar events to encourage existing residents and new residents to socialise and build social networks;
 - Encouraging new residents to participate in local volunteer roles such as the Bylong RFS by providing information relating to these services promoting the need for volunteers in the workforce and identifying key contacts in volunteer services;
 - Encouraging new residents to participate in community groups and organisations such as the Bylong Hall Committee by promoting the existence of such groups and organisations and identifying key contacts;

Ref Mitigation and Management Measures

- Potentially holding open days at the Bylong Coal Mine to encourage existing residents to learn about the working environment of new residents;
 - Requesting a local community member be responsible for welcoming new residents to Bylong and familiarising them with the local area; and
 - Ensuring the Project Community Liaison or HSE officer is accountable for meeting new residents.
37. KEPCO will develop and implement a Project Fatigue Management Policy including an education program in consultation with emergency service providers.
38. KEPCO will become a partner in the Mudgee Liquor Accord.
39. KEPCO proposes the following actions to minimise fatigue related incidents in the workforce:
- Develop and implement a Project Fatigue Management Policy including an education program in consultation with emergency service providers;
 - Provide detailed information to employees and their families about managing sleep cycles and the impact of fatigue on lifestyle and relationships;
 - Identify and implement a program to encourage the operations phase workforce residing in Mudgee, Rylstone and Kandos to car pool for commuting to the Project;
 - In consultation with stakeholders, investigate the potential for the establishment of a driver rest area between Bylong and Mudgee. Identify a suitable lead agency to develop the rest area and consider the provision of funding assistance through the VPA or Corporate SD Fund for construction of the necessary facilities; and
 - Investigate the provision of a bus service between Mudgee and the Project for the operations phase, once the residential status of the workforce is understood and where demand indicates a need.
40. Logistics scheduling will be conducted in a manner that ensures Project related vehicle movements during both construction and operation are undertaken to occur outside school drop off and pick up periods.
41. A construction Traffic Management Plan will be prepared as part of pre-construction planning detailing how the traffic associated with each of the construction phases will be managed. The construction Traffic Management Plan will be prepared in consultation with and to the approval of the MWRC and the relevant roads authority.

Ref Mitigation and Management Measures

42. Should the Project be granted approval, the development consent will specify landholders where predicted amenity impacts are determined to be unacceptable in accordance with the NSW Government's Voluntary Land Acquisition and Mitigation Policy. In this instance these landholders will be provided the opportunity to be acquired by KEPCO if they so wish or at-site mitigation within terms negotiated and agreed by both parties.
43. Residences identified in the development consent as outside the Project Acquisition Boundary but as experiencing amenity impacts will be offered at-site mitigation

COMMUNITY INFRASTRUCTURE ACCESSIBILITY

44. Engage with Western NSW LHD and Mudgee Heath Service to identify a suitable strategy to meet the health needs of the workforce accommodated in the WAF.
45. Where practicable, encourage the construction workforce to undertake mine safety health checks and general medical appointments at their place of residence and not at private health clinics in Mudgee. This is to reduce demand for GP services in the MWRC LGA.
46. Complete a Community Needs Assessment to define the key priorities for investment in community infrastructure and services.
47. Engage further with MWRC LGA in relation to the provision of early intervention services at the proposed new preschool service. Where specific needs are identified through the Community Needs Assessment these should be considered for funding through the VPA, in consultation with MWRC.
48. Conduct ongoing engagement with the MWRC and Mudgee children's service providers to monitor service demand and to inform any future decision regarding potential investment in children's services through the VPA.
49. Finalise an MOU with the NSW DED in relation to the future management of the BUPs.
50. Establish relationships with primary and secondary schools in Mudgee and Kandos and engage in regular communication related to the changing levels of service demand as the Project operations phase progresses.
51. Conduct an assessment of education service priorities via the Community Needs Assessment to inform investment decisions under the VPA.
52. Establish a line of communication with Mudgee PS and Mudgee SHS to monitor Project related demand for places in the special needs classes.

Ref	Mitigation and Management Measures
53.	Engage further with key training providers in MWRC LGA including TAFE Western Mudgee College, MSC and Cudgegong TTC to further define available training resources and capacity.
54.	Provide information to new employees about the available health services in Mudgee and Rylstone.
55.	Through the Community Needs Assessment conduct further engagement with youth service providers in the MWRC LGA including the MWRC, Barnardos and PCYC to identify key priorities in youth service provision in Mudgee and Kandos to guide potential investment under the VPA.
56.	In consultation with key stakeholders, explore opportunities to support the attraction and retention of medical staff in the MWRC LGA.
57.	Partner with health agencies in promoting healthy lifestyles and disease prevention to the Project workforce.
58.	Provide regular information in relation to Project timing and changes in Project workforce numbers to the Western NSW LHD and Mudgee and Rylstone Health Services to assist key health service providers to plan for future growth.

Ref	Mitigation and Management Measures
59.	KEPCO will meet regularly with the Mudgee and Rylstone Health Councils and representatives of the Mudgee Health Service to remain informed of key issues in local health service delivery and potential issues directly attributed to the Project.
60.	Provide a 24 hour security service at the WAF to reduce demands on Rylstone Police and the Mudgee LAC.
61.	Engage with the NSW Police and NSW Ambulance in relation to the timing of Project induced road closures and advise of the location of any new roads to ensure minimal impact on emergency service response times.
62.	Through the VPA, provide financial support and/or in-kind support to the RFS, NSW Ambulance Service and other valued community services in the MWRC LGA where need is identified through a targeted Community Needs Assessment.
63.	Encourage employees who are residents of Bylong Valley to volunteer for the Bylong RFS Brigade. Develop employee policies that enable emergency services personnel to be released from duties to attend emergency calls and to allow release of employees to perform crucial volunteer actions outside of the Project Boundary. Indeed, Project staff and family members are already volunteering for the Bylong RFS.
64.	KEPCO will make contributions to the Westpac RHS consistent with industry practice.

Benefit Cost Analysis

BCA is the recommended method used to consider the economic efficiency of proposals by providing a comparison of the present value of aggregate benefits to society, as a result of a project, with the present value of the aggregate costs (i.e. the net benefit). Provided the present value of aggregate benefits to society exceed the present value of aggregate costs (i.e. a net present value of greater than zero), a development is considered to improve the well-being of society and hence is desirable from an economic efficiency perspective.

BCA involves the following key steps:

- Identification of the base case (or without the Project scenario);
- Identification of the Project and its implications;
- Identification and valuation of the incremental benefits and costs;
- Consolidation of value estimates using discounting to account for temporal differences;
- Application of decision criteria;
- Sensitivity testing; and
- Consideration of non-quantified benefits and costs.

A product marketability report has been prepared for the Project which estimated the price forecasts in US\$/t over the mine life. A key finding of the product marketability analysis is that global thermal coal prices are at multi-year lows due to an enduring oversupply. These price forecasts together with an AUD/USD exchange rate of 0.84 have been used in the analysis. It should be noted that recent forecasts of the AUD/USD exchange rate are around 0.72 (Westpac, 2015) and hence all other things being equal, the assumed exchange rate in this assessment will understate the revenues and hence economic benefits of the Project. Due to the uncertainty around future coal prices and the exchange rate, the assumed coal prices have been subjected to sensitivity testing as part of this assessment (see **Section 7.22.3**).

Regional and State Economic Impact Assessments

Regional impact analysis is concerned with changes in direct and indirect economic activity to a region, State, or Nation associated with changes in land and resource use. A range of methods can be used to examine the direct and indirect economic activity impacts of an expenditure on an economy. The effects of the Project on regional economic activity (or stimulus) have been predicted using IO analysis. The IO analysis provides information of interest to decision-makers, particularly regarding regional employment and other indicators of direct and indirect regional economic activity. The IO analysis involves the following steps:

- Development of an appropriate IO table (regional transaction table) that can be used to identify the economic structure of the region and multipliers for each sector of the economy; and
- Identification of the initial impact or stimulus of the Project (construction and/or operations) in a form that is compatible with the IO equations so that the input-output multipliers and flow-on effects can then be estimated (West, 1993).

The economic activity assessment (or economic stimulus) is primarily concerned with the effect of a project on an economy in terms of a number of specific indicators, such as gross regional output, value added, income and employment.

These indicators can be defined as follows:

- *Gross regional output* – the gross value of business turnover;
- *Value-added* – the difference between the gross regional output and the costs of the inputs of raw materials, components and services bought in to produce the gross regional output;
- *Income* – the wages paid to employees including imputed wages for self-employed and business owners; and
- *Employment* – the number of people employed (including full-time and part-time).

The economic activity assessment has been estimated for two economies:

- The regional economy, comprising the MWRC LGA; and
- The NSW economy.

7.22.3 Impact Assessment

Benefit Cost Analysis

The BCA prepared for the Project is provided in **Appendix AE**. The Project will have the potential incremental economic benefits and costs as illustrated in **Table 99**. The main potential economic benefit is producer surplus (net production benefits) generated by the Project and any non-market employment benefits it provides. The main potential economic costs relate to any environmental, social and cultural costs.

The BCA demonstrated that the Project will have a total net production benefit of \$807 Million (net present value), with a minimum of \$596 Million of these net production benefits accruing to Australia. The BCA compared the production costs (acquisition costs for affected land, opportunity cost of land, operating costs, decommissioning costs, etc.) and production benefits (revenues from production, residual values of land, etc.).

This total net production benefit is distributed amongst a range of stakeholders, including:

- The Commonwealth government in the form of Company tax payable (\$302 Million present value) which is subsequently used to fund provision of government infrastructure and services across Australia and NSW, including the local and regional area;

TABLE 99 Benefit Cost Analysis

	Costs	Benefits
Net Production benefits	▪ Opportunity cost of water ▪ Opportunity costs of capital equipment ▪ Opportunity costs of land ▪ Development costs including labour, capital equipment and acquisition costs for impacted properties and offsets ▪ Operating costs of mine including labour and mitigation, offsetting and compensation measures ▪ Rehabilitation and decommissioning costs at the end of Project life	▪ Value of coal ▪ Residual value of capital equipment and land at end of Project life
Potential environmental, social and cultural impacts of mining, processing and transport to port after mitigation, offsetting and compensation	▪ Subsidence impacts ▪ Agricultural production impacts¹ ▪ Noise impacts ▪ Blasting impacts ▪ Air quality impacts ▪ Greenhouse gas impacts ▪ Surface water impacts	▪ Groundwater impacts ▪ Ecology impacts ▪ Road transport impacts ▪ Aboriginal heritage impacts ▪ Historic heritage impacts ▪ Visual impacts ▪ Any non-market benefits of employment

¹ The value of foregone agricultural production is included in the value of land.

- The NSW government, via royalties (\$290 Million present value) which are subsequently used to fund provision of government infrastructure and services across the State, including the local and regional area;
- The local and regional community (\$4 Million present value) in the form of voluntary contributions to community infrastructure and services; and
- KEPCO in the form of residual net production benefits (after company tax, royalties and VPA payments).

Environmental, social and cultural impacts of the Project have generally been minimised through Project design and mitigation, offset and ameliorative measures.

The economic values of residual impacts are considered to be immaterial from an aggregated economic efficiency perspective.

The main quantifiable environmental impacts of the Project that have not already been incorporated into the estimate of net production benefits via mitigation, offset and compensation costs, relate to greenhouse gas emissions and historic heritage impacts. These impacts to Australia are estimated at \$4 Million, which are considerably less than the estimated net production benefits of the Project.

There may also be some external benefits (non-market benefits) associated with employment provided by the Project to the NSW economy which are estimated to be in the order of \$165 Million. Overall, the Project is estimated to have net production benefits to Australia of \$596 Million and hence is desirable and justified from an economic efficiency perspective.

While the main environmental, cultural and social impacts have been quantified and included in the Project BCA, any other residual environmental, cultural or social impacts that remain unquantified would need to be valued at greater than between \$592 Million and \$757 Million for the Project to be questionable from an Australian economic efficiency perspective.

A sensitivity analysis of the various assumptions used in the BCA was undertaken for Australia and NSW results by applying 20% (+ and -) changes to the following variables at a 4%, 7% and 10% discount rate:

- Opportunity costs of land and water;
- Development costs;
- Decommissioning and rehabilitation costs;
- Operating costs;
- Value of coal;
- Residual value of land;
- Greenhouse costs; and
- Historic heritage costs.

The sensitivity analysis showed that the Project will have net social benefits to Australia and NSW under each of the sensitivity testing scenarios examined.

Regional and State Economic Activity Assessment

An economic impact analysis, using IO analysis found that the operation of the Project is estimated to make up to the following average annual contribution to the regional economy for approximately 23 years:

- \$624 Million in annual direct and indirect regional output or business turnover;
- \$378 Million in annual direct and indirect regional value added;
- \$72 Million in annual direct and indirect household income; and
- 830 direct and indirect jobs.

The regional sectors are most impacted by output, value added and income flow-on that would be felt across a range of sectors in the economy. Sectors that would be impacted include the construction service sector, retail trade sector, coal mining sector, professional, scientific and technical services sector, exploration and mining support services sector, and wholesale trade sectors.

For the NSW economy, the operation of the Project is estimated to make up the following average annual contributions for 23 years:

- \$855 Million in annual direct and indirect regional output or business turnover;
- \$492 Million in annual direct and indirect regional value added;
- \$135 Million in annual direct and indirect household income; and
- 1,496 direct and indirect jobs.

While the Project would result in some displacement of agricultural activity (as discussed in **Section 7.16.4**), these economic activity impacts are estimated at between 0.5% and 5.6% of the regional economic activity impacts of the Project.

Project Cessation

Should further approvals not be sought in the future to continue mining operations, the cessation of the Project operations may lead to a reduction in economic activity in the region. The significance of these Project cessation impacts will depend on:

- The degree to which any displaced workers and their families remain within the region, even if they continue to be unemployed. This is because continued expenditure by these people in the regional economy (even at reduced levels) contributes to final demand;
- The economic structure and trends in the regional economy at the time. For example, if Project cessation takes place in a declining economy, the impacts may be felt more greatly than if it takes place in a growing and more diversified economy; and
- Whether other mining developments or other opportunities in the region arise at the time of Project cessation which allows the employment of displaced workers.

Due to the potential impacts at the cessation of the Project, it is important for decision-makers to effectively utilise the economic benefits, skills and expertise generated by the Project to further strengthen and broaden the region's economic base beyond the life of the Project.

Government Fiscal Considerations

The main fiscal benefit of the Project to the State and Commonwealth Governments include:

- \$302 Million (present value) to the Commonwealth Government in company tax;
- \$109 Million (present value) to the Commonwealth Government in personal income tax from Project employees;
- \$290 Million (present value) in royalties to the NSW Government; and
- \$21 Million (present value) in payroll tax to the NSW Government.

Additional to the benefits provided to the State and Commonwealth Governments, the Project will provide a fiscal benefit of \$4 Million (present value) to the Local Government in relation to the VPA to be entered with the MWRC.

SEPP Mining Considerations

In addition to the provisions of Section 79C of the EP&A Act, SEPP Mining identifies a number of economic heads of consideration that the decision-maker must take into account when making a determination on a mining project. These considerations include:

- Significance of the resource, in terms of:
 - (a) Size, quality and availability;
 - (b) Proximity to and access of the land to existing or proposed infrastructure;
 - (c) The relationship of the resource to any existing mine; and
 - (d) Whether other industries or projects are dependent on the development of the resource; and
- Economic benefits, including:
 - (a) Employment generation;
 - (b) Expenditure, including capital investment; and
 - (c) The payment of royalties to the State.

The Project seeks to extract approximately 124 Mt of ROM coal from a total measured, indicated and inferred coal resource of approximately 874 Mt within A287 and A342. The coal resource to be recovered by the Project is able to be mined by KEPCO in a financially viable and environmentally sound manner. The Project is a greenfield development in an area which has been recognised to contain a valuable coal resource for more than 30 years.

The Project will provide employment opportunities for a workforce of up to 800 employees during construction. During operations, the Project will provide direct employment for up to 470 workers with an average annual direct workforce of 290 over its 25 year life. It will also provide indirect employment in the regional economy from employee and Project expenditure.

The capital investment associated with the Project is estimated to be in the order of \$1.3 Billion. The Project will result in total royalties at \$763 Million, or \$290 Million present value at 7% discount rate.

The Project is located adjacent the Sandy Hollow to Gulgong Railway Line which was specifically constructed to transport coal from the region to the Port of Newcastle in the 1980s. Both the rail network and the port have also recently been upgraded in anticipation of this and other coal developments largely in Mid-Western NSW.

7.22.4 Mitigation and Management

Mitigation measures for the specific environmental issues are addressed within other sections throughout this EIS.

7.23 CONTAMINATION

7.23.1 Background

A Contamination Impact Assessment for the Project was undertaken by DLA Environmental Pty Ltd and is provided in full in **Appendix AG**. The purpose of the assessment was to identify anthropogenic contamination sources which may have caused contamination to the soils or the groundwater underlying the Project Disturbance Boundary, assess the significance of this contamination and to develop possible management and control measures to remediate any areas identified as a concern.

7.23.2 Methodology

A desktop assessment was completed to provide an understanding of the environmental setting, develop a detailed site history, potential contaminated sites and review available site information with reference to local geology and groundwater.

The desktop assessment included a detailed search and review of records and site plans available through local and State Regulatory Authorities, including WorkCover NSW, Office of Finance and Services – Land and Property Information Division and OEH. Historical aerial photographs available from the Land and Property Division's Information Centre were utilised to review the land use changes over time. A comprehensive overview of the past and current land uses and potential contamination issues was completed.

From the desktop assessment a site inspection and survey plan was developed. The site inspection included targeted soil sampling and laboratory analysis to assess residual soils identified as potentially contaminated. The assessment has been undertaken in accordance with the relevant guidelines and standards including:

- *The National Environment Protection (Assessment of Site Contamination) Measure (NEPM), National Environment Protection Council 2013;*
- *NSW EPA Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites, 2011;*
- *NSW EPA Contaminated Sites: Guidelines for the NSW Site Auditor Scheme, second edition 2006;*
- *NSW EPA Planning Guidelines SEPP 55 – Remediation of Land, 1998;*
- *NSW EPA Guidelines for Assessing Service Station Sites, 1994;*
- *The Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites, Australian and New Zealand Environment and Conservation Council and the National Health and Medical Research Council (NHMRC), January 1992; and*
- *NSW DECC Waste Classification Guidelines, 2009.*

The Contamination Impact Assessment completed for the Project also meets the requirements for a *Preliminary Investigation* in terms of that definition provided within SEPP 55 relating to the planning aspects of contamination assessments.

7.23.3 Impact Assessment

The Contamination Impact Assessment focused on six key components of the Project that occur within the Study Area. These are discussed below:

Eastern Open Cut Area

The field observations and a review of site history information identified some minor potential sources of contamination. A minor amount of hydrocarbon contamination was identified adjacent to above ground diesel storage tanks on the former agricultural properties in this area.

Asbestos was identified in existing farm buildings within the Eastern Open Cut Area in the form of internal and external wall sheeting. There was no evidence indicating contamination by heavy metals or pesticides. Soil analysis for all samples collected from the areas investigated complied with relevant statutory standards and the site acceptance criteria.

North Western OEA, South Western OEA and Western Open Cut Area

The desktop assessment did not identify any potential contamination in these areas. Minor hydrocarbon staining of surface soil was identified adjacent to above ground fuel storage tanks in this area. There was no evidence indicating contamination by heavy metals or pesticides. Asbestos is likely to occur in some of the existing buildings within the area in the form of internal and external wall sheeting. Soil analysis for all samples collected from these areas complied with relevant statutory standards and the site acceptance criteria.

Administration, Amenities and Rail Loop

The desktop assessment did not identify any potential contamination sources in the Mine Infrastructure Area. During the site assessment a gully area was noted containing general agricultural waste including old cars, trucks, machinery, batteries, used chemical drums, timber, wire and other assorted rural waste. There was no material identified within any of the waste piles containing asbestos. Minor contamination is possibly associated with this area, but could be remediated by removing the waste material and surface layer of soil to remove any minor hydrocarbon stains.

The potential for asbestos contamination within the rail corridor is low due to the small volume of trains utilising the railway line. However a set of soil samples should be collected from the existing rail corridor and analysed for asbestos prior to works commencing which may disturb the existing ballast and ground surface.

Workforce Accommodation Facility

The desktop assessment did not identify any potential contamination sources within the area proposed for the WAF. However asbestos may be present in some of the existing buildings within the area in the form of internal and external wall sheeting.

Remaining areas within Study Area

The remaining land within the Study Area consists of land utilised for rural production and areas of open woodland.

There is a service station located within the Bylong township general store. The facility includes underground storage tanks and an above ground storage tank for Diesel and Unleaded Petrol.

Groundwater monitoring wells have been previously installed by others to monitor the quality of the groundwater and identify any hydrocarbon contamination from the underground storage tanks. There are no known records of contamination at the Service Station in Bylong.

There is a quarry located on the Bylong Valley Way which may include a diesel storage tank. There is also a council run waste transfer station located on the eastern side of the Study Area. Waste is collected by the council for transport to a waste facility outside the Study Area and therefore no refuse is left onsite. It was determined that the local quarry and Council waste transfer station were unlikely to have any contamination implications for the Project.

Groundwater

Based on the onsite observations, soil and water sampling, the likelihood of groundwater contamination is considered to be very low across the Study Area. The detected low levels of contaminants in the soil coupled with the lack of hydraulic conductivity have greatly reduced the risk of any impacts on groundwater quality. Based on the lack of potential sources of contamination materials in the Study Area, no further groundwater investigation for potential contamination is warranted.

Conclusion

The Contamination Impact Assessment has not identified any evidence to infer contamination by heavy metals, pesticides or asbestos (other than bonded and within existing dwellings) at the Site. There were no offsite influences identified as having the potential to impact the suitability of the Site or future occupants of the land.

7.23.4 Mitigation and Management

The following preventative measures will be undertaken:

- Remove the minor volumes of contaminated soil identified as occurring within the Study Area;
- Prior to undertaking any demolition or refurbishment of existing structures, complete a Hazardous Materials Survey to determine if asbestos is present and if so how this should be managed to ensure no risk to human health or the environment;
- Collect a set of soil samples from the existing rail corridor and analyse these for asbestos prior to works commencing which may disturb the existing ballast and ground surface;
- Remove batteries and general agricultural waste from the gully located within the proposed Administration, Amenities and Rail Loop area;
- Establish the necessary environmental safeguards and procedures to prevent or minimise unacceptable risk to human health and the environment prior to the completion of the above required remediation works; and
- Establish operational policies and procedures for the storage, handling and transport of potentially contaminating materials required for the construction and operational phases of the Project.

7.24 PRELIMINARY HAZARD ANALYSIS

7.24.1 Introduction

A PHA for the Project is provided in the following sections. This study aimed to identify any potential hazards associated with the Project, assess the significance of each and develop possible management and control procedures as specified in the relevant legislation.

This assessment was undertaken in accordance with *SEPP 33 – Hazardous and Offensive Development Application Guidelines* (DUAP, 1994). The *Hazardous Industry Planning Advisory Papers* (HIPAPs) developed under SEPP 33 were also considered throughout the assessment. HIPAPs of particular relevance to the Project hazard assessment included the:

- 'Hazardous Industry Planning Advisory Paper No 3 – Risk Assessment' (DOP 2011a);
- 'Hazardous Industry Planning Advisory Paper No 4 – Risk Criteria for Land Use Planning' (DOP, 2011b); and
- 'Hazardous Industry Planning Advisory Paper No. 6 – Guidelines for Hazard Analysis' (DOP, 2011c).

7.24.2 Methodology

The Preliminary Hazards Analysis required the key components of the Project to be reviewed against the threshold values and screening procedure required under SEPP 33 and HIPAPs. The methodology applied as per the HIPAPs included:

- Identification of potentially hazardous materials and events associated with the Project;
- Examine the potential consequences of identified hazards;
- Qualitatively estimate the likelihood of Project hazards occurring;
- Examine any proposed mitigation measures;
- Qualitatively assess the risks to the environment, safety of members of the public and their property arising from sudden and unexpected incidents and compare these to the applicable qualitative criteria. Specifically considering location, land use planning implications and existing infrastructure;
- Develop any further risk mitigation, management or remedial measures as required for the Project in consideration of the relevance and adequacy of proposed safeguards; and

- Determine the acceptability and level of risk associated with the Project to allow industry classification and the implementation of appropriate management procedures.

7.24.3 Impact Assessment

Potentially Hazardous Materials

The key hazardous materials required for the Project include explosives, hydrocarbons and other hazardous chemicals. The key hazardous chemicals likely to be utilised for the Project include (but are not limited to): fuels such as diesel and petrol, degreaser, kerosene, oils, greases and explosive materials. Hazardous materials and storage volumes anticipated for the Project are summarised in **Table 100**.

Explosives

The Project will require the use of explosives and other related materials to support open cut and underground mining operations (as discussed in **Section 3.3.1**). Within the open cut mining areas, the hard rock overburden material will require blasting. Certain thicker sections of the coal resource within the open cut mining areas will also require blasting. Some blasting may be undertaken for the Project associated with construction of the rail loop and the underground entries and initial pit bottom service areas. Blasting may also be undertaken infrequently should any unexpected rock intrusions in the coal seams be encountered during mining operations. The key potential hazards associated with explosives include onsite storage locations, proximity to fuel and workshop and possible explosions as a result of mixed materials.

As described in **Section 3.6.2**, the explosives storage facility will be located adjacent to the haul road approximately 1 km from the Open Cut MIA as shown on **Figure 18**.

This proposed location is greater than the minimum offset distance of 500 m from the Open Cut MIA, current and proposed public roads and private dwellings as required by the relevant Australian Standards. A storage and reload facility will be located approximately 400 m from the explosives storage facility for the handling and management of materials in preparation for blasting events. The explosives storage facility will have sufficient capacity to meet the blasting needs for the open cut and underground mining activities for the Project.

Potential hazards to the surrounding environment during the transport, storage and use of explosives for the Project will be managed in accordance with *AS 2187.1 – 1998: Explosives – Storage, Transport and Use – Storage, the Code of Practice – Precursors for Explosives* (AEISG, 1999) and the relevant management plans and procedures.

TABLE 100 Indicative Hazardous Materials and Storage Volumes

Storage Location	Material	Quantity	Description	Capacity
Temporary Construction Facilities	Diesel fuel	1	Tank	75,000 L
	Lubricant	10	Intermediate Bulk Containers	1,000 L
Open Cut Mine Infrastructure Area	Diesel fuel	2	Tank	95,000 L
	Lubricant	25	Intermediate Bulk Containers	1,000 L
Underground Mine Infrastructure Area and CHPP	Diesel fuel	2	Tank	75,000 L
	Lubricant and coolant	36	Intermediate Bulk Containers	1,000 L
	Longwall hydraulic fluid	1	Tank	30,000 L
		1	Tank	50,000 L
	Emulsion facility	2	Tank	28,000 L
Explosives Storage Facility	ANFO	2	Silo	20,000 L
	Emulsion	2	Tank	30,000 L
	Diesel	2	Tank	75,000 L

The explosives storage facility will be securely fenced and enclosed by a vegetated earthen safety bund. The products at these facilities will be stored and handled in accordance with 'AS2187.2-2006 – Explosives – Storage, Transport and Use, Part 2: Use of Explosives'.

KEPCO will obtain the relevant licences to store explosives and associated materials, issued under the OH&S Act for the explosive storage facility.

Fuels

Fuel and lubricant storage facilities will generally be located in the Open Cut and Underground MIAs and the in-pit facilities adjacent to the Eastern Open Cut. The fuel and lubricant storage facility in the Open Cut MIA will be constructed adjacent to the main access road, adjacent to the heavy vehicle hardstand. Light vehicles will be able to refuel from a station located on the opposite side of the access road to the fuel and lubricant storage facility located adjacent the hardstand in the Open Cut MIA. The main refuelling of heavy vehicles will occur at the in-pit facilities located on the western side of the Eastern Open Cut.

The fuel and lubricant storage facility in the Underground MIA will provide fuel to machinery and equipment used in the underground mining operations and activities at the CHPP.

Fuels, lubricants, coolants and waste materials at all locations will be held in self-bunded storage tanks in accordance with the relevant Australian Standards, including (although not limited to) NSW OH&S regulations and 'AS 1940 - 2004 The Storage and Handling of Flammable and Combustible Liquids'.

Diesel is a combustible liquid as classified by 'AS 1940 – 2004: The Storage and Handling of Flammable and Combustible Liquids' (Class C1) for the purposes of storage and handling. However, this hazardous material is not classified as a dangerous good under the 'Australian Code for the Transport of Dangerous Goods by Road and Rail' (National Transport Commission, 2007). The Project will store diesel in above ground class C1 storage tanks as outlined in **Table 100**.

For heavy vehicles and equipment that will not be regularly transported back to the Open Cut MIA, refuelling will be undertaken at the in-pit facilities.

Petrol is classified as a flammable liquid (Class 3) by 'AS 1940 - 2004 *The Storage and Handling of Flammable and Combustible Liquids*' and as such is classified as a dangerous good by the criteria of the '*Australian Code for the Transport of Dangerous Goods by Road and Rail*' (National Transport Commission, 2007). Only very small volumes of petrol will be required for Project related activities such as some site maintenance equipment (i.e. light vehicles and mowers) and in workshop areas.

Longwall Hydraulic Fluid

To provide an adequate supply of longwall hydraulic fluid for the underground mining operations, two surface tanks will be constructed in the Underground MIA.

One tank will contain longwall hydraulic fluid concentrate while the second will contain a diluted mixture with 98% water. Longwall hydraulic fluid will be premixed in the above ground tanks at the Underground MIA and then delivered to the longwall hydraulic tanks in the underground mine workings for the operation of the longwall face. The longwall hydraulic fluid will be stored in self bunded tanks at the Underground MIA and managed in accordance with relevant site procedures and Australian Standards.

Other Hazardous Materials

Any other smaller volumes of potentially hazardous materials required for the Project will be stored within designated locations in infrastructure areas in accordance with relevant Australian Standards and Guidelines. Substances will be stored onsite in above ground facilities in the Open Cut MIA and/or Underground MIA, at a suitable distance from diesel or explosive storage areas to minimise any potential risks. These substances will be located in a bunded area in accordance with the NSW OH&S Regulations, which will minimise the risk and consequence should a fire or explosion occur and prevent any toxic contamination of the surrounding environment.

Potentially Hazardous Activities

The key potentially hazardous activities associated with the Project include:

- Storage of potentially hazardous materials onsite;
- Transportation of materials including onsite and offsite handling;
- Spill, leakage or runoff causing land contamination; and
- Natural events.

Storage

The explosive storage facility will be surrounded by a 2.45 m high man-proof fence, including barbed wire extension and security gates. The explosives storage facility will also have CCTV monitoring installed. Explosive accessories such as detonating cords and boosters will be secured in an explosives magazine. KEPCO will obtain a '*Licence to Store*' for the storage of detonators, boosters, detonating cord and primers.

KEPCO will also obtain an Acknowledgement of Notification of Dangerous Goods on Premises from WorkCover for the storage of liquid fuels and gases.

Transport

All bulk materials will be transported to and from the Project by a licensed contractor in accordance with the relevant contractor's transport codes and standards and site operation procedures. The vehicles used for the transport of hazardous substances will be required to have appropriate signage displayed in accordance with the '*Australian Code for the Transport of Dangerous Goods by Road and Rail*' (ADG Code) (National Transport Commission, 2007), the '*Australian Code for the Transport of Explosives by Road and Rail 3rd Edition*' (Workplace Relations Ministers' Council, 2009) and relevant NSW legislation.

Spills / Leakage and Contaminated Runoff

Any hazardous material releases will be managed in accordance with KEPCO emergency response procedures and Pollution Incident Response Management Plan as required under the POEO Act. These procedures will provide specific handling techniques and storage requirements which will be implemented to prevent spills and leakages from occurring and ensure that prompt and effective clean-up practices are employed should any spills or other environmental contamination event occur.

Emergency response procedures will incorporate regular training and the implementation of best practice management, mitigation and response procedures for hazardous materials.

Emergency Oil Spill Response Kits will be readily available, particularly in areas where work involving activities require the use of hydrocarbons.

Natural Events

Natural events such as floods, bushfires and landslides can also create hazardous conditions. The Project has been designed to minimise any impacts from severe weather and or other natural events.

The Project is located in an area with no recorded history of landslides and exhibits no evidence of instability. Slope angles and shapes are negligible across the area within the Project Boundary. On this basis the geological and geomorphological conditions indicate negligible risk of landslide occurrence. Infrastructure has been located outside of flood zones, away from possible cliff fall areas and high risk fire areas.

The potential risk of fires will be managed in accordance with a Bushfire Management Plan in consultation with the local bush fire brigade and other relevant regulatory authority. KEPCO will install and maintain fire control infrastructure, with firefighting equipment at key points and will have an in-house emergency team in place to respond in the event of a bushfire.

Risk Assessment Summary

A number of potential hazards have been identified for the Project. The potential hazards identified and adequacies of the proposed safeguards for each have been considered to assess the risks to the environment and public safety.

A hazards risk assessment has been undertaken for the Project. The high level hazards assessment has considered:

- The level of risk associated with the identified potential hazards and hazardous activities;
- A consequence analysis; and
- An estimated likelihood of occurrence.

The qualitative risk assessment has identified potential hazards associated with the Project and ensures that adequate risk mitigation and response measures have been considered and will be implemented for each.

The high level assessment has confirmed that the use of hazardous materials for the Project is consistent with other open cut and underground coal mining operations currently operating in NSW and will not impose any unacceptable level of risk to the environment or public. A summary of the Project hazard and risk assessment is provided in **Table 101**.

7.24.4 Mitigation and Management

The Project is not considered hazardous or offensive and no offsite impacts are predicted. Management procedures will be implemented to ensure that all potential hazards are avoided or minimised and their likelihood of occurrence decreased by ensuring compliance with relevant legislation, regulations and guidelines.

The hazard management measures for the Project are summarised below:

- A Hazard Management Plan will be developed to support an application for a notification from WorkCover for the Project. This will outline procedures for the transport and storage of hazardous substances, management of storage locations for the Project and detailed response procedures should an event such as fire, explosion or spill occur;
- A database will be maintained to assist in the recording and management of chemicals and other hazardous materials stored onsite. This chemical management system will contain a Material Safety Data Sheet for all chemicals used onsite;
- All hazardous materials associated with the Project will be transported by a licensed contractor in accordance with the relevant Australian Standards and legislation;
- Storage facilities, vehicles and transport vessels will be regularly inspected for leaks, spills and other damage or faults;
- All storage facilities for explosives, diesel, oil and other hazardous materials identified will be designed in accordance with applicable Australian Standards to minimise potential for any offsite impacts, toxic contamination of the surrounding area and minimise the severity of an incident in the case of fire, explosion or hazardous substance spills;
- Explosive storage facilities will be located a minimum of 500 m from private roads, receivers or site facilities;
- Storage areas will be located at a sufficient distance from the Project Boundary to ensure there will be no offsite impacts; and
- All explosives will be stored in a purpose built magazine, built and maintained to appropriate standards.

Additionally, a Bushfire Management Plan will be developed incorporating a range of management techniques including firebreaks, fuel reduction, firefighting access and sufficient water supply.

TABLE 101 Project Hazards and Risk Assessment Summary

Hazard	Event	Likelihood of Hazardous Incident	Analysis of Consequences	Risk Analysis
Fuel and Lubricant Storage Facilities	Leak / Spill	Possible	Minor	Moderate
Explosives Storage Facility	Explosion	Remote	Moderate	Moderate
	Theft	Remote	Major	Significant
Workshop Storage Areas	Fire	Remote	Moderate	Moderate
	Theft	Remote	Major	Moderate
Transport Hazardous Materials	Explosion	Remote	Moderate	Moderate
	Fire	Remote	Moderate	Moderate
	Leak / Spill	Probable	Moderate	Significant
	Theft	Remote	Major	Moderate
Project Operations	Spill / Leak	Probable	Minor	Significant
	Fire	Remote	Moderate	Moderate
	Explosion	Remote	Major	Significant

7.25 WASTE MANAGEMENT

7.25.1 Background

Waste will be managed in accordance with the objectives of the *Waste Avoidance and Resource Recovery Act 2001* and the POEO Act along with other relevant legislative requirements including the *Waste Classification Guidelines* (DECCW, 2008). Waste streams that are likely to be generated for the Project will include general waste, hazardous waste and sewage.

7.25.2 Impact Assessment

As required under the POEO Act, waste will be monitored, removed, tracked and reported on a regular basis. Activities associated with the Project will generate a range of wastes which will require management.

A key objective of the waste management system for the Project will be to encourage reuse and recycling of waste materials. In order to meet this objective, waste material will be separated into several streams and deposited in the appropriate receptacle for reuse, recycling or disposal. Likely predicted waste streams associated with the Project are described in the following sections.

General Waste

Scrap metal, batteries, empty drums, wooden pallets, timber, green waste and mixed recyclables (including paper cardboard, glass and aluminium cans) are typical of the general waste that will be generated by the Project. Each waste material will be separated into the appropriate receptacle for reuse, recycling or disposal. The Project is anticipated to generate approximately 300 t of domestic waste that is no longer usable or recyclable annually. MWRC has confirmed it will accept general waste from the Project.

Hazardous Waste

The handling and management of hazardous wastes generated by the Project will be conducted in accordance with the *Waste Classification Guidelines* (DECCW, 2008) and the ADG Code (National Transport Commission, 2007).

Contaminated materials generated at the workshop and vehicle wash down bay, such as grease and oil, will be held in storage tanks within a bunded area prior to removal from site by an independent waste contractor for treatment or disposal.

On average, the Project is anticipated to generate approximately 4 ML of waste grease and oil annually. Any spills that occur in the collection areas will be contained within bunds and managed in accordance with pollution control systems. This waste will be collected by a licensed hydrocarbon facility operator. Surface runoff from industrial areas, which may contain high levels of suspended sediment, detergents, oil and other chemicals, will be captured in sediment dams and treated prior to being reused in the water management system.

Sewage

Sewage will be managed via onsite sewerage treatment facilities at the Open Cut MIA, Underground MIA and WAF. The treated effluent will be utilised as irrigation water supply for rehabilitation in accordance with *Environmental Guideline for the Use of Effluent by Irrigation* (DEC, 2003), reused within the mine water management system or removed from site regularly by a licensed contractor. The Project is anticipated to generate approximately 24 ML of sewage annually during dual operations.

Coarse and Fine Rejects Materials

Coarse and fine rejects materials will be produced as a by-product of the coal preparation process. Coarse and fine reject materials will be co-disposed with overburden within the OEAs and where necessary capped with inert material. The Project is anticipated to generate up to 14 Mlcm of coarse and fine reject materials during the life of the Project. Further details regarding coarse and fine reject materials disposal are outlined in **Section 3.5.4**.

7.25.3 Mitigation and Management

As part of the EMS, KEPCO will develop a Waste Management Plan. The following measures will be implemented to manage and minimise the production of waste:

- Each major waste stream, where practicable, will be segregated in the appropriate receptacles for recycling, reuse and/or disposal;
- Waste will be classified and managed as recommended by relevant legislation, with all handling of waste and hazardous materials conducted by suitably qualified personnel;
- Training will be provided to personnel to improve efficiency in the minimisation of waste streams, reuse and recycling options and management strategies for each major waste stream relevant to key work areas;
- An independent waste contractor working within the provisions of the POEO Act will remove and report on wastes; and
- Regular inspections and monitoring will be conducted by qualified personnel to ensure adequate maintenance and operation of the waste facilities and to ensure management practices are sufficient to manage any waste products.



8

Management and Monitoring Summary

Management and Monitoring Summary

This section provides a summary of the proposed management and monitoring measures to be implemented to manage the potential environmental and social impacts of the Project as discussed in **Section 7**.

In addition to the conditions that may be attached to any development consent granted for the Project, KEPCO will use its best endeavours to realise the implementation of the operational controls outlined in **Section 7** for all activities associated with the Project.

Table 102 summarises the major aspects of the Project and the key management and monitoring measures proposed in this EIS.

TABLE 102 Summary of Management and Monitoring Measures

Ref.	Item	Section
MINING OPERATIONS		
1.	Coal will be extracted via open cut and underground mining methods at a combined rate of up to 6.5 Mtpa of ROM coal for 23 years, following an initial construction period of 2 years, generally in accordance with this EIS.	3
2.	Prior to carrying out any development that requires a licence or approval listed in Table 12 , KEPCO will ensure that all such approvals and licences are obtained.	4.1
ENVIRONMENTAL MANAGEMENT		
3.	An EMS will be developed in consultation with the relevant regulators and to the satisfaction of DP&E. The EMS will indicatively include the following: - Construction Environmental Management Plan; - Construction Traffic Management Plan; - Extraction Plans, including Property Subsidence Management Plans; - Biodiversity Management Plan; - Biodiversity Offsets Management Plan; - Water Management Plan (including Erosion and Sediment Control Management Plan); - Air Quality Management Plan; - Energy and Greenhouse Gas Management Plan; - Noise Management Plan; - Blast Management Plan; - Aboriginal Archaeology and Cultural Heritage Management Plan; - Historic Heritage Management Plan; - Burials Management Plan; - Soil Resource Management Plan; - Rehabilitation Strategy; - Farm Management Plan; - Mining Waste Management Plan (including Spontaneous Combustion Monitoring and Management); - Social Impact Management Plan; - Hazard Management Plan; - Bushfire Management Plan; and - Waste Management Plan. The EMS documentation as described in the above list may be added to, amended and/or altered during the life of the Project in consultation with the relevant authorities.	7

Ref.	Item	Section
SUBSIDENCE		
4.	An Extraction Plan will be prepared which will include appropriate TARPs to respond to impacts as they arise from underground mining and to enable adaptive management to occur throughout the life of the Project.	7.1.4
5.	The Extraction Plan will include Property Subsidence Management Plans for individual properties (or features) which will be developed in consultation with owners of properties or infrastructure that have the potential to be impacted by subsidence. The Property Subsidence Management Plans will include the following: ▪ A description of the structures or assets on the property, including description of their methods of construction; ▪ Predicted impacts to the structures or assets; ▪ A risk assessment for each structure or asset prior to mining, to forecast and prevent any hazards that may arise prior to mining; ▪ A protocol for monitoring of subsidence effects and environmental consequences during mining; ▪ A protocol for regular inspections of structures that are considered to be at risk; ▪ A monitoring program to measure subsidence effects and identify environmental consequences; ▪ Management plans addressing predicted impacts to all natural and built features; and ▪ Measures for mitigating or remediation of adverse consequences.	7.1.4
ECOLOGY		
6.	The BOS outlined in this EIS will be implemented for the purposes of maintaining and ultimately improving the ecological values of the region.	7.3.5
7.	In accordance with the Biodiversity Management Plan, the mitigation and management measures as outlined in this EIS will be implemented, including: ▪ Dust minimisation to reduce the indirect impacts on vegetation condition and the habitat quality for all native species; ▪ Noise (and blasting) minimisation to reduce the potential for disturbance of animals in habitat patches around the Project; ▪ Visual and lighting management to reduce the potential for disturbance of nocturnal animals via night light emissions around the Project; ▪ A Land Disturbance Protocol which will include pre-clearing monitoring and/or survey for proposed disturbance areas to limit vegetation and habitat loss as far as practical and ensure safe removal of fauna as required prior to any disturbance occurring; ▪ Removal (and relocation where practicable) of key habitat features such as tree hollows from the Project Disturbance Boundary; ▪ Progressive rehabilitation of disturbed areas; ▪ Implementing a monitoring program and appropriate reference sites; and ▪ Aquatic mitigation measures relating to ground movements and management of surface water, erosion and sedimentation.	7.2.5
WATER		
8.	An expanded surface water monitoring program will be developed to include samples from key storages within the water management system, such as sediment dams and the primary mine water storages.	7.4.4
9.	Monitoring of water quality at upstream, onsite and downstream locations to assist in demonstrating that the site water management system is effective in meeting its objective of minimal impact on receiving water quality. This system will be designed to facilitate the early detection of any impacts and appropriate corrective action.	7.4.4

Ref.	Item	Section
10.	Regular monitoring and/or inspections of the site water management system will be undertaken, in particular, sediment control infrastructure following more than 25 mm of rainfall in 24 hours.	7.4.4
11.	Daily rainfall and dam volumes will be recorded at site to assist in identifying significant rainfall events.	7.4.4
12.	The Water Management Plan will describe a waterway management program which will include inspection of the Bylong River and Lee Creek floodplains at proposed road crossings and the overland conveyor embankment following any significant river flow event to assess impacts, if any, on bed and bank stability and riparian vegetation.	7.4.4
13.	Regular visual inspections and comparative ground level survey will be undertaken during the period of underground mining beneath the catchment to identify changes in surface levels and erosion within Dry Creek and its tributaries. Targeted management actions will be developed to respond to observed impacts and minimise surface disturbance. Potential mitigation measures could include: - Sealing of any observable bed cracking along watercourses by filling and compaction with suitable material followed by revegetation; - Draining of any new ponded areas caused by subsidence to minimise additional water capture, if required; and - Implementation of in-stream bed controls, such as rock rip-rap or large woody debris, in locations where increased bed gradients result in observable change in geomorphic characteristics.	7.4.4
14.	Revegetation of areas of the Dry Creek riparian corridor affected by subsidence related impacts will be undertaken in consultation with the HLLS, with a focus on rehabilitation of the stream bed and embankments to a condition equivalent to or better than existing using soft engineering techniques, where possible.	7.4.4
15.	Detailed design of the haul road crossings and overland conveyor embankment will consider minimising the predicted flooding impacts.	7.4.4
16.	Mitigation works within the Dry Creek tributary will be undertaken prior to subsiding the relevant section of the landform to reduce the potential for breakouts of flow from the current flow path.	7.4.4
17.	Groundwater depths and pressures will continue to be monitored on a monthly basis and water quality on a quarterly basis in accordance with the Water Management Plan.	7.6.4
18.	Additional groundwater monitoring bores will be installed (where required) within the predicted zone of depressurisation to monitor the regional groundwater regime and to provide for comparison against the modelling predictions.	7.6.4
19.	Yearly audits will be conducted of the performance of the groundwater monitoring network as part of the Annual Review.	7.6.4
20.	Mine water seepage will be monitored, particularly to identify seepage rates and quality. The seepage monitoring program will be described within the Water Management Plan.	7.6.4
21.	A testing program will be undertaken on the alluvial aquifer prior to the construction of the Project borefield to determine an optimal design that will minimise impacts on the aquifers and streams. This testing program will likely include test pumping bores and modelling to optimise the bore locations.	7.6.4
22.	Should monitoring indicate the changes in groundwater levels and quality, and surface water flow and quality are more extensive or significant than predicted, mitigation measures will be implemented.	7.6.4
23.	The Erosion and Sediment Control Plan will incorporate control measures to separate runoff from disturbed and undisturbed areas and to treat runoff from disturbed areas.	7.4.4
24.	The rehabilitated OEAs will include the relevant sediment and erosion controls to maintain the water quality of the existing environment.	7.4.4

Ref.	Item	Section
AIR QUALITY AND GREENHOUSE GAS		
25.	As part of the Construction Environmental Management Plan, a number of measures will be adopted to manage its activities to minimise dust emissions during the construction phase, including (but not limited to): ▪ The modification of working practices to limit excavation during periods of high winds, as required; ▪ Limiting the extent of clearing of vegetation and topsoil to the designated footprint required for construction activities and to stage any clearing to minimise the total exposed area at any one time, where possible; ▪ Progressive rehabilitation of any exposed areas no longer required following the completion of construction works; ▪ Use of water carts on exposed surfaces and haulage routes, particularly during unfavourable weather conditions; ▪ Operation of equipment on designated areas and routes only, with speed limits enforced as necessary to reduce road generated dust emissions; and ▪ Clearing of dirt / dust tracked onto sealed roads / surfaces as soon as practicable.	7.7.4
26.	In accordance with the Air Quality Management Plan, the following air quality controls or similar controls will be implemented: ▪ Use of speed control signage, water carts and/or suppressants to control emissions from haul roads and other trafficked areas; ▪ Adoption of the largest truck size practicable within the constraints of the active mining areas of the conceptual mine plans; ▪ Minimisation, to the extent practicable, the drop heights from equipment associated with loading and dumping operations for coal and overburden; ▪ Minimisation of areas disturbed at any one time, with progressive rehabilitation (and temporary rehabilitation) undertaken following the completion of mining to reduce total exposed areas; ▪ Modification / cessation of mining operations in areas of the site during adverse / unfavourable weather conditions where visible dust is leaving the site; ▪ Delay of blasts in unfavourable weather conditions to avoid potential for elevated dust and blast fume emissions; ▪ Enclosure of conveyors and transfers points, where operationally practicable and safe to do so; ▪ Use of water sprays / injection during drilling activities; ▪ Use of water sprays on coal stockpiles; ▪ Design and construction of a partially enclosed ROM coal transport system; ▪ Profiling and orientation of coal stockpiles along prevailing wind axis; and ▪ Profiling of train loading and water sprays to minimise dust emissions.	7.7.4
27.	A real-time dust monitoring and management system, including a predictive meteorological forecasting system will be installed to manage operations.	7.7.4
28.	The existing monitoring network will be reviewed and updated to facilitate determination of compliance with relevant air quality criteria at representative private receivers.	7.7.4
29.	The following measures will be incorporated into the Blast Management Plan to minimise or avoid imperfect blasts in accordance with <i>Code of Good Practice: Prevention and Management of Blast Generated NOx Gases in Surface Blasting</i> (AEISG, 2011): ▪ Formulation of appropriate explosive products to reduce the likelihood of fumes; ▪ Reviewing geological conditions in the development of blast designs; ▪ Reviewing ground conditions (e.g. presence of clay or loose / broken ground); ▪ Minimising the time between drilling and loading, and loading and firing of the blast; and ▪ Reviewing forecast meteorological conditions during blast planning, to avoid blasting in unfavourable conditions, where practical.	7.7.4

Ref.	Item	Section
30.	Where considered feasible and practicable, the following greenhouse gas mitigation strategies will be implemented: ▪ Consideration of energy efficiency in the mine planning process (i.e. minimising haul distances, fuel usage); ▪ Investigation of options for capture and treatment of fugitive methane emissions from underground mine ventilation; ▪ Sealing of underground mining panels to reduce methane emissions from the goaf; ▪ Use of ventilation control devices in sections of the mine not in active use enabling them not to be ventilated (unless required for safety purposes), thereby reducing fugitive emissions; ▪ Use of real-time gas (methane and carbon dioxide), temperature, pressure and associated volumetric flow monitoring at the ventilation shaft site to allow accurate measurement of ventilation (including methane and carbon dioxide) emissions, which will then allow further feasibility assessment of potential reuse options; ▪ Ensure maintenance, calibration and record keeping is undertaken on the main ventilation shaft and fans to allow for the calculation of greenhouse gas emissions; and ▪ Maintain records for monthly electricity and diesel use and monthly ROM coal production to allow for the calculation of greenhouse gas emissions.	7.8.4
NOISE		
31.	A Construction Noise and Vibration Management Plan will be developed for the Project construction phase which will consider the following controls for construction activities: ▪ Mitigation of specific noise sources or operational areas using portable temporary screens, where possible; ▪ Maximising the offset distance between noisy plant items and sensitive receivers and orienting equipment away from sensitive receivers; ▪ Using noise source controls, such as the use of residential class mufflers, to reduce noise from all plant and equipment including cranes, excavators and trucks; ▪ Using lower powered or reduced size equipment, where practical; ▪ Using spotters, smart or broadband reversing alarms in place of traditional tonal reversing alarms; ▪ Operating machinery in a manner which reduces maximum noise level events including excavators and dozers; and ▪ Turning off machinery when not in use.	7.9.4
32.	The following noise controls will be implemented to the Project: ▪ Fitting fixed and mobile plant with noise attenuation and suppression to achieve the sound power levels as identified within this EIS; ▪ Periodic noise monitoring to ensure that mobile plant continues to operate at the specified and modelled sound power levels; ▪ Regular maintenance of plant and equipment as required to ensure noise controls are working effectively; ▪ Operational responses to limit noise generating activities in potentially sensitive areas or under adverse weather conditions, particularly for the North Western OEA during PY 3; ▪ Education of staff and contractors with regard to noise management as part of training and induction programs. This will include training in good practice protocols identified for the operation of machinery to minimise potential noise events, including: – Haul trucks; – Dozers; – Extraction of waste and coal from open cut mining areas; – OEAs; – Operation of the CHPP, conveyors, rail loader, stockpiles, ROM pad and crusher; – Operation of trains on the rail loop; and ▪ Operational planning to take into account potential for adverse noise impacts under certain meteorological conditions.	7.9.4

Ref.	Item	Section
33.	Consultation will continue to occur with ARTC in regard to the proposed rail movements for the Project, the status of their Pollution Reduction Program and the implementation of leading practice noise control measures.	7.9.4
34.	A real-time noise monitoring network will be developed to be representative of the closest private receivers, and will include: ▪ A weather prediction system to identify potentially noise enhancing weather conditions up to 24 hours in advance; ▪ A noise prediction system informed by a weather prediction system to provide advanced warning of enhancing conditions to allow operational responses to be put in place; ▪ Real-time noise monitors representative of private receivers will be put in place to enable ongoing noise management. Data from the real-time noise monitors will be transmitted to an onsite office or control room for use as a noise management tool; ▪ A TARP will also be developed and implemented as part of the noise monitoring program to allow the proactive management of noise impacts and guide any actions required to minimise Project noise. Such responses may include modifying or ceasing operations under certain conditions or times of the day, or preferentially using equipment in specific areas; ▪ Quarterly operator attended noise monitoring will occur at a minimum of four locations during normal mining operations to confirm Project noise levels. The monitoring locations will vary from time to time as the mine progresses and will be reviewed annually; ▪ Noise surveys will include two non-consecutive 15 minute noise measurements, and associated observations to identify and quantify dominant sources of noise during the day, evening and night at each location; and ▪ Results from real-time noise monitoring and quarterly noise surveys will be reported annually in the Annual Review.	7.9.4
35.	A Noise Management Plan will be developed for the Project, which will include all operational noise management strategies and responses required to minimise noise from mining operations. The document will include: ▪ A description of all reasonable and feasible noise controls adopted to minimise Project noise impacts, as described above. This will include a summary of specific equipment attenuation commitments, operational controls and mine plan design; ▪ Management measures for the Project meteorological and noise monitoring program and a summary of responses to minimise noise impacts; ▪ Procedures for investigating noise monitoring results to confirm compliance with relevant impact criteria, if required; and ▪ Noise incident, complaint and reporting protocols for regulatory agencies and the local community. The Noise Management Plan will be reviewed on a regular basis to ensure that the document incorporates any additional noise management measures put in place onsite over the life of the Project.	7.9.4
BLASTING		
36.	A Blast Management Plan will be prepared for the Project and include the following management measures: ▪ Restriction of blast events to occur outside of adverse weather conditions, where possible; ▪ Commitment to complete dilapidation / condition surveys of private residences (on request), sensitive heritage sites, rock features and sensitive infrastructure prior to Project blasting. This will be undertaken to establish a baseline condition level and procedures for regular follow-up surveys; ▪ Undertaking smaller 'trial blasts' to assist in the development of site specific "site laws" with regard to protecting sensitive features for the Project; ▪ Protocols for complaints response, property inspections and investigation; and ▪ Protocols for road closures, community consultation and the establishment of blast exclusion zones of at least 500 m from public roads and property.	7.10.4

Ref.	Item	Section
37.	A Blast Monitoring Program will be developed for the Project which will include: - Detail on required blast monitoring procedures, including the use of a predictive meteorological element to guide the timing and design of blast events; - Ongoing monitoring of overpressure and ground vibration at representative private receivers and sensitive sites (including heritage items) to ensure compliance with the relevant blast impact criteria; - Procedure for the review of blast fume generation; and - Regular review of blast design and recording of blast performance under different operational parameters to minimise blast impacts.	7.10.4
ABORIGINAL ARCHAEOLOGY AND CULTURAL HERITAGE		
38.	An AACHMP will be developed in consultation with RAPs, OEH and DP&E. The AACHMP will include: - Detailed pre-mining and post-mining mitigation strategies for all Aboriginal archaeological sites and cultural features; - A detailed research design for salvage methodologies; - Detailed salvage methodologies to be carried out, including: - Surface collection of select archaeological sites; - Combined surface collection and excavation of select archaeological sites; - Detailed management strategy for items identified to be impacted by subsidence inclusive of: - Full archival recording; - Engineering solutions to prevent rock fall and cracking if impact is unavoidable at the identified ochre quarry; - Regular inspection schedule; - Specific mitigation and management measures will be developed to minimise any impacts on the ochre quarry (OQ01). These management and mitigation measures will include reasonable and feasible actions to reduce the potential for rockfalls or cracking of this site. Prior to the commencement of any works or actions that have the potential to impact OQ01, an archival recording and site specific management plan will be prepared; - A staged Aboriginal heritage clearance process for all areas to be disturbed; - Provision for all archaeological salvage work to be undertaken by, or under the supervision of qualified archaeologists and RAPs; - Protection and conservation of archaeological sites that are not impacted by the Project by means of fencing and signage; - Identification of the storage location (keeping place) and procedure for the care of salvaged artefacts in accordance with the <i>Code of Practice for Archaeological Investigation for Aboriginal Objects in New South Wales</i> (DECCW, 2010); - Provision for modified trees to be removed in consultation with RAPs and a qualified arborist; - Provision for the discovery of human remains; - Provisions to facilitate continuing access to non-salvaged Aboriginal archaeological sites within and outside of the Disturbance Boundary for archaeological research purposes; and - Periodic review of the Aboriginal Archaeology and Cultural Heritage Management Plan. As part of the implementation of the AACHMP, ASIR Forms will be completed for each site investigated.	7.11.4
39.	A surface collection will be undertaken for artefact scatters, isolated finds and modified trees to be directly impacted by the Project. This will be staged in relation to commencement of ground disturbing works.	7.11.4
40.	Full archival recordings will be completed pre-mining at sites predicted to be indirectly impacted. Regular monitoring of these sites post-mining will identify any potential impacts at which point all reasonable and feasible measures will be investigated and implemented to prevent further impact.	7.11.4

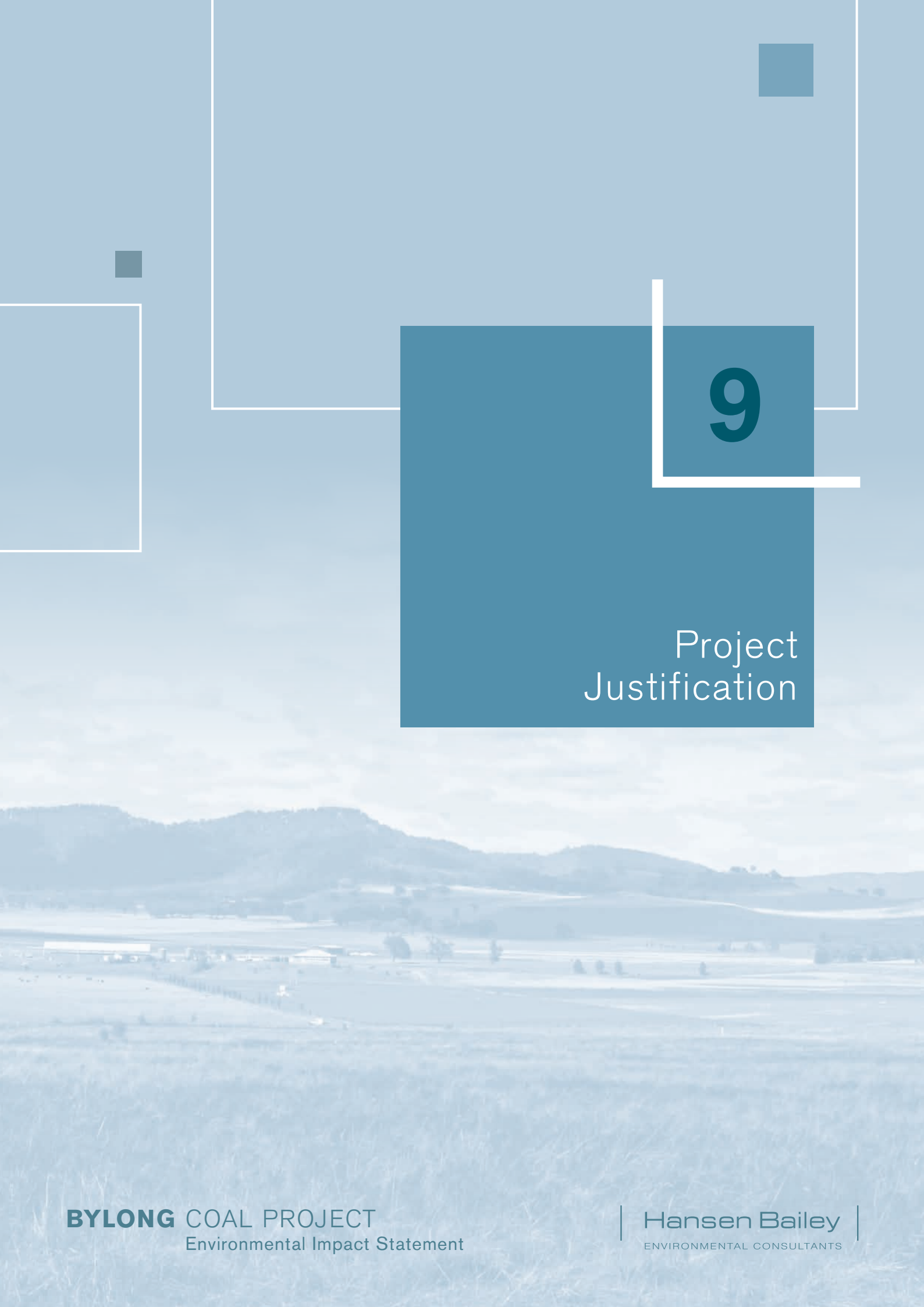
Ref.	Item	Section
41.	A program of subsurface test excavation and salvage excavation will be undertaken for select sites to obtain a more detailed understanding of the nature and extent of Aboriginal archaeology within the Study Area. The program will include a detailed geomorphological assessment, followed by test excavation and salvage excavation and will be completed in consultation with the RAPs.	7.11.4
42.	Conservation and management will be undertaken for all archaeological sites within the Project Boundary that are not impacted by the Project. These sites will be identified on onsite plans to avoid accidental disturbance and included in the AACHMP. Where mining activities will occur in close proximity to these sites, fencing will be erected.	7.11.4
43.	Consultation will continue to occur with the RAPs to develop the management measures and the AACHMP for the Project. The consultation will be undertaken and conducted in accordance with the guiding principle of mutual respect for all cultures.	7.11.14
HISTORIC HERITAGE		
44.	Historic heritage items will be managed in accordance with a Historic Heritage Management Plan developed in consultation with OEH which will include: ▪ A list and map indicating the location of historic heritage sites identified within to the Project Boundary; ▪ A significance assessment and Statement of Significance for each historic heritage site; ▪ Procedures for archival recording of impacted heritage items in accordance with <i>Heritage Branch Guidelines How to Prepare Archival Records of Heritage Items</i> (1998) and <i>Photographic Recording of Heritage Items using Film or Digital Capture</i> (2006); ▪ Management procedures, including dilapidation reports, impact prevention measures, and remediation strategies for potentially impacted heritage items; ▪ Details and procedures, including research design, for carrying out test and salvage excavations (if required) for the Cheese Factory Remains; and ▪ Unexpected finds procedure, including a specific procedure for human remains.	7.12.4
45.	In accordance with the Historic Heritage Management Plan, the following matters will be implemented at each historic heritage site to be directly impacted by the Project, where appropriate: ▪ Archival recordings, including scaled drawings and photographs, prepared in accordance with <i>How to Prepare Archival Records of Heritage Items</i> (Heritage Office, 1998) and <i>Photographic Recording of Heritage Items using Film or Digital Capture</i> (Heritage Office, 2006); and ▪ Documentation (including photographic record) followed by test excavation, and salvage excavation (as determined by testing).	7.12.4
46.	A Blast Management Plan will be prepared and implemented so as to keep blasting within the following predicted levels at: ▪ Tarwyn Park Homestead (32 mm/s); ▪ Tarwyn Park Stables (80 mm/s); ▪ Harley Hill Cottage Remains (35 mm/s); and ▪ Swiss Cottage (56 mm/s). The following management protocol will be undertaken for each item: ▪ A dilapidation assessment will be completed for each item prior to potential impact from vibration caused by construction or operation activities; ▪ During both construction and mining operations, all reasonable actions will be taken to manage the vibration impacts at each site so as to not exceed that predicted in the EIS Noise and Blasting Impact Assessment (Pacific Environment Limited, 2015) when blasting in closest proximity assuming a MIC of 410 kg; and	7.12.4

Ref.	Item	Section
	At the site of each item identified above, where vibration will exceed 15 mm/s, an assessment will be undertaken by a suitably qualified structural engineer to determine whether, on the basis of the maximum predicted vibration, mitigation measures such as temporary bracing should be put in place to reduce any possibility of mine blast related damage. Further, a site specific monitoring program will be instigated to identify damage from mine blasting and appropriate remedial action is taken. Once open cut mining operations have been completed, any damage identified from the monitoring program will be assessed and a targeted works program will be implemented with the aim of restoring the item to a structurally stable state similar to that of its pre-existing condition.	
47.	CMPs will be included as appendices to the Historic Heritage Management Plan in accordance with the principles of Kerr's <i>Conservation Plan</i> (2013) and the <i>Burra Charter</i> (2013). CMPs will be prepared to guide the conservation of Tarwyn Park Farm Complex, Bylong Station Farm Complex and c1848 Homestation.	7.12.4
HISTORIC BURIALS		
48.	To complete the archaeological investigations and exhumations of the burials located within the former Catholic Cemetery and then the reburial of the remains at an appropriate alternative location(s) in accordance with the relevant regulations, guidelines and policies in place at any such location(s), the following will be undertaken: - Seek to consult known descendants; - Seek all relevant approvals for the exhumation and reburial of remains and re-erection of the grave markers. Stakeholders in the exhumation and relocation process may include: - KEPCO; - Relatives and descendants; - Community members; - The trustees of the Bathurst Diocese of the Catholic Church and possibly other denominations; - Relevant consent and approval authorities, being the DP&E, NSW OEH Heritage Division, the Department of Health and MWRC; and - Develop a Burials Management Plan to outline the process for obtaining all relevant approvals, procedures and reporting relevant to the exhumation and reburial of the remains. The Burials Management Plan will detail the following: - Applications for Exhumation for each burial recorded in the former Catholic Church Cemetery, signed by the appropriate person in accordance with the provisions of the <i>Public Health Regulation 2012</i>; - Community liaison plans and procedures; - Procedures for the exhumation, relocation and reburial; - Location and requirements for forensic analysis and storage of skeletal material, prior to reburial; - Procedure for accidental discovery of human remains; - Recommendations for selecting suitable locations for the reburials; and - Appendices including: - Procedures for archaeological investigation and forensic analysis; and - Conditions for approval for exhumation, under the <i>Public Health Regulation 2012</i>.	7.13.4
SOILS AND LAND CAPABILITY		
49.	A Soil Resource Management Plan will be prepared to guide the implementations of the following measures: - Soil material will be stripped to the depths provided in Appendix V, subject to ongoing inspections; - Soil will be maintained in a slightly moist condition during stripping. Material will not be stripped in either excessively dry or wet conditions; - Place stripped material directly onto area to be rehabilitated and spread immediately (if mining sequences, equipment scheduling and weather conditions permit) to avoid the requirement for stockpiling;	7.14.4

Ref.	Item	Section
	- Soil will be graded or pushed into windrows with graders or dozers for later collection by open bowl scrapers, or for loading into rear dump trucks by front-end loaders. This will minimise compression effects of the heavy equipment that is often necessary for economical transport of soil material. These techniques are examples of preferential less aggressive soil handling systems; - Soil transported by dump trucks may be placed directly into storage. Soil transported by scrapers is best pushed to form stockpiles by other equipment (e.g. dozer) to avoid tracking over previously laid soil; - The surface of soil stockpiles should be left in as coarsely structured a condition as possible in order to promote infiltration and minimise erosion until vegetation is established, and to prevent anaerobic zones forming; - As a general rule, maintain a maximum stockpile height of 3 m for subsoil (or 2 m for topsoils). Clay soils should be stored in lower stockpiles for shorter periods of time compared to coarser textured sandy soils; - If long term stockpiling is planned (i.e. greater than 12 months), topsoil stockpiles will be seeded and fertilised as soon as possible. An annual cover crop species that produce sterile florets or seeds (e.g. oats) will be sown; - An inventory of available soil resources will be maintained to ensure adequate topsoil and subsoil materials are available for planned rehabilitation activities; - Subsoil and topdressing materials will be spread to depths dependent on target land capability and as stated in Section 7.15; and - Where possible, suitable subsoil/topsoil will be re-spread directly onto reshaped areas. Topsoil will be spread, treated with fertiliser and seeded in one consecutive operation, to reduce the potential for topsoil loss to wind and water erosion.	
REHABILITATION AND FINAL LANDFORM		
50.	The Rehabilitation Strategy will endeavour to: - Rehabilitate all mined areas and implement best industry standard soil management measures to minimise degradation of soil reserved for rehabilitation; - Manage soil resources in accordance with the Soil Resources Management Plan; - Reinstate BSAL to be directly and permanently impacted; - Conduct the required rehabilitation and weed/ feral animal management to ensure compliance with the preliminary rehabilitation criteria; and - Conduct the rehabilitation monitoring as specified in Section 7.15 of this EIS.	7.15.3
51.	KEPCO will contribute to and actively participate in trials and research to improve mine site rehabilitation techniques and enhance performance outcomes.	7.15.3
52.	KEPCO will progressively rehabilitate mined areas, with an emphasis on re-establishing existing land uses.	3.3
AGRICULTURE		
53.	A Farm Management Plan will be developed to manage activities on KEPCO owned land and will include (at least) the following measures: - A weed and pest management plan to control the distribution of invasive species and feral animals over all KEPCO owned land; - Minimise the time that disturbed areas are removed from agricultural production by progressively rehabilitating disturbed areas as soon as practical; - Implement sustainable farming practices and management of land situated outside the Project Disturbance Boundary and Biodiversity Offset Areas on all KEPCO owned agricultural land; - Continued appointment of a dedicated Farm Manager to ensure the long term productivity of KEPCO owned agricultural lands; and - Expand the existing environmental monitoring network within the Project Boundary and in the locality to facilitate the prevention of unforeseen environmental impacts that may deleteriously affect agricultural activities adjacent to the Project Boundary.	7.16.6

Ref.	Item	Section
TRAFFIC AND TRANSPORT		
54.	In accordance with the Construction Traffic Management Plan KEPCO will aim to safely and efficiently manage traffic throughout the construction phases of the Project in accordance with the Roads and Traffic Authority 2010, <i>Traffic Control at Work Sites</i> , as well as relevant Australian Standards including AS1742.	7.18.4
55.	KEPCO will also: - Upgrade and relocate roads and intersections in accordance with this EIS and the Traffic and Transport Impact Assessment (Appendix Z); - Implement speed and fatigue management strategies; - Run shuttle buses to transport workers between the WAF and the MIAs; and - Investigate the provision of a bus service between Mudgee and the Project at shift change over. The sustainable provision of a bus service will ultimately be determined based on demand.	7.18.4
56.	KEPCO will continue to consult with MWRC, RMS and other local authorities as necessary prior to the movement of oversize loads on public roads.	7.18.4
57.	KEPCO will continue consultation with MWRC in providing the appropriate funding for road maintenance activities on the key roads to be utilised by the Project (i.e. Bylong Valley Way, Wollar Road, Upper Bylong Road), commensurate with the potential Project-related impacts to these roads.	7.18.4
GEOCHEMICAL		
58.	The Mine Waste Management Plan will address: - Confirmation of the occurrence and distribution of any PAF material via a sulphur grid / layered geological model with updated exploration data; - The requirement to pre-strip topsoil from areas to be disturbed and then utilise this in the final rehabilitation activities to limit the risk of dispersion and erosion of potentially sodic overburden; - Selective handling and capping of PAF materials with NAF materials; - Additional overburden testing as mining progresses to ensure the most appropriate rehabilitation options are considered during mine closure; - Treatment of potential acid water in underground workings or in the open cut workings (if required) (e.g. mobile lime dosing plant or the broadcast application of agricultural lime); - Ongoing testing to confirm spontaneous combustion propensity of selected mine materials as they are generated to be detailed in a Spontaneous Combustion Monitoring and Management Plan; and - Monitoring of runoff and seepage from overburden, interburden and coal rejects on a regular basis during the operations phase of the Project to ensure key water quality parameters, are maintained within relevant criteria as forecast.	7.20.4
SOCIAL		
59.	If the Project is approved, KEPCO shall use its best endeavours to enter into a VPA with MWRC, generally consistent with its letter of offer dated 26 June 2015 (see Appendix AD).	7.21.4
60.	In accordance with the Social Impact Management Plan, KEPCO will implement relevant social management and mitigation measures listed in Table 98 of Section 7.21.4 .	7.21.4
CONTAMINATION		
61.	The following preventative measures will be undertaken with regards to potential areas of contamination within land under KEPCO ownership: Remove minor volumes of contaminated soil identified within the Study Area;	7.23.4

Ref.	Item	Section
	▪ Prior to undertaking any demolition or refurbishment of existing structures, complete a Hazardous Materials Survey to determine if asbestos is present and if so how this should be managed to ensure no risk to human health or the environment; ▪ Collect a set of soil samples from the existing rail corridor and analyse these for asbestos prior to works commencing which may disturb the existing ballast and ground surface; ▪ Remove batteries and general agricultural waste from the gully located within the proposed Administration, Amenities and Rail Loop area; ▪ Establish the necessary environmental safeguards and procedures to prevent or minimise unacceptable risk to human health and the environment prior to the completion of the above required remediation works; and ▪ Establish operational policies and procedures for the storage, handling and transport of potentially contaminating materials required for the construction and operational phases of the Project.	
HAZARDS		
62.	The following hazard management measures will be undertaken: ▪ Develop a Hazard Management Plan to support an application for a notification from WorkCover for the Project. This will outline procedures for the transport and storage of hazardous substances, management of storage locations for the Project and detailed response procedures should an event such as fire, explosion or spill occur; ▪ Maintain a database to assist in the recording and management of chemicals and other hazardous materials stored onsite. This chemical management system will contain a Material Safety Data Sheet for all chemicals used onsite; ▪ Transportation of all hazardous materials associated with the Project by a licensed contractor in accordance with the relevant Australian Standards and legislation; ▪ Storage facilities, vehicles and transport vessels will be regularly inspected for leaks, spills and other damage or faults; ▪ All storage facilities for explosives, diesel, oil and other hazardous materials identified will be designed in accordance with applicable Australian Standards to minimise potential for any offsite impacts, toxic contamination of the surrounding area and minimise the severity of an incident in the case of fire, explosion or hazardous substance spills; ▪ Explosive storage facilities will be located a minimum of 500 m from private roads, receivers or site facilities; ▪ Storage areas will be located at a sufficient distance from the Project Boundary to ensure there will be no offsite impacts; and ▪ All explosives will be stored in a purpose built magazine, built and maintained to appropriate standards.	7.24.4
BUSHFIRE		
63.	In accordance with the Bushfire Management Plan, firebreaks, fuel reduction practices, firefighting access and sufficient water supply will be developed and maintained.	7.24.4
WASTE		
64.	In accordance with the Waste Management Plan, the following will be implemented: ▪ Segregate each major waste stream, where practicable, in the appropriate receptacles for recycling, reuse and/or disposal; ▪ Classify and manage waste as recommended by relevant legislation, with all handling of waste and hazardous materials conducted by suitably qualified personnel; ▪ Provide training to personnel to improve efficiency in the minimisation of waste streams, reuse and recycling options and management strategies for each major waste stream relevant to key work areas; ▪ Ensure an independent waste contractor working within the provisions of the POEO Act removes and reports on wastes; and ▪ Instigate regular inspections and monitoring by qualified personnel to ensure adequate maintenance and operation of the waste facilities and that management practices are sufficient to manage any waste products.	7.25.3



9

Project Justification

Project Justification

This section provides a justification of the Project based on the findings of this EIS. It provides a summary of the need for the Project, the various alternatives that have been considered to develop the Project layout and the key environmental impacts and proposed management measures to be implemented. It also describes how the Project is consistent with the objects of the EP&A Act and other matters for consideration by the determining authority.

9.1 OVERVIEW

This EIS has assessed the potential impacts of the Project in accordance with the SEARs, all relevant regulatory requirements and feedback from the extensive consultation program undertaken for the Project.

KEPCO acquired A287 and A342 in December 2010 from Anglo American, with the intention to develop a coal mine to recover the extensive high quality thermal coal resources that are known to occur within those areas. KEPCO's acquisition and proposed development of the Bylong Coal Project is a key component in meeting the company's overarching objective of securing the supply of critical energy coal resources for the people of Korea. By increasing supply security, KEPCO Korea can better manage the impact of sudden and unexpected fluctuations in global fuel availability for its coal-fired power generation facilities.

KEPCO has undertaken an extensive exploration program which has focused on defining the potential coal resources within the Authorisations. Due to the varying topography and geology, exploration has identified that the majority of the coal resources subject of this application are most suited to being recovered utilising underground mining methods. Exploration has also identified additional coal resources that are too shallow to be effectively recovered by underground mining methods and as such have been identified to be most suitable for extraction utilising open cut mining methods.

As discussed in **Section 3.17**, the Project team has investigated numerous mine planning scenarios to maximise the recovery of the coal resource within the Authorisations. During this process, a vital consideration in refining each mine planning option was an assessment of the key environmental and social constraints. This has resulted in some material concessions being made to the mine plans and infrastructure layouts including reducing the number of open cut mining areas from seven to two, to avoid impacts or where impacts are unable to be avoided, to minimise impacts whilst maintaining the viability of the Project. The open cut mining areas to be developed in the initial eight years of mining operations are essential for ensuring the economic viability of the Project whilst also providing the most robust solution for the emplacement of coarse and fine reject materials which are generated from the longer term underground mining operations. The criticality of the two remaining open cut mining areas to what is primarily an underground mining proposal cannot be over emphasised.

Without the resultant void space generated by the open cut mining areas, extensive emplacement areas (or dams) would need to be constructed to accommodate the estimated 14 Mlcm of coal processing waste which will be generated throughout the 23 operational years of the Project.

The Project will optimise the social and economic benefits from the extraction of this NSW government owned coal resource which will be realised by the region and the State with the direct employment of up to approximately 470 people throughout the operations.

At the same time, the mine plan has been designed to avoid significant impacts to the natural environment, with residual impacts being managed through the implementation of a number of mitigation, management and compensatory measures. The Project and any residual material impacts fall on land largely owned by the proponent. Significant noise impacts are predicted to occur on three remaining private properties (Landowner IDs 60, 63 and 69) as a result of the initial mining operations for the Project. Amenity impacts to neighbouring private receivers as a result of the Project have been substantially reduced by mine plan refinements and the extensive buffer land purchased by KEPCO to facilitate the approvability of the Project.

This Project is consistent with the objects of the EP&A Act when its resultant social and economic benefits are weighed carefully against its predicted social and environmental costs.

9.2 PROJECT NEED

9.2.1 The World

The Project will result in the production of approximately 90 Mt of thermal coal destined primarily to South Korea and export markets over its 23 years of active mining.

The United Nations sponsored International Energy Agency (IEA, 2014) expects the world's energy consumption will grow 37% by 2040. Local and international predictions are that the need for coal as a source of energy for electricity production will continue to increase for some years as energy demand grows, despite an expectation of an increase in energy generated by alternate sources and the ultimate transition from carbon based energy to alternative fuel sources.

Wood Mackenzie (2014) forecast that seaborne demand for thermal coal will increase from 952 Mt in 2013 to 1,660 Mt by 2030, representing a compound annual growth rate of 3.3% over this period.

While steps are being taken across the world to reduce the reliance on the use of fossil fuels for electricity production, the forecasts are that increasing energy production from alternate energy sources (i.e. wind and solar) and energy saving actions will not match the anticipated increased demand for electricity. This is particularly the case from the developing countries of south-east Asia, Africa and South America. The result will be an increase in demand for energy coal over (at least) the next 20 years.

In South Korea, coal consumption increased by around 55% between 2005 and 2012, and globally, is the fourth largest importer of coal. KEPCO imported approximately 80 Mt of thermal coal in 2014, with approximately 27 Mt coming from Australia. KEPCO Korea is forecasting demand for thermal coal to rise to approximately 110 Mtpa by 2020.

The share of coal-fired electricity generation is projected to decrease from 40% in 2010 to 33% in 2035. However, the International Energy Agency of the United Nations forecasts that the world's demand for coal will increase at an average annual rate of 0.8% between 2010 and 2035 (Geoscience Australia and the BREE, 2014).

Nations such as South Korea are very aware of this fact and are seeking to secure their medium term energy needs.

9.2.2 Australia

As of December 2013, Australia had an estimated 60 Billion tonnes of proven black coal reserves, which equate to the fourth largest reserve and approximately 9% of the world's proven coal resources. Australia, because of its relatively smaller population has the largest per capita coal reserves in the world and, unlike other countries, obtains a large surplus beyond its domestic use demands. In 2013, Australia produced 538 Mt of ROM coal which places it as the fifth largest producer of coal in the world, following China, USA, India and Indonesia (Geoscience Australia, 2015).

Over 80% of all black coal recovered in Australia is exported to international markets. During 2013 approximately 336 Mt of coal was exported from Australia (World Coal Association, 2015). The main destinations for Australia's coal are Japan (39%), China (14%), South Korea (14%), India (11%), and Taiwan (9%) (ACA, 2011).

Coal is Australia's second-largest export earner after iron ore and is the largest export industry in both Queensland and NSW. Over the last five years, coal has accounted on average for more than 15% of Australia's exports. In the same period, Australia's coal exports have added on average \$44 Billion a year to national income (Minerals Council of Australia, 2013).

The coal mining industry is a major provider of revenue for governments. Coal is mined in all six states, however Queensland (52%) and NSW (46%) together account for almost 98% of Australia's black coal production. Combined coal royalties for Queensland, NSW and Victoria were approximately \$3.0 Billion in 2012-13 alone. For the period between 2013 and 2016, a further \$18.3 Billion is expected to be levied in royalties on the coal mining industry (Minerals Council of Australia, 2013).

This demonstrates that Australia's coal resource is not only an important natural resource demanded by others but is also a significant economic asset to the nation.

The Australian coal industry provides significant employment opportunities for Australians. In 2013, approximately 54,900 people were directly employed in the coal industry, with wages and salaries paid totalling over \$6 Billion.

The mining industry also generates a significant number of jobs in other sectors that support the mining industry with indirect employment of over 150,000 Australians, mainly in rural and provincial Australia (Minerals Council of Australia, 2013).

The Project will generate an estimated \$302 Million (present value) for the Commonwealth government in the form of company tax alone. This revenue is used to fund the provision of government infrastructure and services across Australia.

With Australia exhibiting a politically stable society and the coal reserves being relatively close to the coast, Australia is seen to be a desirable and low cost supplier of coal to world markets which leads to material economic benefits for Australia.

With relatively stable agricultural production and diminishing manufacturing in the country, mining (including coal mining) is increasingly important to Australia's economy and the maintenance of Australia's standard of living.

9.2.3 NSW and the Western Coalfield

Approximately 84% of the demand for electricity across NSW is met from the combustion of locally mined thermal coal (NSW Minerals Council, 2015). NSW has a recoverable coal resource of more than 15 Billion tonnes. In 2013/2014, NSW produced approximately 196 Mt of saleable coal, of which around 87 per cent was exported, with the remainder used to generate electricity in coal fired power stations (DRE, 2015).

Coal mining is the largest contributing industry to the economy of NSW. In 2013-2014, NSW received \$1.32 Billion in mining royalties, with coal accounting for 93% of this (DRE, 2015). Approximately 80% of the total value of mineral production in NSW is derived from thermal and coking coal, the total value of which was around \$17 Billion in 2013-2014 (DRE, 2015).

In 2014, the NSW coal industry employed around 22,000 persons directly and indirectly supports approximately 90,000 persons in mining and non-mining related positions (DRE, 2015). The Project will generate an estimated \$12.6 Million in royalties per year for the NSW government. These royalties are used by the State government to fund infrastructure projects and community services across NSW. A proportion of these funds is expended locally each year in the regions where the coal is produced by way of the NSW Governments Royalties for Regions funding initiative.

In June 2014, the known coal reserves of the Western Coalfields were approximately 3,300 Mt (NSW Trade and Investment, 2014). In 2014, approximately 47 Mt of ROM coal was recovered from the numerous mines within the Western Coalfield.

The Western Coalfield predominantly contains thermal coal resources and around 40% has historically been used domestically for power generation and cement production, with the remainder being exported (NSW Trade and Investment, 2014). In addition to the critical function of supporting the production of electricity, coal mining in the State and the Western Coalfield provide significant economic contributions to the respective communities and significantly contributes to the economy of NSW and the MWRC LGA.

Economic Value of Resource

The existence of the coal resource in the Bylong area has been known for a considerable period of time. The ability for this resource to be mined in an economic and environmentally acceptable manner has been subjected to limited investigation and planning by the former owners of the Authorisations. This ability has now been further developed by KEPCO, who is now prepared for the significant investment required to develop this valuable NSW Government owned coal resource. The coal resource within the Bylong Authorisations has a significant material value to the Local, State and Australian communities, which would be foregone without its recovery.

9.2.4 Economic Benefits of the Project

The Project will facilitate the recovery of a valuable, export quality thermal coal resource. Thermal coal remains a highly sought after energy source in Asian countries, including South Korea, Japan, China and India. These countries continue to be the world's largest coal importers, and will largely account for more than approximately 70% growth in total coal imports from 2009 to 2035. This increasing demand supports the need for the Project and justifies further investment in the thermal coal mining industry.

To this end, the Project will:

- Assist Australia to continue to meet the international demand for thermal coal for at least the next 25 years, during which time it is expected that there will continue to be a strong world demand for coal for the purposes of electricity generation;
- Support Australia in maintaining its reputation as a consistent and reliable supplier of thermal coal to its existing and expanding markets; and
- Contribute materially to sustaining the Australian economy and maintaining the economic stability of NSW, the MWRC LGA and the broader local Hunter region.

The Project will deliver substantive socio-economic benefits to the MWRC LGA and in doing so will create a need for supporting infrastructure and services. To this end, KEPCO is in the advanced stages of discussions with MWRC with regard to entering into a VPA pursuant to Section 93F of the EP&A Act.

The operational phase of the Project is expected to generate, both directly and indirectly, a total of approximately 863 jobs in the MWRC LGA. These employment opportunities will provide significant benefits to the local region.

An analysis of the current labour force in the MWRC LGA shows that in 2014 there was predicted to be:

- Approximately 780 unemployed people living in the MWRC LGA; and
- A potential available labour supply of 672 people.

As such, it appears that the MWRC LGA will be able to absorb the proportion of the jobs created by the Project, thereby improving the social environment of this area. The impact of the Project on local labour supply will be influenced by the potential demand for local hires and the number of flow-on jobs generated by the Project. All employees will be encouraged to reside locally (within 1 hours drive), thereby maximising the economic benefit to the MWRC LGA. Initiatives to promote local employment training opportunities are under consideration.

As part of increasing employment opportunities, it is expected that the Project will assist in improving the current high rates of youth and Indigenous unemployment in the local region. Further, with the NSW Minerals Council's concerted efforts to improve female workforce participation rates in the mining industry, the Project may also assist in improving women's labour force participation rates within the region.

Should the Project be approved, KEPCO will implement the following strategies which will result in tangible social benefits to the MWRC LGA:

- Direct and indirect employment generation. During dual operations (PY 9) the Project is anticipated to generate demand for approximately 470 full time equivalent direct jobs and approximately 521 indirect jobs in the MWRC LGA. KEPCO will use best endeavours to achieve the majority of its permanent workforce residing within the MWRC LGA;
- Improved local business opportunities associated with Project related procurement and the potential for increased business viability, profitability and capability;
- Investment in training and skills development, particularly in the youth and Indigenous sectors;
- Encourage skilled partners of the incoming mining workforce to also relocate to the local area to fill skilled jobs that are required outside the mining industry; and
- Investment in community infrastructure and services which is made possible through Royalties for Regions, the Project VPA and supplemented with funding from KEPCO's Corporate Sponsorship and Donations Fund.

When the Project production costs (acquisition of affected land, opportunity cost of land, operating costs, environmental costs, decommissioning costs, etc.) are considered in the context of production benefits (revenues from production, residual values of land, etc.), the net financial benefits of the Project are approximately \$766 Million.

A minimum of \$596 Million of these will be net benefits accruing to Australia (and \$315 Million accruing to the State). There may also be non-market benefits of employment provided by the Project which in total are estimated to be in the order of \$165 Million.

The Project will deliver significant socio-economic benefits to the region and the State of NSW through the provision of employment, taxes and fees.

The peak year of construction is predicted to result in the following approximate average annual contributions to the regional economy:

- \$297 Million in annual direct and indirect regional output or business turnover;
- \$104 Million in annual direct and indirect regional value added;
- \$55 Million in annual direct and indirect household income; and
- 863 direct and indirect jobs.

The Project is estimated to result in the following approximate average annual contributions to the regional economy throughout its 23 operational years:

- \$624 Million in annual direct and indirect regional output or business turnover;
- \$378 Million in annual direct and indirect regional value added;
- \$72 Million in annual direct and indirect household income; and
- 830 direct and indirect jobs.

For the NSW economy, the operation of the Project for 23 years is estimated to result in up to the following approximate contributions:

- \$855 Million in annual direct and indirect output or business turnover;
- \$492 Million in annual direct and indirect value-added;
- \$135 Million in annual direct and indirect household income; and
- 1,496 direct and indirect jobs.

9.3 ALTERNATIVES CONSIDERED

The Project alternatives are discussed at **Section 3.17**. A number of different project alternatives were considered to identify if there was a Project which would address the following environmental planning imperatives:

- Protection of those environmental features that must be protected;
- Confirmation that it could be conducted with predictable and acceptable environmental planning outcomes;
- Best practice science applied to ensure all environmental effects have been determined with certainty;
- The application of all available feasible and reasonable management controls; and
- Assurance that any residual impacts would not have unacceptable environmental effects.

Due to the established need for the Project, the 'Do Nothing' option was rejected when it was determined that there was a feasible and acceptable development as proposed.

The 'Underground Mining only' alternative is not economically appropriate given the extensive costs of developing an underground mine in relation to the limited value of the thermal coal resource. This 'Underground Mining only' alternative would also result in material sterilisation of a NSW Government owned coal resource which can only be safely and economically recovered via open cut mining methods. It is further constrained by its need for an environmentally appropriate receptacle for the emplacement of reject materials from the washing of ROM coal.

The 'Open Cut Mining only' option was rejected as it would sterilise the vast majority of the coal resource within the Authorisations due to the topographical and physical constraints to parts of the resource which could only be recovered by underground mining methods.

The Project, involving limited open cut and more extensive underground mining operations presents a logical solution to coal recovery by maximising the efficient and safe extraction of the coal resource from the Authorisations, while at the same time avoiding significant environmental and social impacts. The Project also avoids the permanent sterilisation of other coal reserves known to occur within the locality.

In particular, there may be the opportunity to extend the life of the underground mining area beyond the currently proposed 25 year mine life if the demand for thermal coal continues as currently projected and the appropriate Government planning and other environmental approvals are obtained.

9.4 ENVIRONMENTAL IMPACTS

The environmental assessment of the Project has been conducted in accordance with the objects of the EP&A Act, including the principles of ESD and leading practice environmental and social standards.

This process has involved:

- A Project environmental risk assessment (**Section 6**);
- Consultation with stakeholders to identify any additional issues to be addressed in this EIS (**Section 5**);
- Technical assessment conducted in accordance with current 'best practice' and as required by the SEARs including independent expert peer reviews of key technical studies;
- Quantification of any potential environmental impacts with certainty (**Section 7**); and
- The application (as part of the operation of the Project) of environmental management and mitigation measures (**Section 7**) to which KEPCO is committed.

Project impacts are outlined in **Section 7** with the most significant environmental impacts summarised below.

9.4.1 Groundwater

The Project falls within the Bylong River catchment from which water resources that occur on the surface or within the alluvial water sources is administered under the Hunter Unregulated WSP. The Permian units are also identified to contain groundwater which is regulated under the *Water Act 1912* in the absence of a WSP.

From the outset of mine planning, the importance of the alluvial aquifers bordering the main drainage lines within the catchment were identified as constraints to mining operations. The highwalls of the open cut mining areas have been offset by a minimum of 150 m from the Bylong River and Lee Creek interpreted alluvial aquifers.

Additionally, the Underground Extraction Area has been designed to ensure that no direct connection between the underground and the Bylong River and Lee Creek alluvials occurs.

The groundwater modelling confirms with certainty (through a sensitivity analysis) that no alluvial bores which are located on neighbouring privately owned land will be adversely impacted as a result of the Project. The groundwater model predicts an average groundwater seepage rate from the Permian into the open cut mining areas of 138 ML/Year with a peak of up to 354 ML/Year in PY 9. The groundwater model predicts an average groundwater seepage rate from the Permian into the underground mining areas of 1,248 ML/Year with a peak of up to 2,093 ML/Year in PY 18.

The groundwater flow from the underlying Permian units to the alluvium is predicted to reduce by a maximum rate of 0.8 ML/day, with the maximum annual loss at 295 ML/Year in PY 25 (average of 154 ML/Year for life of Project). The rate of transfer of water from the Permian to the alluvium reduces as the zone of depressurisation increases to the north and reaches a peak when mining in the Underground Extraction Area is most extensive (i.e. in PY 25).

The borefield proposed to be included within the Bylong River and Lee Creek alluvium is predicted to extract up to 1,172 ML/Year (average of 367 ML/Year over 25 years) to supplement processing water for the Project. All "take" of water from the Bylong River Water Source of the Hunter Unregulated WSP will be accounted for within WALs with appropriate volumetric entitlements already held by the proponent.

Under post-mining conditions, the water levels surrounding the open cut mining areas and the Underground Extraction Area will recover as the surrounding Permian aquifer regains pressure. The emplacement of overburden in the open cut mining areas and the associated enhanced recharge rapidly reverses the effects of groundwater depressurisation on the alluvial aquifer system. The model indicates that 100 years after mining ceases, upward flow to the alluvium will be returned to pre-mining rates. Beyond 100 years of recovery, a marginal increase of around 5 ML/Year is predicted to occur to the alluvial areas, which means there is no long term deficit of water to the alluvial aquifer post-mining.

9.4.2 Surface Water

A site surface water management system is proposed to both provide suitable water for mine site use and to ensure that mine water is not released from the site. The mine site water balance has indicated that water from an external water supply will be required. As a result, the Project proposes the construction of a borefield and associated infrastructure to provide the water required for the operation of the Project.

During average and dry years, it is predicted that annual volumes up to 1,172 ML (average of 367 ML/Year over 23 years) will be required to supplement the mine water supplies to ensure a reliable source of water to the CHPP and mining activities. This water will be pumped from the Bylong River Water Source for which KEPCO holds appropriate WALs.

Based on the configuration and capacity of the proposed water management system, there will be no uncontrolled offsite spills from mine water storages or controlled discharges throughout the life of the Project. However it was identified within the site water balance that in the circumstance that extreme wet conditions occur during the period of the longer term underground mining operations, up to 3,560 ML of surplus mine water may need to be stored within the open cut mining area. Assessments have confirmed that this worst case situation can be appropriately managed within the mining area. Any water remaining within the open cut mining area at the completion of underground mining operation may be pumped to the abandoned underground mine workings to assist in the recharge of the Permian aquifer.

During the life of the Project, there is a potential for the reduction of catchment flows to surrounding waterways, including the Bylong River, Lee Creek and Goulburn River. A reduction in catchment area will decrease the volume of stormwater runoff. Assessments confirm that only a small proportion of existing catchments will be taken throughout the life of the open cut mining operations. At the completion of mining, surface runoff from the rehabilitated OEAs will be re-established.

KEPCO will implement a sophisticated water management system to minimise impacts on surface water and conduct monitoring of water quality throughout the life of the Project. Further, KEPCO will prepare an Erosion and Sediment Control Plan as part of the Water Management Plan to appropriately manage the design and maintenance of sediment structures.

9.4.3 Noise

The various components of the Project are located on land which is predominantly owned by KEPCO. As a result an extensive buffer exists surrounding the various components of the Project resulting in relatively few impacted private receivers.

KEPCO has committed to the inclusion of all reasonable and feasible noise mitigation and management measures to be implemented during the construction and operational phases of the Project to minimise noise to neighbouring receivers. These measures include fitting of sound suppression and/or attenuation to the mobile fleet and fixed plant, as well as implementing operational changes during adverse meteorological conditions.

Despite the buffer surrounding the proposed operations and the incorporation of all reasonable and feasible noise management and mitigation measures into the Project, three receivers are predicted to experience significant noise impact at their residences (Landowner IDs 60, 63 and 69) during the initial years of open cut mining operations.

Further, six receivers are predicted to experience moderate noise impacts (i.e. exceedance of the intrusive criteria between 3 and 5 dBA) and three receivers will experience negligible noise impacts (i.e. exceedance of intrusive criteria between 1 and 2 dBA). The noise impacts predicted during the initial open cut years of the Project will substantially reduce during the longer term underground mining operations due to the less intense activities required on the surface of the land.

Due to the relatively short term and transient nature of the majority of noise sources, KEPCO has held discussions with those receivers predicted to be significantly and moderately impacted by noise emissions in an attempt to reach negotiated agreements with these residents. They have also committed to installing a real-time noise monitoring and management system for the Project including a predictive meteorological forecasting system. KEPCO will also prepare a Noise Management Plan to minimise and manage noise impacts associated with the Project.

9.4.4 Ecology and Offsets

A total of 24 vegetation communities were identified within the Study Area, of which three are listed as Threatened Ecological Communities under the EPBC Act and TSC Act.

Seven threatened flora species which are listed under the TSC Act and/or the EPBC Act have been identified within the Study Area. Although not recorded during field surveys, a suite of other threatened flora species listed under the TSC Act and/or the EPBC Act are considered to have potential to occur.

A total of 24 threatened fauna species which are listed under the TSC Act and/or the EPBC Act have been recorded within the Study Area. Although not recorded during field surveys, a suite of other fauna species listed as threatened or migratory under the TSC Act and/or the EPBC Act are considered to have potential to occur.

The Project will directly disturb approximately 1,160 ha within the Project Disturbance Boundary including:

- Approximately 82 ha of native vegetation communities (11 ha woodland and 71 ha grassland) listed under the TSC Act only;
- Approximately 135 ha of native vegetation communities (61 ha woodland and 74 ha grassland) listed under both the TSC Act and the EPBC Act;
- Approximately 229 ha of native woodland (including 72 ha of the listed woodland communities), providing known and potential habitat for the various threatened flora and fauna species occurring within the locality; and
- Approximately 786 ha of non-listed grassland, planted and exotic pasture and areas disturbed for existing roads and agricultural infrastructure.

A BOS has been designed to compensate for ecological impacts of the Project that will achieve a net gain in biodiversity in the region in the long term. The BOS has involved the acquisition of offset properties for permanent conservation of flora and fauna which includes habitat for species predicted to be impacted by the Project. The BOS has been developed with a primary focus on Box Gum Woodland and Derived Native Grassland and other habitats for all threatened fauna known to occur in the Project Boundary.

Based on the detailed vegetation mapping undertaken, the Onsite and Offsite Biodiversity Offset Areas will contribute approximately 3,684 ha of native woodland and grassland, including approximately 1,271 ha of Box Gum Woodland and Derived Native Grassland listed under both the TSC Act and EPBC Act (667 ha woodland and 604 ha grassland); and a further 238 ha of Box Gum Woodland and Derived Native Grassland (grassland form) listed under the TSC Act only. The Biodiversity Offset Areas will also contribute approximately 426 ha of other TSC Act listed communities. The Biodiversity Offset Areas as a whole, will provide a substantial amount of habitat for the suite of threatened species to be potentially impacted by the Project, including the Regent Honeyeater, Brush-Tailed Rock-Wallaby and Greater Long-eared Bat.

The BOS will ultimately provide an offset ratio of 9.4:1 for Box Gum Woodland and Derived Native Grassland listed under the TSC Act and EPBC Act; 36.8:1 for other TSC Act communities and 10.6:1 for all woodland vegetation to be disturbed.

Based on the application of the *Biodiversity Offset Policy for Major Projects*, the BOS satisfies the vegetation community and species credits required for the impacts of the Project, providing almost double (i.e. 198%) the required credits for the Projects impacts on Box Gum Woodland and Derived Native Grassland. Further, the biodiversity offset policy more than satisfies the requirements of the Commonwealth's *Environmental Offset Policy*.

In the medium to long term, the Project will result in a net increase in woodland in and around the Project Boundary, and in the wider region.

9.4.5 Aboriginal Archaeology

A total of 216 Aboriginal archaeological sites and 32 cultural features have been identified within the Project Disturbance Boundary and Subsidence Study Area (see **Section 7.11.3**). The majority (90%) of the Aboriginal archaeological sites comprised surface artefacts (artefact scatters and isolated finds), while approximately 5% were rockshelters and the remainder were Potential Archaeological Deposits (some with artefacts), grinding grooves, modified trees and an ochre quarry. The RAPs involved in the field surveys identified a number of cultural features largely comprised of natural rock features.

A total of 102 archaeological sites will be directly impacted and 146 archaeological sites will be subject to subsidence related effects within the Subsidence Study Area.

Approximately 42% of the identified archaeological sites and cultural features are not anticipated to be impacted by the Project at all and approximately 40% of the archaeological sites and cultural features with predicted impacts are of low regional archaeological significance. The Aboriginal archaeological sites identified as high regional archaeological significance which will be potentially impacted by the Project include the ochre quarry, three grinding groove sites and three rockshelters.

An Aboriginal and Archaeological Cultural Heritage Management Plan will be prepared for the Project. It will be informed by specific policies and procedures so as to minimise any impacts and manage identified sites within the Project Boundary. The Management Plan will be periodically reviewed in consultation with the RAPs and relevant regulators.

9.4.6 Historic Heritage

At the time of writing, there are no heritage items or sites within the Project Disturbance Boundary listed on the UNESCO, Commonwealth, NSW State or Local Government Heritage Lists, Registers or Schedules. Two items are listed on the non-statutory, non-government organisation National Trust (NSW) Register, the Bylong Landscape Conservation Area (registered 2013) and the Our Lady of the Sacred Heart Catholic Church and Cemetery (registered 2003).

The Historic Heritage Impact Assessment has identified and assessed seven items or sites within the Project Disturbance Boundary as having values of local conservation significance. The Project will require the removal of those items which include: the former Our Lady of the Sacred Heart Catholic Church building and Cemetery, BUPs, the former Upper Bylong Post Office and Store, Bylong Upper Hall, Renfrew Park Remains 1 & 2 and the remains of the former Cheese Factory.

In addition to the sites to be removed, the Project will partially impact, on 11 sites or items in proximity to the Project that have been identified and assessed as having values of local conservation significance. Those sites include Homestation (visual), Bylong Station Farm Complex (direct and visual), Bylong Anglican Church and Cemetery (visual), Harley Hill Farm Complex (visual and potential vibration), Bylong Trig Station (visual), Swiss Cottage (visual and potential vibration), Bylong Hall (visual), Tarwyn Park Farm Complex (direct, visual and potential vibration), Cottage Chimney Remains (visual and potential vibration), the Bylong Valley Cultural Landscape and the National Trust Registered Bylong Landscape Conservation Area (direct and visual).

A Historic Heritage Management Plan will be prepared in accordance with the Principles of the Burra Charter to guide the management of all sites or items within the Project Boundary and in proximity to it. Additionally, a mine Rehabilitation Strategy will be prepared taking into consideration the cultural values of the identified sites or items and their landscapes, including views and vistas, with the aim of restoring the landscape to its current condition and land use capabilities once mining is complete.

9.4.7 Historic Burials

KEPCO acknowledges the sensitivity of the plan to exhume and relocate the burials located on its land within the grounds of the former Our Lady of the Sacred Heart Catholic Church and Cemetery. KEPCO has been consulting with and will continue to consult with the relevant descendants and liaise with the approval authorities to ensure that the exhumation and relocation protocol is appropriately managed.

In this regard, a Burials Management Plan will be prepared to guide the excavation, exhumation and relocation of the remains of the people buried within the grounds of the former Cemetery. The Burials Management Plan will outline the procedures for obtaining the necessary permits, approvals or consents and ongoing consultation with the known descendants and relations of those buried in the former Cemetery.

9.4.8 Agriculture

The land within the Project Disturbance Boundary and the Biodiversity Offset Areas and water resources lost to agricultural production represents a best case gross value of approximately \$2.66 Million per annum. This equates to 4.12% of the total agricultural production within the MWRC LGA, 0.02% of NSW, and 0.005% of Australia. Much of this potential lost production is temporary in nature. It is concluded that the Project will not lead to a material reduction in agricultural productivity of the Mid-Western region or the State of NSW (**Section 7.16.5**).

Strategic Agricultural Land

The mine plan for the Project has been specifically designed to minimise the potential impacts to SAL. Further, all recommendations attached to the Gateway Certificate issued over the Project have been comprehensively addressed within this EIS.

Approximately 440 ha of land verified as BSAL is located within the Project disturbance footprint and a further 486 ha is mapped within the proposed Biodiversity Offset Areas. Additionally, there is approximately 2,400 ha of mapped Equine CIC within the Agricultural Assessment Areas of which 699.9 ha is within the Project Disturbance Boundary and a further 415 ha within the Biodiversity Offset Areas.

To compensate for the direct and long term impacts of the Project on BSAL, KEPCO has committed to progressively stripping and reinstating the BSAL as part of its rehabilitation strategy. Upon reinstatement, KEPCO will aim to adjoin or create connectivity with larger areas of insitu BSAL. These reinstated BSAL areas will be contiguous with other areas of BSAL to enhance the total agricultural productivity of the undisturbed areas within the Project Boundary. Soil stripping and handling protocols for BSAL are provided in the Rehabilitation Strategy as discussed in **Section 7.15**.

The Equine CIC mapped within the Agricultural Assessment Areas represents less than 0.94% of the total Equine CIC mapped within the Upper Hunter region. The Project will result in temporary disturbance to less than 0.44% of the total Equine CIC mapped within the Upper Hunter region. A total of three properties in the vicinity of the Project Boundary are located within mapped Equine CIC. This mapping largely reflects historical uses of this land and there are no registered thoroughbred horses on any of these three properties. The impacts of the Project on Equine CIC are considered to be negligible, given:

- The small proportion (0.94%) of the mapped Equine CIC within the Agricultural Assessment Areas compared to the total mapped within the Upper Hunter Region;
- The considerable distance of the Project from the main equine centre in Scone;
- The land is predominantly owned by KEPCO and is not currently utilised for equine related activities; and
- KEPCO's rehabilitation strategy has been prepared with due consideration of the land potentially being utilised by the equine industry post-mining.

The groundwater modelling has indicated that the impacts of the Project on the groundwater regime will not impact on any privately owned bores surrounding the Project. Additionally, all take of water from the Bylong River water source will be appropriately accounted for by WALs held by KEPCO with appropriate volumetric allocations.

Groundwater modelling indicates that water allocations presently used for agriculture on KEPCO land will continue to be available for this purpose. However, in the circumstance (i.e. extreme dry weather conditions) that the Project may require a greater proportion of KEPCO's available water allocation, it will adjust its agricultural activities on its land to accommodate this.

Agricultural Trials and Research

KEPCO is not proposing to conduct any open cut mining on the alluvial land which falls outside of the footprints of the Eastern and Western open cuts, which has previously been the subject of Natural Sequence Farming (or Soil Hydrology Management).

However, KEPCO has committed to establishing a small trial area within the Class 4 and 5 rehabilitated lands to investigate the benefits of Soil Hydrology Management that has been previously pioneered in the locality.

This trial will be conducted in conjunction with local farming experience and expertise and may involve other organisations such as the Tom Farrell Institute centred at the University of Newcastle and the Outcomes Australia Soils for Life Program.

Benefit Cost Analysis

The direct annual output of the Project is estimated at \$469 Million per annum. In contrast, the direct annual output of the continued use of the agricultural lands and water for agricultural purposes that will be utilised by the Project is estimated at \$3 Million per annum. The direct and indirect regional employment provided by the Project will be up to 830 full-time equivalent jobs compared to up to 19 agricultural-related jobs that would be forgone as a result of the Project.

Gillespie Economics also undertook a BCA which included an estimation of the present value of production costs and benefits of the Project over a 25 year period (see **Section 7.22**). The present value of net production benefits of the Project to Australia are estimated at \$596 Million (of which \$315 Million accrues to the State) (7% discount rate). In contrast, the present value of the continued use of the agricultural lands and water for agricultural purposes that will be utilised by the Project is estimated at \$16.8 Million (7% discount rate). Based on these comparative values, the Project is considered to be the highest value use of the land.

9.4.9 Greenhouse Gas

Greenhouse and anthropogenic climate change is a global issue. Since the 2009 Copenhagen Climate Conference, it has become more apparent that the path to achieving a material reduction in the use of carbon based energy is challenging and will take time.

There will continue to be actions to manage climate change which include different approaches in different jurisdictions. The objective of these actions will be to reduce reliance on carbon by making it more expensive and by developing alternate non-carbon based sources of energy such as wind, solar, geothermal and others. As the largest electricity generator in South Korea, KEPCO Korea is at the forefront of developing alternate non carbon energy sources for the people of South Korea.

However, it is accepted that an alternative to coal will not be developed sufficiently to replace carbon based energy entirely for some time (International Energy Agency, 2014). The demand for electricity is predicted to continue to increase with growing populations and the standards of living that are being demanded in the developing world.

KEPCO Korea itself is forecasting an approximate 27% increase in direct coal imports from approximately 80 Mtpa (in 2014) to approximately 110 Mtpa by 2020.

KEPCO will continue to develop its non-carbon based energy supply portfolio and will prepare an Energy and Greenhouse Gas Management Plan and implement energy and greenhouse reduction initiatives at the design, operation and decommissioning phases of the Project.

9.5 CONSISTENCY WITH THE OBJECTS OF THE EP&A ACT

Section 5, Part 1 of the EP&A Act contains its objects which are reproduced below followed by a consideration as to how the Project achieves these:

"To encourage the proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment."

The Project will facilitate the efficient recovery of 124 Mt of ROM coal reserves within the Illawarra coal measures together with the progressive rehabilitation of the disturbed land. At the same time, the Project will provide for the management of land owned by KEPCO and the establishment of a BOS to conserve the biodiversity values of the region. The Project will not result in any material impacts on the availability of water on surrounding private landholdings or significantly impact on surface water and groundwater resources in the longer term. The Project will generate additional employment within the region which will assist in sustaining the socio-economic viability of the MWRC LGA.

"To encourage the promotion and co-ordination of the orderly and economic use and development of land."

The Project will result in the recovery of a valuable coal resource from within NSW's identified coal reserves. The recovery of this coal resource has been designed to occur with identified, manageable and acceptable environmental and social impacts resulting in material social and economic benefits to NSW.

The mining land use will be the highest value land use available with the present value of net production benefits of the Project to NSW and Australia estimated at \$596 Million (\$315 Million to the State) (7% discount rate) as compared to the present value of the continued use of the same land and water resources for agricultural being \$16.8 Million (7% discount rate).

The Project will generally stimulate the economy with regional spending for production related costs and with wages for labour which will also contribute to the regional economy.

"To encourage the protection, provision and co-ordination of communication and utility services."

The Project will expand utility services in the local area, improving the potential for increased connectivity by other users. The provision of services such as water, high voltage power and telecommunications to this location is currently low.

Development of the Project will facilitate upgrades to and the provision of these and other services and as such, any subsequent access by other parties located in the vicinity of the Project will be improved.

"To encourage the provision of land for public purposes."

The Project will result in the establishment of a BOS which will include the conservation, restoration and rehabilitation of 1,509 ha Box Gum Woodland and Derived Native Grassland, 426 ha of other EECs and 1,749 ha of other native vegetation. These areas will be set aside for scientific and conservation purposes in perpetuity.

"To encourage the protection, provision and co-ordination of community services and facilities."

The net economic benefit of the Project will encourage and support the provision and co-ordination of community services and facilities to the MWRC LGA. In particular, the Project will also generate an estimated \$290 Million (present value) in royalties, which will be used by the State government to provide community services and facilities across NSW.

The Project will also result in the implementation of a VPA with the MWRC for the ongoing provision of community services, facilities and other local infrastructure.

"To encourage the protection of the environment, including the protection and conservation of native animals and plants, including the Threatened species, populations and ecological communities, and their habitats."

The Project will result in the loss of CEEC, EEC and some habitat for threatened species. In order to compensate for these impacts, KEPCO has developed a BOS for the Project which includes the conservation, restoration and rehabilitation of 1,509 ha Box Gum Woodland and Derived Native Grassland, 426 ha of other EECs and 1,749 ha of other native vegetation.

"To encourage ecologically sustainable development."

The Project has been developed through a comprehensive planning, stakeholder engagement and environmental assessment process to ensure that the principles of ESD are addressed. The Project's form has been determined by careful consideration of a number of alternatives. The impacts of the Project have been predicted with certainty in a detailed assessment process outlined in this EIS. Management measures to address the impacts that will occur have been incorporated into the Project as required, thus addressing the Precautionary Principle.

The environmentally optimised recovery of the in situ coal resource and the establishment of the BOS address the principles of Intergenerational Equity and Improved Valuation. The BOS proposed for the Project also addresses the principle of the Conservation of Biological Diversity and Ecological Integrity.

The Project is consistent with the principles of ESD as discussed further in **Section 9.6**.

"To provide increased opportunity for public involvement and participation in environmental planning and assessment."

Section 5 describes the stakeholder engagement process relied upon during the preparation of this EIS. This process was extensive and hence fulfils this objective of the Act.

9.6 CONSISTENCY WITH THE PRINCIPLES OF ESD

The objects of the EP&A Act adopt the principles of ESD in the application of the Act. These principles are articulated in Section 6 (2) (a) of the *Protection of the Environment Administration Act 1991* where it is stated that "ecologically sustainable development requires the effective integration of economic and environmental considerations in decision-making processes. Ecologically sustainable development can be achieved through the implementation of the following principles ...". Each Principle, in relation to the Project, is discussed below.

9.6.1 Precautionary Principle

The precautionary principle is "that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

In the application of the precautionary principle, public and private decisions should be guided by:

- (i) careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment, and
- (ii) an assessment of the risk-weighted consequences of various options,"

Adherence to the precautionary principle requires avoiding serious or irreversible environmental damage by properly assessing potential impacts and taking the necessary mitigation measures. This EIS identifies, with certainty, all environmental impacts from the development of the Project, which has been designed to avoid serious or irreversible environmental damage.

To ensure this, actions involving unquantifiable and unacceptable environmental consequences have been avoided. Environmental consequences have been assessed on a 'worst case scenario' basis, where if potential serious or irreversible damage was identified, an appropriate re-design of the Project was implemented to avoid those consequences. Additionally, this EIS adopted a risk-based approach to assessment whereby key aspects of the Project with a high risk profile have been peer reviewed by authoritative experts to ensure certainty over the predicted impacts of the Project.

9.6.2 Intergenerational Equity

This principle requires *"that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations"*.

The Project design, determined through the examination of the alternatives along with the commitments to environmental management systems and the management and mitigation measures, will operate to ensure that there is no significant effect on the environment as a result of the Project which will diminish the health, diversity or productivity of the environment for future generations. The immediate cost of environmental effects will be borne through the Project life and will not be left to be borne by future generations.

This has been achieved by limiting the scale of the Project and excluding development from environmentally sensitive areas (e.g. mining on alluvial floodplains and beneath areas containing significant cliff lines). Long term ecological conservation areas will be established for the Project as part of the BOS. Expert peer reviews and sensitivity analyses of key scientific studies have confirmed with certainty that the Project will not measurably impact on the longer term productivity of the region's groundwater resources.

9.6.3 Biodiversity Conservation

This principle requires the *"conservation of biological diversity and ecological integrity—namely, that conservation of biological diversity and ecological integrity should be a fundamental consideration"* of any development proposal.

The design of the Project excludes, where possible, areas of native vegetation and endangered species. With the BOS committed to by KEPCO, this demonstrates adherence to this principle. These actions will ensure that the Project will not threaten the preservation of biodiversity and ecological integrity of the area and that the biodiversity and ecological value of the area is maintained and potentially improved in the long term.

9.6.4 Improved Valuation

This principle addresses *"improved valuation, pricing and incentive mechanisms—namely that environmental factors should be included in the valuation of assets and services, such as:*

- (i) *polluter pays—that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement,*
- (ii) *the users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste,*
- (iii) *environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems."*

As KEPCO will be a producer of coal as a result of the Project, only the 'polluter pays principle' is applicable through:

- Capital investment in the acquisition of offset lands and the establishment of rehabilitation programs to protect and enhance local and regional ecological biodiversity values;
- Establishment of the perpetual protection of the offset lands;
- The purchase of surface and groundwater entitlements; and
- Purchase of land unacceptably affected by noise emissions from the Project.

9.7 MATTERS FOR CONSIDERATION UNDER SECTION 79C OF EP&A ACT

The Minister for Planning (or delegate) is to take into consideration the following matters in Section 79C of the EP&A Act as are of relevance to the Project:

“(a) the provision of:

- (i) any environmental planning instrument, and*
- (ii) any proposed instrument that is or has been the subject of public consultation under this Act and that has been notified to the consent authority (unless the Director-General has notified the consent authority that the making of the proposed instrument has been deferred indefinitely or has not been approved), and*
- (iii) any development control plan, and*
- (iiia) any planning agreement that has been entered into under section 93F, or any draft planning agreement that a developer has offered to enter into under section 93F, and*
- (iv) the regulations (to the extent that they prescribe matters for the purposes of this paragraph), and*
- (v) any coastal zone management plan (within the meaning of the Coastal Protection Act 1979), that apply to the land to which the development application relates,*
- (b) the likely impacts of that development, including environmental impacts on both the natural and built environments, and social and economic impacts in the locality,*
- (c) the suitability of the site for the development,*
- (d) any submissions made in accordance with this Act or the regulations,*
- (e) the public interest.”*

These sections below describe how this EIS has addressed each in relation to the Project.

9.7.1 Environmental Planning Instruments

The Project is located wholly within the MWRC LGA to which the Mid-Western Regional LEP applies. The majority of the land within the Project Boundary is zoned as RU1 (Primary Production) with the land utilised for the Sandy Hollow to Gulgong Railway Line zoned as SP2 (Infrastructure). The land use table in the Mid-Western Regional LEP states that open cut mining is permissible with development consent on land within Zone RU1.

The SEPP Mining applies to the whole of NSW and pursuant to clause 5(3) of the SEPP Mining, it prevails over any other EPI to the extent of any inconsistency. The practical effect of clause 5(3) is that if there is any inconsistency between the provisions in the SEPP Mining and those contained in any other EPI, including relevantly the Mid-Western Regional LEP, the provisions of the SEPP Mining will prevail. As discussed in **Section 4.2.1**, the application of the SEPP Mining results in the Project being permissible in Zone SP2.

The SEPP Mining also provides that underground mining is permissible with development consent on any land zoning. Accordingly, the Project is permissible with development consent on the land on which the Project will be carried out.

If development consent is granted in relation to the Project, KEPCO understands that the Deed Poll for the management of the Cemetery (as referred to in **Section 7.13.1**) shall no longer apply by operation of section 28 of the EP&A Act and clause 1.9A of the Mid-Western Regional LEP. Together, these provisions operate so as to enable KEPCO to carry out the Project despite the restrictions contained in the Deed Poll, if development consent is granted for the Project. In light of this position, KEPCO has commenced consultation with the beneficiaries of the Deed Poll and will continue to do so throughout the assessment of the Development Application for the Project.

9.7.2 Instruments Subject to Public Consultation

The relationship between the Project and the government's SRLUP has been discussed and considered as is also required by the SEARs. It has been confirmed that the Project as proposed will not have a significant impact on SAL.

9.7.3 Planning Agreement

Section 93F of the EP&A Act enables a VPA to be established which may replace the imposition of a condition under Section 94 or Section 94A. KEPCO has consulted with and made an offer to MWRC to enter into a VPA to meet the required contributions in relation to the Project under Division 6 of Part 4 of the EP&A Act.

9.7.4 Regulations

This EIS has been prepared in accordance with Part 2 of Schedule 2 of the EP&A Regulation. Indicative detailed design plans as required under Schedule 1 of the EP&A Regulation are provided in **Appendix D**. SEARs were issued for the Project under Part 2 of Schedule 2 of the EP&A Regulation on 23 June 2014 and amended by DP&E on 11 November 2014. **Section 5.4.1** lists each SEAR and indicates where each is addressed in this EIS.

No coastal zone management plan applies to the area within the Project Boundary.

9.7.5 Natural and Built Environment Impacts

This EIS provides a detailed assessment of identified potential impacts on the natural and built environments. **Section 7** provides a summary of the predicted impacts associated with the Project and the mitigation and management measures to be implemented to manage these potential impacts. The Project design minimises the environmental impacts to the natural and built environment, whilst maximising resource recovery.

9.7.6 Site Suitability

Abundant natural resources in the Hunter region and in the Western Coalfield have enabled a long history of coal mining in the vicinity of the Project.

The vast majority of the land within the Project Boundary is zoned as RU1 (Primary Production). The Sandy Hollow to Gulgong Railway Line is zoned as SP2 (Infrastructure). The various components of the Project are permissible with development consent on land within which they are proposed.

The Project is not likely to have a significant impact regarding land use trends, or be incompatible with any of those existing, approved or likely preferred uses of privately owned land surrounding the Project Boundary. A significant buffer of over 2 km exists between the proposed open cut mining areas and private residences. Further, the Project Boundary is generally surrounded by agricultural properties rather than residential areas.

The Sandy Hollow to Gulgong Railway Line and the Bylong Valley Way run through the Project Boundary providing a suitable mode for the transport for product coal (via the proposed Rail Loop) and access for employees and materials required for the Project respectively.

The Project is considered to be suited for the site.

9.7.7 Submissions

The Minister will consider any submissions made in accordance with the EP&A Act or the EP&A Regulation.

9.7.8 Public Interest

On the basis of this EIS which has quantified the Project's social and environmental impacts with scientific certainty, it is available to conclude that the Project is consistent with the objects of the EP&A Act, addresses the principles of ESD and that the economic and social benefits of the Project outweigh its social and environmental costs. As such, it is open for the Minister to conclude that the Project is in the public interest.

9.8 CONCLUSION

The Project addresses the principles of ESD, has been assessed in accordance with the EP&A Act, its '*objects*' and as required by the SEARs. This assessment has determined that it is open for the Minister to conclude that the Project is in the public interest and as such should be approved under the EP&A Act.

There are environmental impacts which have been identified with certainty and which are proposed to be acceptably managed by operational controls, negotiated agreements with landowners and management plans that would be established and adopted as approved by the Secretary of DP&E and other relevant Government agencies and authorities. Ecological impacts have been minimised during the design of the Project and will be offset by management strategies to maintain and over time, improve vegetation and ecological values in the locality.

The Project mine plan has represented a material reduction in the scale and impacts from the initial mine plan (containing up to seven open cut mining areas and large areas of underground mining) developed for the maximum recovery of coal resources within the Authorisations and justifiably sacrifices a substantial proportion of the remaining insitu coal resource from the current application.

The Project is predominantly located on land owned by KEPCO and, as proposed, is considered to meet all environmental and social requirements whilst maintaining an economic mine plan to produce coal for which there is a demonstrated need and from which material social, environmental and economic benefits will flow.

The Project will maximise the economic and social value from the extraction of the coal resource by utilising a mine plan that will appropriately address the identified environmental and socio-economic constraints and the objects of the EP&A Act, including the principles of ESD. The Project will provide net production benefits to Australia of \$596 Million (\$315 Million to NSW) and will:

- Maximise the recovery of a thermal coal resource for which there is an increasing global demand;
- Create approximately 830 direct and indirect jobs on a regional basis (MWRC LGA);
- Create approximately 1,496 direct and indirect jobs in NSW;
- Continue and extend financial support to the region, NSW and Australia with taxation and royalty benefits of \$592 Million over the Project life; and
- Achieve the most efficient economic use of the land.

The Project will generate significant economic benefits to the local region, NSW and the wider Australian economy. As a result of the extensive mine planning process, the mine plan has been carefully formulated to avoid and/or minimise environmental effects. The Project's social and environmental impacts have been avoided or minimised as far as practicable by implementing all reasonable and feasible management and mitigation measures. As a consequence, the socio-economic benefits of the Project will far outweigh its social and environmental impacts. Therefore, there is a compelling case that the Project should be found to be in the public interest.

Abbreviations

Abbreviations

Abbreviation	Description
%	Percentage
°C	Degrees celsius
A	Authorisation
ACA	Australian Coal Association
AACHMP	Aboriginal Archaeological Cultural Heritage Management Plan
AECOM	AECOM Australia Pty Limited
AGE	Australasian Groundwater and Environmental Consultants
AHIMS	Aboriginal Heritage Information Management System
AIP	<i>Aquifer Interference Policy</i>
AIS	Agricultural Impact Statement
ARI	Average Recurrence Interval
ARTC	Australian Rail Track Corporation
AS	Australian Standard
ASIR Forms	Aboriginal Site Impact Recording Forms
AUSRIVAS	Australian Rivers Assessment System
Authorisations	Authorisations 287 and 342
BCA	Benefit Cost Analysis
BoM	Bureau of Meteorology
BSAL	Biophysical Strategic Agricultural Land

Abbreviation	Description
BUPS	Bylong Upper Primary School
CEEC	Critically Endangered Ecological Community
CHPP	Coal Handling and Preparation Plant
CPP	Coal Preparation Plant (a component of the CHPP)
CIC	Critical Industry Cluster
CMHS Act	<i>Coal Mines Health and Safety Act 2002</i>
CO ₂ -e	Carbon Dioxide Equivalent
dB	Decibels
dBA	The peak sound pressure level, expressed as decibels (dB) and scaled on the 'A-weighted' scale, which attempts to closely approximate the frequency response of the human ear
DoE	Commonwealth Department of the Environment
DP&E	NSW Department of Planning and Environment
DRE	Division of Resources and Energy
DSC	NSW Dams Safety Committee
DSE	Dry Sheep Equivalent
DTIRIS	Department of Trade and Investment, Regional Infrastructure and Services
EC	Electrical Conductivity

Abbreviation	Description
EEC	Endangered Ecological Community
EIS	Environmental Impact Statement
EMP	Environmental Monitoring Program
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i>
EPA	NSW Environment Protection Authority
EP&A Regulation	<i>Environmental Planning and Assessment Regulation 2000</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i> (Commonwealth)
EPI	Environmental Planning Instrument
EPL	Environment Protection Licence
ERP	Estimated Resident Population
ESD	Ecologically Sustainable Development
g/m ² /month	Grams per square metre per month
GDE	Groundwater Dependent Ecosystem
GPS	Global Positioning System
GWh	Gigawatt hour
ha	Hectare
Hansen Bailey	Hansen Bailey Environmental Consultants
HEC-RAS	Hydrologic Engineering Centres River Analysis System
Heritage Act	<i>Heritage Act 1977</i>
HVAS	High Volume Air Sampler
ICNG	<i>Interim Construction Noise Guideline 2009</i>
IESC	Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development
INP	<i>NSW Industrial Noise Policy 2000</i>
Interim Protocol	<i>Interim Protocol for Site Verification and Mapping of Biophysical Strategic Agricultural Land</i>

Abbreviation	Description
IO	input-output economic modelling
ISO	International Standards Organisation
KEPCO Korea	Korean Electric Power Corporation
KEPCO	KEPCO Bylong Australia Pty Ltd
kg	Kilogram
kL/day	Kilolitres per day
km	Kilometres
kV	Kilovolt
LA ₁	The noise level exceeded for 1% of the time
LA ₉₀	Level exceeded 90% of the time, equivalent to the noise level representing the quietest 10% of the time, and is widely recognised as the background noise level
LA _{eq}	The A-weighted equivalent continuous, or logarithmic average, noise level over a defined time period either measured or predicted at a specific location.
LA _{max}	Predicted maximum noise level.
LGA	Local Government Area
HLLS	Hunter Local Land Services
LoS	Level of Service
LSC	Land and Soil Capability
m ³	Cubic metre
m	Metre
m/s	Metres per second
Mbcm	Million bank cubic metres
MIcm	Million loose cubic metres
MIA	Mine Infrastructure Area
MIC	Maximum Instantaneous Charge
Mining Act	<i>Mining Act 1992</i>
ML	Mining Lease

Abbreviation	Description
ML	Megalitre
ML/Year	Megalitre per year
mm	Millimetres
mm/s	Millimetres per second
MNES	Matters of National Environmental Significance
MOP	Mining Operations Plan
Mt	Million tonnes
Mtpa	Million tonnes per annum
MWRC	Mid-Western Regional Council
MWRC LGA	Mid-Western Regional Local Government Area
Mid-Western Regional LEP	<i>Mid-Western Regional Local Environment Plan 2012</i>
MW	Megawatt
NEMP	National Environment Protection Measures
NLH	Non Local Hire - workforce sourced from outside the one hour commute zone
NO ₂	Nitrogen dioxide
NO _x	Nitrogen oxides
NOW	NSW Office of Water
NPV	net present value
NPW Act	<i>National Parks and Wildlife Act 1974</i>
NSW	New South Wales
NSWMC	NSW Minerals Council
NT Act	<i>Native Title Act 1993</i>
NV Act	<i>Native Vegetation Act 2003</i>
OAS&FS	Office of Agricultural Sustainability and Food Security
OEA	Overburden Emplacement Area

Abbreviation	Description
OEHS	NSW Office of Environment and Heritage
PAC	NSW Planning Assessment Commission
PAD	Potential Archaeological Deposits
PEL	Pacific Environment Limited
PHA	Preliminary Hazard Analysis
PM	Particulate matter
PM _{2.5}	Particulate matter with a diameter less than 2.5 µm
PM ₁₀	Particulate matter with a diameter less than 10 µm
POEO Act	<i>Protection of the Environment Operations Act 1997</i>
Project Boundary	The Project Boundary to which this EIS applies
PSNLs	Project Specific Noise Levels
PVZ	Primary Viewing Zone
PY	Project Year
RAP	Registered Aboriginal Party
RBL	Rating Background Level
RGS	RGS Environmental
RING	<i>Rail Infrastructure Noise Guideline 2013</i>
RL	Reduced Level
RMS	NSW Roads and Maritime Services
RNP	<i>NSW Road Noise Policy 2011</i>
Roads Act	<i>Roads Act 1993</i>
ROM	Run of Mine
SAL	Strategic Agricultural Land
Scott Barnett & Associates	Scott Barnett & Associates Pty Ltd
SEARs	Secretary's Environmental Assessment Requirements

Abbreviation	Description
SEPP	State Environmental Planning Policy
SEPP 33	<i>State Environmental Planning Policy 33 - Hazardous and Offensive Development</i>
SEPP 44	<i>State Environmental Planning Policy 44 - Koala Habitat Protection</i>
SEPP 55	<i>State Environmental Planning Policy 55 - Remediation of Land</i>
SEPP Mining	<i>State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007</i>
SIA	Social Impact Assessment
SO ₂	Sulphur dioxide
SO _x	Sulphur oxides
SRD SEPP	<i>State Environmental Planning Policy (State and Regional Development) 2011</i>
SRLUP	<i>Strategic Regional Land Use Plan - Upper Hunter</i>
SRLU Policy	Strategic Regional Land Use Policy
SSD	State Significant Development
t	Tonne
TARP	Trigger Action Response Plan
TDS	Total Dissolved Solids
TEC	Threatened Ecological Communities
TEOM	Tapered Element Oscillating Microbalance
the Project	Bylong Coal Project

Abbreviation	Description
tph	Tonnes per hour
TSC Act	<i>Threatened Species Conservation Act 1995</i>
TSP	Total Suspended Particulates
TSS	Total Suspended Solids
µg	Microgram
µg/m ³	Micrograms per cubic metre
VCU	Visual Character Units
VPA	Voluntary Planning Agreement
VWP	Vibrating Wire Piezometers
WAF	Workforce Accommodation Facility
WAL	Water Access Licence
Wallys Road	The name denoted within this EIS (and associated technical reports) for the most eastern section of Wooleys Road.
Water Act	<i>Water Act 1912</i>
WM Act	<i>Water Management Act 2000</i>
WM Regulation	<i>Water Management (General) Regulation 2011</i>
WRM	WRM Water and Environment
WSP	Water Sharing Plan

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12

Study Team

Study Team

Table 103 lists the persons involved in the preparation of this EIS.

TABLE 103 EIS Study Team

EIS Role	Team Member and Company	
EIS Management		
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EIS Role	Team Member and Company	
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	Rory Gordon Rob Power Kane Smith Elena Miceski Cassie Jones Shaun Smith	WorleyParsons
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Peer Review - Subsidence Impact Assessment	Dr Ken Mills	SCT
Ecological Impact Assessment	Dr David Robertson Katrina Wolf	Cumberland Ecology
	Dr Stephen Bell Colin Driscoll	Eastcoast Flora Surveys
Biodiversity Offset Strategy	Dr David Robertson Katrina Wolf	Cumberland Ecology
Surface Water Impact Assessment	Dr David Newton Matthew Brody Andrew Thompson	WRM Water and Environment
Groundwater Impact Assessment	James Tomlin Neil Manwell	Australasian Groundwater and Environmental Consultants
Peer Review - Groundwater Impact Assessment	Dr Noel Merrick	HydroSimulations
Air Quality and Greenhouse Gas Impact Assessment	Judith Cox	Pacific Environment Limited
Peer Review - Air Quality and Greenhouse Gas Impact Assessment	Shane Lakmaker	Jacobs Group (Australia)

EIS Role	Team Member and Company	
Noise and Blasting Impact Assessment	Aaron McKenzie Chris Marsh	Pacific Environment Limited
Peer Review - Noise and Blasting Impact Assessment	Mark Bridges	Bridges Acoustics
Aboriginal Archaeological and Cultural Heritage Impact Assessment	Tessa Boer-Mah	RPS Australia East
Historic Heritage Impact Assessment	Geordie Oakes	AECOM Australia
Archaeological Assessment for Historical Burials	Dr Edward A K Higginbotham	Edward Higginbotham & Associates
Soil, Land Capability and Strategic Agricultural Land Assessment	Rod Masters Adele Calandra	SLR Consulting Australia
Rehabilitation Strategy and BSAL Reinstatement Strategy	Rod Masters Adele Calandra	SLR Consulting Australia
Agricultural Impact Statement	Scott Barnett	Scott Barnett & Associates
Visual Impact Assessment	John van Pelt Annette Allen	JVP Visual Planning and Design
	David Patrick	Greenpond TSG
Traffic and Transport Impact Assessment	Ryan Miller Claire Mead	Parsons Brinckerhoff Australia
Stygofauna Impact Assessment	Peter Hancock	Eco Logical Australia
Geochemistry Impact Assessment	Dr Alan Robertson	RGS Environmental
Social Impact Assessment	Bronwyn Pressland	Hansen Bailey
Economic Impact Assessment	Dr Robert Gillespie	Gillespie Economics
Economic Impact Assessment Peer Review	Drew Collins	BDA Group
Contamination Impact Assessment	Stephen Challinor	DLA Environmental
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