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Review of Integrated Bylong Project

BYLONG COAL PROJECT
Response to PAC Review Report

Hansen Bailey
ENVIRONMENTAL CONSULTANTS

REVIEW OF INTEGRATED BYLONG PROJECT

New South Wales, Australia

Prepared For

HANSEN BAILEY PTY LTD

By

John T. Boyd Company

Mining and Geological Consultants

Brisbane, Australia

Report No. 5172.001

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15 December 2017
File: 5172.001

Mr James Bailey
Director
Hansen Bailey Pty Ltd
6/127-129 John Street
Singleton NSW 2330

Subject: Review of Integrated Bylong Project

Dear Sirs

The report provides John T Boyd Company's [BOYD] independent review of specified components of the integrated Bylong Coal Project.

BOYD was engaged by Hansen Bailey, on behalf of KEPCO Bylong Australia Pty Ltd [KEPCO]. We reviewed the information provided to us relating to: the integrated project, rehabilitation of the open cut mine, the socio-economic benefits of the project, and coal market forecasts particularly relating to Bylong coal.

We appreciate the opportunity to assist you in this study. Our findings are contained herein.

Respectfully submitted,

JOHN T. BOYD COMPANY
By:

John T Boyd II
President and CEO

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TABLE OF CONTENTS

Page

1.0 GENERAL STATEMENT

1.1 Introduction

The Bylong Coal Project (Bylong, or the Project) is a greenfields thermal coal project owned by KEPCO, a subsidiary of Korea Electric Power Corporation (KEPCO Korea). Bylong is located in the Western Coalfields of New South Wales, approximately 55 km north-east of the regional centre of Mudgee and 230 km by rail from the Port of Newcastle. The location of the Project is shown on Figure 1.1, following this chapter.

The Project comprises of two coal Authorisations, acquired by KEPCO in 2010, namely A287 and A342 (the Authorisations) which encompass an area of approximately 10,317 ha. The actual project as proposed will disturb a total area of 2,875 hectares, representing just under 28% of the total area.

1.1.1 Project Overview

The Project is an integrated project consisting of the following:

1. Construction, operation and rehabilitation of an open cut mine
2. Construction, operation and decommissioning of a coal handling and preparation plant (CHPP), and
3. Construction, operation and decommissioning of an underground mine

The integrated Project has a life of 25 years. A timeline of major activities that will be undertaken over the life of the Project is shown in the following chart:

	Project 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
1	**Open Cut Mine and Infrastructure**																									
	a. Construction	■	■																							
	b. Operations			■	■	■	■	■	■	■	■															
	c. Progressive Rehabilitation					■	■	■	■	■	■	■	■													
	d. Decommissioning*											■	■													■
2	**CHPP**																									
	a. Construction	■	■																							
	b. Operations			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	c. Decommissioning																									■
3	**Underground Mine**																									
	a. Construction					■	■																			
	b. Operations**							■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	c. Decommissioning																									■

* Note that some items of infrastructure will remain as a part of reject disposal and for rehabilitation.

** Note that underground operations include roadway development.

A brief description of each of the major Project activities follows:

1. Open Cut Mine and Surface Infrastructure

a) Construction: Construction of the mine infrastructure areas, surface facilities, water and power reticulation, bore field, and development of the open cut mining areas and overburden emplacement areas (OEAs) will be undertaken during Project Years 1 and 2.

b) Operations: Open cut mining activities will commence following the completion of construction activities in Project Year 3 and continue until Project Year 10.

c) Rehabilitation: Progressive rehabilitation of the open cut will be undertaken throughout the life of the open cut. No final voids will be left on completion of the Project – all voids will be backfilled with tailings and rejects resulting from the processing of coal. Decommissioning activities will commence following the completion of open cut activities in Project Year 10. Rehabilitation of the open cut, with the exception of the Eastern Void, will be completed in Project year 12. The capping and rehabilitation of the Eastern Void area will occur progressively from Project Year 12, and will be completed during and following Project Year 25.

2. Coal Handling and Preparation Plant

a) Construction: Construction of CHPP, stockpiles, rail spur and loop and rail load out facility will be undertaken during Project Years 1 and 2.

b) Operations: Operation of the CHPP with a throughput capacity of 6 million tonnes per annum (Mtpa) of Run of Mine (ROM) coal will include the use of belt press filters to dewater the fine rejects and the co-disposal of both fine and coarse rejects in the OEAs and final open cut voids for the life of the project.

c) Decommissioning: Operation of the CHPP will extend over the life of the Project (through Project Year 25). Decommissioning of the CHPP will occur following the cessation of underground mining in Project Year 25.

3. Underground Mine

a) Construction: Development of the drifts, ventilation shafts, pit bottom, initial development headings and surface facilities for the underground longwall mine will commence at the end of Project Year 4 and continue until the end of Project Year 6.

b) Operations: Underground mining operations will commence in Project Year 7 with the development of roadways being undertaken by Continuous Miners. Longwall mining will commence in Project Year 9 and continue until Project Year 25.

c) Decommissioning: Decommissioning of the underground mine and all associated infrastructure will occur following the cessation of underground mining in Project Year 25.

Each of the above major Project activities makes an important and necessary contribution to the integrated project:

- From Project Year 3 to Project Year 6 the open cut mine will be the only source of coal for the Project.
- From Project Year 7 to Project Year 10 – a period of 4 years following construction of the underground mine – open cut and underground operations will be undertaken concurrently. This will enable the underground mine to ramp up production levels.
- From the end of Project Year 10 through to the end of mine life in Project Year 25 the underground mine will be the only source of coal.

The Project will mine 124 Mt of ROM coal over a period of 23 years (with 2 years for construction activities at the start of the project) at an average rate of 5.4 Mtpa of ROM coal, or an average of 3.9 Mtpa of product coal. Product coal will be exported from the Port of Newcastle to South Korea.

1.1.2 Development Consent Approvals Process

KEPCO is seeking State Significant Development Consent under the *Environmental Planning and Assessment Act* 1979 to develop the Project.

The Bylong Coal Project Environmental Impact Statement (EIS) based on KEPCO's integrated project mine plan was completed by Hansen Bailey Environmental Consultants (Hansen Bailey) in July 2015. Following public exhibition of the EIS between 23 September and 6 November 2015, a number of submissions were received by the NSW Department of Planning and Environment (DP&E). A Response to Submissions (RTS) was prepared and lodged with DP&E in March 2016. A Supplementary RTS was prepared and lodged with DP&E in August 2016. DP&E finalised its Assessment Report for the Project in March 2017.

The NSW Minister for Planning referred the matter to the Planning Assessment Commission (PAC) in January 2017. The PAC held public hearings in May 2017 and issued its report in July 2017.

1.2 BOYD Scope of Work

BOYD's scope of work was to review the information provided to us for the following components of the project, and to opine on the merits of the integrated Bylong Project:

1. Mine Plan, and in particular for the open cut mine, considering:
    - Practicality of mine plan, access to low ratio, higher yielding coal early.
    - Resource boundaries.

- Recovery/sterilisation of coal resources in shallow areas and potential gain/loss of socio-economic benefits.
- Impact of early cash flow.
- Location of pits to minimise visual aspects.
- Comparative aerial extent of open cut and size of dumps versus neighbouring mines.
- Ramp up to full production.
- Capital efficiency due to project life, increased total throughput.
- “Underground Only” Scenario
  - Delays or cancellation of the Project.
  - Project financial viability.

2. Environment
   - Final open cut voids strategy.
   - Progressive rehabilitation strategy.
   - Water management.
   - Open cut footprint.
   - Tailings/rejects disposal.
   - Standard of rehabilitation versus best practice nationally and internationally.

3. Coal Market Analysis
   - Demand.
   - Benefits.
   - Demand for Bylong coal.
   - Ranking versus Australian and international coal.

4. Community and Socio-economic
   - Number of direct and indirect jobs.
   - KEPCO local hiring policy.
   - Economic stimulus to region.
   - Level of support from local community.
   - Total royalties and taxes paid to Government.
   - Total wages paid to employees.

1.3 BOYD Qualifications

BOYD is a privately owned consultancy firm. We are one of the largest independent consulting firms in the world exclusively serving the coal, mineral, financial, utility, power and mining related industries. We have provided consultancy services on a continuous basis since 1943 and have worked in over 50 countries. Our full-time staff includes specialists in the analysis of geology, resources and reserves, mine planning and costs, material handling, markets, business planning, transport, and environmental issues.

We have over 70 years of expertise in completing independent technical reports, resource and reserve statements, mining plans/projections, and mine valuations; our recognised experts have qualifications in all the primary technical disciplines related to mine and transportation operations. Our full range of professional services includes:

- Geologic, reserve and mine plan modelling
- Exploration design and supervision
- Economic feasibility studies and valuations
- Fuel and energy supply planning
- Strategic business planning
- Due diligence of mining operations
- Transport issues
- Market and transport analyses
- Permitting and environmental analysis
- Asset appraisals
- Minerals industry restructuring
- Privatisation studies
- Contract negotiations
- Assessment of existing operations
- Reserve and geotechnical studies
- Technical assistance in legal matters
- Monitoring of operating companies
- Financial analysis

1.4 Disclaimer

BOYD has no ownership interest in the Bylong Project, or in KEPCO and its associated entities. Payment for our services is not contingent upon our opinions regarding the Project.

Our study was completed based on a desktop review of data supplied. BOYD assumed that all available information was developed by experienced, competent, trained professionals in each area of study.

We use the terms resources and reserves in the same context as used in the JORC Code[1]. BOYD did not evaluate alternative mine plans, neither did we re-work studies such as the generation of alternative resources or reserves, operating costs and capital estimates.

The findings and conclusions presented herein represent the independent opinions of BOYD based on available source documentation, which has been supplemented by BOYD's general industry knowledge. Our findings have been prepared in a manner consistent with prudent engineering practices and accepted industry standards.

The findings and opinions presented herein are prepared for the use of KEPCO, and are not warranted in any manner, express or implied.

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[1] Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves, The Joint Ore Reserves Committee of The Australasian Institute of Mining and Metallurgy, Australian Institute of Geoscientists and Minerals Council of Australia, 2012 Edition

Following this text is Figure 1.1, General Location Map.

Respectfully submitted,

JOHN T. BOYD COMPANY
By:

Hugh Morrison
Principal Mining Engineer

William Wolf
Vice President, Business
and Market Analysis

Ian Alexander
Managing Director – Australia

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FIGURE 1.1
GENERAL LOCATION MAP
Showing
BYLONG COAL PROJECT
SYDNEY BASIN
New South Wales, Australia

Prepared For
HANSEN BAILEY PTY LTD

John T. Boyd Company
December 2017
Scale 1 : 2,000,000

P:\CAD_GROUP-jfg\5172.001\FIGURE 1.DWG

2.0 EXECUTIVE SUMMARY

2.1 Introduction

The Bylong Coal Project is a greenfields thermal coal project located in the Bylong Valley in New South Wales, Australia. The Project is an integrated project consisting of an open cut mine, an underground mine, a CHPP and associated infrastructure.

The Bylong Valley is recognised for its heritage, social and environment values.

The Project has been the subject of a staged and systematic study and evaluation process undertaken over a number of years, commencing in 2011. The process followed is an established and sound project evaluation used by mining companies throughout the world. Significant changes were made to the open cut and underground mine plans to avoid or minimise social, visual and heritage impacts, maximise environmental protections whilst balancing the delivery of an economic return and optimising State-owned resource recovery. Studies have continued throughout 2017.

The Project will have a life of 25 years, with 2 years of construction followed by 8 years of open cut operations. The underground longwall mine will overlap with the open cut for a period of 3 years and, following the end of open cut mining, will be the source of all coal to the CHPP. The open cut will mine coal resources that are too shallow and too difficult to feasibly recover via underground methods. The strategically located underground longwall mine will mine deeper coal resources. Production will remain relatively consistent peaking at 6.5 Mt ROM and will be washed in a centrally located CHPP. A total of 90 Mt of thermal coal will be exported to South Korea for consumption by KEPCO's power generator subsidiaries (KEPCO GENCOS).

2.2 BOYD's Findings

1. BOYD considers that the Bylong Project is a practical proposal that:

    - Utilises well established and proven responses to environmental protection to minimise potential impacts on social, visual and heritage values; it optimises the recovery of State-owned coal resources; it is feasible; and it can be achieved within known environmental and mining constraints.

    - Provides substantial social, employment and economic benefits to the local area, NSW and the broader community.

2. The open cut is integral to the Project and will provide substantial benefits, namely:

    - Increased recovery of 33 Mt ROM coal from mining efficiencies.

- Long term, low environmental impact facilities for both water management and tailings/rejects disposal.
- Increased revenue and accelerated output provide early cash flows and lasting economic benefit to the Project.
- Socio economic benefits through direct employment (average 194 FTE) and significant royalty payments to NSW.

3. There is a clear demand for Bylong coal:

   - KEPCO has advised that all coal from the Project will be consumed by its five subsidiary power generators.
   - Bylong coal properties are compatible with product quality delivered to the international thermal coal market and consumed by KEPCO GENCOS.
   - 2017 forecasts by the International Energy Agency and Australian Department of Industry Innovation and Science indicate an ongoing dependence on coal generated power with global coal demand increasing 90 million tonnes of coal equivalent, or 10%, by 2040 due to increasing overall energy demand notwithstanding changing market dynamics.

4. Responsibility by KEPCO for environmental, social, visual and heritage management, mitigation and controls are demonstrated through:

   - KEPCO's commitments to minimise environmental, social, visual and heritage impacts, by:
     - Constraining Project activities to avoid impacts and minimise to areas of disturbance.
     - Progressive project rehabilitation with 52% of the disturbance area rehabilitated by the end of Project Year 12, minimising the risk of outstanding rehabilitation liabilities in the highly unlikely event that KEPCO does not continue operating Bylong.
     - Managing the operations to preclude environmental risk associated with tailings dams.
     - Leaving a final landform containing no voids.
   - A commitment to exceed current industry standards.
   - The systems and practices proposed are well established across the international mining industry.

5. A hypothetical scenario – restriction of the Project to an "underground only" mine by excluding open cut operations – was assessed at a high level and showed that:

   - Project value was substantially reduced to a level BOYD considers to be economically unsustainable, with a Net Present Value of $25M for the investment of $1,314M – or a Rate of Return of only 2%.

- The "underground only" scenario compared to the proposed integrated Project had the project life reduced by four years; revenue decreased by 30% or $3.2B; and Net Present Value (NPV) reduced by 93%.

- 33 Mt ROM or 26 Mt product coal was sterilised. These are viable State-owned coal resources and comprise 29% of the total product coal.

- Additional disturbance areas are required under this scenario to accommodate infrastructure for water storage and tailings/rejects disposal, increasing potential environmental risk and long term visual landscape impacts.

- The scenario introduces significant risk to the Project which if mandated, may not proceed, negating any benefit to stakeholders including the local community, and the NSW and Commonwealth Governments, due to:

  - Additional Project approval delays.
  - Unacceptable project returns and margins.
  - Increased environmental risk due to the additional surface storages.

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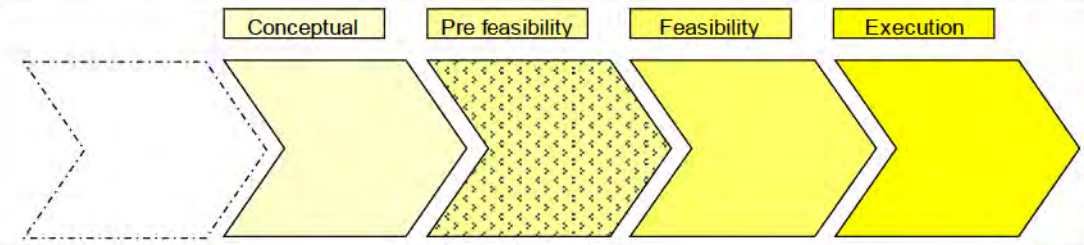
3.0 REVIEW OF MINE PLAN

3.1 Project Evaluation

3.1.1 Project Stages

The following figure developed by BOYD provides a summary of the standard staged approach to project evaluation and development adopted by mining companies to address the technical, economic and commercial feasibility of a mining project. It follows a traditional engineering project management methodology to provide sufficient detail, rigour and due diligence.

STAGES OF A PROJECT



CONSIDERED OPTIONS	Multiple	Few	One	One
LEVEL OF ACCURACY	+/- 30 to 35%	+/- 20 to 25%	+/- 10 to 15%	+/- 5 to 10%
QUANTITIES ESTIMATES		**Basis of Estimate**		
Resources/Reserves	Indicated	Probable	Proved/Probable	Proved/Probable
Geology	Preliminary	Preliminary	Detailed	Detailed
Geotechnical	Preliminary	Preliminary	Detailed	Detailed
Modelling	Limited	Preliminary	Detailed	Detailed
Mine Plan	Initial	Preliminary	Detailed	Detailed
Mine Schedule	High Level	Approximated	Detailed	Final - Yr 1; then firm
CAPITAL COST ESTIMATES				
Equipment	Factorised	Single check price	Multiple quotes	Fixed price
Civils/Structural/etc	Sketch	Take-off sketch	Quotes	Tender
Labour	Factorised	Assumed	Evaluated	Evaluated
Contingency	+/- 20 - 25%	+/- 15 - 20%	+/- 10 - 15%	+/- 5 - 10%
OPERATING COST ESTIMATES				
Estimate Method	Factorised	Preliminary	Known	Known
Cost Rates	Data bank	Budget quotes	Firm quotes	Firm quotes
Staffing	Factorised	Preliminary	Detailed	Known

1. Stage 1: Conceptual Study. At this level of study information is generally sketchy and limited. A number of options may be considered. The aim of the study is to determine whether there are economic and technical benefits to proceeding with the project, and identify further technical studies that are required prior to proceeding to the next stage of evaluation.

2. Stage 2: Prefeasibility Study. This level of study is undertaken following the generation of additional studies and is at a greater level of detail than that undertaken in a concept level study. It will generally consider a few preferred options and the technical and economic benefits to proceeding further are

identified. Further studies that are required prior to proceeding to a feasibility study will be identified.

3. Stage 3: Feasibility Study. The feasibility study aims to optimise the design scenarios and select a single go-forward option on completion. The objective of the study is to demonstrate, with supportive data and information, that the project objectives have been met.

4. Stage 4: Execution. The execution phase incorporates development of the project with the method of establishing the capability to commission, start-up and operate the proposed mine facility.

3.1.2 Project Investment Evaluation

All large transnational companies evaluate projects which require the investment of large amounts of capital. The competing projects are located in different parts of the world, have diverse risk profiles, dissimilar project lengths and varied financial outcomes.

Large companies all have investment evaluation processes in place to identify, screen, prioritise and evaluate all potential investments. The intention of the investment processes is to ensure evaluation consistency, and promote projects, which are all competing against each other for investment funding, that create value and achieve approved business objectives. The processes ensure that projects are aligned with the company's goals and achieve optimal returns.

Individual companies have different approvals criteria however they all include social, environmental, regulatory and financial metrics. Social, environmental and regulatory metrics are non-discretionary gates – the company's standards have to be met for the project to proceed. Financial metrics include Net Present Value (NPV), rate of return, payback period, operating costs, and capital efficiency ratios. The financial criteria generally include set minimum hurdles which all projects being evaluated have to meet.

Since each project not only has to meet the set minimum hurdles but also competes against every other project for scarce capital, it is only projects that meet all the company's criteria, and which provide the highest financial returns, that attract investment. Projects that fail to meet the criteria do not proceed.

Throughout the course of a project's development stages (see previous section) approvals criteria continue to be reviewed and must be met, i.e. approval of a project at an earlier stage of a project such as at a Feasibility Study Stage does not automatically result in Execution of the project. The project will be reviewed to ensure that all criteria are still valid and have been met prior to Board approval being provided.

3.2 Bylong Project Planning and Evaluation Studies

The Bylong Project has been the subject of a staged and systematic study and evaluation process undertaken over a number of years as summarised below:

Project Evaluation Stage	Year of Study
Concept Study	March 2011
Prefeasibility Study	July 2012
Mine Options Study	October 2013
Feasibility Study	September 2014

Over this period, knowledge of the Bylong deposit increased as a result of additional exploration being undertaken. Between May 2011 and December 2017, a total of 587 exploration bore holes were drilled. These exploration efforts supplemented the 53 boreholes drilled between 1972 and 1984, and the 27 bore holes drilled by Anglo Coal between 2003 and 2011.

A number of options were assessed during the project evaluation process:

1. The Concept Study indicated the potential for both open cut and underground resources suitable for extraction. Eight (8) open cut pits and extensive bord and pillar underground mining formed the basis for the study. The Coggan Seam was identified as the primary target with reasonable to favourable coal quality. Potential environmental constraints were identified as being: visual, cliffs, rivers, alluvial land and productive farmland[1].

2. The Prefeasibility Study (PFS) was completed with the primary objective of maximising coal output. The PFS included four (4) underground areas and seven (7) open cut areas across the whole area of the authorisations. Output was 10 Mtpa ROM coal.

3. The Options Study was undertaken following completion of the PFS and engagement with a number of stakeholders who expressed concerns and likely approvals issues. In recognition of the Project's impact on environmental, social, visual and heritage concerns, the open cut footprint was reduced significantly and the infrastructure was relocated.

   A total of seven (7) different open cut and underground options were examined. These included underground mining only, and combinations of underground mining and open cut mining with varying timing and open cut mining quantities.

   The option determined to be the most feasible, which balanced environmental, social, visual and heritage imperatives against the recovery of State-owned coal resources and adequate economic returns to KEPCO, was an integrated open cut and underground mining option. The option consisted of a relatively small open cut mine based on comparative industry standards that commenced in Project Year 3 and concluded in Year 10, with longwall underground mining commencing in Project Year 7. This option formed the single "go forward" case that was progressed to Feasibility Study (FS).

[1] p6 Bylong Coal Project Feasibility Study, Parsons Brinkerhoff, September 2014

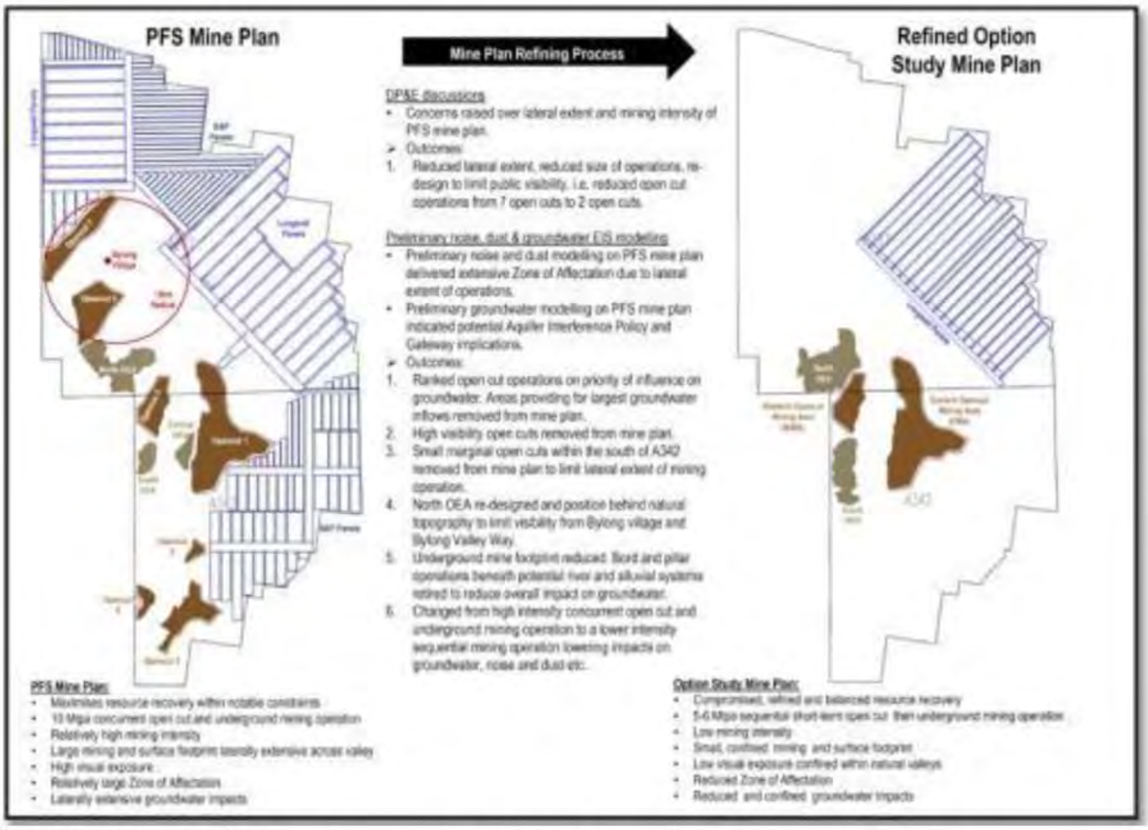
4. The FS analysed the "go forward" case to greater levels of detail, and formed the basis for the subsequent project submission.

BOYD considers that KEPCO's project evaluation process and study progression was undertaken in accordance with established and sound project evaluation methods used by mining companies throughout the world.

BOYD is unaware of KEPCO's project evaluation criteria, however we opine that in common with all other transnational companies we are familiar with, that Bylong not only has to meet KEPCO's social, environmental, regulatory and financial metrics, but has to compete with other projects elsewhere in the world that require capital expenditure funding. We also consider it likely that KEPCO will need to approve the transition of Bylong from Feasibility Study Stage to an Execution Stage. That approval is yet to be provided and will be based on a full review of the Project against KEPCO's internal evaluation criteria and other competing projects.

3.2.1 Changes to Overall Bylong Mine Plan Footprint

The Bylong Project is an integrated project consisting of an open cut mine and an underground mine. The following figure[2] clearly shows the significant difference in the mine plan footprints (open cut and underground) between the PFS and the Feasibility Study or "go forward" case.



[2] p9 Mine Plan Justification Report, Mine Advice, Appendix E, Bylong Coal Project Environmental Impact Statement, Hansen Bailey Environmental Consultants, September 2015

The figure on the previous page shows the PFS mine plan in the schematic on the left, included four underground areas which are shown in blue, and seven open cut areas which are shown in brown. The “go forward” case that progressed to Feasibility Study, as can be seen in the schematic on the right, shows the large reduction in extent of the underground mine and the open cut area. Case critical geological exploration, to deliver reliable data, was then conducted thus reducing significant project risk. Since then project studies have been ongoing continuing into 2017.

KEPCO made significant changes to the open cut and underground mine plans to avoid or minimise social, visual and heritage impacts[3], maximise environmental protections whilst balancing the delivery of an economic return and optimising resource recovery, including[4]:

- The mine infrastructure area (MIA) and OEAs were positioned within previously cleared land to minimise impacts to sensitive native vegetation and habitat features. The MIA was positioned adjacent to the existing rail infrastructure and to the proposed open cut areas to minimise the amount of clearing of flora and fauna. The CHPP was sited within the rail loop to further reduce the disturbance footprint.
- The footprint of the OEAs was adjusted and reduced to avoid a population of *Tylophora linearis* which is listed as Endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)[5].
- The duration during which open cut mining was undertaken was reduced.
- Progressive rehabilitation was implemented to reduce the visual effects of mining.
- Iconic topographic areas were retained.

The change in the open cut mine plan down to only two mining areas reduced surface disturbance by 46%[6]. The utilisation of total coal resources on the Authorisations has been impacted substantially with changes in the mine plan. The following table shows the difference between the quantities of coal reported in the Resource Statement, the PFS and the FS respectively:

	Resources (Mt insitu)	PFS[7] (Mt ROM)	FS (Mt ROM)	Utilisation Change PFS to FS %
Open Cut	392	68	33	48
Underground	483	161	91	56
Total	874	228	124	54

[3] p292 Main Report, Bylong Coal Project Environmental Impact Statement, Hansen Bailey Environmental Consultants, September 2015
[4] p164 ibid
[5] p160 ibid
[6] Presentation titled Open Cut Mine Justification, Bylong Coal Project, Internal Document, KEPCO, 16 October 2017
[7] p8 Mine Plan Justification Report, Mine Advice, Appendix E, Bylong Coal Project Environmental Impact Statement, Hansen Bailey Environmental Consultants, September 2015

The change of mine plan footprint between the PFS mine plan and the FS mine plan, resulted in the total quantity of ROM coal being recovered reducing from 228 Mt to 124 Mt, a reduction of 46%.

BOYD opines that the adjustments made to the mine plan have resulted in the Project balancing important environmental, social and visual imperatives against overall recovery of State-owned coal resource and adequate economic return to KEPCO.

3.2.2 FS Project Development and Operations Schedule

The following timeline shows major activities that will be undertaken over the life of the Project:

	Project 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
1	**Open Cut Mine and Infrastructure**																									
	a. Construction	■	■																							
	b. Operations			■	■	■	■	■	■	■	■															
	c. Progressive Rehabilitation					■	■	■	■	■	■	■	■													
	d. Decommissioning											■	■													■
2	**CHPP**																									
	a. Construction	■	■																							
	b. Operations			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	c. Decommissioning																									■
3	**Underground Mine**																									
	a. Construction					■	■																			
	b. Operations							■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	c. Decommissioning																									■

3.2.3 Development Consent Submisson

KEPCO is required to demonstrate to the NSW Department of Planning and Environment, Division of Resources & Geoscience (DP&E) that the Bylong proposal is: practical; feasible; optimises resource utilisation; and can be achieved within known environmental and mining/production constraints[8].

KEPCO based its application for a State Significant Development Consent on:

- A Resource Statement and a Reserves Statement in accordance with the JORC Code.
- An FS that assessed the technical and economic requirements of the Project.
- An EIS supported by Supplementary Studies and Reports. These were developed in a staged process which included public displays and presentations and receipt of submissions from stakeholders. The proposed plan has integrated key criteria drawn from consulting with stakeholders and planning requirements and guidelines and has identified key issues and any major constraints to the Project.

[8] http://www.resourcesandenergy.nsw.gov.au/miners-and-explorers/applications-and-approvals/mining-and-exploration-in-nsw/project-approvals/development_plans

The FS underpins the EIS and the assessments supporting the State Significant Development application (i.e., the Mine Justification Reports, Response to Submissions, and Supplementary Response to Submissions). A number of important technical assessments have been peer reviewed to verify the reasonableness of their findings, in particular Subsidence, Groundwater, Air Quality, Noise, Economic and Social Impact Assessments.

In addition to the conditions that may be attached to any State Significant Development Consent granted, KEPCO has identified and committed to the operational controls summarised in the Management and Monitoring Summary in the EIS and subsequent approvals documents. These commitments aim to ensure that potential environmental impacts are minimised and managed by relevant monitoring, management and mitigation strategies. These commitments will form the basis of a Statement of Commitments and are likely to be attached as an Appendix to any Development Consent for the Project.

3.3 Integrated Bylong Project – Open Cut Mine

3.3.1 Operational Benefits

Open cut operations using flexible excavator and truck methodologies will be undertaken over a period of eight years, following two years of construction. The open cut will produce coal early in the life of the Project resulting in significant financial benefits.

The open cut will provide the following operational benefits:

- Increases coal resource recovery.
- Rapid access to low strip ratio, low cost coal within the first year of overburden removal in Project Year 3. Targeting areas of shallow depth to coal provides low cost coal early in the life of the Project. The use of contractors who provide their own equipment reduces capital expenditure. This has an immediate and lasting effect on the economics of the Project.
- Provides early cash flow with a relatively low capital requirement.
- Provides cash flow between Project commencement and construction of surface infrastructure and services, and the period required to commission and ramp up the underground longwall to full production[9].
- Provides voids to dispose of tailings and rejects from the Coal Handling and Beneficiation Plant (CHPP) negating the need to construct and maintain above ground tailings and rejects disposal areas.

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[9] p36 Main Report, Bylong Coal Project Environmental Impact Statement, Hansen Bailey Environmental Consultants, September 2015

- The voids provide water storage locations where excess water will be stored when required to ensure the nil discharge commitments are met.
- Extends the Project's lifespan and the utilisation of infrastructure.
- Over the life of the Project, 29% of product coal is supplied by the open cut:

	ROM Coal (Mt)	Product Coal (Mt)	Product Coal Percent of Total
Open Cut	33	26	29
Underground	91	64	71
Total tonnage	124	90	100

3.3.2 Resource Recovery Benefits

KEPCO will operate the open cut mine using excavator-truck equipment. The operating flexibilities provided by excavator-truck methods will result in the extraction of 33 Mt of ROM coal or 26 Mt product coal. A large proportion of this coal cannot be mined by underground mining methods due to:

- Shallow Depth of Coal: The coal resources that will be recovered by the open cut mine are too shallow to be extracted by underground longwall mining. The thickness of competent roof required for underground mining (typically 20 – 24 m) and the depth of weathering which is up to 30 m in some areas, precludes underground mining of all the Western Pit area and a large portion of the Eastern Pit area. The targeted open cut coal resources are generally too shallow to be extracted by underground longwall mining
- Proximity of Coal Seams: The proximity of one seam to an over/underlying seam can prevent mining of the both seams, notwithstanding that seam depth and surface constraints may enable underground mining to be undertaken, such as at the southern extent of the Eastern Pit. The Coggan and Ulan seams lie in close vertical proximity to each other (interburden ranging from 0.5 – 7.4 m across the project area)[10] which precludes mining of both these seams using underground longwall mining methods. The use of open cut mining will result in the recovery of both seams, resulting in higher quantities of coal being recovered.
- Coal Seam Thickness: The flexibility of open cut mining enables the selective extraction of thinner coal seams with the inter-seam material discarded in pit. 55 – 60% of the target plies are 0.3 – 1 m thick[11] . Whilst Ulan Seam plies and Glen Davis Seam can be mined using open cut mining, these are too thin to be mined using underground mining methods.

  In Australia coal seams/plies less than approximately 2.0 m thick are generally considered to be too thin to be efficiently mined using underground mining methods.

[10] p15 Vol B Geology, Bylong Coal Project Feasibility Study, Parsons Brinkerhoff, , September 2014
[11] p397 Vol C Open Cut Mining, Bylong Coal Project Feasibility Study, Parsons Brinkerhoff, September 2014

- Selective Mining: The open cut mine plan includes selective mining of the Ulan and Coggan seams. This will enable some better quality coal plies to be selectively mined and sold on an as-mined basis (without washing). The as-mined coal bypasses the CHPP with nearly 100% recovery avoiding additional costs. This affords the following opportunities:

  - Higher recovery of the coal resource (increased efficiency).
  - Increased product coal tonnages.
  - Increased revenue and royalties.
  - Reduction in the quantity of rejects handled and disposed.
  - Reduction in the water required for coal processing.
  - Reduction in the volume of PAF material to be managed.

  Selective mining is only available using open cut mining. The bypass coal may be blended or sold on a stand-alone basis depending on contract requirements. BOYD estimates that 14 Mt or 16% of the total 90 Mt product coal may be supplied as bypass coal.

3.3.3 Environmental Effects

Evaluation of the open cut mining areas was undertaken to ensure compatibility with social, environmental and economic impacts. This resulted in five (5) of the seven (7) open cut mining areas originally identified in the PFS not being included in the "go forward" case. The two areas that will be mined using open cut methods have a strip ratio (defined as the total cubic metres of overburden required to be moved for each tonne of coal) that is relatively low (4.6:1 average) which is lower than the NSW open cut mines average (July 2015 – June 2016) of 4.8[12]. The low strip ratio enables:

- A reduction in the mine's operating footprint, which in turn reduces the environmental impacts and assists with the timing for rehabilitation being undertaken.
- A reduction in the volume of overburden to be moved, which reduces the size of the equipment fleet, reduces the need and quantum of blasting, reduces the sources of dust and noise and reduces the quantity of water needed for dust suppression.
- A reduction in the size (footprint and height) of the OEAs.
- A reduction in operating costs resulting from the removal of less waste per product tonne, improving economic viability of the Project.

The open cut will be progressively rehabilitated over the life of the operation.

The proposed Bylong open cut operations are located adjacent to or in the vicinity of a number of surface features: Bylong town, water courses, valley areas, alluvial flood plains, aquifers, Tal Tal Mountain, equine critical industry clusters (CIC), areas that

[12] BOYD internal database, compiled from Coal Services – NSW Black Coal Production Statistics to June 2016

utilised natural selection farming, heritage features such as Tarwyn Park, visual features such as rock escarpments and cliff lines and biophysical strategic agricultural land (BSAL).

Recognising the significance and sensitivity of the features KEPCO plans to minimise environmental impacts from the open cut and has committed to the following strategies to mitigate and manage impacts:

- No final voids will remain in areas disturbed by open cut mining.
- Operating voids are utilised for tailings and rejects storage facilities avoiding the need for additional dams and storages
- Constrain the open cut project life to eight years with progressive rehabilitation being undertaken to enable timely rehabilitation of disturbed areas.
- Target mining of areas previously impacted by activities (agriculture, industry or residential) and are already cleared therefore reducing impacts on natural vegetation.
- Position the extent of the OEAs and infrastructure footprints to minimise impacts on BSAL.
- Adopt low angle visual slopes on the final surfaces of overburden emplacement areas.
- Ensure that mine operations are located more than 2 km from the village of Bylong. All properties that may be impacted have been purchased by KEPCO.
- Constrain the footprint of and maximum heights of the OEAs to strategically utilise the neighbouring topography and native vegetation to shield open views of the mining areas from the Bylong Valley Way and privately owned properties, and to maintain a landform which integrates with the surrounding natural landscape features.
- Sequence development of the OEAs to screen mining operations from Bylong village and public roads.
- Locate mining pits to stand off 150 m from alluvial aquifers, and watercourses and avoid the need for watercourse diversions
- Develop a final landform design which integrates with the surrounding natural landform, maximises surface water drainage, contains no final void and is capable of supporting agricultural uses consistent with those in place prior to mining operations.
- Schedule disturbed areas to generally be reshaped within one year of overburden emplacement and rehabilitated to the target LSC Classes, with BSAL reinstatement a priority.

- Implement a Biodiversity Offset Strategy (BOS) that includes, but is not limited to the following:
  - Prepare and implement a Biodiversity Management Plan[13].
  - Mitigate the impact on native vegetation by offsetting the 753 ha[14] of native vegetation impacted by the Project with more than 2,380 ha[15].
  - Provide appropriate long term security for identified offset areas and lodge a conservation bond[16].
- Implement a number of management plans, including[17]
  - Historic Heritage Management Plan.
  - Strategic Property Conservation Management Plan.
  - Blast Management Plan.
  - Rehabilitation and Biophysical Strategic Agricultural Land Reinstatement Strategy.

KEPCO's commitments to prevent and/or minimise material harm to environment together with performance conditions are described in the draft Development Consent[18].

The following table summarises the mine design provisions for surface features:

Barrier/Control	Mine Design Provision
Increase separation or stand-off distances	- Strategically locate mining pits, emplacement areas and infrastructure.
Barriers/levees adjacent to water courses	- Place open cut crests above 1:1,000 year flood levels.
Minimise mining activity and impacts	- Locate mine infrastructure areas and spoil emplacements to have minimal footprints. - Place the CHPP inside the rail loop. - Locate the rail loop adjacent to the rail network. - Strip and store BSAL soil resources prior to mining for reclamation and rehabilitation. - Raise spoil dump elevations – with limitations so as to not visually impact the landscape – thereby reducing footprint for the same volume. - Dispose rejects material within waste/spoil emplacements. - Selectively position ex-pit spoil emplacements using existing features for a visual screen and minimise impacts on BSAL. - Reduce the number of pits from 7 to 2

[13] p23 Development Consent, Appendix M, State Significant Development Assessment, Bylong Coal Project (SSD-6367), Assessment Report, NSW DP&E, March 2017
[14] p161 Main Report, Bylong Coal Project Environmental Impact Statement, Hansen Bailey Environmental Consultants, September 2015
[15] p21 Table 10, Appendix M - Development Consent, State Significant Development Assessment, Bylong Coal Project (SSD-6367), Assessment Report, NSW DP&E, March 2017
[16] p24 ibid
[17] Bylong Coal Project PAC Presentation, May 2017
[18] p33 Bylong Coal Project – SSD-6367 Preliminary Assessment Report – Appendix M, 2017

BOYD considers that the open cut plan is sound, and that prudent, practical measures have been adopted to protect the environment, and to minimise potential impacts on social, visual and heritage values. KEPCO's commitments are consistent with established practices used by mining companies throughout the world.

3.4 Integrated Bylong Project – Underground Mine

The underground mine will target the Coggan Seam which varies in depth in the project area ranging from <90 m to >270 m[19] precluding the use of open cut mining methods. Longwall mining is feasible.

3.4.1 Operational Benefits

Underground operations will be conducted over a period of 19 years with mined coal beneficiated by the CHPP. The underground will continue to produce coal after closure of the open cut. It will provide the following operational benefits to the integrated Project:

- Access 91 Mt of ROM coal in the Coggan Seam that cannot be feasibly accessed by open cut means.
- Approximately 71% of the total 90 Mt of product coal produced by the Project is coal recovered from the underground.
- Significantly extends Project life:
  - Development of the underground mine will commence in Project Year 7, with longwall mining commencing in Project Year 9 and continuing through to Project Year 25.
  - Utilisation of capital infrastructure and installed services is extended.

3.4.2 Resource Recovery Benefits

The underground will recover 91 Mt of ROM coal in the Coggan Seam that is not practically recoverable by open cut mining methods, and is environmentally acceptable. The excessive depth of overburden to Coggan Seam generally results in open cut mining being uneconomic within these underground areas.

3.4.3 Environmental Effects

The underground mine is designed to minimise direct surface disturbance impacts.

- It is positioned to avoid potential impacts to significant surface features such as cliff lines and rock structures.

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[19] p105, Vol D Underground Mining, Bylong Coal Project Feasibility Study, Parsons Brinckerhoff, September 2014

- Levels of subsidence will vary across the subsidence study area from less than 20 mm to a maximum of 3,300 mm[20]. Remediation of surface cracks will be undertaken in accordance with standard industry practice. The disturbance area due to cracking is expected to be less than 10% of the subsidence study area.

- Reaches of the western end of Dry Creek, an ephemeral creek, are expected to experience ponding between 50 to 100 m in length and up to 1 m in depth. Bed cracking will be sealed and compacted, and ponded areas drained if required. Rehabilitation of the riparian corridor will be a key component.

- Groundwater inflows to the underground workings are modelled to be higher than those for the open cut due to the larger footprint, hydraulic gradients and the effects of hydraulic fracturing overlying the underground mine.

- Groundwater impacts and management were initially assessed in the EIS. Following further monitoring, field investigations and numerical modelling, groundwater inflows were reassessed in the Supplementary Response to Submissions in August 2016[21]. Modelled groundwater inflows are predicted to average 2,104 ML/year over the life of the underground, peaking at 4,099 ML in Project Year 23[22]. Excess water will be pumped to the water storage areas in the open cut void.

- Rejects and tailings resulting from the processing of underground production will be disposed of in the open cut void, precluding the need for additional surface disposal areas. The voids are planned to be utilised as storage areas for excess mine water if required, removing the need to construct large surface dams. This strategy reduces both potential environmental risks and longer term visual impacts.

The following table provides a summary of the mine design provisions adopted to minimise environment impacts:

Barrier/Control	Mine Design Provision
Increasing separation or stand-off distances to surface features	- Include a 40 m[23] subsidence barrier for alluvials. - Increased subsidence angle to 35°[24] (from 26.5°) for sensitive cliff features.
Minimise mining activity and impacts on surface features	- Locate mine infrastructure areas to minimise footprint. - Drive underground drifts to access the underground mine areas instead of excavating a box cut. - Strategically position underground mains roadways to minimise subsidence areas and sensitive surface areas. - Dispose of rejects and tailings in open cut void.

[20] p12 Mine Plan Justification Report, Mine Advice, Appendix E Bylong Coal Project Environmental Impact Statement, Hansen Bailey Environmental Consultants, May 2015
[21] p1 Table 6-8, Response to Submissions on Groundwater, Australasian Groundwater and Environmental Consultants, Appendix J, Supplementary Response to Submissions, Bylong Coal Project Environmental Impact Statement, Hansen Bailey Environmental Consultants, August 2016
[22] p78 ibid
[23] p12 Mine Plan Justification Report, Mine Advice, Appendix E Bylong Coal Project Environmental Impact Statement, Hansen Bailey Environmental Consultants, May 2015
[24] p16, Vol D Underground Mining, Bylong Coal Project Feasibility Study, Parsons Brinckerhoff, September 2014

Barrier/Control	Mine Design Provision
	- Utilise existing infrastructure and services – CHPP, infrastructure, roads. - Maintain a consistent level of mine output to minimise expansion of services. Utilise installed services and infrastructure capacity provided for the open cut.

The impact on disturbance areas attributable to the various components of the integrated project is summarised in the table in Section 4.2.2. As would be expected from an integrated project, the two mining stages utilise common areas and therefore have common areas of disturbance.

BOYD considers that the underground plan is sound, and that prudent, practical measures have been adopted to protect the environment, and to minimise potential impacts on social, visual and heritage values. KEPCO's commitments are consistent with established practices used by mining companies throughout the world.

3.4.4 "Underground Only" Scenario

BOYD reviewed the "underground only" scenario presented within the Response to Submissions, March 2016[25] and the Supplementary Response to Submissions, August 2016[26] in order to determine the financial impact of simply excluding the open cut mine. It was assumed that coal will only be mined from the existing proposed underground mining area. As noted in the Supplementary RTS, the hypothetical scenario was investigated for comparison purposes only and does not represent a fully engineered or planned alternative underground only option for the Project. It would represent a considerable change from the current development application.

A comparison of the integrated Project against the hypothetical "underground only" scenario demonstrated the following differences:

- Decrease in overall ROM coal mined from 124 Mt to 91 Mt[27], a reduction of 33 Mt ROM, or -27%.
- Reduction in product coal from 90 Mt to 64 Mt [28], a reduction of 26 Mt, or -29%. The relative impact on product coal is higher due to the higher yield (78%) of coal produced from the open cut.

[25] Supplementary Mine Plan Justification Report, Mine Advice, Appendix G Response to Submissions, Bylong Coal Project Environmental Impact Statement, Hansen Bailey Environmental Consultants, March 2016
[26] Mine Plan Justification Report – Additional Supporting Information, Appendix A Supplementary Response to Submissions, Bylong Coal Project, Environmental Impact Statement, Hansen Bailey Environmental Consultants, August 2016
[27] Supplementary Mine Plan Justification Report, Mine Advice, Appendix G, Response to Submissions, Bylong Coal Project Environmental Impact Statement, Hansen Bailey Environmental Consultants, March 2016
[28] ibid

- Reduction in personnel. The underground will employ 240 FTEs[29] and the CHPP[30] will employ 35 FTEs following construction. Personnel employed in the open cut - an average of 194 FTEs (peaking at 245) will not be required.

- Requirement to construct above ground plant rejects disposal facilities for approximately 14 Mlcm[31] of tailings and rejects that would otherwise have been disposed of in the open cut and Eastern Void. This could require an area of approximately 153 ha[32] and likely be located in the former OC disturbance area.

- Requirement to construct excess mine water storage structures to handle at least 1,350 ML[33]. This could require an area of approximately 45 ha and likely be located in the former OC disturbance area.

- Increased risk to local waterways and aquifers from seepage, overtopping or structural failure by constructing above ground tailings dam structures. The lack of an above ground tailings dam entirely removes the risk of tailings dam structural failure.

- Reduction in revenues and royalties.

Using information provided to us, BOYD prepared a high level financial analysis to highlight the difference between the integrated Project as proposed by KEPCO and the hypothetical "underground only" scenario presented within the Supplementary Response to Submissions report. The model replicated the integrated Project as proposed and was used in our previous report[34].

BOYD considers that our financial analysis reasonably replicated the results of the more detailed Feasibility Study model, being slightly more conservative in its forecast results. The results of our analysis were undertaken independently and will be marginally different to the information presented within the EIS and other approvals documents, as identified within the PAC Review Report. Notwithstanding this, we consider that our analysis provides a valid comparison between the integrated Project and the hypothetical "underground only" scenario.

The financial assumptions used by BOYD, included an average coal price of US$100/tonne over the life of the Project, with discounts applied to high ash and moderate ash products. All costs are reported on an undiscounted basis.

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[29] Bylong Project Worksheet 160608B HB Revised Workforce Tables
[30] ibid
[31] p9 ibid
[32] p16 ibid
[33] p14 ibid
[34] Appendix 6, Applicants Further Submission to Planning Assessment Commission, Appendix C, Independent Mine Plan Peer Review Bylong Project, Project 5172.000, John T Boyd Company, May 2017

A comparison of BOYD's financial assessment of the proposed integrated Project with the hypothetical "underground only" scenario indicated the following differences:

- Mine life reduced by four years, assuming that all construction activities were undertaken in parallel.
- Product coal tonnage decreased by 29% to 63 Mt.
- Revenue decreased by 30%.
- Positive cash flow is delayed. In the integrated Project this occurred in Project Year 4, whilst in the "underground only" scenario it is cash flow positive five years later (in Project Year 9) due to the accelerated timing of significant levels of capital expenditure for the underground.
- Royalty payments to the NSW Government decreased by 27%.
- Total mine costs (FOB/t product) only decreased 4% in comparison to the integrated Project. This decrease was the result of the exclusion of open cut mining costs which were prepared assuming supply of mining equipment and relevant infrastructure were provided by the mining contractor and not a capital cost to Bylong.
- Total overall capital expenditure required increased marginally due to the construction of surface tailings storage facilities and dams.
- Net Present Value (NPV) reduced by 93%.

BOYD concludes that:

- When compared to the investment potential of the integrated Project, the "underground only" scenario is significantly inferior.
- The hypothetical underground only scenario is not feasible or viable.

  In general, no mine developer that BOYD is aware of would invest $1,314M for such a low NPV. The "underground only" scenario would not meet investment metrics.
- A mine developer with a suite of project alternatives would invest in other projects which would provide higher returns.

3.5 BOYD's Summary and Conclusions

BOYD makes the following comments and conclusions in relation to the proposed Bylong Project:

- The mine planning process undertaken by KEPCO has been thorough. It has balanced the competing needs to develop an economic project against the environmental issues and has arrived at a robust and systematically designed mine plan for the Project.

- The Project as proposed results in a higher extraction of coal resources when compared against a hypothetical “underground only” scenario.
- The open cut provides a higher recovery of coal mined resulting in a higher quantity of product coal.
- There is a lower risk to contamination of waterways and aquifers due to the use of the Eastern Pit void for the disposal of tailings and rejects, which also negates the requirement for above ground tailings dams.
- The lack of an above ground tailings dam entirely removes the risk of tailings dam structural failure.
- The Eastern Pit void at the completion of open cut mining operations provides additional mine water storage capacity where excess water from the underground operations can be stored without the need to construct additional surface structures.
- Comparison of the hypothetical “underground only” scenario with the integrated Project shows a significant reduction in revenue and more importantly, a substantial reduction in NPV. These outcomes are inadequate to justify the risk associated with an investment of $1,314M and are highly unlikely to be sufficient to support a decision to proceed with the project.
- The Bylong Project is a practical proposal that utilises well established and proven responses to environmental protection and to minimise potential impacts on social, visual and heritage values; it optimises the recovery of State-owned coal resources; it is feasible; and it can be achieved within known environmental and mining constraints.

4.0 ENVIRONMENTAL IMPACTS

4.1 Introduction

The Bylong Project is an integrated project consisting of an open cut mine and an underground mine. This chapter focuses principally on environmental impacts associated with the open cut component of the Project.

The Open Cut mine plan includes the development of two open cut mining areas: the Western Open Cut and the Eastern Open Cut, and associated OEAs as shown in Figure 4.1, following this chapter.

KEPCO undertook a number of iterations to the mine plan over a period of time, which have been summarised in Chapter 3.

4.2 Rehabilitation of the Open Cut Mine

The Project encompasses a total area of approximately 10,317 ha. An area of 2,875 ha (or 28% of the total area) will be disturbed due to open cut mining, infrastructure and surface subsidence caused by underground mining.

4.2.1 Mining Areas, Overburden Emplacement Areas and Final Voids

Two OEAs will be developed external to the open cut mining areas in the early years of the Project:

- The North Western OEA will be located to the north west of the Western Open Cut. It will be developed to a final height of approximately RL 320 m.
- The South Western OEA will be located to the west of the Eastern Open Cut and south of the Western Open Cut. It will be developed to a final height of approximately RL 390 m.

The OEAs will be used to place overburden material excavated during pit development and in the early years of open cut mining. The OEAs will be external to the main pit areas, i.e. the OEAs will be out-of-pit dumps.

Once mining in the two open cut areas advances sufficiently so that the voids created in the pits are large enough to enable overburden material to be placed in-pit, direct backfilling will be undertaken. Figures 4.1 to 4.5, following this chapter, show the development of the open cut mining areas and OEAs over the life of the mine.

Minimising the quantity of overburden material that is placed in out-of-pit OEAs provides a number of advantages to Bylong. From an environmental perspective it will result in a reduced disturbance area footprint because less area is required for overburden placement. In addition, placing overburden in-pit in conjunction with coarse and fine rejects from the CHPP will eliminate any voids left at the conclusion of mining activities. Mining voids from the active Eastern and Western Open Cuts will be backfilled[1] and progressively rehabilitated to meet the final landform design as shown in Figure 4.5[2]. To reiterate, the final landform for the open cut mining area will contain no voids.

The suitability of topsoil and subsoil has been assessed by SLR Consulting. Topsoil and subsoil on 1,160 ha that will be subject to direct and temporary impacts and direct and permanent impacts will be removed and stockpiled in specifically designated areas. A total of 6.5 million long cubic metres (Mlcm) of topsoil and subsoil is available and will be used for land rehabilitation[3]. This is in excess of the total estimated requirement of 5.4 Mlcm[4].

BOYD considers that KEPCO's commitment to implement a final landform containing no voids at the conclusion of open cut mining exceeds current industry standards. It is a demonstration of the actions KEPCO has taken to minimise environmental, social and visual impacts of the Project.

4.2.2 Progressive Rehabilitation

Open cut mining areas will be completely backfilled and rehabilitated to meet the final landform design. KEPCO's rehabilitation objectives include a commitment to "undertake progressive rehabilitation as soon as areas become available for practical rehabilitation"[5]. Progressive rehabilitation is an integral goal of the Project: as mining advances, areas that are disturbed by open cut mining will be progressively rehabilitated.

Impacts have been identified for each primary domain[6] after decommissioning strategies and post-mining commitments have been achieved:

- Indirect and temporary, are impacts that do not directly disturb the surface, and are temporary.
- Direct and temporary, are impacts which disturb the surface, however are short term and the area will be rehabilitated to pre-mining status.

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[1] p35 Main Report, Bylong Coal Project Environmental Impact Statement, Hansen Bailey Environmental Consultants, September 2015
[2] p40, Bylong Coal Project Rehabilitation Strategy and BSAL Reinstatement Strategy, SLR Consulting, Appendix W Bylong Coal Project Environmental Impact Statement, Hansen Bailey Environmental Consultants, May 2015
[3] p26 Response to Department of Primary Industries – Agriculture Submission, Hansen Bailey, Appendix K Bylong Coal Project Environmental Impact Statement, Supplementary Response to Submissions, Hansen Bailey Environmental Consultants, August 2016
[4] p29 ibid
[5] p268 Main Report, Bylong Coal Project Environmental Impact Statement, Hansen Bailey Environmental Consultants, September 2015
[6] p32 Bylong Coal Project Rehabilitation Strategy and BSAL Reinstatement Strategy, SLR Consulting, Appendix W Bylong Coal Project Environmental Impact Statement, Hansen Bailey Environmental Consultants, May 2015

- Direct and permanent, are impacts which directly disturb the surface and the area will not be rehabilitated to pre-mining status.

The following table shows the impacts that Project activities will have[7] on the area disturbed:

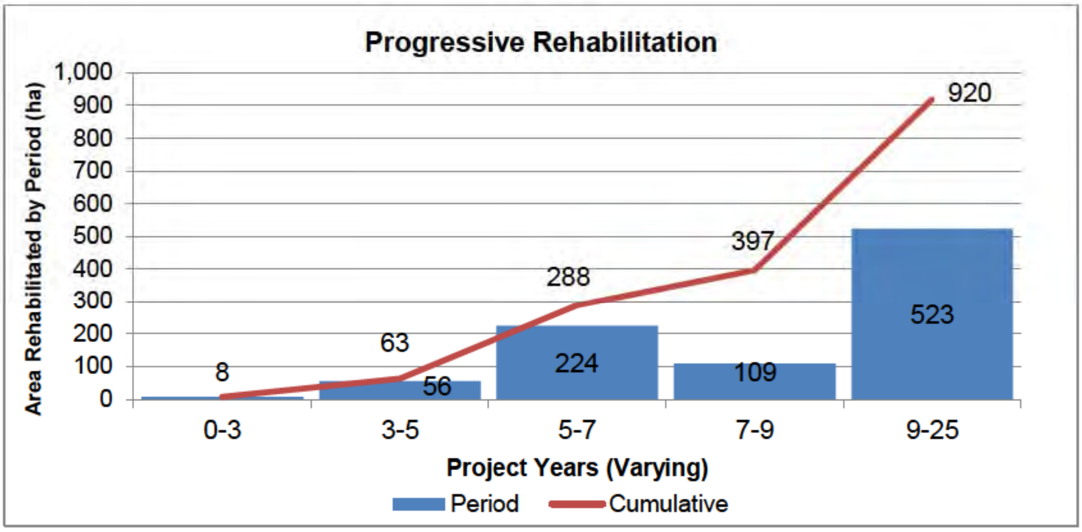
Impact	Area (ha)	Percent of Total	Project Activity
Indirect and Temporary	1,714	60	Entirely due to underground mine subsidence. Requires minor remediation work
Direct and Temporary	241	8	Haul roads, mine infrastructure, stockpile area, water storage facilities. Rehabilitated post-mining or during operations.
Direct and Permanent	920	32	Internal roads, rail loop, open cut mining areas, OEAs. Progressive rehabilitation to be undertaken.
TOTAL	2,875	100	

Of the 920 ha of Direct and Permanent impacts, 846 ha will be progressively rehabilitated over the life of the Project. The remaining 74 ha consists of internal roads which will remain[8].

Figures 4.1 to 4.4 clearly demonstrate progressive rehabilitation of the open cut mining areas as committed to by KEPCO. BOYD developed the following chart to show that rehabilitation of land disturbed by open cut mining will commence as early as Project Year 3[9]. The chart also shows that 397 ha (or 43% of the land disturbed by open cut mining) is targeted to be rehabilitated by the end of Project Year 9, only seven (7) years following the commencement of open cut mining activities.

Rehabilitation of an additional 80 ha[10], totalling 477 ha (or 52% of the total 920 ha) will be completed by the end of Project Year 12, a period that is less than half of the Projects' life.

[7] p33 Bylong Coal Project Rehabilitation Strategy and BSAL Reinstatement Strategy, SLR Consulting, Appendix W Bylong Coal Project Environmental Impact Statement, Hansen Bailey Environmental Consultants, May 2015
[8] Email from Nathan Cooper, Hansen Bailey to Ian Alexander, John T Boyd Company, 17 November 2017
[9] p46 Bylong Coal Project Rehabilitation Strategy and BSAL Reinstatement Strategy, SLR Consulting, Appendix W Bylong Coal Project Environmental Impact Statement, Hansen Bailey Environmental Consultants, May 2015 (UPDATED with information from footnote above)
[10] Personal communication, Hansen Bailey Environmental Consultants, December 2017



The Western Open Cut void will be backfilled with overburden and will be progressively rehabilitated to follow mining activities. It will be completely backfilled at the completion of open cut mining operations in Project Year 10, and rehabilitation of this area will be complete by the end of Project Year 12.

The Eastern Open Cut void will also be progressively rehabilitated following mining activities and will be backfilled with overburden and co-disposal of coarse and fine reject material from the CHPP. Following the completion of open cut mining, a void will remain open which will be used for the disposal of coarse and fine rejects generated by washing the ROM coal produced by the underground mining operation from Project Years 11 to 25. This void will be capped and rehabilitated at the end of the life of the Project with material from the South Western OEA and spoil material from within the Eastern Open Cut.

The rail loop will be rehabilitated following mine closure in Project Year 25[11].

BOYD developed the following chart using Figures 4.1 to 4.5 to provide a timeline of when open cut mining activities and progressive rehabilitation will be undertaken, by mining area:

	Project Activity – Open Cut Mining Operations and Progressive Rehabilitation	Project Year												
		1	2	3	4	5	6	7	8	9	10	11	12	13 to 25
A	Open Cut Mine Construction	■	■											
B	Open Cut Mine Operations													
	Eastern Open Cut and Eastern OEA			■	■	■	■	■	■	■	■			
	Western Open Cut, NW OEA and SW OEA			■	■	■	■	■						
C	Open Cut Mine Rehabilitation													
	Progressive rehab NW OEA, Western OEA and SW OEA			■	■	■	■	■	■	■	■			
	Complete rehab Western OC, Western OEA, SW OEA											■	■	
	Progressive rehab Eastern OEA					■	■	■	■	■	■			
	Complete rehab Eastern OC, Eastern OEA and NW OEA											■	■	■

[11] p114 Supplementary Response to Submissions, Bylong Coal Project Environmental Impact Statement, Hansen Bailey Environmental Consultants, March 2016

The chart above shows that progressive rehabilitation will commence the same year that mining activities commence at Bylong in Project Year 3, with rehabilitation of an area on the NW OEA.

BOYD opines that:

- KEPCO's commitment to undertaking rehabilitation within a relatively short period of time following the commencement of open cut mining is a demonstration of the Company's commitment to undertaking progressive rehabilitation.
- The benefit of this commitment to progressive rehabilitation by KEPCO is that outstanding rehabilitation liabilities are minimised in the highly unlikely event that KEPCO does not continue operating Bylong.
- Rehabilitation of 477 ha (or 52%) will be completed by the end of Project Year 12 - less than half way through the Projects' life.
- With underground mining operations continuing through to the end of Project Year 25, rehabilitation activities and outcomes will continue to be undertaken, monitored and remediated if required by personnel and equipment available on site. This will ensure that final landform objectives will be achieved.

4.2.3 Visual Impacts

An assessment of the visual impacts of the Project was undertaken by JVP Visual Planning & Design. The assessment included: 1) a field review of existing landscape settings; 2) an assessment of the visual characteristics of the Project in the context of the existing landscape; 3) identification of Project impacts at specific locations in consideration of both visual sensitivities and visual effects; and 4) the impact on landscape values based on the total perception of landscape.

A number of key viewing locations were assessed to determine the level of impacts associated with views of the Project. Computer-generated photomontage models were utilised to determine visual effects. These enabled the generation of accurate views of the Project from the key viewing locations whilst taking into account screening by topography and natural vegetation[12].

The visual impact assessment concluded[13] that:

- The visual impact of the Project is generally low from key viewing locations, with impacts confined to local settings.

[12] p294 Main Report, Bylong Coal Project Environmental Impact Statement, Hansen Bailey Environmental Consultants, May 2015
[13] p1 Bylong Coal Project Visual Impact Assessment, JVP Visual Planning & Design, Appendix Y Bylong Coal Project Environmental Impact Statement, Hansen Bailey Environmental Consultants, May 2015

- Visual impacts are generally restricted with visual effects restored by progressive rehabilitation. Where visual effects are high, they are of short duration of 2 – 5 years, following which they reduce to low as a result of rehabilitation activities being completed.
- Visibility to high sensitivity use areas such as Bylong Valley and Bylong Valley Way is limited, with topography and vegetation screening providing protection.

BOYD concludes that over the life of the Project the visual impacts will be confined. This has been significantly assisted by the changes made to the mine plan to constrain the footprint of and maximum heights of the OEAs, to strategically utilise the neighbouring topography and native vegetation to shield open views of the mining areas from the Bylong Valley Way and privately owned properties, and to maintain a landform which integrates with the surrounding natural landscape features.

4.2.4 Geochemistry Characteristics of Overburden and Coal

An assessment of the geochemical characteristics of the overburden, coal and rejects material was undertaken by RGS[14]. The study included an assessment of potential impacts and subsequent management measures that would be required.

4.2.4.1 Overburden

Tests undertaken on samples of overburden, interburden, coal seam and composite overburden materials indicated that:

- A significant majority, 98.5%, of overburden tested is Non-Acid Forming (NAF) and not Potentially Acid Forming (PAF) material. In addition, most of the overburden materials had sulphur content less than the typical background concentration of 0.1% sulphur and were therefore classified as NAF-barren, with significant capacity for acid buffering.
- The remaining material tested was classified as Uncertain and could have a low capacity to generate acid.

The study concluded that since the large majority of overburden is NAF barren, the overburden materials have a high factor of safety with respect to the potential to generate acid[15]. BOYD concurs with this conclusion.

Trace metals and metalloid concentrations in the overburden are relatively low and sparingly soluble. The study concluded that these are unlikely to present a significant risk to rehabilitation activities and water quality.

[14] p327 Bylong Coal Project Rehabilitation Strategy and BSAL Reinstatement Strategy, SLR Consulting, Appendix W Bylong Coal Project Environmental Impact Statement, Hansen Bailey Environmental Consultants, May 2015

[15] p328 Bylong Coal Project Rehabilitation Strategy and BSAL Reinstatement Strategy, SLR Consulting, Appendix W Bylong Coal Project Environmental Impact Statement, Hansen Bailey Environmental Consultants, May 2015

4.2.4.2 Coal and Rejects Material

Tests undertaken on samples of coal (Coggan and Ulan seams) and rejects material indicated that:

- 80% of the material is NAF. The majority of samples also have relatively low sulphur content and are classified as NAF-barren.
- 10% of the material tested was classified as Uncertain and could have a low acid forming capacity.
- The remaining 10% of material comprising of coarse and fine reject and Coggan Seam floor were classified as PAF[16].

Trace metals and metalloid concentrations in the coal and rejects are relatively low and sparingly soluble. The study concluded that they are unlikely to present a significant risk to rehabilitation activities and water quality.

4.2.4.3 Seepage and Runoff Water Quality

The study concluded that "the risk of significant water quality impacts from NAF coal and mining waste material is low"[17].

Tests indicate the surface runoff and seepage is likely to be pH neutral to slightly alkaline. It was found that the risk of water quality impacts from NAF coal and overburden material is low; however, some of the Coggan Seam rejects have the potential to generate acid.

Salinity levels of surface runoff and seepage from:

- Overburden is likely to be low.
- Coal and coal reject materials is also likely to be low but may increase over time if PAF material (albeit a small quantity) is exposed to oxidising conditions.
- The Coggan Seam may generate higher levels of metal leachate and salinity, especially if exposed to oxidising conditions.

4.2.4.4 Management

In order to manage the relatively few issues relating to the disposal of coal and rejects materials on water quality, KEPCO intends to:

- Undertake further analysis of the occurrence and distribution of PAF material within the mine as part of the ongoing exploration and geological modelling program.
- Selectively handle PAF material and ensure it is capped with NAF materials.
- Treat potential acid water in the open cut mine with appropriate chemicals such as lime, if required.

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[16] p328 Main Report, Bylong Coal Project Environmental Impact Statement, Hansen Bailey Environmental Consultants, September 2015

[17] p328 ibid

- Monitor seepage from overburden regularly to ensure key water quality parameters are within the relevant criteria.

BOYD considers that:

- Selective handling of PAF material and capping with NAF materials is a well proven response to dealing with PAF material in the coal mining industry.
- Where required, the treatment of acidic water with lime is commonly used in the coal mining industry.
- With underground mining operations continuing through to the end of Project Year 25, water quality will be monitored and remediation actions can be taken if required to ensure that discharge quality objectives are achieved. Personnel and equipment will be available on site.

4.3 Water Management

A fundamental objective[18] of the water management system that will be implemented at Bylong is to maximise both the diversion of clean water around the mining operation, and the use of poorer quality or dirty water for onsite needs prior to the use of clean water.

The water management system includes:

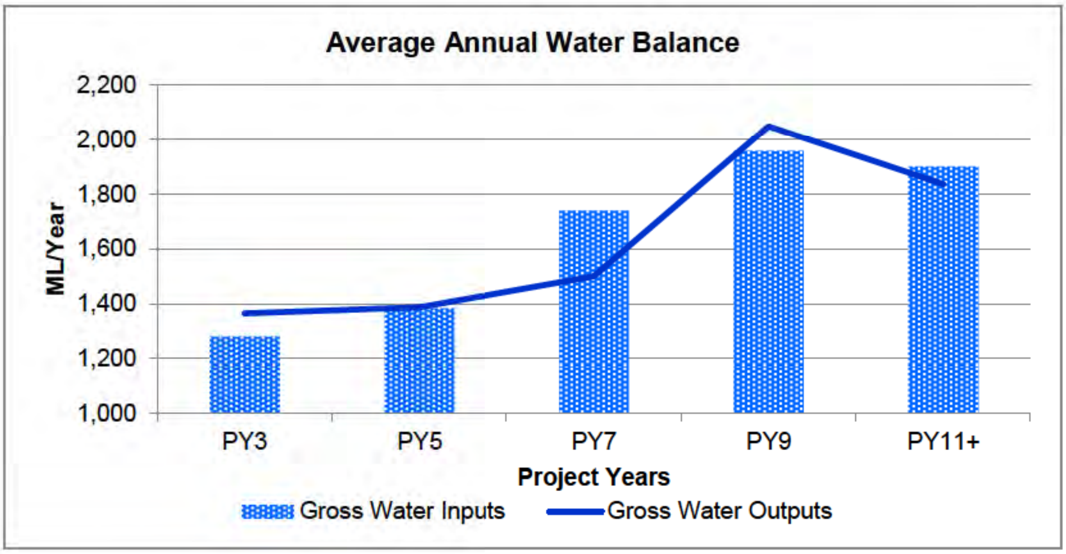
- Sediment dams.
- Drains to divert run-off (dirty water) from the OEAs to sediment dams.
- Drains to divert run-off (clean water) from undisturbed areas around the disturbed areas.
- Bore field with up to 15 bores.
- Storage of mine affected water within the open cut areas and mine water dam.

The water management system will enable excess water to be pumped and stored in the open cut mining areas when the overall water storage capacity is exceeded.

Modelling work undertaken by WRM indicates that: during the open cut only phase of operation (Project Years 3 to 6) low quantities of water are generated, and hence need to supplement water demands from the bore field. However, once underground operations commence ground water inflows are forecast to increase resulting less water being drawn down from the bore field thereafter. Excess water volumes have to be managed and the ability to pump and store water in the Eastern Open Cut Void is a fundamental requirement of the solution.

[18] p186 Main Report, Bylong Coal Project Environmental Impact Statement, Hansen Bailey Environmental Consultants, September 2015

The following chart developed by BOYD shows the average annual water balance for the Project from the commencement of open cut mining only in Project Year 3, through to the commencement of underground mining only in Project Year 11[19]:



The capacity of the Eastern Open Cut Void at the conclusion of open cut mining in Project Year 10 will be approximately 18,800 ML and the total volume of coarse and fine rejects that will be disposed of is approximately 11,700 ML[20]. The remaining void volume will be used to store excess mine water. The void will be compartmentalised with one compartment used for disposal of coarse and fine rejects and the other compartment used for the storage of water[21].

KEPCO's stated aim is to avoid the release of mine-affected water[22],[23] to prevent adverse impacts of the Project on water quality in the Bylong River and the downstream Goulburn River system.

Water balance modelling indicates that even with unrealistically high assumptions of surface water and groundwater inflow the system is sufficient for full containment for the first 19 years of the project[24]. This provides an extended period to monitor and validate the system, and manage and modify the storages and/or mine plan. There is very high confidence that there will be no uncontrolled release of water over the life of the Project[25].

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[19] p189 Main Report, Bylong Coal Project Environmental Impact Statement, Hansen Bailey Environmental Consultants, September 2015

[20] p190 ibid

[21] p207 Main Report, Bylong Coal Project Environmental Impact Statement, Hansen Bailey Environmental Consultants, September 2015

[22] p64 ibid

[23] p19 Development Consent, Appendix M, State Significant Development Assessment, Bylong Coal Project (SSD-6367), Assessment Report, NSW DP&E, March 2017

[24] p10 Bylong Coal Project Response to PAC Report, WRM Water & Environment Pty Ltd 0887-0-7-B1, 29 November 2017

[25] p10 ibid

BOYD considers that:

- The water management system that will be implemented is a well-established practice at coal mines.
- Compartmentalising and the use of the Eastern Open Cut Void and longwall goaf areas as storage for excess mine water provides a robust solution to ensure that no uncontrolled releases of water occur.

4.4 Open Cut Mining Area Final Landform, Post Mining Land Use

KEPCO is committed to progressively rehabilitate land directly and permanently disturbed by open cut mining, generally within one year of overburden placement and shaping to the target LSC classes.

Mapping of Biophysical Strategic Agricultural Land (BSAL) indicates that approximately 1,610 ha of land classified as BSAL is present within the study area. Generally, BSAL is associated with alluvial influenced black soil units on gently inclined land, however some red dermosols and red chromosols on more elevated land beyond the alluvials were also classified as BSAL[26]. KEPCO has undertaken a significant amount of mine planning to avoid and/or minimise disturbance of BSAL.

4.4.1 Area of Land Directly and Permanently Disturbed

KEPCO's rehabilitation goals in relation to land that is directly and permanently impacted is to "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"[27].

Direct and Permanent impacts are defined as those impacts that will directly disturb the land surface and the area will not be rehabilitated to pre-mining status[28]. The total area impacted by the Project will be 920 ha[29]. The two open cut mining areas, the OEAs, the internal roads and the rail loop will therefore by definition, result in direct and permanent impacts to the land, despite being reinstated to equivalent productivity. An area of 74 ha disturbed by internal roads will remain as non-rehabilitated infrastructure[30].

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[26] p264 Main Report, Bylong Coal Project Environmental Impact Statement, Hansen Bailey Environmental Consultants, September 2015
[27] p268 ibid
[28] p32, Bylong Coal Project Rehabilitation Strategy and BSAL Reinstatement Strategy, SLR Consulting, Appendix W Bylong Coal Project Environmental Impact Statement, Hansen Bailey Environmental Consultants, May 2015
[29] p33 ibid
[30] Email from Nathan Cooper, Hansen Bailey to Ian Alexander, John T Boyd Company, 17 November 2017

A total of 320 ha of BSAL[31] will be directly and permanently impacted by open cut mining. KEPCO has committed to not reducing the area of BSAL following mining and subsequent reinstatement of the land, and intends to reinstate an equivalent area of BSAL to that disturbed. The location of the BSAL areas will be different to the pre-mining landscape. BSAL will be reinstated on land that meets LSC Class 3 criteria and its reinstatement will be a priority.

The change in the LSC classes between pre- and post-mining land for land that is directly and permanently disturbed is shown in the following table[32]:

LSC Class	Pre Mining ha	Pre Mining %	Post Mining ha	Post Mining %	Difference ha	Difference %
Rehabilitated Land						
3 – High Capability	142	16	320	35	+178	+19
4 – Moderate Capability	195	21	172	19	-23	-3
5 – Moderate – Low Capability	441	48	320	35	-121	-13
6 – Low Capability	128	14	11	1	-117	-13
7 – Very Low Capability	14	2	23	2	+9	+1
Sub-total	920	100	846	92	-74	-8
Non-rehabilitated Infrastructure	0	0	74	8	+74	+8
Total	920	100	920	100	0	0

Note: Some columns may not add due to rounding.

4.4.2 Rehabilitation Closure Criteria and Post Mining Land Use

4.4.2.1 Closure Criteria

KEPCO has committed to rehabilitating all directly and permanently disturbed land to LSC Classes 3, 4, 5, 6 and 7. The following closure criteria apply to the various LSC classes[33]:

- LSC Class 3/BSAL: Flat to sloping land capable of sustaining cultivation on a rotational basis; capable of supporting a range of crops including cereals, oilseeds and legumes; productivity varies with soil fertility; BSAL soil fertility varies from moderate to high, consistent with the current landscape.
- LSC Class 4: Land used for grazing and suitable for pasture improvement; can be cultivated occasionally for sowing of pasture and crops; cropping limitations due to chemical and or physical factors.
- LSC Class 5: Land suitable for grazing; severe limitations for high impact land use such as cropping.
- LSC Class 6: Land generally only suitable for grazing; very severe limitations for land use; nominated land use is woodland.

[31] p14 Response to Department of Primary Industries – Agriculture Submission, Hansen Bailey, Appendix K Bylong Coal Project Environmental Impact Statement, Supplementary Response to Submissions, Hansen Bailey Environmental Consultants, August 2016
[32] Email from Nathan Cooper, Hansen Bailey to Ian Alexander, John T Boyd Company, 17 November 2017
[33] p271 ibid

- LSC Class 7: Land unsuitable for any type of grazing or cropping; extremely severe limitations for land use; nominated land use is woodland.

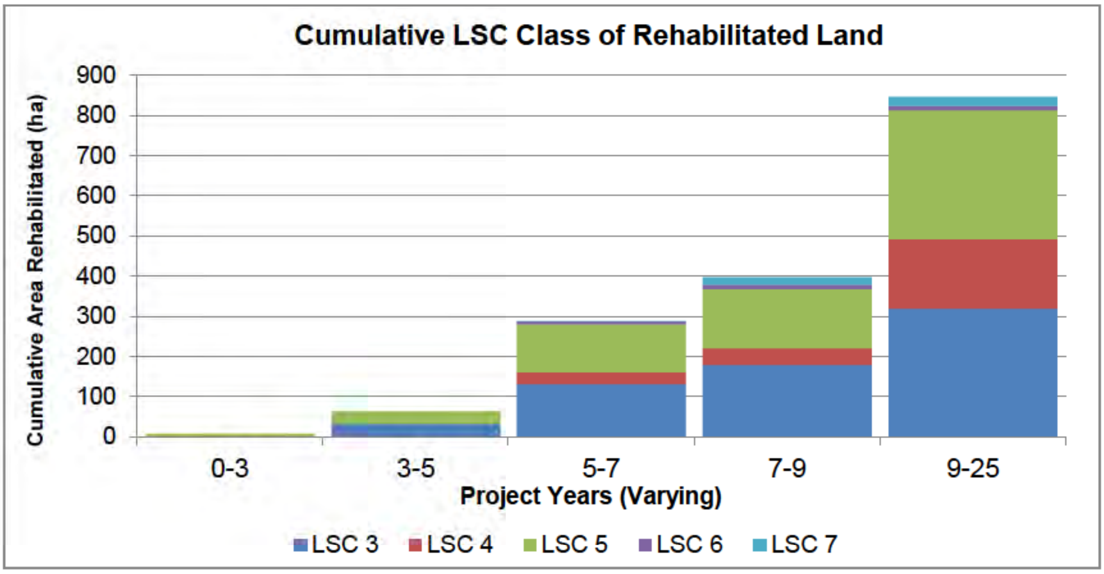
Following the completion of mining, LSC classes are forecast to remain within the same pre mining capability range of Classes 3 to 7 however the area will change.

4.4.2.2 Post Mining Land Use

The following table shows the total area of land directly and permanently disturbed and the intended post mining land use[34]:

	Post Mining			Change of Area
LSC Class	Land Use	Area (ha)	Percent	Pre- to Post-Mining
Rehabilitated Land				
Class 3	Cropping	320	35%	+19%
Class 4 and 5	Grazing	492	54%	-16%
Class 6 and 7	Woodland	34	3%	-12%
	Sub-total	846	92%	-8%
Non-Rehabilitated Infrastructure		74	8%	+8%
	Total	920	100%	0%

The chart below shows the rehabilitated LSC classes for the land disturbed by open cut mining on a cumulative basis. It shows the Project Years and area rehabilitated[35]:

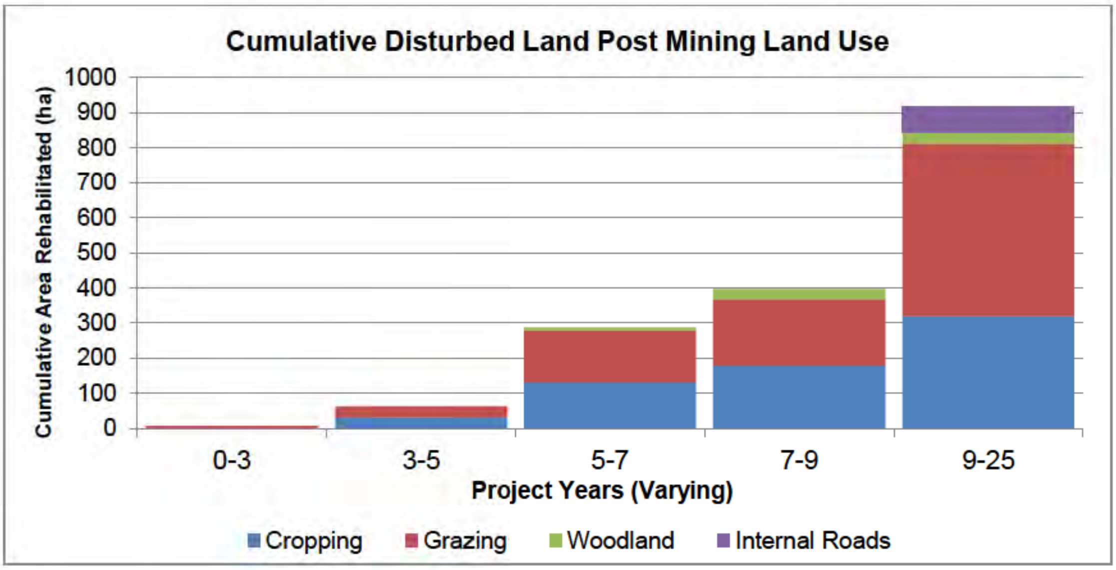


The following chart shows the post mining land use that the land disturbed by open cut mining will be returned to, on a cumulative basis. It also shows the period of time when the land will be rehabilitated. All LSC 3/BSAL land will be returned to cropping

[34] Email from Nathan Cooper, Hansen Bailey to Ian Alexander, John T Boyd Company, 17 and 28 November 2017

[35] p45 Bylong Coal Project Rehabilitation Strategy and BSAL Reinstatement Strategy, SLR Consulting, Appendix W Bylong Coal Project Environmental Impact Statement, Hansen Bailey Environmental Consultants, May 2015 (UPDATED with information from footnote above)

or grazing land, LSC 4 and LSC 5 land will be returned to grazing land, and LSC 6 and 7 land will be returned to woodland[36].



The preceding charts and table show that by the end of Project Year 9:

- Rehabilitation of 397 ha, or 43% of the total land area of 920 ha of the area disturbed by open cut mining will be completed. Note that at the end of Project Year 12, 52% of the total land area disturbed by the open cut mining will be rehabilitated.
- A total of 179 ha, or 56%, of LSC 3/BSAL land will be rehabilitated to a cropping land use. The remaining 140 ha, or 44%, of LSC 3/BSAL will be rehabilitated between Project Years 9 and 25 due to the requirement to keep the Eastern Open Cut void open until the end of the mine.
- A total of 189 ha, or 38%, of LSC 4 and 5 land will be rehabilitated to grazing land. The remaining 305 ha, or 62% of LSC 4 and 5 land will be rehabilitated between Project Years 9 and 25.
- A total of 29 ha, or 88%, of LSC 6 and 7 land will be rehabilitated to woodland. The remaining 4 ha, or 12%, of LSC 6 and 7 will be rehabilitated between Project Years 9 and 25.

BOYD opines that:

- KEPCO's commitment to rehabilitate 52% of all land directly and permanently disturbed by Project Year 12, only ten years after open cut mining commences, is a clear demonstration of its commitment to progressive rehabilitation. In that same period, 56% of LSC 3/BSAL land will have been rehabilitated.

[36] p45 Bylong Coal Project Rehabilitation Strategy and BSAL Reinstatement Strategy, SLR Consulting, Appendix W Bylong Coal Project Environmental Impact Statement, Hansen Bailey Environmental Consultants, May 2015

- KEPCO will replace 142 ha of Class 3 agricultural land that is disturbed by mining with 320 ha of Class 3 agricultural land. This again, demonstrates KEPCO's commitment to exceed industry standards.

4.5 Case Studies

4.5.1 Comparison of Disturbance at Bylong with Nearby Mines

BOYD undertook a high level comparison of Bylong with three (3) mines: Mangoola[37], Moolarben[38], and Wilpinjong[39]. Mangoola is located in the nearby Muswellbrook Local Government Area (LGA) NSW, while both Moolarben and Wilpinjong are located in the Mid-Western Regional Council LGA, NSW.

The following table shows a comparison of the current (2016/2017) mine activities, projected disturbance areas and final void strategy and tailings/rejects disposal strategies for each operation, with Bylong, by referencing the current Mining Operations Plan (MOP) available in the public domain. Bylong OC data shows the annual average open cut activity and the mines' total disturbances.

		Mangoola	Moolarben	Wilpinjong	Bylong OC
Mine commenced	Year	2010	2008/09	2006	NA
Current year	Year	2016	2017	2017	NA
Open Cut mine life (nominal)	Year	21	29	27	8
Underground Operations		No	Commenced	No	Planned
<u>Annual Quantities</u>					
Overburden	Mbcmpa	34.7	43	47.5	19.3
ROM Coal	Mtpa	13.5	13.8	15.9	4.1
Strip Ratio (estimated)	bcm:ROMt	2.6	3.1	3.0	4.6
Product Coal	Mtpa	10.7	11.1	13.8	3.3
Yield (estimated)	%	79	80	87	78
Rejects	Mtpa	2.4	2.7	3	1
<u>Areas (at end of MOP / Bylong LOM)</u>					
Infrastructure	Ha	641	490	342	365
Mining Area	Ha	Incl in OEA	211	161	533
Tailings	Ha	40	Minimal	30	Nil
Water Management	Ha	59	100	44	27
Overburden Emplacement[1]	Ha	518	903	1018	758
Stockpile	Ha	16	incl in CHPP	-	11
Final Void	Ha	Yes	Yes	Yes	No
Future Mining Area	Ha	530	NA	916	Included
Conservation and Offset	Ha	3,020	1,150	837	4,082
Underground Subsidence Area	Ha	NA	227	NA	1,714
Active disturbance (2016/17)[2]	Ha	1,806	1,492	2,350	NA
Total mine footprint[3]	Ha	2,067	NA	2,222	1,160
Tailings/reject	Ha	in-pit/out-of-pit	In-pit	in-pit/out-of-pit	in-pit

Notes:
1. Includes open cut mining area, OEAs and active rehabilitation
2. Current - excludes future areas, conservation areas, subsidence areas
3. At end of MOP period (2019/2020) - includes future areas, excludes underground subsidence

[37] Mangoola Coal Mining Operations Plan, January 2016 – December 2020, December 2016
[38] Moolarben Coal Complex Mining Operations Plan, December 2016 – January 2019, November 2016
[39] Wilpinjong Coal Project Open Cut Operations Mining Operations Plan, July 2017 – June 2019, June 2017

The following comments summarise our findings:

- The three mines are all open cut operations. Underground operations have also commenced at Moolarben.
- All three mines commenced operations between 2006 and 2010 and have open cut mine lives ranging from 21 to 29 years, compared to 8 years for open cut mining at Bylong.
- The quantity of overburden moved annually at each operation varies from 34.7 Mbcm at Mangoola to 47.5 Mbcm at Wilpinjong, compared to Bylong 19.3 Mbcm.
- The annual ROM coal production rate at each of the mines 2016/2017 varies from 13.5 Mt ROM at Mangoola to 15.9 Mt ROM at Wilpinjong, all substantially higher than the Bylong project 4.1 Mtpa
- The strip ratio reported for 2016/2017 varies from 2.6:1 at Mangoola to 3.1:1 at Moolarben. The life of mine average strip ratio of the reference mines is not known to enable a comparison to be made with Bylong which ranges from 2.8:1 to 5.6:1.
- Mangoola, Moolarben and Wilpinjong all plan to dump tailings and rejects back in their open cut pits. This is also planned at Bylong. Mangoola intends to also use tailings dams and Moolarben has planned for a dam to provide an emergency tailings disposal area.
- Mangoola and Moolarben both intend to leave final voids on closure notwithstanding that they also utilise large OEAs.
- The combined OEA and mining area in 2019/20, at Moolarben and Wilpinjong will be 903 ha and 1,018 ha respectively. This is significantly higher than Bylong's total disturbance area of 758 ha at the end of the life of mine.
- At the end of the current MOP period in 2019/20 the area of disturbance of the open cut only (current plus forecast) for Mangoola will be 2,067 ha, Moolarben will be 1,706 ha and Wilpinjong will be 3,059 ha. This can be compared to 1,160 ha the total disturbance at Bylong at the end of the life of mine.

BOYD opines that when the environmental strategies proposed to be implemented at Bylong are compared with other nearby operating mines, they demonstrate a clear commitment by KEPCO to exceed standard industry environmental practices.

4.5.2 Successful Rehabilitation Case Studies

BOYD has drawn on two case studies to demonstrate how the application of clearly defined objectives and good planning – both in relation to mine planning and environmental reclamation – can result in successful outcomes for areas which were, in their original pre mining condition, considered to be highly productive farmland.

One of the case studies is the Hunter Valley Operations Mine Alluvial Land Rehabilitation project in the Hunter Valley, NSW. The study demonstrated that Class I and Class II land can be successfully rehabilitated and returned to being highly productive as proposed at Bylong.

The second case study relates to the Cottage Grove Mine located in Illinois, USA. This study demonstrated that land that was classified to be prime farmland was returned to being highly productive post open cut mining operations.

4.5.2.1 Case Study – Australia

Hunter Valley Operations, New South Wales - Alluvial Land Rehabilitation

4.5.2.1.1 Background

In 1993, Coal & Allied sought to mine an area of 165 ha of alluvial land in the floodplain of the Hunter River which had rich fertile soils. As a condition to mine the area of farming land, Coal & Allied was required to reinstate 63 ha of Class I and II lands suitable for irrigated agricultural use. The remaining 102 ha was required to be rehabilitated to Class IV land suitable for grazing[40].

To demonstrate that the land had been restored, Coal & Allied was required to produce Lucerne hay with a productivity yield equivalent to the average crop productivity yields for the Upper Hunter Region for three consecutive years.

4.5.2.1.2 Planning and rehabilitation

Planning for rehabilitation commenced prior to the commencement of mining. Mapping of the soil profile was undertaken with both topsoil and subsoil being removed and stockpiled separately. Backfilling was completed by 2003 and rehabilitation commenced. Topsoil and subsoil was replaced to a depth of 0.4 m and 1 m respectively (a total depth of 1.4 m) onto a surface constructed 1.4 m below the designed surface. The acceptable surface tolerance was +/-0.5 m from plan[41]. The total depth of subsoil and topsoil was required to accommodate crops with deep roots, such as Lucerne.

4.5.2.1.3 Cropping Trial Results

Rehabilitation was divided into two stages. Stage one consisted of the sowing of Lucerne and began in spring 2003. The absence of comparative data for Lucerne crop yields in the district initiated a project to monitor neighbouring farms in 2004.

[40] p51 Mining Operations Plan, HVO North, Coal & Allied Operations, January 2016
[41] p56 ibid

The table below shows that by 2007 the trial area demonstrated production of hay yields above the district average for three consecutive years.

Year	Yield (tonnes of hay/ha		
	Stage 1	Stage 2	District Average
2003/04	11.7*	Not sown	Not available
2004/05	15.9	18.4	14.8
2005/06	14.8	15.6	14.9
2006/07	Compliant	8.72	7.6

*Shortened harvest season due to crop establishment

4.5.2.1.4 Ongoing Performance

In 2010, Coal & Allied let a tender for the commercial cropping of the land following a competitive tender process. In July 2013 the first commercial crop was planted on the land since the productivity trial ended in 2007. It was a hybrid crop of wheat and rye used in cereals. The crop was hit by late frost in October 2013 and was baled and used for fodder.

In 2013, HVO received approval to mine a further 136 ha of land within the alluvium of the Hunter River on the condition that 65 ha is reinstated to Class II land and 65 ha is reinstated to Class III land[42]. A Lucerne cropping trial is also proposed to demonstrate successful reinstatement of Class II and Class III and hay yields from the reinstated land will be compared with yields from unmined reference sites[43].

4.5.2.2 Case Study – USA

Cottage Grove Mine, Peabody Energy, Equality, Illinois

4.5.2.2.1 Background to Regulatory Requirements

Prime Farmland

The US Natural Resource Conservation Service (NRCS), the federal agency responsible for soil surveys, has determined that prime farmland is land having the best combination of physical and chemical characteristics for producing food, feed and forage. In addition, to meet the requirements of the Surface Mining Control and Reclamation Act (SMCRA), to be considered as prime farmland the land must have been historically used for crop production.

It is required that a minimum of 48 inches (1.2 m) of soil (topsoil and subsoil) be removed, stored and replaced on all prime farmland areas.

Prime farmland must be restored to 100% of pre-mining level of productivity for a minimum of three (3) years of the operator's responsibility period which is a minimum of five (5) years[44].

[42] p51 Mining Operations Plan, HVO North, Coal & Allied Operations, January 2016
[43] p63 ibid
[44] p9 Citizen's Guide to Farmland Reclamation, Illinois Department of Natural Resources, Office of Mines and Minerals

High Capability Land

High Capability Land is land which does not meet the requirements of prime farmland, but is capable and suitable for crop production.

Sufficient soil must be replaced to restore the land to its pre-mining capability. In Illinois a minimum of 8 inches (0.2 m) of topsoil and a total of 48 inches of topsoil and rooting medium (1.2 m) must be replaced. Not all high capability land is reclaimed to cropland use even though the soil replacement requirements are unchanged. Land uses may include pasture, forest, and wildlife habitat[45].

4.5.2.2.2 Cottage Grove

Cottage Grove consists of five different mine sites near the town of Equality, Illinois. Coal is mined 24 hours a day on the site, which is more than 3,500 acres (1,416 ha) in area. Approximately 250 people are employed at the mine, producing coal from seams as deep as 120 feet (36.5 m) below the land surface. The mine produces about 2.3 Mtpa of coal each year. About 85% of the Cottage Grove Mine site is classified prime farmland. Because the mine complex is located in some of the most productive agricultural land in Illinois, it can be difficult to meet Federal post-mining Proof of Productivity standards.

4.5.2.2.3 Rehabilitation

Peabody investigated soil conditions prior to the commencement of mining, and removed and stockpiled all topsoil from the area. After mining is completed, the unconsolidated topsoil is spread to specified depths and contours. A wide variety of crops are planted to produce hay: alfalfa, orchard grass, medium red clover, alsike clover, perennial ryegrass and winter rye. Periodic mowing of the hay provides ground cover, food for insect life, and prevents erosion.

Hay crops are maintained for two years to ensure the reclaimed land meets the required productivity standards. The land is then ripped and allowed to sit fallow for a year, which is the final preparation before the land is returned to planting of row crops.

4.5.2.2.4 Results

From 2004 until 2010, the land produced 64 successful hay yields before lying fallow. During this time, the land provided food for wildlife, and geese, deer, and other animals which have returned to Cottage Grove Mine. Many of the areas are used to grow corn, and yields have averaged over 200 bushels per acre, well above the county average.

[45] p5 Citizen's Guide to Farmland Reclamation, Illinois Department of Natural Resources, Office of Mines and Minerals

In 2012, the mine received the Mid-Continent Regional Award for Excellence in Surface Coal Mining from the US Department of the Interior, Office of Surface Mining, Reclamation and Enforcement, in recognition of its reclamation performance. These awards are presented to coal mining companies that achieve "the most exemplary mining and reclamation in the country".

4.5.2.3 BOYD's Comments

These case studies demonstrate that cropping and farming land can be rehabilitated to pre-mining land uses given the appropriate planning and commitment.

4.6 BOYD's Summary and Conclusions

BOYD makes the following comments and conclusions in relation to the proposed Bylong Project:

- A number of modifications were made to the mine plan to reduce the potential for adverse impacts on the environment.
- Minimising the quantity of overburden material placed in out-of-pit OEAs will result in a smaller footprint because less area is required for overburden disposal placement.
- The mining voids will be filled and progressively rehabilitated: the final landform for the open cut mining area will contain no voids. This exceeds current industry standards.
- The same year that open cut mining activities commence (in Project Year 3), Bylong will commence progressive rehabilitation activities. 43% of the land disturbed by open cut mining that will be rehabilitated, 397 ha of 920 ha, is targeted to be rehabilitated by the end of Project Year 9.
- Land directly and permanently disturbed by open cut mining will be progressively rehabilitated within one year of mining.
- Changes were made to the mine plan to constrain the footprint and heights of the OEAs, to utilise the topography to shield open views of the mining areas, and to maintain a landform which integrates with the surrounding natural landscape.
- 320 ha of BSAL to be reinstated will be rehabilitated final landform. This reinstated BSAL will also meet the LSC Class 3 criteria. Reinstatement of the land capability will be a priority.
- Selective handling of PAF material and capping with NAF materials is a well proven response to dealing with PAF material in the coal mining industry.
- The water management system that will be implemented is a well-established practice at coal mines

- Comparison of the proposed environmental strategies to be implemented at Bylong with other nearby operating mines, demonstrates a clear commitment by KEPCO to exceed standard industry environmental practices.
- The two case studies provided show where agricultural land has been able to be rehabilitated to pre-mining land uses given the required planning and commitment.
- The Project will continue with underground mining operations through to the end of Project Year 25. Rehabilitation activities and outcomes will continue to be undertaken, monitored and remediated if required by personnel and equipment available on site to ensure that final landform objectives will be achieved

Following this page are:

Figures

<u>Bylong Coal Project - Conceptual Opencut Mine Plan</u>

U:\BOYD_PROJECTS\5172.001 Hansen Bailey - Bylong PAC Response\BOYD Report\Final\4.0 Environment.docx

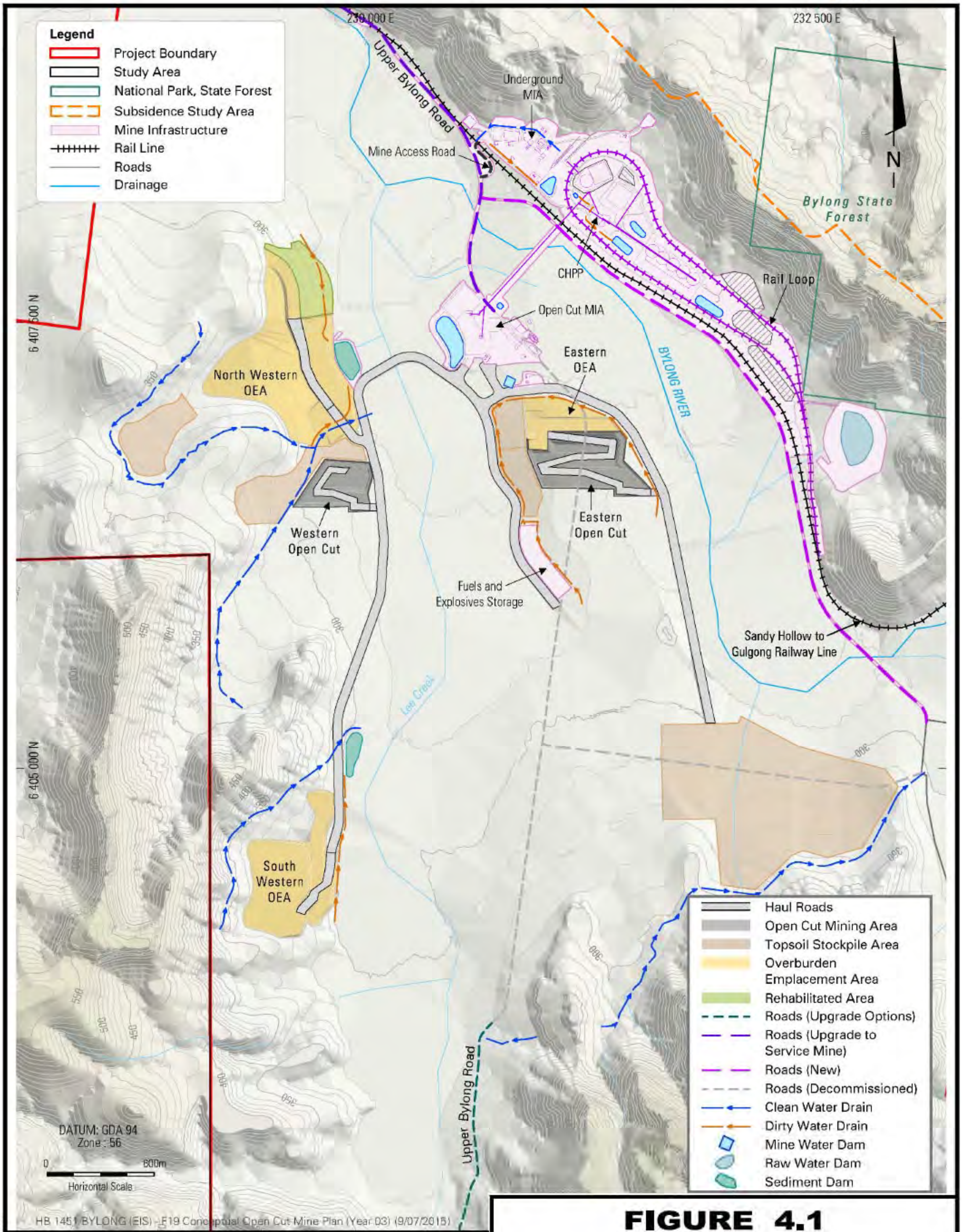


FIGURE 4.1

MAP SHOWING
CONCEPTUAL OPENCUT MINE PLAN - YEAR 3
BYLONG COAL PROJECT
SYDNEY BASIN
New South Wales, Australia

Prepared For
HANSEN BAILEY PTY LTD

John T. Boyd Company

December 2017
Scale 1 : 30,000

SCALE (m)
300 0 300 600

Image Source : Bylong Coal Project, Environmental Impact Statement, September 2015 (Figure 19, Page 40), Hansen Bailey Environmental Consultants, with Additions by John T. Boyd Company.

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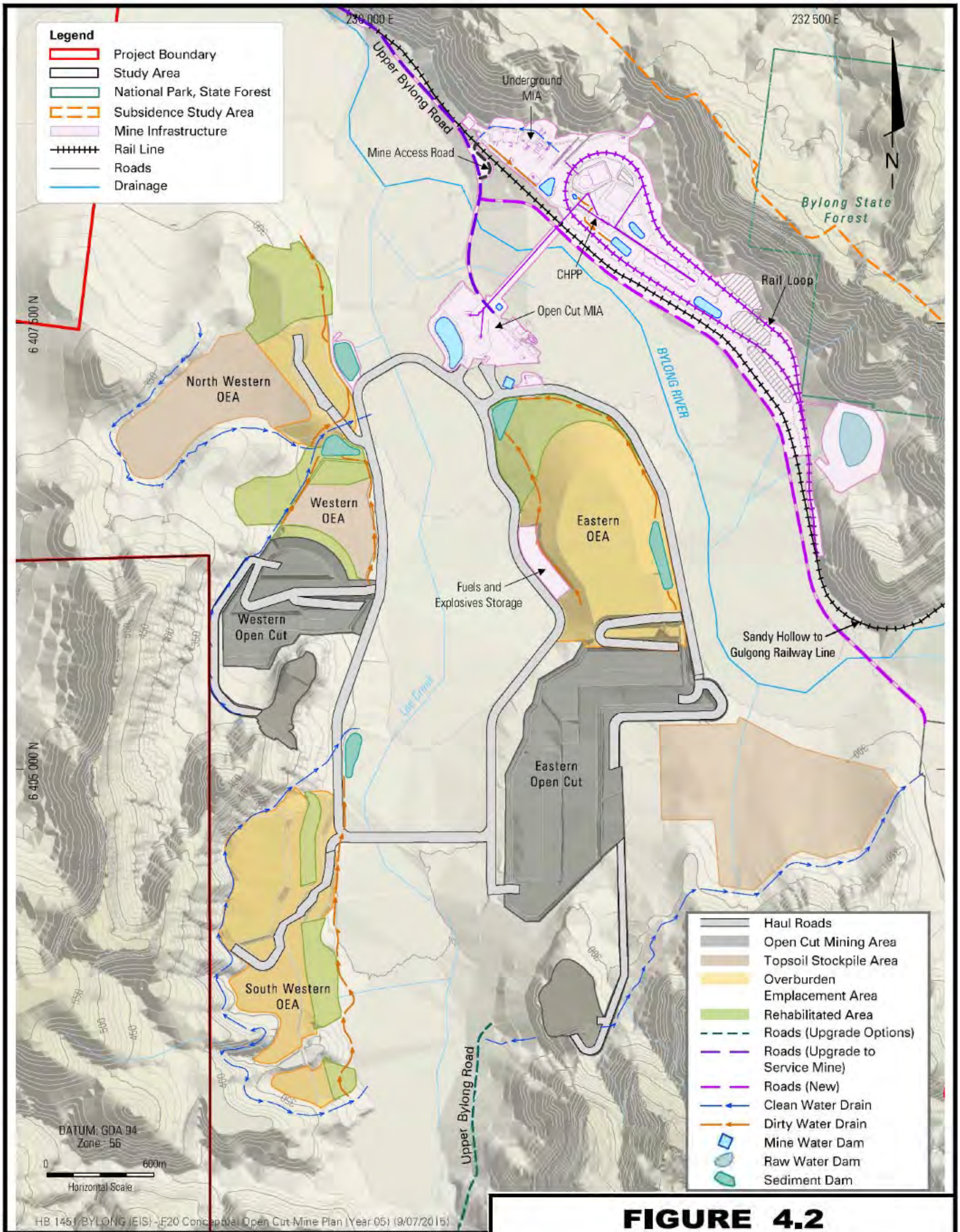

FIGURE 4.2

MAP SHOWING

CONCEPTUAL OPENCUT MINE PLAN - YEAR 5

BYLONG COAL PROJECT

SYDNEY BASIN

New South Wales, Australia

Prepared For

HANSEN BAILEY PTY LTD

John T. Boyd Company

December 2017

Scale 1 : 30,000

SCALE (m)

300 0 300 600

Image Source : Bylong Coal Project, Environmental Impact Statement, September 2015 (Figure 20, Page 41), Hansen Bailey Environmental Consultants, with Additions by John T. Boyd Company.

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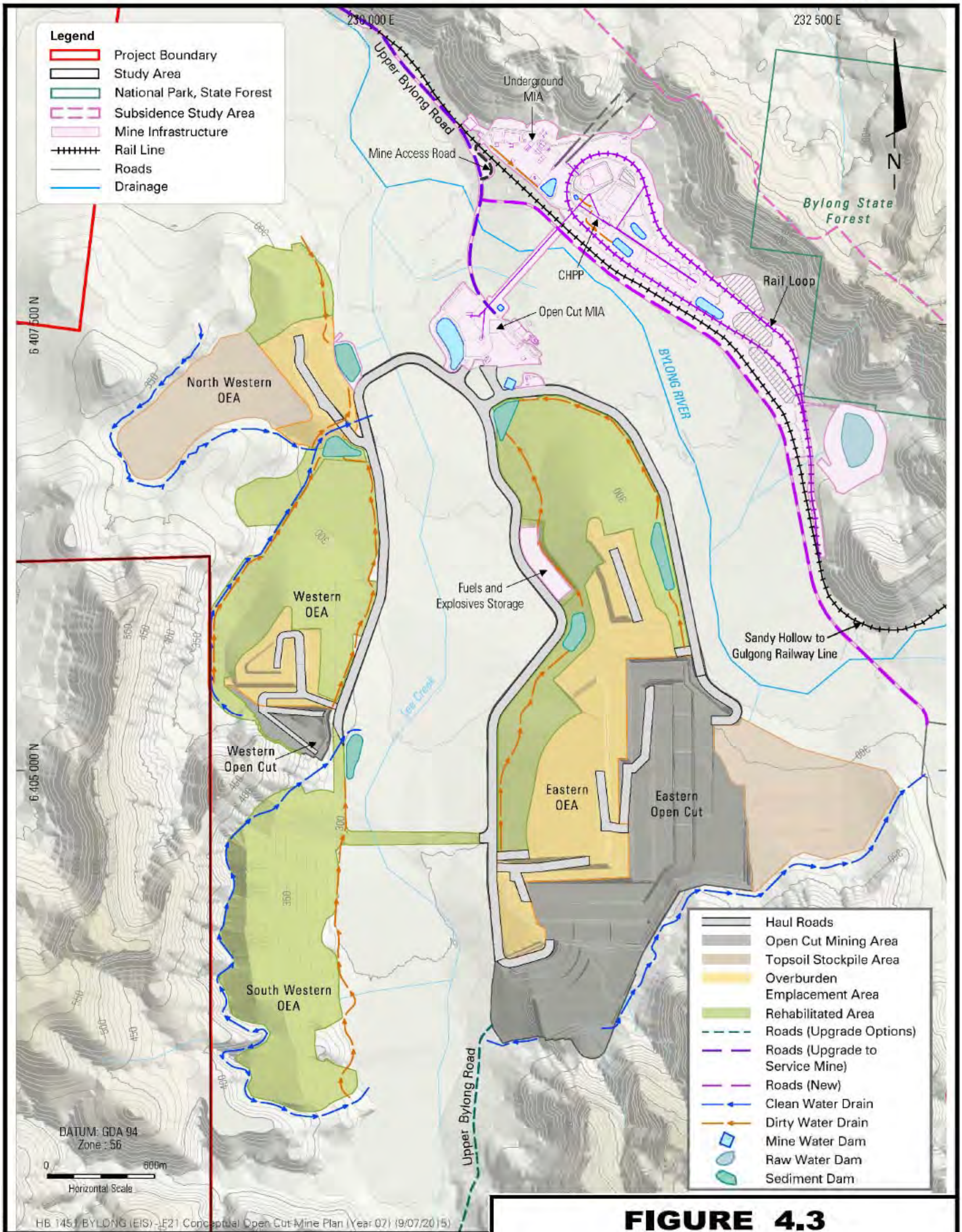


Image Source : Bylong Coal Project, Environmental Impact Statement, September 2015 (Figure 21, Page 42), Hansen Bailey Environmental Consultants, with Additions by John T. Boyd Company.

FIGURE 4.3

MAP SHOWING

CONCEPTUAL OPENCUT MINE PLAN - YEAR 7

BYLONG COAL PROJECT

SYDNEY BASIN

New South Wales, Australia

Prepared For

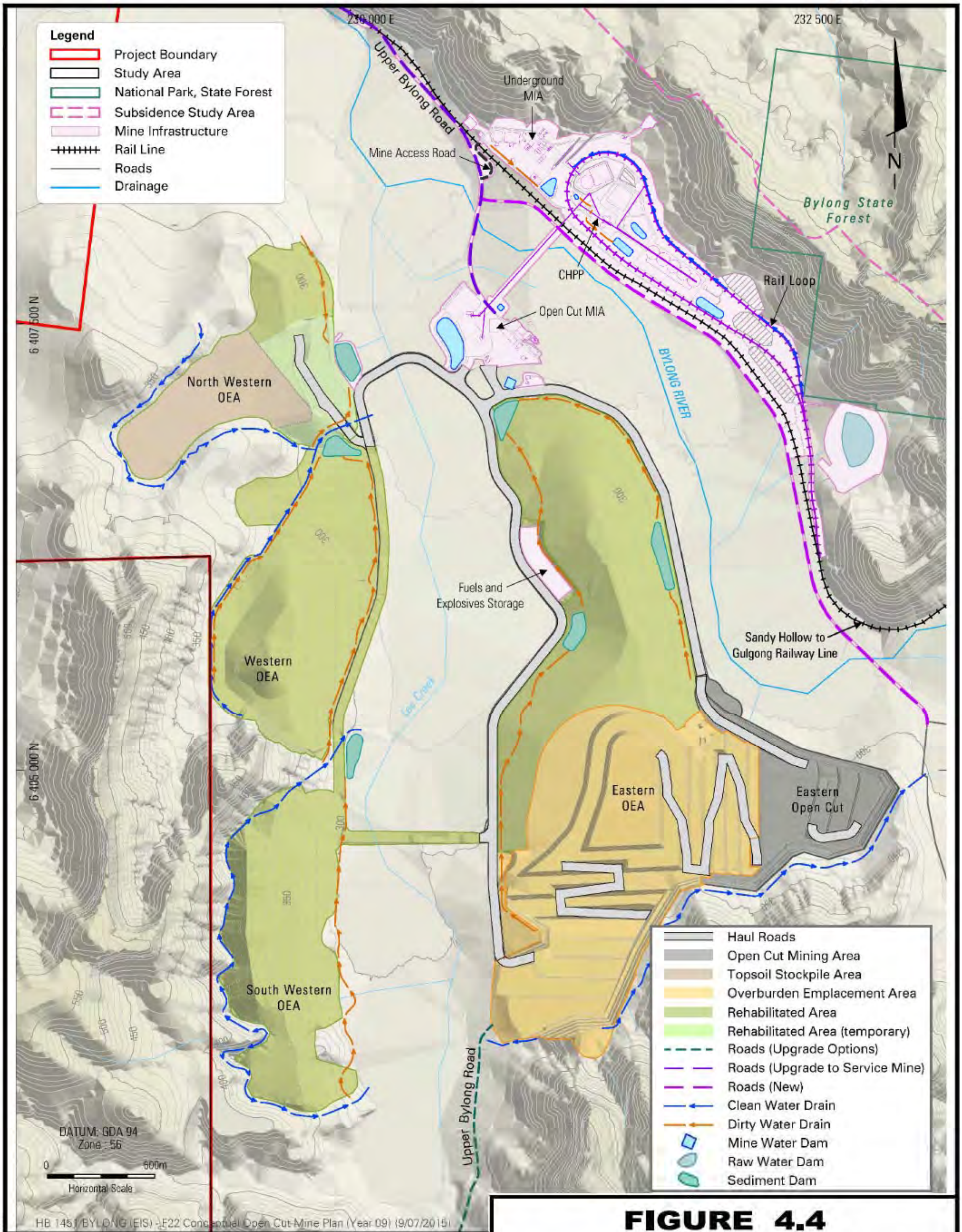
HANSEN BAILEY PTY LTD

John T. Boyd Company

December 2017

Scale 1 : 30,000

P:\CAD_GROUP-jfg\5172.001\FIG YR7.DWG



SCALE (m)
300 0 300 600

Image Source : Bylong Coal Project, Environmental Impact Statement, September 2015 (Figure 22, Page 43), Hansen Bailey Environmental Consultants, with Additions by John T. Boyd Company.

FIGURE 4.4

MAP SHOWING
CONCEPTUAL OPENCUT MINE PLAN - YEAR 9
BYLONG COAL PROJECT
SYDNEY BASIN
New South Wales, Australia

Prepared For
HANSEN BAILEY PTY LTD

John T. Boyd Company

December 2017
Scale 1 : 30,000

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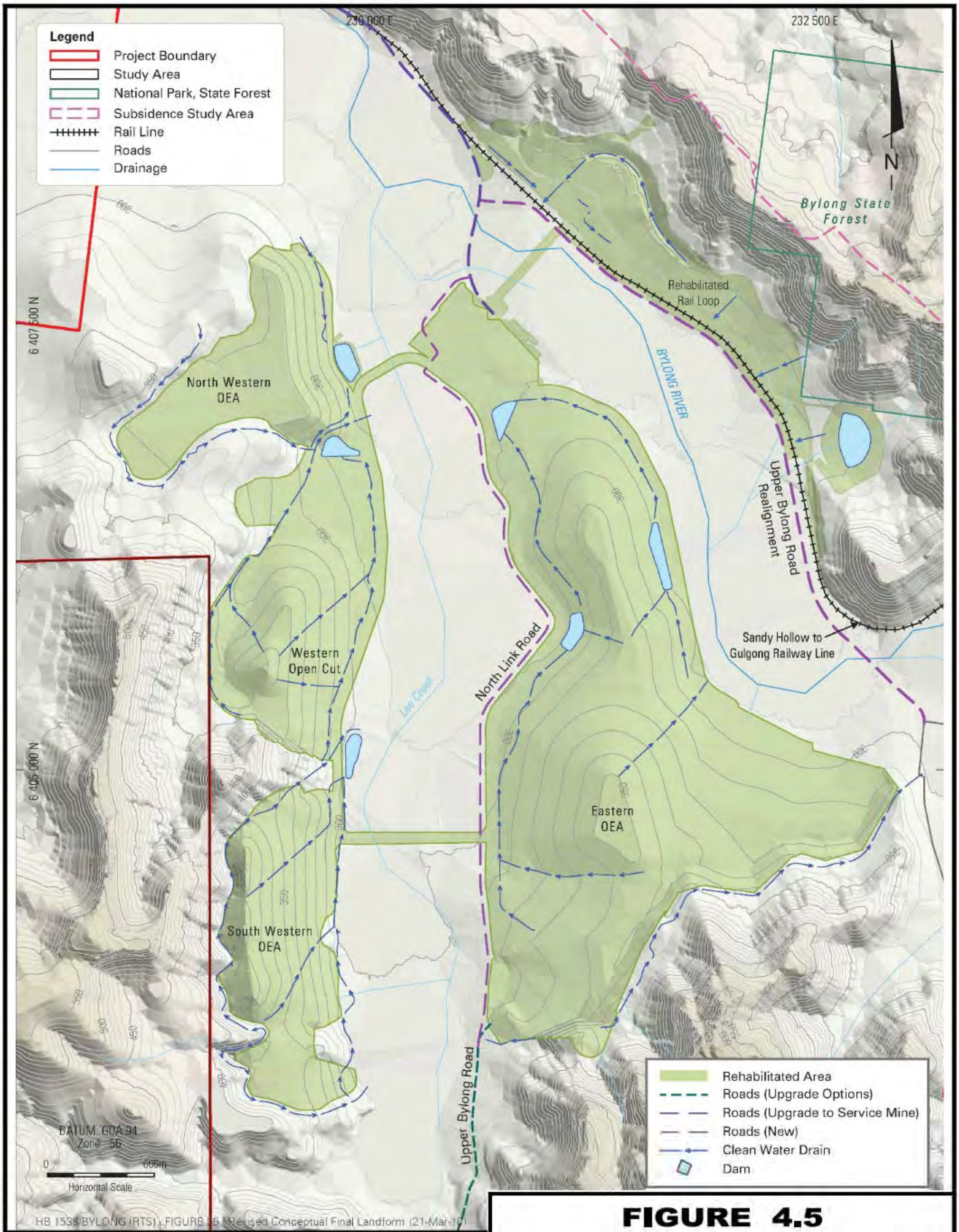

SCALE (m)

300 0 300 600

Image Source : Bylong Coal Project, Environmental Impact Statement, Response to Submissions, March 2016 (Figure 10, Page 115), Hansen Bailey Environmental Consultants, with Additions by John T. Boyd Company.

FIGURE 4.5

MAP SHOWING

REVISED CONCEPTUAL FINAL LANDFORM

BYLONG COAL PROJECT

SYDNEY BASIN

New South Wales, Australia

Prepared For

HANSEN BAILEY PTY LTD

John T. Boyd Company

December 2017

Scale 1 : 30,000

P:\CAD_GROUP-jfg\5172.001\FIG FINAL LF.DWG

5.0 SOCIO ECONOMIC BENEFITS

5.1 Introduction

The socio economic benefits of the Project have been studied as part of the EIS, including:

- A Social Impact Assessment (SIA) completed by Hansen Bailey which integrated the social and economic impacts with a stakeholder engagement program:
  - DP&E commissioned a peer review of the SIA by Elton Consulting in 2015.
  - The Response to Submissions included a Social Impact Assessment for a "No WAF" scenario, as well as various responses to submissions relating to the SIA.
  - The Supplementary RTS included responses to various stakeholder submissions in relation to the potential social impacts of the Project.
- An Economic Impact Assessment (EIA) study of the Project was undertaken by Gillespie Economics:
  - The EIA was peer reviewed on behalf of KEPCO by BDA Group in 2015 as part of the EIS submission.
  - DP&E commissioned the Centre of International Economics (CIE) in 2015 to undertake its own peer review of the EIA.
  - The Response to Submissions and Supplementary Response to Submissions provided further clarification and responses to the various stakeholder queries.

5.1.1 Project Socio Economic Setting

The Bylong Valley is a small agricultural community of approximately 100 residents in 2015. Bylong Village is located in the Valley and is the focus of community activities.

Residents of the Bylong Valley were consulted to ascertain their opinions on issues such as community identity, values, aspirations and lifestyle. They identified a number of issues including economic, social, physical, natural and cultural heritage as being important[1].

Within the broader region, the Mid-Western Regional Council Local Government Authority (MWRC LGA) consists of the large regional town of Mudgee and a number of smaller settlements, including the nearby Rylstone and Kandos.

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[1] p119 Main Report, Bylong Coal Project Environmental Impact Statement, Hansen Bailey Environmental Consultants, September 2015

Key economic features of the MWRC LGA as at June 2017[2], except for unemployment, are:

- Population within the region (MWRC LGA) of 24,569.
- Total jobs were 8,618, of which the largest number, 1,339 or 16% of the total, was in the mining industry. Other large employers were retail (1,029 jobs), and agricultural, forestry and fishing (854 jobs) industries.
- Total wages and salaries were A$725.1M, of which the mining industry was the largest contributor with A$193.6M or 27% of the total, outstripping the next three largest industries combined of health care, manufacturing, and education. Wages and salaries paid to the retail and agriculture, forestry and fishing industries were ranked 5th and 12th respectively.
- As at October 2017, the unemployment rate was 4.5%, as compared to 4.6% in NSW[3].

From the above, it is clear to BOYD that continued economic growth of the MWRC LGA is highly dependent on the continuing success of the mining Industry.

5.2 Project Employment Numbers (Full Time Equivalent)

Personnel engaged to work at Bylong will generally be focused on local hires. The workforce will be further supplemented by non-local hires. Personnel will be encouraged to relocate to live nearer to the Project within a maximum commuting time of one hour.

The Project workforce will peak at 650 full time equivalents (FTEs) during construction in Project Years 1 and 2. An average of 194 FTEs will be employed at the open cut during the 8 years of operations from Project Year 3 to Project Year 10. Employment will peak at 470 FTEs during the combined open cut and underground operations, and will then stabilise at 275 FTEs during the period of underground only operations (240 in the underground operations and 35 in the CHPP)[4].

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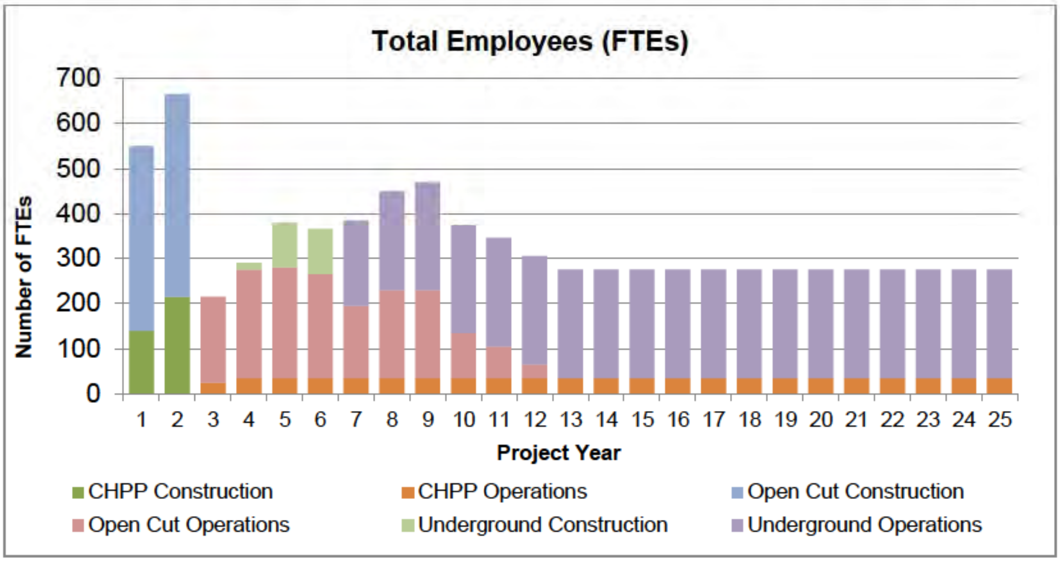
[2] Mid-Western Regional Council website http://www.economyprofile.com.au/midwestern, accessed 25 November 2017

[3] Australian Government Department of Employment, Labour Market Labour Portal, http://lmip.gov.au/default.aspx?LMIP/LFR_SAFOUR/NSW_LFR_LM_byLFR_UnemploymentRate accessed 27 November 2017

[4] p106 Appendix C Social Impact Assessment No WAF Accommodation Scenario, Response to Submissions, Bylong Coal Project Environmental Impact Statement, Hansen Bailey Environmental Consultants, March 2016

The following chart shows employees (FTEs) directly engaged in the Project:



The EIA has forecast that during the operations phase the Project will result in an average of 290 direct and 540 indirect jobs in the regional area[5]. On a state-wide basis, during the operations phase the Project will provide an average of 290 direct and 1,206 indirect jobs to the state of NSW[6].

BOYD opines that within the MWRC as well as within the broader State of NSW the Project will provide a high level of employment. The Project will significantly increase the number of employees directly employed by the mining industry in the MWRC by another average of 290 over its life.

5.3 Economic Impact Assessment

The EIA included a Cost Benefit Analysis which compared the present value of the aggregate benefits to society as a result of the project with the present value of the aggregate costs. When the present value of the aggregate benefits exceeds the present value of the aggregate costs to society, a project is considered to be desirable to society from an economic efficiency perspective[7].

The Cost Benefit Analysis indicates that the Project will have a total net social benefit for Australia of $592M NPV (@ 7% discount), excluding employment benefits[8], or $757M including employment benefits.

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[5] p63 Appendix AE Bylong Coal Project Economic Impact Assessment, Bylong Coal Project Environmental Impact Statement, Hansen Bailey Environmental Consultants, June 2015
[6] p65 ibid
[7] p339 Main Report, Bylong Coal Project Environmental Impact Statement, Hansen Bailey Environmental Consultants, September 2015
[8] p44 Appendix AE Bylong Coal Project Economic Impact Assessment, Bylong Coal Project Environmental Impact Statement, Hansen Bailey Environmental Consultants, June 2015

The main fiscal benefits[9] (present value at 7% discount rate) of the Project are:

- Company tax: $302M to the Commonwealth Government.
- Personal income tax: $109M to the Commonwealth Government.
- Royalties: $290M to the NSW Government.
- Payroll Tax: $21M to the NSW Government.
- Voluntary Contributions: $4M to Local and Regional community.

An economic activity analysis using input/output analysis[10] concluded that the Project will make the following contribution to the NSW State economy over its contributing life of 23 years (out of the total Project life of 25 years):

- $855M in annual direct and indirect regional output of business turnover.
- $492M in annual direct and indirect regional value added.
- $135M in annual direct and indirect household income.
- 1,496 direct and indirect jobs.

The EIA assessed the net production benefits and aggregate cost benefits to the State of NSW, the Local and Regional community, and the Commonwealth in terms of employment, capital expenditure and royalties.

Displacement of some agricultural activity will occur as a result of the Project however the EIA showed that the net production benefits of the Project to Australia are estimated at 37 times of the displaced agriculture. KEPCO intends to reinstate/rehabilitate 423.1 ha of land that meets the criteria for BSAL in order to compensate for the BSAL that would be directly impacted by the Project[11].

Sensitivity analysis was undertaken by applying +/-30% changes to the assumptions at 4%, 7% and 10% discount rates. The sensitivity analysis demonstrated that the Project delivered a net positive social benefit under all the scenarios tested.

BOYD concurs with the findings of Gillespie and other economists: the Project will deliver significant socio economic benefits to the MWRC LGA, the State of NSW and the Commonwealth of Australia over its life.

5.4 Case Studies

BOYD has provided three case studies – a mine located in Central Queensland, a mine located in the MWRC LGA of NSW, and a mine located in the Hunter Valley of NSW to provide examples demonstrating the socio economic benefits each of the mines provides to the local and broader community.

[9] p75 Appendix AE Bylong Coal Project Economic Impact Assessment, Bylong Coal Project Environmental Impact Statement, Hansen Bailey Environmental Consultants, June 2015
[10] p65 ibid
[11] Email from Nathan Cooper, Hansen Bailey to Ian Alexander, John T Boyd Company, 17 November 2017

5.4.1 Coppabella Mine

Coppabella Mine in the Mackay region of Queensland is an open cut coal mine. In April 2003, Rolfe, Lockie and Franettovich[12] from Central Queensland University analysed the economic and social impacts of the mine. Their findings are relative to a scenario in which no mining takes place on the site.

Operations began at Coppabella Mine in 1998, and 340 people are employed on site. Coppabella Mine is responsible for $7.1M in annual spend in the Nebo Shire, and $26.8M annually in the broader Mackay area. This was due to direct wages expenditure, expenditure from miners not living in the area, contracted services and supplies and miscellaneous services and supplies. It is possible to account for secondary impacts, which increases the annual spend in the Nebo Shire to $8.3M.

It is estimated that Coppabella Mine accounts for the direct and indirect employment of 62 FTEs in the Nebo Shire and 783 FTEs in the broader Mackay region.

5.4.2 Wilpinjong Mine

Wilpinjong Mine in central NSW is an open cut coal mine that has operated since 2006. In 2015, Deloitte Access Economics analysed a proposal to expand the mine and extend the mine's life[13]. The analysis is in comparison with a baseline scenario in which the mine is not expanded and the mine's life remains as was approved at the time (i.e., extends to 2026).

Relative to the baseline, Wilpinjong Mine expansion was estimated to deliver net benefits of around $735M over its life, on a net present value basis. The benefit cost ratio was estimated to be approximately 1.43. The project was estimated to provide royalties of $190.5M to the NSW government. The net benefit to the MWRC LGA was approximately $263.5M. Underlying that estimate is an assumption that employees and suppliers earn the average income if the expansion were not to occur. It was estimated that 278 additional full time equivalent workers would be employed, both directly, and indirectly. Of those FTE workers, 77 per cent of them were expected to be employed from the broader region which includes Mudgee.

5.4.3 Mount Owen Complex

Mount Owen Complex in the NSW Hunter Coalfields is made up of three open cut coal mines: Mount Owen, Ravensworth East and Glendell. In October 2014 Deloitte Access Economics analysed a proposal to continue mining at Mount Owen Mines from 2018 to 2030.[14] Their findings are relative to a scenario in which mining stops in 2018.

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[12] Rolfe, J; and Lockie, S; and Franettovich, M; 'Economic and Social Impacts of the Nebo Shire and the Mackay Region', prepared for Australian Premium Coals Pty Ltd, April 2003
[13] Deloitte Access Economics, Cost Benefit Analysis and Economic Impact Analysis of the Wilpinjong Extension Project, 2015
[14] Deloitte Access Economics, Cost Benefit Analysis and Economic Impact Analysis of the Mount Owen Continued Operations Project, October 2014

Relative to the baseline in which mining stopped in 2018, Mount Owen Complex was estimated to deliver net benefits of $758M over its life, on a net present value basis. The benefit cost ratio was estimated to be 1.30. The project was estimated to provide royalties of $258M to the NSW government. The net benefit to the Singleton community was approximately $306M. Underlying that estimate is an assumption that workers could earn the average income in Singleton if the extension did not occur. It was estimated that around 1,200 additional FTEs would be employed, both directly, from suppliers and accounting for crowding out. Almost all of those were expected to be in the Hunter region.

5.5 BOYD's Summary and Conclusions

BOYD's summary of socio economic findings in relation to the Project are:

- The Project provides significant direct and indirect employment opportunities at the local, regional and state levels over its life. The operations workforce will peak at 470 FTEs. An annual average of 194 FTEs will be directly employed over the life of the open cut operations, and an average of 275 FTEs will be employed over the life of the underground operations (240 underground and 35 in the CHPP).
- Gillespie Economics estimated that the present value of the Project's fiscal benefits (at a discount rate of 7%) are:
  - Company tax: $302M to the Commonwealth Government.
  - Personal income tax: $109M to the Commonwealth Government.
  - Royalties: $290M to the NSW Government.
  - Payroll Tax: $21M to the NSW Government.
  - Voluntary Contributions: $4M to Local and Regional community.
- The Project will make the following annual average contribution to the NSW State economy over its 23 year operational life:
  - $855M in annual direct and indirect regional output of business turnover.
  - $492M in annual direct and indirect regional value added.
  - $135M in annual direct and indirect household income.
  - 1,496 direct and indirect jobs.

The Project will make a significant contribution to the MWRC LGA and to the State of NSW.

6.0 COAL MARKET AND SUPPLY

6.1 Introduction

KEPCO assessed the demand and marketability of Bylong coal in 2014 using reputable market analysts. However, world energy markets are characterised by continuously changing dynamics which challenge the ability of forecasters to provide accurate projections of both energy supply and energy demand.

Since that time, the strategic importance of the Republic of Korea, the world's 13th largest economy, to NSW led the two to formulate a "NSW International Engagement Strategy", October 2015[1], to drive increased trade and investment ties. The NSW Government, recognising the long term supply relationship and value ($2.3B 2013-14[2]) of resources and energy exported to Korea, committed to halving assessment timeframes for major projects. Continued opportunities were identified to attract inward investment into NSW resources and energy: renewable energy, Mining Equipment and Technology Services (METS) and research and development to support high tech manufacturing. A Korea-Australia Free Trade Agreement (KAFTA) commenced in December 2014 and was expected to provide a major boost for agricultural and service exports to Korea and increase two-way investment. The Department of Foreign Affairs and Trade (DFAT) estimates the annual boost to the Australian economy will be $653M. In 2014 Korea had invested approximately $22.8B[3] in Australia, reflecting the bilateral economic relationship.

Evidence of the relationship between the countries is supported by KEPCO Korea who advised KEPCO[4] that all coal produced by the Project will be consumed by its five South Korean power generating subsidiaries (Genco's), KOSEP, KOMIPO, WP, EWP and KOSOP.

Notwithstanding variable dynamics of international trade and politics, BOYD has developed an updated independent outlook of coal market supply and demand for Bylong-type thermal coal.

To assess the potential market opportunities available to the Bylong Project, BOYD reviewed the future outlook for thermal coal represented by China and India, as well as other key Asian thermal coal consumer countries. Immediate forecasts and longer term projections were sourced from the International Energy Agency (IEA) and the Australian Government Department of Industry, Innovation and Science (DIIS).

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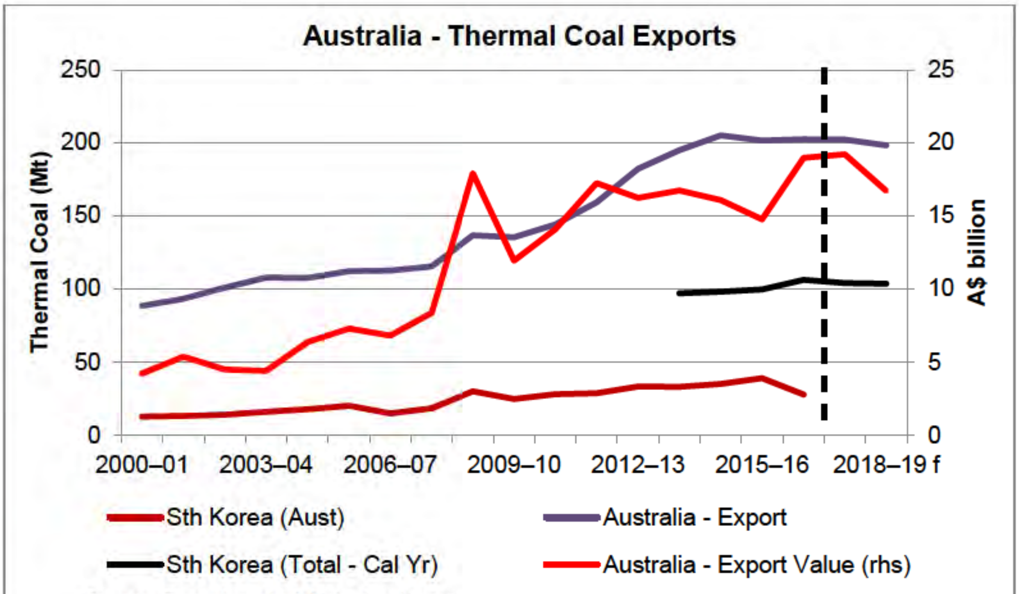
[1] The Republic of Korea Strategy, New South Wales Government, October 2015.
[2] p5 The Republic of Korea Strategy, New South Wales Government, October 2015.
[3] p5 ibid.
[4] Support Letter from KEPCO Korea.

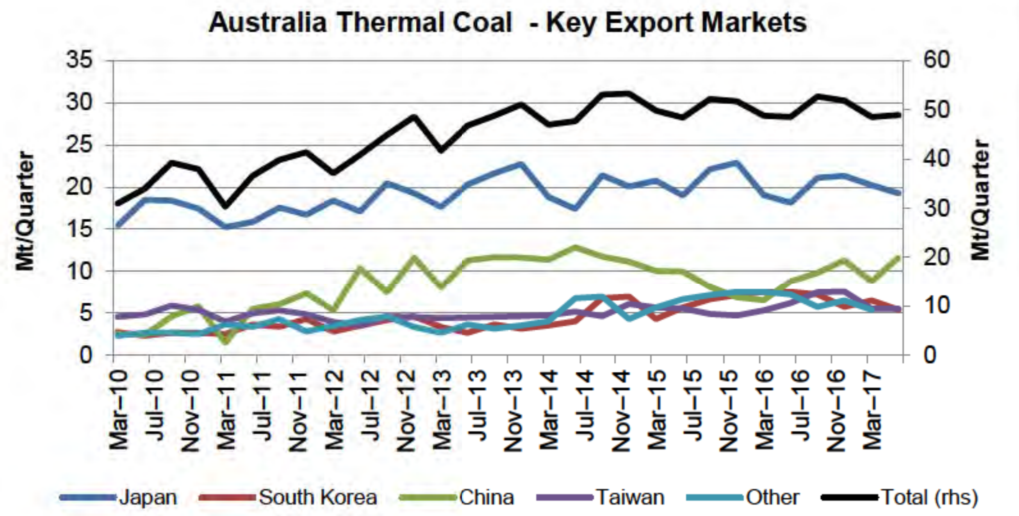
As can be seen in the following chart, Australian thermal coal exports were maintained at 202 Mt in 2016-17 and are expected to stabilise at this level. The value of exports decreased from A$16.07B in 2014-15 to A$14.75B in 2015-16, increasing again to A$18.94B in 2016-17 and are forecast to increase to A$19.18B in 2017-18[5].



Source: Department of Industry, Innovation and Science (2017)

The following chart shows that the key importers of Australian thermal coal in Asia – namely Japan, China, South Korea and Taiwan – increased total imports from 2015 to 2016[6]. However, during that same period Australia's share of imports decreased by 8 Mt to 173 Mt[7] due to a reduction of imports by China. Total coal imports by these same countries are forecast to increase in 2017 by 17 Mt to a total of 510 Mt[8] with a similar tonnage in 2018 and a 2% reduction projected in 2019. Similarly, imports to South Korea are projected to increase from 100 Mt in 2016 to 106 Mt in 2017. They will decrease marginally but remain constant at 104 Mt in 2018 and 2019[9], before increasing to 110 Mt in 2022[10].

[5] Department of Industry, Innovation and Science 2017 Resource and Energy Quarterly, September 2017.
[6] Department of Industry, Innovation and Science 2017, Forecast data, December 2016.
[7] Department of Industry, Innovation and Science 2017, Historical data, March 2017
[8] Department of Industry, Innovation and Science 2017, Forecast data, September 2017
[9] ibid
[10] Department of Industry, Innovation and Science 2017, Forecast data, March 2017



Data source: Department of Industry ,Innovation and Science (September 2017) Historical data

Thermal coal markets are demand driven. Coal's share of global primary energy generation (power and heat) in 2017 was 29%[11] and remains the backbone of many power systems around the world.

In the Asian market, the influence of China and India is particularly acute, as both countries represent nearly 40% of the region's future import demand by the end of this decade.

6.2 Recent Market and Policy Development

Recent assessments by the IEA[12,13] and the DIIS have identified a number of potential significant market influences, including:

- Efforts to decarbonise the electricity system in the high income economies of the world have led to a fall in coal consumption in the OECD[14].
- Reduced natural gas prices result in a surge in gas fired power generation at the expense of coal.
- Changes in energy generation policies, taxes and commitments by governments to reduce air pollution by the adoption of alternatives to coal-fired power generation, decrease the reliance on coal imports and stimulate domestic production, and reduce the level of nuclear generated electricity.

[11] p206 World Energy Outlook 2016, International Energy Agency
[12] p206 World Energy Outlook 2016, International Energy Agency
[13] World Energy Special Report, Southeast Asia Energy Outlook 2017, International Energy Agency
[14] p206 World Energy Outlook 2016, International Energy Agency

- Alleviate energy poverty. Of the total population of 640M people in Association of South East Asian Nations (ASEAN) countries, an estimated 65M people remain without electricity and 250M people are reliant on solid biomass as a cooking fuel[15].
- Increased energy security and reliability.
- Investment in advanced technology coal-fired coal plants in order to reduce emissions.
- Incentivising by increased prices due to price competition driven by supply side policies in China (the largest consumer and producer of thermal coal) where imported coal is more competitive than domestic supply.
- Transition of China away from heavy industry (crude steel and cement) to services.
- Falling prices challenging production viability leading to a rebalancing and capacity adjustment.
- Growth in industrialised economies and anticipated increased energy needs in Asia in general and South Korea in particular.

6.2.1 Medium term Scenarios

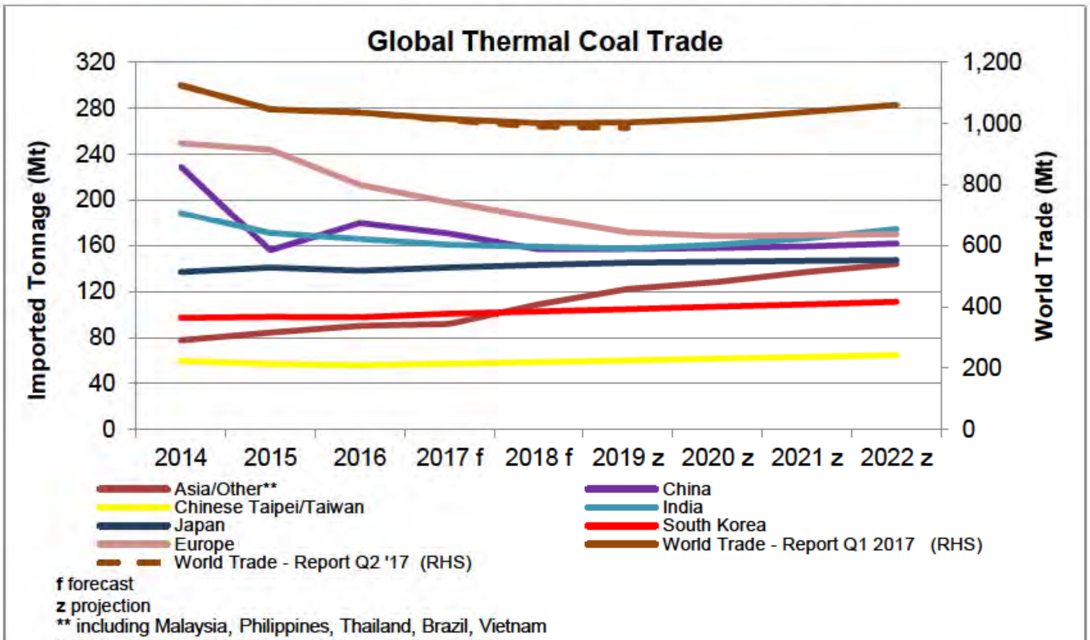
Medium term dynamics (to the end of the decade) indicated by the IEA[16] include:

- Key uncertainty lies with the determination of governments to rigorously implement climate and environmental policies whilst balancing energy reliability, security and costs.
- Further capacity cuts, either politically administered, market driven or resulting from depletion, are expected to fully absorb over capacity in the market.
- Further increases in international coal prices by 10%-15% over 2015 averages.
- Global coal demand to rebound to 2014 levels.
- Sluggish investment in coal related infrastructure.

The DIIS also provides medium term market assessments and projections to 2020[17] and 2022[18]. The 2020 report reflects the potential impact of the 2017 presidential elections in South Korea to reduce immediate coal demand. However, long term coal demand is projected to increase through 2022, influenced by other markets, including

[15] World Energy Special Report, Southeast Asia Energy Outlook 2017, International Energy Agency
[16] World Energy Outlook 2016, International Energy Agency
[17] Department of Industry, Innovation and Science, Resources and Energy Quarterly, June 2017
[18] Department of Industry, Innovation and Science, Resources and Energy Quarterly, March 2017

Vietnam, Malaysia and Brazil, shown as Asia/Other in the chart below:



Source: Office of the Chief Economist, Australian Government, Resources and Energy March 2017 Forecast

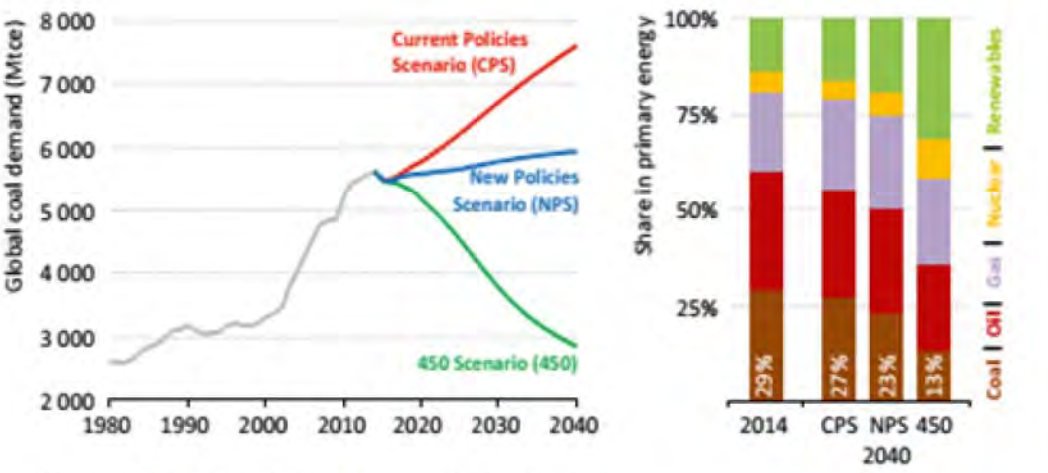
6.2.2 Long term Scenarios

The IEA forecasts that despite falling prices, excess capacity, technical and economic feasibility of carbon reduction strategies, climate and environment policies, coal's share of primary energy supply is sensitive to climate action and its future is unclear. It provides three coal demand scenarios[19]: Current Policies, New Policies and 450 Scenario. These are summarised below:

- Current Policy: No new measures beyond those adopted in 2016 and without the impetus of changes implied by pledges made at the 21st Conference of Parties. (COP21) in December 2015. Coal demand will expand at 1.2% per year to 2040 and its share in primary energy is 27% (in 2040). This scenario represents an OECD import price of US$100/t and conditions where coal profitably expands into new or under-developed deposits.
- New Policies: This is the central scenario. It takes into account the Current Policy and also the targets and intentions pledged by 180 countries to limit greenhouse gas emissions announced at COP21. Coal consumption growth will reduce from an historical rate of 2.4% to 0.2% reflecting the falling cost of renewable energy and climate pledges. Coal's share in primary global energy supply falls to 23% in 2040.
- 450 Scenario: This pathway is considered consistent with a 50% limit to global increase in temperature, to 2º by 2100. Global demand is assumed to drop sharply by 2.5% per year, with coal consumption half that assumed in the New Policies Scenario and its share in primary supply falling to 13%.

[19] World Energy Outlook 2016, International Energy Agency

Global coal demand for each scenario is shown in the chart below:



Source: IEA 2016 World Energy Outlook p 206

The IEA projects that under the New Policies Scenario coal demand will increase in real terms despite its significant reduction in primary global energy supply by 2040.

Global demand (thermal and metallurgical coals) by key sector in the New Policies Scenario indicates a number of significant changes in the power and industry sectors:

- Coal demand for power will increase by 90 million tonnes of coal equivalent (Mtce), or 10%, despite the share of coal in global power generation dropping from 41% in 2014 to 28% in 2040. Coal will be surpassed by renewables and gas as the primary source in 2030. Despite a projected construction of 400 GW of supercritical and 330 GW of ultra-supercritical plants during the period, subcritical plants are also retired, delivering energy efficiency and therefore reducing demand for coal.

- Production of iron and steel (consuming coking coal) is projected to expand 20% to 2040, however, coal consumption is projected to fall. This is due to increased steel production in electric arc furnaces – supported by the availability of scrap, increased efficiency improvements and increasing thermal coal use as pulverized coal injection in steel production.

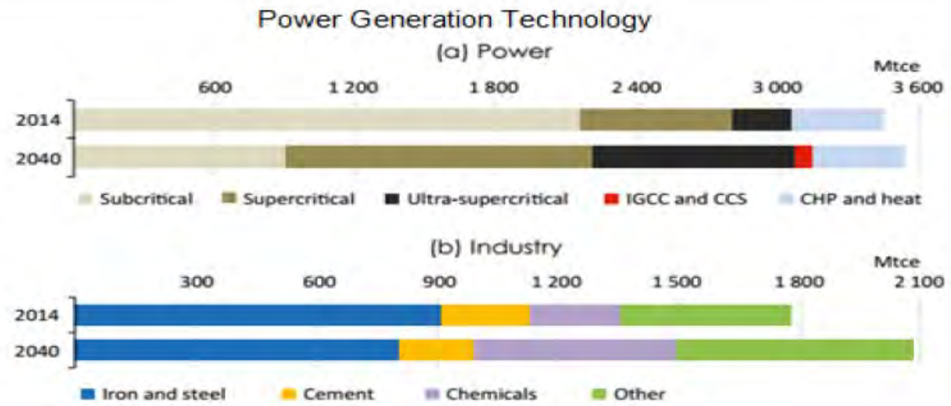
- Coal consumption in the chemical industry is projected to grow by 2.5 times. Some 70% of the growth will come from changes in power plant technology stemming from coal to liquid and coal to gas transformation (mostly in China) due to strong price growth in oil and gas.

- Much of the growth from non-energy intensive industries (textiles, food, beverage and machinery) will arise in India due to strong economic growth.

- Total primary energy demand from 2014 – 2040 will increase from 3,926 Mtce to 4,140 Mtce, a compound annual growth rate (CAGR) of 0.2%[20].

[20] p550 World Energy Outlook 2016, International Energy Agency

The chemical industry is identified as the primary growth centre (from coal to gas or coal to liquid transformation) for coal demand supported by changes in plant technology in the power sector generation structure[21], as indicated in the chart below:



- IGCC – integrated gasification combined cycle
- CCS carbon capture and storage
- CHP – combined heat and power

Source: IEA, World Energy Outlook 2016 p214

Southeast Asia's energy demand is forecast to increase by two thirds between 2016 - 2040[22], as the economy triples in size and population increases by 20% with urban population growing by 150M people. Country pledges were made as part of the Paris Agreement and despite a strong growth in low carbon energy, coal accounts for 40% of the growth[23]. The region is forecast to be a net energy importer[24] by 2040 and electricity demand forecast to more than double at an annual growth rate of 3.7%[25]. Coal demand is forecast to increase from 161 Mtce to 387 Mtce between 2014 and 2040, a CAGR average of 3.7%[26].

The projected demand scenarios provided by a number of sources including DIIS, IEA and commercial forecasters such as Wood Mackenzie and BOYD, may vary in detail but indicate similar trends for the projected demand for thermal coal, consistent with that proposed to be produced by the Project.

6.3 Coal Supply-Demand Forecasts by Key Country

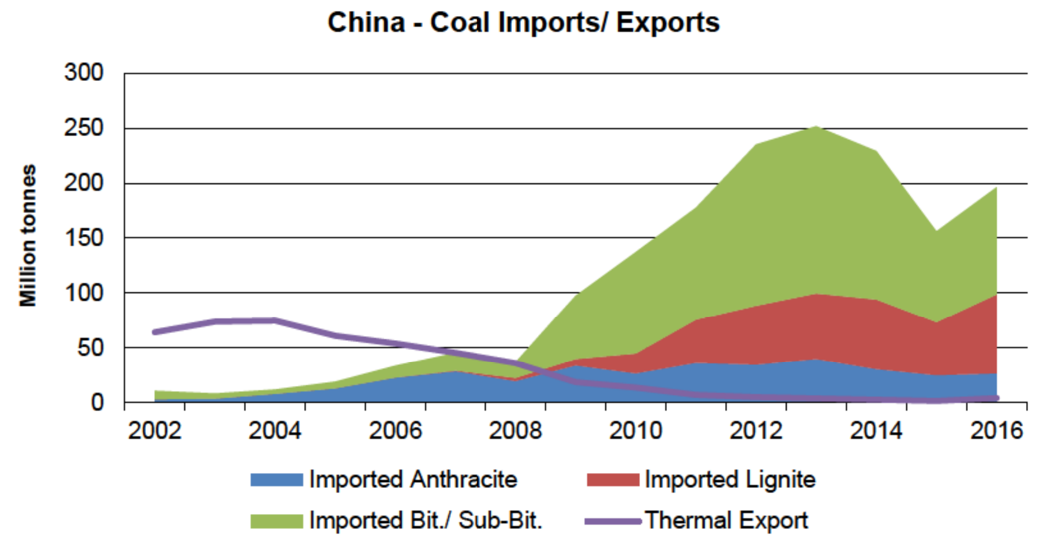
The IEA provides projections for global regions: OECD-Europe, European Union, non-OECD, OECD-Asia Oceania, OECD-Americas, United States, Japan and others and whilst projecting energy demand, gross electricity generation and electrical capacity the data does not discriminate between most of the countries in Asia.

[21] p214 World Energy Outlook 2016, International Energy Agency
[22] p53 World Energy Special Report, Southeast Asia Energy Outlook 2017, International Energy Agency
[23] p15 ibid
[24] p53 ibid
[25] p57 ibid
[26] p73 ibid

BOYD has prepared the following assessment on a key country basis within the Asia region.

6.3.1 China

Thermal coal is a major driver in China's economy, providing power and heat generation for industrial uses and households. With a consumption level nearly three times larger than the next closest nation, the leverage China has on the rest of the international market and ultimately on coal prices, is dramatic. China's impact on the international market became apparent in 2009, when China transitioned from being a net exporter to a net importer. Global prices rallied in response. China's import and export shipments since 2002 are shown below:



Source: BOYD internal database

China's trend of decreasing exports appears to have started in 2004, whilst its movement toward imports began in earnest in 2008. This reflects the structural change that occurred within the country (it was no longer able to meet its growing demand from domestic supply), as well as some opportunistic manoeuvring as China took advantage of the less expensive import market in order to preserve its domestic reserves. The financial crisis of 2008 and the subsequent collapse in international coal prices only served to accelerate China's move to the international market – an event that would have happened eventually. The slowdown in the Chinese economy, which began to emerge in 2013, curtailed the country's appetite for international coal over the 2013 to 2015 period. In 2016, China's coal imports rebounded strongly, although this rebound was more a factor of weak domestic supply rather than increased overall coal demand.

China will continue to rely heavily on thermal coal to meet a major portion of its electricity requirements and energy production over the long term. BOYD opines that coal fired generation will represent more than 65% of China's total generation capacity going forward. Despite this outlook, China's demand for imported coal is expected to decline as the Chinese government implements various measures designed to control the production, while promoting the use of domestic coal. These measures have only been recently announced and their full impact is yet to be determined. However, it is widely believed these protectionist actions will slow the flow of imported coal into the country. BOYD forecasts that thermal coal imports into China will fall from an estimated 196 Mt in 2016 to approximately 160 Mt by 2030.

Historical coal imports into China (by coal type and major source country) for the period 2011 through 2016 is shown in the following table:

China Thermal Coal Imports (Tonne 000)

	2011	2012	2013	2014	2015	2016
			Anthracite			
Australia	1,680	2,051	3,691	2,987	1,666	769
North Korea	11,048	11,807	16,494	15,432	19,579	22,438
Russia	1,300	3,030	5,513	4,469	2,772	2,565
Vietnam	22,033	17,423	13,142	6,830	720	487
Other Sources	70	160	807	648	33	155
Subtotal	36,130	34,471	39,647	30,366	24,770	26,415
			Lignite			
Indonesia	35,770	50,094	57,565	58,741	45,416	64,725
Philippines	2,434	2,630	1,849	4,444	2,700	7,109
Other Sources	942	970	374	406	135	351
Subtotal	39,146	53,694	59,788	63,591	48,251	72,185
			Bituminous/ Sub-Bituminous Thermal Coal			
Australia	20,549	43,530	54,341	60,240	43,538	42,954
Canada	1,273	1,168	887	993	-	-
Colombia	1,279	2,484	328	1	-	-
Indonesia	62,928	65,558	65,457	46,959	28,115	38,500
Mongolia	116	2,667	1,882	4,435	1,618	2,654
Russia	5,617	12,354	13,298	15,077	9,780	13,458
South Africa	9,252	14,277	12,360	5,165	-	-
United States	566	4,828	2,390	1,529	0	1
Other Sources	733	144	1,382	791	60	131
Subtotal	102,312	147,011	152,326	135,189	83,112	97,697
Total	177,589	235,176	251,761	229,147	156,133	196,297

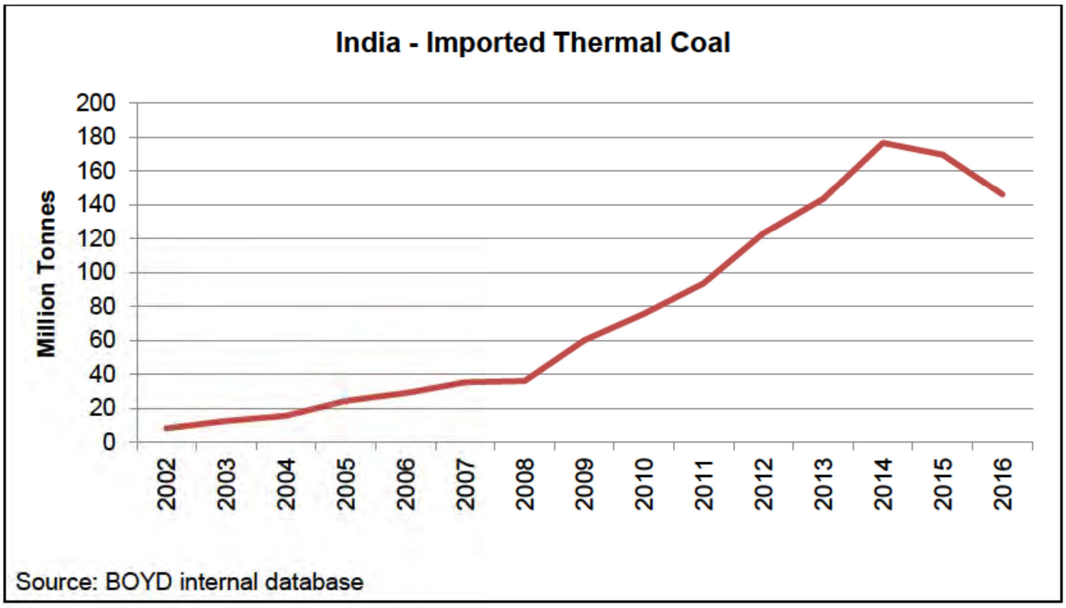
Source: BOYD internal database

Despite the downturn witnessed in 2015/2016, Australia still represented the largest source of higher rank thermal coal imports to China, accounting for over 44 percent of China's imports of bituminous and sub-bituminous coal over the past three years. BOYD's expectations that China will reduce its reliance on coal fired generation and associated coal imports will likely weigh on Australia's overall export business in the future. However, we opine that Australian high energy coal will continue to be a large component of China's coal imports. Substitution of Australian coal with lower energy coal, such as that from Indonesia, is considered to be unlikely due to the boiler specifications for existing power station.

6.3.2 India

Like China, India is a large producer and consumer of thermal and metallurgical coal. Unlike China however, India has exhibited a lower degree of industrialisation and has experienced more modest economic growth performance over the past decade. Consequently, India's coal consumption behaviour has been much more subdued compared to China's.

India maintains a large domestic coal industry, with an estimated production base of over 420 Mt. However, India's indigenous reserves are of lower quality (between 4,000 to 4,500 kcal/kg NAR) and annual production consistently suffers from inefficient infrastructure and poor performance by a predominately state-owned coal industry. As a result, production budget shortfalls are commonplace, leading to India's growing reliance on imported coal over the past decade. India's thermal coal imports since 2002 are shown in the following chart:



In 2015 and again in 2016, India's thermal coal imports declined. This two-year downturn was predicated by the Indian Government's efforts to replace imported coal through increased output from domestic sources. The commitment by state-owned Coal India (responsible for more than 80 per cent of the country's coal production) to increase output was thought have the biggest impact on the recent decline in imports[27].

India is going through a massive investment program in new coal power plants, in particular along the country's West and East coasts. More than 100 GW of new coal-fired capacity is under construction (and scheduled to come online by the end of

[27] In November 2016, the company released a medium term strategy (spanning to 2019–20) to Parliament. The plan highlighted the company's intent to increase its project numbers and employ mass production technologies.

2018) as part of plans to improve electricity access and meet the growing energy needs of its middle class. Other conventional forms of power generation have not kept pace with demand and their proportion has reduced considerably. As a result, India's dependence on coal-based generation will be even higher in the near- to mid-term.

In light of its planned expansion of coal-fired generation and the fact that its production base has not consistently coped with the rate of increased consumption (despite Coal India's plans to increase domestic output), India will need to import increased quantities of thermal coal over the next decade. However, the rate of increase will be lower than previously anticipated due to increased production from Coal India and delays in power sector reform. While India's coal imports are forecast to be 161 Mt in 2016, BOYD estimates Indian imports will increase to 170 Mt by 2025, putting it above the expected imported coal tonnage of China.

In terms of thermal coal imports, shipments to India in Financial Year (FY) 2015/16 totalled 127.6 Mt, down 12.2 percent from FY 2014/5. Indian thermal coal imports over the past 2 years by source country are shown below:

India Thermal Coal Import Statistics

	FY 2014/15		FY 2015/16	
Country	Tonnes (000)	%	Tonnes (000)	%
Indonesia	107,239	74	86,283	68
South Africa	26,327	18	27,157	21
US	869	1	2,883	2
Russia	377	-	2,713	2
Australia	5,157	4	2,389	2
Other	5,363	4	6,189	5
Total	145,332	100	127,614	100

Source: BOYD internal database

Australian shipments have traditionally been a minor component of India's thermal coal imports due to the Indian generating industry's reliance on sub-bituminous Indonesian coal and/or lower grade bituminous coal from South Africa. However, future expansion of Indian thermal coal imports is expected to have a material impact on Australia's export of mid-quality export coal tonnages following the slated development of the Adani, Galilee Basin and Mt Pleasant, Hunter Valley projects.

6.3.3 Japan

Japan is the third largest importer of thermal coal in the Asian market (behind India and China). Over the past 10 years, Japan's annual thermal coal imports have typically ranged between 120 and 140 Mt, with the majority of this coal being sourced from Australia. Japan's historical thermal coal imports and source countries are shown in the table below:

Japan Thermal Coal Imports (Tonnes 000)

Country	2000	2005	2010	2011	2012	2013	2014	2015	2016
Australia	46,761	64,131	75,619	69,752	81,603	86,457	87,510	94,350	90,354
China	11,505	17,913	4,333	2,985	1,905	755	629	566	1,213
Indonesia	10,535	29,279	33,730	35,089	35,841	35,903	35,372	21,297	32,065
USA	3,095	221	679	975	1,261	2,424	2,885	2,290	2,134
Russia	-	6,775	7,399	7,844	8,499	8,418	11,016	11,504	12,406
South Africa	1,645	143	299	616	424	466	219	78	143
Canada	1,268	969	2,509	2,679	2,849	2,999	2,689	2,621	1,936
Colombia	-	-	60	204	145	148	25	-	236
Others	2,812	414	330	287	64	29	62	103	91
Total	77,620	119,884	124,958	120,431	132,591	137,600	140,406	143,810	140,577

Source: BOYD internal database

In 2015, Japanese thermal coal imports into the electricity generation sector totalled nearly 92 Mt or 63 percent of the country's total imports. Following the devastating effects of the March 2011 earthquake and the Japanese government's subsequent protracted closure of its nuclear fuelled generation fleet, the Japanese Power Utilities (JPU)'s reliance on imported thermal coal grew considerably.

The Japanese government is easing its stance on nuclear power plants and working with Japanese generators to re-start some of its nuclear units. This will help take the pressure off coal-fired units that are operating close to capacity. However, there is a high level of uncertainty regarding the speed and extent to which the nuclear fleet will be reinstated. Accordingly, Japanese utilities are still hedging their generation needs by increasing coal fired capacity over time:

Planned Coal Fired Power Capacity Additions (MW)

JPU	as of 12/2015	JFY 2016	JFY 2017	JFY 2018	JFY 2019	JFY 2020	Beyond
Hokkaido	3,080	-	-	-	-	-	-
Tohoku	3,200	-	-	-	-	600	-
Tokyo	3,200	-	-	-	-	1,600	540
Chubu	4,100	-	-	-	-	600	1,070
Hokuriku	2,900	-	-	-	-	-	-
Kansai	1,800	-	222	-	-	-	2,300
Chugoku	2,706	-	-	100	-	1,000	1,000
Shikoku	1,106	-	-	-	-	-	500
Kyushu	2,460	-	-	-	-	1,000	2,000
Okinawa	752	-	-	-	-	-	-
J-Power	8,412	-	-	-	-	1,600	2,400
Sakata J	700	-	-	-	-	-	-
Joban J	1,700	-	-	-	-	-	540
Soma J	2,000	-	-	-	-	-	-
IPPs	4,421	210	436	363	212	112	1,300
Retirements	-	-	250	-	-	-	655
Total	42,537	210	408	463	212	6,512	10,995
Cum.	42,537	42,747	43,155	43,618	43,830	50,342	61,337

Note: JFY - Japanese Financial Year ending March
Source: Ministry of International Trade and Industry (MITI) as of Dec. 2016

Consequently, any adverse effect nuclear restarts may have on coal imports is likely to be outweighed by the Japanese Government's focus on increasing the share of coal in the power generation mix. Tied to the increase in coal-fired capacity, BOYD anticipates thermal coal imports will grow, with much of this increased demand continuing to be met by high energy thermal coal from Australia.

6.3.4 South Korea

Imports to South Korea are expected to increase over the near term as the country's nominal coal-fired capacity is increased from 25.1 GW in 2014 to 43.3 GW by 2022. The scheduled coal plant additions are summarised in the following table:

Planned Coal Fired Capacity Additions (MW)

Unit	2015	2016	2017	2018	2019	2020	2021	2022
Dangin 9 *	1,020	-	-	-	-	-	-	-
Dangin 10 *	-	1,020	-	-	-	-	-	-
Samcheok Green 1 *	-	1,022	-	-	-	-	-	-
Samcheok Green 2 *	-	1,022	-	-	-	-	-	-
Bukpyeong 1 *	-	595	-	-	-	-	-	-
Bukpyeong 2 *	-	595	-	-	-	-	-	-
Taean 9 *	-	1,050	-	-	-	-	-	-
Taean 10 *	-	1,050	-	-	-	-	-	-
Shin Boryeong 1 *	-	1,000	-	-	-	-	-	-
Shin Boryeong 2 *	-	-	1,000	-	-	-	-	-
Yeosu 1 *	-	350	-	-	-	-	-	-
Shin Seocheon 1 *	-	-	-	-	1,000	-	-	-
Gangneung Anin 1 *	-	-	-	-	1,040	-	-	-
Gangneung Anin 2 *	-	-	-	-	-	1,040	-	-
Goseong Hai 1 *	-	-	-	-	-	1,040	-	-
Goseong Hai 2 *	-	-	-	-	-	-	1,040	-
Samcheok Thermal 1	-	-	-	-	-	-	1,050	-
Samcheok Thermal 2	-	-	-	-	-	-	1,050	-
Dangjin Echo 1, 2	-	-	-	-	-	-	580	580
Total	1,020	7,704	1,000	0	2,040	2,080	3,720	580
Retirement	450	250	1,067	455	0	0	1,200	0
Cumulative Capacity	25,719	33,173	33,106	32,651	34,691	36,771	39,291	39,871

Note: * KEPCO Subsidiary

Source: "7th Electricity Supply and Demand Basic Plan", Ministry of Trade, Industry and Energy, July 2015

To meet this increase in coal-fired generation, thermal coal imports are expected to increase from approximately 93 Mt in 2016 to over 120 Mt by 2022. Following this robust build up in capacity, thermal coal demand is projected to stabilise at this level through to 2030.

In terms of imports, Australia has historically acted as South Korea's main supply source for high energy thermal coal:

Country	South Korea Thermal Coal Imports (Tonnes 000) 2000	2005	2010	2011	2012	2013	2014	2015	2016
Australia	11,597	22,554	28,053	29,633	30,331	33,425	35,354	37,589	31,115
Canada	1,647	645	5,093	8,474	6,246	6,433	5,834	3,388	1,498
China	18,660	16,755	3,740	2,003	1,115	1,412	1,157	792	1,621
Colombia	-	-	1,657	306	1,936	324	-	-	2,455
Indonesia	4,645	15,381	40,714	40,174	37,854	36,380	35,991	33,951	36,062
Russia	2,171	3,152	6,951	10,135	9,799	11,881	13,779	16,584	16,266
South Africa	2,503	-	2,346	3,030	2,751	165	323	167	2,195
United States	755	398	131	597	1,716	1,747	151	1,226	1,059
Other	81	61	66	22	66	2	147	-	808
Total	42,059	58,944	88,751	94,375	91,814	91,768	92,736	93,697	93,080

Source: IHS Markit

It should be noted that between 2011 and 2015, KEPCO's five power generating subsidiaries have accounted for approximately 85 percent of the total thermal coal imports to South Korea. A summary of KEPCO GENCO deliveries for this period is shown in the following table:

Company	Coal Consumption by KEPCO GENCOS (Tonnes 000) 2011	2012	2013	2014	2015
EWP	16,739	16,407	16,033	15,424	15,515
KOSEP	23,306	24,727	23,715	25,043	27,466
KOMIPO	14,643	13,334	14,286	14,259	13,576
KOWEPO	13,428	12,823	13,260	12,722	12,543
KOSOP	13,397	13,311	13,195	12,284	12,458
Total	81,513	80,601	80,488	79,732	81,558

Source: KEPCO

According to company reports, imported Australian thermal coal has typically represented 40 to 45 percent of the coal deliveries to the KEPCO GENCOS. Although KEPCO has indicated its desire to increase the diversity of its supply sources, BOYD considers it is reasonable to assume that future Australian imports to Korea should continue to represent 35 to 40 percent of the country's thermal coal requirements over the near term.

The newly elected President Moon Jae-in announced a suite of policies to curb the use of coal in power generation to combat air pollution. Since he announced temporary shutdowns of coal fired power plants and increases in the coal consumption tax, a new power plant has come online (595 MW) and thermal coal imports have increased 21 per cent year on year in the three months to August, since the election. In 2017, South Korea's thermal coal imports are forecast to increase by 6.5% to 106 Mt[28].

[28] Department of Industry, Innovation and Science 2017, Resource and Energy Quarterly September 2017

BOYD opines that on completion of a review of the plan to cancel new plants, it will be evident that South Korea will be unable to meet projected electricity demand. Much of the planned capacity additions in coal and nuclear plants are already under construction and if terminated a demand for compensation is expected. We consider that the government's announcement is not sustainable. Notwithstanding short term political issues, demand for coal in South Korea will be maintained and Bylong coal will be consumed as planned.

6.3.5 Coal Demand Summary

Although inconsistent growth is anticipated among Asia's major economies, an overall increase in coal imports is projected. BOYD's projection of Asian and total global coal imports are shown below:

Global Seaborne Thermal Coal Outlook (Million Tonnes)

	Historical			Forecast/Projection					
	2014	2015	2016	2017	2018	2019	2020	2025	2030
China	229	156	196	187	173	172	170	165	160
India	177	170	161	155	157	160	162	170	170
Japan	140	141	140	141	142	145	146	147	149
South Korea	98	98	99	110	112	114	120	123	123
Taiwan	62	63	64	65	66	67	68	69	69
Malaysia	26	27	29	30	32	34	36	40	40
Thailand	18	19	20	21	23	24	25	26	26
Philippines	13	14	14	15	16	17	20	25	30
Vietnam	5	6	8	10	13	17	21	25	30
Subtotal - Asia	767	693	731	735	734	749	769	790	797
United States	9	8	7	7	7	7	7	7	7
Europe	159	157	160	163	163	167	160	155	150
Brazil	9	9	10	11	12	13	14	19	20
Russia	25	25	26	26	27	27	28	28	30
Turkey	21	22	23	24	25	26	27	28	30
Other	52	52	56	58	61	65	70	75	75
Subtotal	274	273	281	289	294	305	305	312	312
Total	1,041	967	1,012	1,024	1,028	1,054	1,074	1,102	1,109

Source: BOYD internal database

Thermal coal imports into the Asian market are expected to increase from 731 Mt in 2016 to 797 Mt in 2030 (a 9% increase). Significant growth is expected in Malaysia, Vietnam, and Philippines where new coal-fired generation capacity will continue to be built over the forecast period. India's coal imports are also expected to increase to 170 Mt by 2025 when it is expected to stabilize. This trend is driven by the Indian Government's desire to reduce the country's dependence on imports[29]. The commitment by state-owned Coal India to increase output is expected to support the stabilization of imports[30]. Outside of India and China, Malaysia, the Philippines, and

[29] "Bridging the Gap; Increasing Coal Production and Sector Augmentation", PricewaterhouseCoopers, June 2016

[30] In November 2016, the company released a medium term strategy (spanning to 2019–20) to Parliament. The plan highlighted the company's intent to increase its project numbers and employ mass production technologies

Vietnam will demonstrate the largest country growth in coal demand in Asia assuming the proposed expansion plans come to fruition.

Overall demand for energy will increase globally and the contribution to global energy supplies provided by renewables will supersede that from coal.

Current projections indicate there will be a net increase in the world demand for thermal coal despite the impacts from the implementation of climate and environmental policies by government, market driven requirements, supply depletion, or increased energy efficiency.

BOYD opines that there is sufficient future demand for thermal coal to enable Bylong coal to be placed in the global market. However, as has been mentioned above, KEPCO Korea has stated that all coal produced by Project will be exported to South Korea.

6.4 Coal Supply Trends

The top five thermal coal exporters (Indonesia, Australia, South Africa, Colombia, and Russia) should remain dominant for the next decade, accounting for over 85% of the net exports over this period. Indonesia will remain the largest exporter closely followed by Australia. South Africa, Colombia, and Russia will make up the second tier of supply. Venezuela, the United States, Poland, and other minor coal exporting countries provide the balance of supply. China's central government control makes it unclear as to whether China will ever participate in any meaningful level in the future export market.

Key factors that will influence the supply of thermal coal in the future include:

- Indonesian production is expected to continue to expand over the next five years, albeit at a slower rate than the previous five years. Beyond the five-year horizon, equipment shortages, rising stripping ratios, and more challenging shipping logistics for new mines will make bringing on new capacity increasingly difficult and costly.
- Future growth in the Asian thermal market will be met largely from sub-bituminous and low grade Indonesian coals which are gaining wider acceptance among international utilities (particularly in India, China, Japan, South Korea, and Taiwan). Indonesia enjoys a significant freight advantage over other competitors in the region and its coals are generally low in ash, sulphur, and phosphorus, making them suitable for blending.
- Due to an increase in domestic demand and constraints to the production base, we expect Indonesian exports to plateau or even begin to decrease slightly from 2020 onward.

- Australia has large tonnages of coal reserves to enable it to meet rising export demand. The major hurdle going forward will be the sustainability of the coal supply chain from a supply base that is moving increasingly inland away from ports. This will become a logistical problem as existing rail infrastructure capacity is challenged with growing traffic. Additionally, port loading facilities have suffered from a chronic shortage of capacity. Australia has commissioned several large-scale expansion projects over the recent years; however, some of these have been delayed or cancelled as a result of the weak global markets.

- South Africa (RSA) exports have remained relatively flat over the past 10 years, but this trend may eventually change as exports will be supported by the development of new mines. The Richards Bay Coal Terminal is expected to increase its capacity to 94 Mt in the near future. However, delays in upgrading the country's rail infrastructure are expected to prevent the facility from making use of its designed capacity until the 2017 to 2020 time frame.

  RSA's coal exports will face increased competition from domestic demand over the near term. Eskom, the world's largest coal-fired utility has suffered severe supply issues in recent years, but is expected to increase its burn from 132 Mt in 2008 to approximately 200 Mt by 2018.

- Russian exports are projected to continue to grow at a steady pace over the next decade. The recent trend that started in 2008-2009 with a shift toward eastern markets is expected to continue, strengthened by the refinements to the export terminals at Vostochny and Vanino. Exports to India via the Black Sea may become significant if logistics and planning can be optimized at a number of terminals already in operation for Mediterranean destinations.

  A major concern with Russia's export industry has been and continues to be its domestic transportation system. Inefficiencies and a shortage of coal wagons have served to make Russia's rail system one of the most expensive. This is a major drawback since it makes Russian exports quite sensitive to international price swings.

- Colombia has significant reserves and ambitious investment plans that could increase its export capacity to 90 Mt by 2016 (from 82 Mt in 2012). The speed at which this expansion occurs will be dependent on the global coal market.

  Over 90% of Colombian coal production goes to export markets for thermal coal. Primary markets for Colombian coal exports are the Americas and Europe. Starting in 2010, Colombia began making significant shipment to Chinese, Korean, and Taiwanese consumers. The likelihood of Colombian coal being exported into Asia was improved following the Itochu Corporation's purchase of 20% interest in Colombian producer Drummond Company. Colombia's competitive position in the Asian market has become suspect in light of low global pricing and weak transportation rates for competing fuels located closer to this market.

- Of the smaller exporters, little is expected from Poland and Venezuela. Thermal export shipments from Poland are expected to stay steady at about 2 Mtpa as this older industry begins to deplete its remaining mines. Venezuela's coal export industry has declined over the past decade, but should remain stable at approximately 1 Mtpa in the future.

- The United States became a more active participant in the international thermal coal market in recent years. US thermal coal exports reached 50 Mt in 2012 and 46 Mt in 2013 on the strength of strong global demand and tightened supply. In 2016, reduced demand forced US exports to retreat to the 20 Mt level, which was more in line with levels experienced earlier in the decade. Thermal coal exports are expected to stay in this range over the near term unless increased demand from Asia and Europe re-materialise.

  The mid- to long-term outlook for US exports depends on international pricing, seaborne shipping rates, the cost competitiveness of US coal, and US domestic infrastructure. The interest in US exports during the 2011 to 2014 period lead to the investigation of installing new port infrastructure on the US west coast. These proposed ports would have provided an outlet for sub-bituminous coal from the Powder River Basin (PRB) in Wyoming to compete in the Asian market. However, opposition from environmental groups will likely mean only one port will be constructed. From a consumer's perspective, the introduction of PRB coal would be welcome competition to low thermal content sub-bituminous coal from Indonesia.

6.5 Demand for Bylong Coal Quality

The primary Bylong coal[31] destined for the thermal export market will be a 16% ash product.

The anticipated products can be summarised as:

	Seam	Specific Energy (kcal/kg, GAR)	Ash (air dried %)
Product 1	Coggan	5,700-6,000	16
Product 2 (High ash)	Ulan	5,500	22

Mine schedules indicate that in the first eight years of operation 9.6 Mt of 22% ash coal is produced out of a total of 30.9 Mt product. Marketing options range from selling this as a stand-alone 22% product, or as an 80:20 blend of Coggan:Ulan seams. Over the life of the Project, the Ulan product (22% ash) represents 11% of total product tonnage.

The EIS EIA[32] identified target markets for Bylong's product coal. These included the KEPCO GENCOS building on KEPCO Korea's unique relationship, and the Chinese market for the high ash product. In the Chinese market, Newcastle High Ash 5500 and Indonesia sourced Envirocoal 5000 are key price benchmarks.

[31] p36 Mine Plan Justification Report, Mine Advice, Appendix E, Bylong Coal Project Environmental Impact Statement, Hansen Bailey Environmental Consultants, September 2015
[32] p33 Economic Impact Assessment, Gillespie Economics, Appendix AE, Bylong Coal Project Environmental Impact Statement, Hansen Bailey Environmental Consultants, September 2015

A comparison of Bylong coal characteristics with other notable benchmark Australian thermal coals[33] is shown in the following table:

Mine	Specific Energy (kcal/kg, GAR)	Ash (air dried %)	Total Moisture (%)
Bylong	5,700-6,000	16	11
Ulan	6,300-6,400	14	9
Wilpinjong	6,400	15	9
Hunter Valley Open Cut (HVOC)	6,300-6,850	13.5	10
Moolarben	6,500-6,100	17 -20	NA
Whitehaven	6,330	10	9.5
Rolleston	5,970	7.5	16

Bylong thermal coal lies in the lower end of the scale in terms of energy (CV content) and in ash content than other NSW thermal coals[34]. Callide Boundary Hill, a mine located in Queensland, exports low energy coal, nominally 5,300 kcal/kg gad (4,950 kcal/kg gar), 14% ash.

In order to provide further insight into marketability of Bylong coal, BOYD reviewed several KEPCO GENCOS' tender notices published in Platt's Coal Trader International industry newsletter in the second half of 2017:

Recent Thermal Coal Tenders from KEPCO Subsidiaries

Date	Company	Tender No.	Volume ('000 tonnes)	Min. kcal/kg (NAR)	Max. TM % (ar)	Max. Ash % (ad)
1-Aug-17	KOSPO	EST09	74	4,600	28.0	17.0
2-Aug-17	KOSPO	EST10	580	5,700	15.0	17.0
3-Aug-17	KOSPO	SMT06	148	4,600	28.0	17.0
8-Aug-17	KOMIPO	SP06	170	5,200-5,700	28.0	20.0
8-Aug-17	KOMIPO	SP07	250	5,700	15.0	17.0
10-Aug-17	KOMIPO	SP08	650	5,700	15.0	17.0
10-Aug-17	KOMIPO	SP09	210	4,600	28.0	17.0
10-Aug-17	KOMIPO	SP10	420	4,600	28.0	17.0
14-Aug-17	KOSPO	EST11	160	4,600	28.0	17.0
29-Aug-17	KOEN	SP02	40	6,300	15.0	30.0
8-Sep-17	KOMIPO	LT02	125 plus 500 for 2018-2020	5,700	15.0	17.0
8-Sep-17	KOMIPO	LT03	70 plus 490 for 2018-2020	5,700	15.0	17.0
8-Sep-17	KOMIPO	LT04	70 plus 600 for 2018-2020	5,100-5,400	23.0	20.0
12-Sep-17	KOMIPO	LT05	125 plus 500 for 2018-2022	5,700	15.0	17.0
13-Sep-17	KOMIPO	SP11	390	5,700-6,100	15.0	20.0

The specifications above demonstrate the demand for coal with calorific values ranging from 4,700 to 5,700 kcal/kg (NAR) and other specifications on an air dried basis ranging from: ash 17% – 20%, sulphur <1%, moisture 15% to 28%.

Whilst the above is a snapshot of the KEPCO GENCOS' requirements it reflects the variation in quality that the power generators require. It also indicates that blending of different coal sources is likely in order to provide the desired feed quality.

[33] Source: ACARP report C17053_Report - Australian Black Coals 2010

[34] For the purposes of comparison, the Bylong Project's ash was converted to an as-received basis.

Based on the ash quality specified in the KEPCO GENCOS' tenders, the Bylong Project coal would be suitable if used to service these potential supply requests. BOYD opines that there is little likelihood that the KEPCO GENCOS will alter the typical coal used to fuel their boilers and that similar tender quality specifications would be anticipated in the future.

BOYD opines that current KEPCO GENCOS fuel purchasing practices indicate that the dominant product coal from Bylong of 16% ash will fit within the current coal quality profile required by coal consumers in Korea. Whilst a 22% ash product does not meet traditional Korean requirements, it can be blended with lower ash coal. An 80:20 blend of Coggan:Ulan seam product could provide a 5,900 kcal/kg (gar) 16% ash product coal which would be suitable for the KEPCO GENCOS, as shown in the data above.

6.6 BOYD's Summary and Conclusions

BOYD makes the following conclusions:

1. KEPCO Korea advised that the Project's product coal delivered to South Korea will be consumed in its subsidiary power generators.
2. There is sufficient future demand for thermal coal to enable Bylong coal to be placed in the global market.
3. South Korea holds an enduring long term relationship with NSW and Australia. As the 13th largest world economy its energy requirements, future growth, trade relationship and investment initiatives are recognised by all entities as integral to their economies, evidenced by Korea and Australia Free Trade Agreement and the NSW International Engagement Strategy.
4. South Korea represents the key markets for coal produced by the Bylong Project. Expected continued growth in thermal coal demand due to planned capacity additions within South Korea, provide a solid basis for sales from the Project.
5. Australia will serve as the major thermal coal supply for much of the Asian market, including South Korea, Japan and China. Sales into the growing markets of India, the Philippines, Malaysia and Vietnam will be secondary markets for Australia since low CV sub-bituminous coal from Indonesia is expected to initially satisfy these markets. Longer term, uncertainty of continued exports from Indonesia at current levels could lead to greater opportunities for Australian thermal coal.
6. Despite Australia's seemingly endless supply of thermal coal production, reserves at existing mines will continue to deplete over time setting up demand for new supply capacity. However regulatory hurdles and community expectations challenge the timely delivery of new production to meet this demand.

7. Future supply of thermal coal outside of Australia is available, although these sources are not without their challenges. Supply from Indonesia in particular is expected to plateau or even begin to decrease slightly from 2020 onward due to an increase in domestic demand and constraints to the production base.

8. Projected future demand and supply scenarios in the period 2015 – 2040 indicate a range of outcomes. All scenarios indicate future demand for coal used to generate power and heat increasing in a range from 0.2% to 3.7%, albeit declining proportionally as a share of primary energy. Notwithstanding this the general trend in the Asia region is for increased coal demand.

9. Comparison of the Project's coal quality specifications with specifications detailed in recent coal supply tenders from KEPCO GENCOS indicates that Bylong coal will be in demand throughout the life of the Project.

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