Wallarah 2 Coal Project

ENVIRONMENTAL RISK ASSESSMENT

November 2009

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Risk Assessment – Wallarah 2 Coal Project

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1. INTRODUCTION

The Wallarah 2 Coal Project (W2CP) will involve the extraction of up to 5 million tonnes per annum of export quality thermal coal by underground mining methods, and the development of associated surface facilities and infrastructure located on industrial land. The coal quality is suitable for both the export and local thermal markets without the need for additional processing so no coal washing plant is required. All coal produced will be railed off site to Newcastle port for export or otherwise to supply domestic power stations.

The project is comprised of an underground longwall mine, a coal handling plant providing crushing and screening and storage facilities, rail loop and loading infrastructure, an underground drift entry, ventilation shafts and gas management facilities. Figure 1 shows the indicative underground mining area and location of surface facilities.

With the exception of the ventilation shafts, all surface facilities will be located on company owned land between the Motorway Link Road and the F3 Freeway. The main ventilation shafts (one downcast and one upcast with exhaust fan) will be on company owned land located near the Buttonderry Waste Management Facility. In future, a second downcast shaft site (air intake only) will be located within the Wyong State Forest away from residential areas.

Gas will be extracted from the mine via in-seam boreholes and brought to the surface facilities by an underground pipeline and used either on site to generate power or transferred into the general gas grid.

The project made an early commitment to seek to ensure that surface coal handling was preferably only undertaken in areas east of the F3 Freeway. To meet this commitment and because the coal seam is located so deep below the surface (between 350m and 650m deep), a long sloped tunnel (drift) will be developed for coal handling purposes which will start at the proposed surface facilities site at Tooheys Road. The main mine access, ventilation and office/bathhouse facilities will be located to the south of the Buttonderry Waste Management Facility on company-owned land.

A number of constraints and design factors identified have been taken into account in the proposed mine plan. These include:

- The need to safeguard water supply catchment functions and infrastructure;
- The requirement to manage impacts on houses and improvements on lands above the underground mine
- The subsidence criteria of the Hue Hue Mine Subsidence District;
- Floodplains and drainage systems of both Dooralong Valley (Jilliby Jilliby Creek) and Yarramalong Valley (Wyong River);
- Other environmental constraints including biodiversity and heritage
- Geological constraints including identified igneous intrusions, faults and coal quality; and
- Protection of public infrastructure such as roads, railways, power lines etc.

Other issues which have had a bearing on the mine plan include the location of the pit top and ventilation shaft facilities. As a result, these facilities will be located as far as reasonably

practicable away from residential receptors but have the benefit of good access to the freeway and main rail line.

This Risk Assessment has been conducted to assess and document potential environmental risks and hazards associated with the proposed Wallarah 2 Coal Project to contribute to the project's Environmental Assessment document required for project approval. Community aspects are also considered although the Risk Assessment is not a review of the project's stakeholder consultation program.

2. ANALYSIS AND REPORT

This analysis was facilitated by: Shane Chiddy

The analysis took place on: 16th October 2009 at W2CP's offices at Tuggerah

This report has been compiled by: Margot Jamieson and Shane Chiddy

3. PARTICIPANTS

A key factor in the effectiveness of the exercise is the availability of relevant information and expertise. A workshop team made up of technical and management personnel as well as an independent facilitator achieved this.

The role of team members was to provide their expertise, experience and technical knowledge, and to respect that provided by others. Outcomes were dependent upon group consensus.

The facilitator's role was to understand the Client's requirements and offer advice as to the best approach to meet the workshop objectives. He assisted the team by providing a systematic process and maintaining focus on the scope and objectives. The facilitator documented the workshop process and outcomes, and will offer post-workshop feedback to the Client and team.

The participants in the Risk Assessment are listed in Table 1.

Table 1 – Risk Workshop Participants

Workshop Managers	**Position**	
Shane Chiddy	Workshop Facilitator, AXYS Consulting	29 Years
Margot Jamieson	Workshop Manager, Comur Consulting	25 Years
Workshop Team Members	**Position/Organisation**	
David Lee	Kores Australia General Manager W2CP	24 Years
Ron Hansen	Minarco–MineConsult Project Director	30 Years
Peter Smith	Minarco–MineConsult W2CP Environment and Community Manager	28 Years
Peter Hayes	Minarco-MineConsult Operations and Engineering Manager	34 Years
Robert Byrnes	International Environmental Consultants	25 Years

	Director	
Keith Bartlett	Minarco–MineConsult Geologist and Information Co-Ordinator	30 Years
John Edwards	W2CP Subsidence Co-Ordinator	30 Years
Bob Purser	Purser Corporate Communication Managing Director	40 Years
Ms Kerry Holmes	PAEHolmes Principal / Founder	20 Years
Graeme Atkins	Atkins Acoustics Director	34 Years
Don Kay	Mine Subsidence Engineering Consultants Director	30 Years

In addition, the input of Jodie Benton and Phil Cameron from OzArk Environmental and Heritage Management was obtained in relation to the archaeological and ecological aspects of the Risk Assessment respectively.

4. PURPOSE

The purpose of the comprehensive risk assessment was to review the potential environmental impacts of the W2CP proposal (including the proposed mitigation measures incorporated into the project) and to identify key issues for further assessment or action. The risk assessment is a requirement for the EA report.

W2CP has obligations to both statutory and private stakeholders to provide a satisfactory level of environmental assessment (EA) documentation about the effects of proposed W2CP.

Preparation of the EA must be undertaken in line with the Environmental Assessment Requirements (EARs) issued by the Director-General of the Department of Planning to ensure that the resultant documentation is adequate for use in the merit assessment of the project under Part 3A of the *Environmental Planning and Assessment Act 1979*.

To confirm the adequacy of the EA report's documentation of the project's environmental risks and relevant management responses for addressing these risks, an externally-facilitated, comprehensive risk assessment was undertaken. The risk assessment involved the project team and its key consultants in a formal, documented process to ensure that key environmental risks are properly identified and appropriate controls defined to eliminate or mitigate risk to an acceptable level and that these are duly documented in the current EA.

A risk-based approach has been adopted throughout the planning and development of the Wyong Areas Coal Joint Venture since its inception in 1995, including periodic formal risk review processes as the project evolved to the current W2CP application. While the current risk assessment workshop focuses on the EA documentation to date, it inherently acknowledges that the current work is a culmination to date of all studies and related risk management efforts.

5. OBJECTIVES

The objective is to employ a comprehensive risk assessment process to address the environmental risks of the W2CP and to identify the key issues for further assessment.

The process will satisfy the documentation requirements needed for the EA report and involved a Risk Assessment Workshop which:

- Identified and quantified risks and determined the effectiveness of the controls and strategies contained within the EA documentation to date to eliminate or mitigate those risks
- Assisted the team to finalise an EA which demonstrably fulfils the obligations under the EARs
- Provided the team with a documented Risk Assessment in accordance with the Scope and NZS 4360:2004, the Australian/ New Zealand Standard for Risk Management and HB 203: 203:2006 Environmental Risk Management – Principles and Process (Standards Australia).
- Provided a written report on the Risk Assessment findings.

6. SCOPE

In October 2009 Comur Consulting engaged AXYS Consulting to facilitate a risk assessment to assist in the development of the Environmental Assessment (EA) for W2CP and consider the potential risk of environmental impacts..

A scoping session was held prior to the Assessment to discuss the approach and the scope was agreed to.

The scope of the workshop was to identify all key environmental risks addressed in the various studies and supporting information undertaken for the W2CP EA and documented to date.

Table 2 show the sub-systems identified and analysed as part of the risk assessment. This list was based on the subsidence management plan process, and additional issues associated with surface facilities have been added to the assessment where appropriate.

Table 2: Sub-Systems Analysed

Sub-System	Step in process		
1. **NATURAL FEATURES**	A	1.01	Catchment Areas or Declared Special Areas
	B	1.02	Rivers or Creeks
	C	1.03	Aquifers or Known Groundwater Resources
	D	1.04	Springs
	E	1.05	Sea or Lake
	F	1.06	Shorelines
	G	1.07	Natural Dams
	H	1.08	Cliffs or Pagodas
	I	1.09	Steep Slopes
	J	1.10	Escarpments
	K	1.11	Land Prone to Flooding or Inundation
	L	1.12	Swamps, Wetlands or Water Related Ecosystems

Table 2: Sub-Systems Analysed

Sub-System	Step in process		
	M	1.13	Threatened or Protected Species
	N	1.14	National Parks
	O	1.15	State Conservation Areas
	P	1.16	State Forests
	Q	1.17	Natural Vegetation
	R	1.18	Areas of Major Geological Interest
	S	1.19	Air Quality
	T	1.20	Acoustic Amenity (Noise)
	U	1.21	Soils
	V	1.22	Energy Usage
	W	1.23	Greenhouse
2. **PUBLIC UTILITIES**	A	2.01	Railways
	B	2.02	Roads (All Types)
	C	2.03	Bridges
	D	2.04	Tunnels
	E	2.05	Culverts
	F	2.06	Water, Gas or Sewerage Infrastructure
	G	2.07	Liquid Fuel Pipelines
	H	2.08	Electricity Transmission Lines or Associated Plants
	I	2.09	Telecommunication Lines or Associated Plants
	J	2.10	Water Tanks, Water or Sewage Treatment Works
	K	2.11	Dams, Reservoirs or Associated Works
	L	2.12	Air Strips
	M	2.13	Any Other Public Utilities
3. **PUBLIC AMENITIES**	A	3.01	Hospitals
	B	3.02	Places of Worship
	C	3.03	Schools
	D	3.04	Shopping Centres
	E	3.05	Community Centres
	F	3.06	Office Buildings
	G	3.07	Swimming Pools
	H	3.08	Bowling Greens
	I	3.09	Ovals or Cricket Grounds
	J	3.10	Race Courses
	K	3.11	Golf Courses
	L	3.12	Tennis Courts
	M	3.13	Visual Amenity
4. **FARM LAND AND FACILITIES**	A	4.01	Agricultural Utilisation or Agricultural Suitability of Farm Land
	B	4.02	Farm Buildings or Sheds
	C	4.03	Gas or Fuel Storages
	D	4.04	Poultry Sheds
	E	4.05	Glass Houses
	F	4.06	Hydroponic Systems
	G	4.07	Irrigation Systems
	H	4.08	Fences
	I	4.09	Farm Dams
	J	4.10	Wells or Bores
	K	4.11	Any Other Farm Features
5. **INDUSTRIAL, COMMERCIAL AND BUSINESS ESTABLISHMENTS**	A	5.01	Factories
	B	5.02	Workshops
	C	5.03	Business or Commercial Establishments or Improvements
	D	5.04	Gas or Fuel Storages or Associated Plants

Table 2: Sub-Systems Analysed

Sub-System		Step in process		
		E	5.05	Waste Storages or Associated Plants
		F	5.06	Buildings, Equipment or Operations that are Sensitive to Surface Movements
		G	5.07	Surface Mining (Open Cut) Voids or Rehabilitated Areas
		H	5.08	Mine Infrastructure Including Tailings Dams or Emplacement Areas
		I	5.09	Any Other Industrial, Commercial or Business Features
6.	**AREAS OF ARCHAEOLOGICAL OR HERITAGE IMPORTANCE**	A	6.01	Areas of Archaeological and/or Heritage Significance
7.	**ITEMS OF ARCHITECTURAL IMPORTANCE**	A	7.01	Items of Architectural Significance
8.	**PERMANENT SURVEY CONTROL MARKS**	A	8.01	Permanent Survey Control Marks
9.	**RESIDENTIAL ESTABLISHMENTS**	A	9.01	Houses
		B	9.02	Flats or Units
		C	9.03	Caravan Parks
		D	9.04	Retirement or Aged Care Villages
		E	9.05	Associated Structures such as Workshops, Garages, On-Site Waste Water Systems, Water or Gas Tanks, Swimming Pools or Tennis Courts
		F	9.06	Any Other Residential Features of relevance
10.	**ANY OTHER ITEM OF IMPORTANCE**	A	10.01	Any Other Item of Importance

The separate issue of community consultation was considered in terms of the requirement for the project's consultation program to be outlined in the EA report, however the detailed evaluation of the elements and efficacy of the stakeholder engagement program was beyond the scope of the workshop.

This report details the methods used and the recommendations resulting from the risk assessment which was conducted at W2CP Offices at Tuggerah on the 16th October 2009.

The aspects included in this risk assessment include not only houses, sheds and improvements but other man made infrastructure features of importance such as the proposed Mardi-Mangrove Creek Dam water supply pipeline, electricity transmission lines, and other key items of infrastructure in the mining area.

The process built upon the proven and comprehensive process involved in the existing Subsidence Management Plan process. Included in the assessment are:

- Natural features;
- Residential establishments and associated structures, such as on-site septic waste systems, sheds, fences etc.
- Farm land and facilities including include farm buildings, fences, farm dams and water bores;
- Public utilities and amenities including power, gas and water infrastructure;
- Industrial, commercial and business establishments;
- Areas of archaeological or heritage significance;
- Air quality and acoustic amenity, and
- Visual and landscape amenity.

7. CONTEXT SUMMARY

7.1 Strategic Context

Wallarah 2 Coal Project is committed to operating the proposed mine, processing and transport loading activities in a manner that seeks to achieve sustainable development, while continuing to safeguard the environment and protect human health and safety.

7.2 Corporate Context

Wallarah 2 Coal Project is committed to responsible stewardship of the environment, to ensure compliance with regulatory requirements and to engage and communicate with the community and key stakeholders.

7.3 Risk Management Context

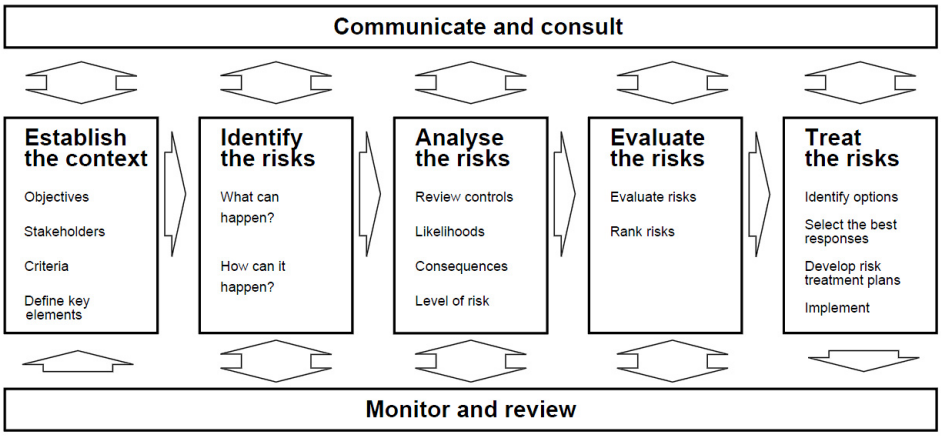
The primary objective of this risk assessment is to review environmental hazards and assess the risks associated with the proposed Wallarah 2 Coal Project, comprising the underground mining operations and surface facilities and associated infrastructure, and to make recommendations for further controls where appropriate. The main consideration is for environmental issues, however public and personal safety or operational loss issues have been considered where relevant.

8. ASSUMPTIONS AND CONSTRAINTS

The following are references were available to the assessment team and were used where relevant:

- AS/NZS 4360:2004 Risk Management (Standards Australia)
- HB 203: 203:2006 Environmental Risk Management – Principles and Process (Standards Australia)

The risk management process set out in the Standard is illustrated in the diagram below:



8.1 Assumptions

The Risk Assessment Workshop was conducted on the basis of the following assumptions:

- The EA relates to the assessment stage of the W2CP Part 3A application
- Qualified experts produced the respective studies, supporting information and documentation of the EA
- The advice from these experts is reliable
- The EA will involve the preparation of a document in line with DOP guidelines and EARs as well as current industry practice
- The team understands the separate concepts of subsidence *effects, impacts* and *consequences* (refer Strategic Inquiries – Wyong 2008, Southern Coalfields 2008). Subsidence *effects* are not to be taken as *impacts* or *consequences* for the purposes of this risk assessment.
- Impacts are assessed on the basis of likelihood and consequence irrespective of the timing of that impact in the life of the project
- Impact assessment and the efficacy of controls and mitigation measures are based on current technical knowledge and the current regulatory and policy contexts
- In terms of impact ranking categories, “People” refers primarily to public health and safety rather than employee OH&S.
- While risk perceptions of stakeholders are acknowledged where relevant in the EA and the risk assessment process, the risks and actions in this risk assessment are based on technical/scientific merits only
- The risk assessment is focussed on environmental studies for approval of the proposed W2CP, not on future operational aspects of the mine which are governed by Coal Mines Health & Safety Act (i.e. the risk assessment does not address mining risks, OHS etc)
- Potential climate change effects (as predicted by reputable Government, Government-appointed or research authorities such as IPCC, CSIRO, etc) are not considered within this planning horizon, apart from formally adopted, relevant planning requirements in NSW.
- The EA will be prepared in accordance with DOP guideline.

8.2 Limitations

The limitations identified in the Risk Assessment Workshop included:

- The EA is based on documents provided to date by various consultants.
- It is acknowledged that ongoing monitoring and assessment work will continue throughout the life of mine and this may provide further information for adaptive management and refinement of future operations. However only current technical knowledge is used for the basis of the risk assessment.
- The risk assessment process focuses only on the (key) potential negative impacts that have been identified and which require mitigation and management, not the beneficial impacts of the proposal. Accordingly, the risk assessment process alone is inappropriate to be used to determine net project benefits.

9. ENVIRONMENTAL RISK STANDARD

This risk assessment has been performed to review and document potential environmental risks of the proposed Wallarah 2 Coal Project and to confirm or determine what controls, if any, are required to reduce or eliminate any identified key environmental impacts to tolerable levels as far as practicable.

The participants were introduced to the Risk Assessment Process at the commencement of the session by the facilitator. The various steps were explained and the participants reviewed the Likelihood, Consequence and Risk Ranking matrix. The risk ranking was done with consideration to existing environmental assessment studies already undertaken to date.

Controls were developed using the following forms.

1. Avoidance – avoid the risk by deciding not to proceed with the activity likely to generate the risk (where this is practicable).

2. Reduction – reduce the likelihood of the impact/event.

3. Reduction – reduce the consequences of the impact/event.

4. Transfer – transfer the risk – involve another party to bear or share some part of the risk.

5. Accept – accept the risk within the organisation and establish an appropriate plan to manage the consequences of these risks if they are to occur.

10. POST WORKSHOP ACTION

EA documentation will be revised to duly incorporate any additional controls identified and to refine the residual risk description in the EA report if required. If necessary, the project will be revised or refined.

11. REFERENCES

Atkins Acoustics and Associates Pty Ltd. (November 2009). *Wallarah No 2 Coal Project Noise and Vibration Impact Assessment Underground Mine and Infrastructure Facilities.*

ERM, (2009). *Wallarah 2 Coal Project Flood Impact Assessment for Wyong Areas Coal Joint Venture.* Environmental Resources Management Australia Pty Ltd 2009.

IEC. (2009) *Wyong Areas Coal Joint Venture Hydromorphology Study Wallarah 2 Coal Project*

Mackie Environmental Research, (2009). *Wallarah 2 Coal Project Groundwater Management Studies*. Mackie Environmental Research 2009

MSEC (2009) *Assessment Of Mine Subsidence Impacts On Natural Features And Surface Infrastructure In Support Of The Part 3a Application For The Wallarah 2 Coal Project*

OzArk Environmental & Heritage Management P/L (October 2009). *Proposed Wallarah 2 Coal Project: Ecology Assessment of the Direct Impact and Proposed Conservation Offset Areas, Wyong, NSW.*

OzArk Environmental & Heritage Management P/L (October 2009). *Proposed Wallarah 2 Coal Project: Ecology Assessment of the Proposed Mining Area, Wyong, NSW.*

OzArk Environmental & Heritage Management P/L (October 2009). *Indigenous & Non-Indigenous Heritage Assessment – Surface Facilities – Wallarah 2 Coal Project Wyong, NSW.*

OzArk Environmental & Heritage Management P/L (October 2009). *Indigenous & Non-Indigenous Heritage Review – Subsidence Area – Wallarah 2 Coal Project Wyong, NSW*.

PAE Holmes (November 2009). *Air Quality Assessment: Wallarah 2 Coal Project.*

ATTACHMENT A

RISK ASSESSMENT WORKSHEETS

System	Sub-system	Hazard	Step in process	Hazards	Planned Control Measures	Predicted Impacts of the Proposed Project (after implementation of the Planned Controlled Measures)	Consequence	Likelihood	Residual Risk	Further Actions
			1 - NATURAL FEATURES							
1	A	1	1.01 Catchment Areas or Declared Special Areas	Environmental effects to Catchment Areas or Declared Special Areas. • Mine is located within the Wyong River catchment area (supply to Mardi Dam)	• Mining under <5% of the region's water supply catchments • Mine design developed in recognition of the commitment that the proposed mine would avoid adverse impacts on the water supply catchments • Commitment to modify mine plan in response to issues as they arise if required • All surface coal handling operations are sited outside the Wyong River drinking water catchment system	• No significant impact or consequence on the region's catchment area as recognised by the Panel of independent experts that undertook the Strategic Review • **Note**: Potential positive impacts with discharge or distribution of highly treated water to system	4	E	L	
1	B	1	1.02 Rivers or Creeks: (associated with subsidence area)	Subsidence effects to the mining area, associated with subsiding areas in the vicinity of: • Wyong River • Jilliby Jilliby Creek • Little Jilliby Jilliby Creek • Hue Hue Creek • Minor tributaries Effects can include Increased levels of ponding, flooding or scouring; changes to stream alignment; fracturing of the bedrock in the floors of valleys; surface water flow diversions to the shallow sub-strata; changes to water quality and release of strata gas.	• Subsidence-induced topographic changes in floodplain are moderated by mine design to limit impacts including: - Focus on the western resource only with eastern resource not included in this proposal - Mine layout modified with shorter LW panels to avoid Wyong River and lower Jilliby Creek • Mine longwall configurations and main roadways have been designed with a view to mitigate effects on streams and stream confluences. • Locations of identified risk potential for more than minor morphological changes will be subject to prior stream stabilisation works and/or remedial works resulting in minor residual impacts • Monitoring programs • Commitment to modify mine plan in response to issues as they arise if required • Subsidence monitoring to be carried out once coal extraction has begun to verify the impacts and that subsidence limits are being met. • If monitoring in the future indicates subsidence limits are being exceeded, revision of the mine plan may be necessary.	Subsidence related effects & impacts: • subsidence induced water flow and quality changes to mine subsidence area and flow on environmental impacts to Jilliby Jilliby Creek and Little Jilliby Jilliby Creek, are considered to be either minor, or of a degree that will be able to be efficiently and effectively managed through the implementation of mitigation measures and rehabilitation works (see IEC, 2009; ERM, 2009; MER 2009).	4	B	M	
1	B	2	1.02 Rivers or creeks: (associated with surface facility areas)	Environmental effects to • Wallarah Creek • Buttonderry Creek • Small unnamed creeks	• Surface facilities location, layout and design will minimise potential for impacts on watercourses near surface facilities • Project Water Management Plan to address erosion & sediment controls & water monitoring & management. • No water to be extracted from the Jilliby Jilliby Creek water source • Rehabilitation of impacted areas where appropriate to manage sedimentation Desalination of surplus saline waters & either enhancing surface flows or directing water to industrial users; - Coal washery & rejects emplacement deleted from project - Changes to surface layouts & infrastructure - Other? • Surface water management systems to be implemented include: - Water treatment facilities at surface sites for dirty water areas - Dirty stormwater containment & treatment prior to reuse or release. Storages to contain 1 in 100, 72 hr event - Diversion of clean water around surface sites where feasible - Soil and Erosion Control Plans - Bunded facilities for diesel & oils - Brine management will be in accordance with DECCW or other regulatory requirement - Spill kits to be available - Vehicle washdown facilities - Water balance to assist management	Surface facility related impacts: • Significant water flow and quality to creeks changes due to surface facilities are not predicted & impacts are considered to be low. Flow-on environmental impacts not likely.	4	C	M	

System	Sub-system	Hazard	Step in process	Hazards	Planned Control Measures	Predicted Impacts of the Proposed Project (after implementation of the Planned Controlled Measures)	Consequence	Likelihood	Residual Risk	Further Actions
					- Surface facilities, including water containment dams, located above the 100 year ARI flood level - Water treatment plant at surface facilities to ensure water quality is suitable for discharge. - Sealing of roads including Tooheys Road - Tertiary sewage treatment systems & reuse of effluent or connection to sewer system • Minimal clearing, mulching of cleared vegetation, use of mulch in landscaping.					
1	C	1	1.03 Aquifers or Known Groundwater Resources	Environmental effects to aquifers and known groundwater conditions namely • regional hard rock strata, within which the coal seam provides limited groundwater storage and the overburden materials act as aquitards or acquicludes (flow rates within system very low: 0.036 – 3.6 mm/yr; brackish to saline). • shallow weathered rock (increased but limited groundwater transmission & storage capacity). • unconsolidated alluvial aquifers within valleys. Rainfall driven, with a shallow water table 2-10 m below ground surface (flow rates within alluvium typically 36 – 3600 mm/yr; fresh to saline).	• Comprehensive investigations of groundwater from drillhole information and monitoring boreholes indentified no significant freshwater hard rock aquifers in the mining area. • Groundwater Monitoring • Subsidence model verification after mining commences • Groundwater modelling revisions to be undertaken if new scenarios and trigger conditions are indicated. • SMP to include further consideration of aquifers and monitoring programs	• The effect of mining will involve long term depressurisation of groundwater contained within the coal seam and in surrounding strata. Water make anticipated to be typically 1 to 1.7 ML/day over 38 years with short term increases of 0.5 ML/day. Potential leakage of shallow hardrock groundwaters to deeper levels (eg. 3-14 millilitres/day/m2). • On cessation of mining, groundwater levels/pressures within hardrock strata will re-establish. Period for significant repressurisation predicted to exceed 200 years • Localised, transient change in shallow alluvial aquifer system induced by subsidence. Short term depletion of alluvial groundwater storage followed by rapid recovery – unlikely to have any measurable impacts; impacts low compared to rainfall recharge rates (320 ml/day/m2). • some enhanced permeability anticipated in near surface hardrock strata but no evidence of connectivity with the deeper, mining induced fracture systems • impacts of mining on groundwater are judged to be low and unlikely to measurably deplete the water resources of the alluvial lands situated within the Dooralong and Yarramalong valleys. • Change in groundwater quality in both hard rock strata and shallow unconsolidated alluvial aquifers is unlikely. (see MER, 2009)	5 5 5 5	A C B C	M L M L	Comment: Note that '5AM' relates to effects while '5CL' is the environmental consequence associated with this effect
1	D	1	1.04 Springs	Environmental effects to springs Isolated springs. Geological dip is to southwest and springs expected to be most prevalent on south facing slopes mainly in hilly forested areas.	Localised and small-scale surface rehabilitation can be generally applied to any significant ground cracking in the area of springs. Monitoring and detailed investigation of spring presence and its properties (e.g. flow variability, quality) can be undertaken as part of pre mining monitoring and Property Subsidence Management Plans.	Subsidence related effects • The potential for significant impacts on existing spring water flow and quality changes, or the creation of new springs due to mine subsidence , is considered to be low. • Potential for iron staining effects considered low and localised only (refer IEC, 2009; MER, 2009)	5	C	L	
1	E	1	1.05 Sea or Lake	Environmental effects to Seas or Lakes • Budgewoi Lake • Tuggerah Lake (outside subsidence area)	• No mining in the vicinity of the lake proposed • Water management strategies for surface facilities sites which drain to Budgewoi Lake (Tooheys Rd site) and Tuggerah Lake	Surface facility related impacts • Negligible impacts associated with impacts on waterways that flow into lake.	5	E	L	
1	F	1	1.06 Shorelines	There are NO shorelines within the nominated area.						
1	G	1	1.07 Natural Dams	There are NO natural dams within the nominated area.						
1	H	1	1.08 Cliffs or Pagodas	Environmental effects to Cliffs or Pagodas • Cliffs are located within the unused quarry • Other cliffs identified are small and predicted not to be impacted	• None identified	Cliff in quarry – possible rock falls	2	E	M	Cliff in unused quarry requires management plan to address safety and access issues when mining occurs.

System	Sub-system	Hazard	Step in process	Hazards	Planned Control Measures	Predicted Impacts of the Proposed Project (after implementation of the Planned Controlled Measures)	Consequence	Likelihood	Residual Risk	Further Actions
1	I	1	1.09 Steep Slopes	Environmental effects to steep slopes within the subsidence area	• Baseline assessment completed & location of steep slopes identified. • Subsidence predictions being developed • Monitoring programs will be implemented • Rehabilitation of cracking as required • Address in public safety management plan	Low potential for mass movement and cracking due to mine subsidence damage to environment .	5	C	L	
1	J	1	1.10 Escarpments	There are NO escarpments within the nominated area.						
1	K	1	1.11 Land Prone to Flooding or Inundation	Environmental effects to Land Prone to Flooding or Inundation • Yarramalong Valley floodplain • Dooralong Valley floodplain	• Development of a robust flood model for Wyong and Jilliby Jilliby Creek system and investigation of other creeks (Buttonderry Ck, Wallarah Ck) • Mine layouts modified to eliminate or minimise flood impacts • Narrower longwall blocks below the 1 in 100 flood zone; • Sequencing panel extraction to minimise ponding; • Modifying mine layout to maintain flow gradients while avoiding channel breakout during major flood events • Mitigation works required to minimise impacts. May include: - flood levees; - channel modifications - upgrade of crossings - raising bridges, - raising low sections of roads, and - improving the hydraulic capacity of channels in some sections • Mine budget includes potential for property purchase	Flooding impacts on land & land use: • some change in the distribution and extent of ponding. Flooding alleviated in some areas and exacerbated in others. Changes in flood depths of -1.1 m to +1.1 m while absolute flood levels (in mAHD) will drop by 0 – 1.85 m. • Low risk of Realignment of Jilliby Jilliby Creek. • several low points in roads and some bridges within the Dooralong Valley and Hue Hue Creek line to become untrafficable for longer periods than the existing situation during flood events – additional durations of inundation modelled (Low impact). • Flood behaviour will not significantly change in the Yarramalong Valley (See ERM flood study report).	4	C	M	• SMP to contain specific management strategies for structures that are deemed to be at risk • Prepare & implement individual property subsidence management plans
1	K	2	1.11 Land Prone to Flooding or Inundation	Environmental effects to Land Prone to Flooding or Inundation • Yarramalong Valley floodplain • Dooralong Valley floodplain	• Mitigation works required to minimise impacts. May include: - flood levees; - house raising; - house relocation; - voluntary purchase or compensation measures - channel modifications - upgrade of crossings - raising bridges, - raising low sections of roads, and - improving the hydraulic capacity of channels in some sections • compensation or outright purchase of the properties if satisfactory mitigation measures cannot be negotiated • Prepare & implement individual property subsidence management plans • Mine Subsidence Board rectification works • Mine budget includes potential for property purchase • Predictions are based on worst case subsidence which may not occur	Flooding impacts on houses • Some properties not previously flood prone will become flood prone (5 with significant impacts; 15 minor impacts). • Properties previously flood prone will experience greater duration and intensity of flooding. (2 with significant impacts; 10 moderate; 2 minor) Total no of houses affected: <40.	4	C	M	Further specific measures may be identified and agreed during consultative negotiations for individual property subsidence management plans.

System	Sub-system	Hazard	Step in process	Hazards	Planned Control Measures	Predicted Impacts of the Proposed Project (after implementation of the Planned Controlled Measures)	Consequence	Likelihood	Residual Risk	Further Actions
1	L	1	1.12 Swamps, Wetlands or Water Related Ecosystems (associated with subsidence area)	Environmental effects to Swamps, Wetlands or Water Related Ecosystems • Water related ecosystems within mining area	• The mine design has been based on avoiding the risk of introducing any continuous cracking from the surface down to the coal seam, thus avoiding the risk of downwards or upwards discernible mixing of the two different water types. At the near-surface are the mostly fresh surface alluvial aquifer groundwaters. These aquifers in most locations are fresher after rain but do not degrade as evidently as the surface waters in the streams and billabongs when they go to low flow and then stagnate. The deep more saline hard rock groundwater at the coal seam level is not capable of migrating to surface and the depressurization of the deep aquifer system will mean that the groundwater flow path will report to the mine void itself (which will be collected and pumped to the mine water management system). • Erosion & sediment control will be addressed in the Project Water Management Plan • Construction phase site management (see OzArk, 2009)	Subsidence related impacts • Any implications for the surface alluvial groundwaters would be very localised and temporary (days and weeks) but would not involve wholesale loss of water that supports surface ecosystems. The localised re-equilibration of the alluvial aquifer groundwaters would only involve the locally occurring water and not exogenous groundwaters of different quality. • There are no high risk acid sulphate soils mapped as occurring within the subsidence zone (refer to OzArk, 2009).	5	D	L	
1	L	2	1.12 Swamps, Wetlands or Water Related Ecosystems (associated with surface facilities)	Environmental effects to Swamps, Wetlands or Water Related Ecosystems • Unnamed wetland to north of Tooheys Road site	• Wetland to north of Tooheys Road site to be safeguarded – access to area to be restricted and water flow quality to area to be maintained. • Erosion & sediment control will be addressed in the Project Water Management Plan • Construction phase site management • Ongoing monitoring	Surface facility related impacts • Low potential for indirect impact on unnamed wetland north of Tooheys Road site	5	D	L	
1	M	1	1.13 Threatened or Protected Species (associated with subsidence area)	Environmental effects to Threatened or Protected Species • No critically endangered ecological populations affected • No endangered ecological populations affected • one endangered, six vulnerable and three regionally significant flora species that have potential to be affected either directly or indirectly • 10 species of threatened and 3 species of regionally significant mammals, 1 species of regionally significant reptile, 2 threatened and regionally significant frogs and 2 threatened and 3 regionally significant species of birds recorded in the study areas, with a further 8 mammals, 3 birds, 2 frogs and 1 insect potentially present. • Four Endangered Ecological Communities above the mining area subject to changed flooding regimes	• Baseline assessment completed & known species within area • Mitigation measures as described in OzArk report (Section 6.2) to be employed including monitoring of EECs	Subsidence related impacts • Unlikely to lead to any significant risk of loss of protected species or their habitat due to direct or indirect effects (e.g. significant flooding changes) • No significant likelihood of disturbance and increased competition from native and introduced species. • No significant impacts predicted to arise from new introduction of predators, nor generation of polluted waters For more information refer to OzArk, 2009.	5	D	L	
1	M	2	1.13 Threatened or Protected Species (associated with surface facilities)	Environmental effects to Threatened or Protected Species • No critically endangered ecological populations affected • No endangered ecological populations affected • one endangered, six vulnerable and three regionally significant flora species that have potential to be affected either directly or indirectly • 10 species of threatened and 3	• Baseline assessment completed & known species within area • Mitigation measures as described in OzArk report (Section 6.2) to be employed. • Referral to the Minister of the Department of Environment, Heritage, Water and the Arts undertaken (Controlled activity assessed) • Offsets strategy • Water management plan and pollution control plan • Site seed collection and propagation strategy for *Angophora inopina* and translocation of *Tetratheca juncea* • Landscape Strategy including revegetation and planting of surface site areas	Surface facility related impacts • Unlikely to lead to any significant risk of loss of protected species or their habitat due to direct or indirect effects • No significant likelihood of disturbance and increased competition from native and introduced species. • No significant impacts predicted to arise from new introduction of predators, road-kill carnage nor generation of polluted waters • Surface clearing limited and localised impacts on specific species that will occur from construction are mitigated by biodiversity management measures. Impacts not regionally significant and can be beneficially offset.	5	D	L	The project has been determined as a controlled action and therefore additional species are to be included in the EA for assessment in accordance with the bilateral agreement for approval under the EPBC Act.

System	Sub-system	Hazard	Step in process	Hazards	Planned Control Measures	Predicted Impacts of the Proposed Project (after implementation of the Planned Controlled Measures)	Consequence	Likelihood	Residual Risk	Further Actions
				species of regionally significant mammals, 1 species of regionally significant reptile, 2 threatened and regionally significant frogs and 2 threatened and 3 regionally significant species of birds recorded in the study areas, with a further 8 mammals, 3 birds, 2 frogs and 1 insect potentially present.		For more information refer to OzArk, 2009.				
1	N	1	1.14 National Parks	No National Parks are impacted						
	O	1	1.15 State Conservation Areas	Environmental effects to State Conservation Areas • Jilliby State Conservation Area	• Minimising surface disturbance • Localised remediation if required to surface profiles adversely impacted by subsidence • Management plan specific to the area will be prepared	Subsidence related impacts • All relevant environmental issues are considered under other natural features throughout this assessment				
1	P	1	1.16 State Forests	Environmental effects to State Forests • Wyong State Forest	• Minimising surface disturbance • Localised remediation if required to surface profiles adversely impacted by subsidence • Management plan specific to the area will be prepared	Subsidence related impacts • All relevant environmental issues are considered under other natural features throughout this assessment				
1	Q	1	1.17 Natural Vegetation / Ecology – (associated with subsidence area)	Environmental effects to Natural Vegetation / Ecology	• The SMP is to include the establishment of several monitoring points within natural vegetation communities to measure and document the health and status of the EEC's. This body of credible data may be drawn upon at a later date to establish if potential impacts to the EEC are due to subsidence or other external processes and to provide appropriate mitigative measures with improvement of future mining technologies for those areas that are not undermined. • Further investigation to occur for threatened amphibians in the forested areas	Subsidence related impacts • The majority of effects associated with the predicted W2CP subsidence will occur in currently cleared and disturbed land in the Dooralong valley floor where changes to flood inundation are likely to occur or where it is unlikely to be significant from an ecological point of view. • Modelling completed by WACJV for 1:100yr (1%), 5:100yr (5%) and 20:100yr (20%) flooding regimes shows that minor increased flooding depths (but not frequency) will potentially impact primarily upon Riverine Alluvial Gallery Rainforest-Moist Forest, with minor impact on Alluvial Floodplain Shrub Swamp Forest, Alluvial Woollybutt-Melaleuca Sedge Forest and Alluvial Footslopes Redgum Forest. All four of these communities occur on already highly flood-prone areas within floodplain alluvium and equate to existing EEC's. Other communities occupy negligible or none of the land surface within the existing or future flood zones. • Of the vegetation communities listed above only one, Riverine Alluvial Gallery Rainforest-Moist Forest is reliant on deep alluvium in close proximity to a permanent water source and in this context may be considered a Groundwater Dependent Ecosystem. There is potential that between 66 and 72% of the extant distribution of Riverine Alluvial Gallery Rainforest-Moist Forest will be affected within the study area. As flooding and groundwater studies (ERM 2008, Mackie 2008) outline, the potential for hydrological changes to impact significantly on the general stream and alluvial systems is low. The main effect will not be in changing the inundation frequency of this community during the range of flooding regimes but from slightly increased depth of flooding during the major flood events. Accordingly there are unlikely to be detrimental impacts to this community and no significant potential for any loss of some rainforest species. For more information refer to OzArk, 2009.	5	C	L	

System	Sub-system	Hazard	Step in process	Hazards	Planned Control Measures	Predicted Impacts of the Proposed Project (after implementation of the Planned Controlled Measures)	Consequence	Likelihood	Residual Risk	Further Actions
1	Q	2	1.17 Natural Vegetation / Ecology – surface related areas	Environmental effects to Natural Vegetation / Ecology from Surface infrastructure. Population of squirrel gliders has been identified along Wallarah Creek in the past (1995) but has not been re-recorded since. • see OzArk ecology report	• Design of rail loop to minimise habitat fragmentation and wetland disturbance • Minimising extent of clearing required for surface facilities, Wallarah Ck rail crossing, etc • Offsets strategy • Monitoring program • Biodiversity management measures as proposed in OzArk report • Biodiversity management measures as proposed in OzArk report (Administrative Controls i.e. inductions and Engineering Controls i.e. clearly marking out areas to be cleared and retained). • Site seed collection and propagation strategy • Landscape Strategy including revegetation and planting of surface site areas • Targeted assessment to determine if squirrel glider population remains and if present, area to be enhanced (for example feral species trapping, vegetation enhancement and nest boxes) and population managed. • Targeted assessment for Wallum Froglet to determine if it occurs in rail loop and if it does, carry out amelioration measure (OzArk, 2009)	Surface Facility related impacts • Impacts above the minor ones listed below are considered unlikely • Vegetation clearing will result in no regional or significant biodiversity impacts • Habitat fragmentation / edge effect on most fauna largely inconsequential • The greatest amount of native vegetation to be removed as a result of the proposed development will be within Narrabeen Doyalson Scribbly Gum Woodland of which only its derivative Narrabeen Doyalson Scribbly Gum Woodland #d has local significance. Of those communities identified as having conservation significance, the most affected (in ha) will be Alluvial Riparian Blackbutt Forest where 1.05 ha will be cleared. This is not considered a significant impact and control measures are offsetting these. For more information refer to OzArk, 2009.	4	D	L	
1	R	1	1.18 Areas of Major Geological Interest	No areas of major geological interest exist within the area						

System	Sub-system	Hazard	Step in process	Hazards	Planned Control Measures	Predicted Impacts of the Proposed Project (after implementation of the Planned Controlled Measures)	Consequence	Likelihood	Residual Risk	Further Actions
1	S	1	1.19 Air quality	Environmental effects to Air quality	• Detailed air quality studies prepared including PM10, PM2.5 & silica • Coal stockpile sprays to be activated when wind > 10 m/s • Upgrade of unsealed Tooheys Road to sealed road • Dust suppression – road watering • Water sprays at key coal handling transfer points and on stockpile areas • The crusher and screens on the Tooheys Road site will be fully enclosed. • Coal conveyors will be three quarter enclosed, against prevailing winds. • Trains loaded via underground tunnel reclaim leading from enclosed conveyor which delivers coal to a rail bin • The product stockpile will be equipped with wind activated water cannons. • All active major roads on the project sites will be clearly defined and suitably paved and the development of minor and unpaved tracks will be limited. • Speed limits to be enforced on all roads on site. • minimum practicable area for construction of surface facilities and infrastructure will be disturbed. • Cover crops established on any topsoil and subsoil stockpiles in place >6 months. • Meteorological conditions will be monitored and weather data will be considered in the conduct of day to day operations such as stockpile management. • Dust control measures to be employed during construction will include use of water carts, defining of trafficked areas, imposition of vehicle speed limits, use of vegetative matting or other erosion control measures on key dust sources, and constraints on work under extreme unfavourable weather conditions. • A spontaneous combustion management strategy will be developed for the project and will include coal stockpile management measures and monitoring of the potential causes and occurrence of spontaneous combustion conditions. • W2CP will install first flush systems on rural residential rain water tanks, at the request of landowners located within 500 metres of the project disturbance boundary at time of construction. • Monitoring Program to include - high volume samplers and dust deposition gauges - protocol for evaluating compliance with the air quality impact assessment and land acquisition criteria in the project approval • real-time dust monitoring to assist with pro-active dust control from project operations. • If dust emissions generated by the project exceed stated criteria at any non company-owned residence, or on more than 25% of any privately owned vacant land, W2CP will, upon receiving a written request for acquisition from the landowner, acquire the land in accordance with the procedures set out in the project approval. • compensation or outright purchase of the properties if satisfactory mitigation measures cannot be negotiated (for further information see PAE Holmes, 2009 & EA)	Air quality impacts associated with construction and operation of surface facilities are considered to be non-significant (low to negligible) • Concentrations of dust and deposition rates of dust from the construction phase predicted to be well within DECC air quality criteria. • During the operational phase of the project, air quality impacts for dust (particulate matter) are predicted to remain in compliance with long-term goals when background is taken into account, and in compliance with the short-term 24-hour PM10 goal when the project is considered on its own. • Risks include dust generation from stockpiles, loaders, trucks, coal trains and any interruption to efficient operation and maintenance of dust suppression measures and other safeguards.	4	D	L	
1	S	2	1.19 Odour	• Environmental effects to odour	• Odour modelling carried out • 30 degree angle of discharge from upcast vent shaft included in design • Operational odour campaign monitoring in shaft	Odour predicted from upcast shaft – below specified goals. Should this not occur additional action may be required. No health effects associated with it.	4	C	M	
1	T	1	1.20 Acoustic Amenity (Noise)	Environmental effects to Acoustic Amenity (Noise)	• Inclined drift obviates need for conveyor transport across F3 or private land • Rail loop to be constructed to prevent noise from road transportation • Preparation of a noise & vibration management plan that contractors will have to comply with during construction	• No predicted exceedences affecting Blue Haven • No predicted exceedences with the Buttonderry operations • No predicted exceedences affecting the proposed Warnervale town centre and Wyong employment zone	3	C	M	

System	Sub-system	Hazard	Step in process	Hazards	Planned Control Measures	Predicted Impacts of the Proposed Project (after implementation of the Planned Controlled Measures)	Consequence	Likelihood	Residual Risk	Further Actions
					• Noise controls at Tooheys Road site: - location of stockpiles & infrastructure to take advantage of natural topographic shielding where practical; - double skin cladding of coal handling plant; - low noise rated conveyors and motor drives; - conveyor structures designed with side and roof screens to provide effective directional noise amelioration; - underground coal reclaim system to minimise reliance on dozers for loading trains; - mobile plant fitted with secondary noise control kits; - removal of surface rail crossings and hence the requirement for trains to sound warning horns whilst on-site; - laminated (soft loading) steel chutes; - low level 'broadband sound' mobile plant reversing alarms; and - selection of plant to limit noise emissions. Where practical and feasible, motor drives and gearboxes would be specified and selected to achieve a noise level of less than 85dB(A) measured at one (1) metre from the source. • Noise controls at Buttonderry site: - fully enclosing the mine winding equipment; - fully enclosing the mine ventilation fans/motors; - inline attenuators installed on the fan discharges; and - earth bunding along the southern alignment of the car park. • Mine to comply with existing standards for assessment and monitoring procedures for noise, which provide sufficient safeguards against noise impacts • Where risk of exceedance exists or impacts occur, a noise management agreement will be developed with landowner if required • Noise Monitoring Program may include a combination of real-time and attended monitoring measures, and a noise monitoring protocol for evaluating compliance with the noise impact assessment and land acquisition criteria in the project approval. • Potential noise mitigation strategies to be discussed with the property owners if: - the owner believes he or she is adversely affected by intrusive noise from the proposal; and - noise level measurements confirm the recommended goals are exceeded. • Where a predicted exceedence is of a minor and intermittent nature, it is unlikely that outright purchase of property would be necessary. However this would be offered if noise monitoring during operation confirms that the recommended goals cannot be complied with and other acoustic treatments at these locations are not successful. (for further information see Atkins, 2009 & EA)	• No operational noise with the Western Shaft • Marginal exceedence of project assessment goals predicted due to Tooheys Road site operations at two locations during adverse weather conditions (based on conservative analysis and adopted background noise estimation) • Short term exceedences due to construction activities at Buttonderry & Western Shaft sites – levels considered acceptable • Traffic noise levels satisfy project noise goals • Rail noise to marginally increase existing noise levels • Should unplanned exceedences of operational noise emission goals occur in the future, specific agreements may be entered into with landholders (in accordance with DECCW Industrial Noise Policy) • With the exception of the above, noise emissions from the project, will not exceed the predicted worst case noise levels (in accordance with DECCW Industrial Noise Policy).				
1	U	1	1.21 Soils	Environmental effects to soils due to subsidence	• Pre-mining inspections • Repair program for mining related disturbances to the soil surface • Monitoring of - banks of Jilliby Jilliby, Little Jilliby Jilliby and Myrtle Creeks - scattered ridgetops throughout mining area - Small section on western perimeter of mining area - Scattered locations adjacent to creeklines - Isolated occurrences of water flow changes • Filling of cracks if required	Subsidence related impacts • Short term impacts prior to control measures being put in place including: - The potential for localised changes of water flow to occur which may exacerbate existing erosion (not likely to be significant): - Minor potential for erosion associated with cracking - potential for some localised slumping to occur in susceptible soil materials • wet-strength of the soil material may be of importance in areas of increased localised pooling of water • Unlikely to be more than minor impacts	5	D	L	• detailed rehabilitation plans should they be required • Refinement of monitoring program in association with landholders (dependant on permission to access)

System	Sub-system	Hazard	Step in process	Hazards	Planned Control Measures	Predicted Impacts of the Proposed Project (after implementation of the Planned Controlled Measures)	Consequence	Likelihood	Residual Risk	Further Actions
1	U	2	1.21 Soils	Environmental effects to soils from surface infrastructure	• Soil and Erosion control plan proposed to manage soil impacts • Water Management Plan • Landscaping and revegetation of surface facilities sites following construction • No acid sulphate soils have been mapped in surface facilities development sites	Surface facility related impacts • Potential erosion and sedimentation due to construction activities managed via management plans.	5	C	L	
1	V	1	1.22 Energy Usage	Environmental effects from excessive energy usage	• Energy and Greenhouse Strategy to be developed within 2 years after the commencement of longwall coal extraction / Energy Savings Action Plan • Installation of energy efficient appliances, lighting and hot water system (such as gas boosted solar hot water system). • Project design excludes a washery and site tailings disposal and rejects emplacements – significantly reducing energy demands. • Co-ordination of energy development requirements in consultation with energy authorities	• Project (construction and operation) will be a locally significant power user • Methane collected will be managed with a view for development of energy generation or reticulated gas supply potential for effective overall energy management.	4	D	L	Conduct an energy efficiency audit each three years after the commencement of mining
1	W	1	1.23 Greenhouse	Environmental effects from greenhouse gas emissions	• Flaring of methane from an early stage of the project will be augmented by further gas management and utilisation initiatives when commercialisation is feasible • Use of 5% bio-diesel or similar & low-sulphur diesel fuel, where feasible • Energy and Greenhouse Strategy to be developed within 2 years after the commencement of longwall coal extraction • Coal mine methane & utilisation strategy to be developed within 3 years of longwall operations following monitoring experience	• Release of greenhouse gases from vehicles, machinery and coal used in power generation (very low proportion of Australian and world emissions) • Methane collection, flaring and more advanced utilisation proposals will contribute to reduction in project greenhouse emissions	4	D	L	Monitor greenhouse emissions & mitigation measures Coal mine methane & utilisation strategy to be developed within 3 years of longwall operations following monitoring experience
			2 - PUBLIC UTILITIES							
2	A	1	2.01 Railways	Environmental effects to Main Northern Railway	Railway not being subsided and not affected by surface sites. Project aims to use railway for coal transportation. W2CP will continue co-ordinate with rail infrastructure authorities and service providers to develop project facilities and operational requirements. Environmental management factors on the Main Northern Rail Line are governed by licence conditions upon the facility owner.	Subsidence & surface facility related impacts • No subsidence related impacts • No surface related impacts				
2	B	1	2.02 Roads (All Types) associated with subsidence areas	Environmental effects to Roads (All Types • Local roads above mining area – sealed and unsealed	• F3 road way not affected by subsidence • Will comply with requirements of SMP (to be prepared in the future) • MSB to cover road impacts • Prepare & implement Plan of Management to address road impacts & ensure the safety and serviceability of public roads, 4WD tracks and existing fire fighting access tracks. To be done as part of SMP process.	Subsidence related impacts • Damage to local roads due to mine subsidence including buckling, cracking & flooding – considered to be manageable and repairable	4	B	M	
2	B	2	2.02 Roads (All Types) associated with surface facilities	Environmental effects to other roads • F3 Freeway • Wallarah Interchange • Motorway Link Rd / Tooheys Road intersection • Sparks Rd / Hue Hue Rd intersection • Local roads	• No product coal to be hauled on public roads • W2CP to co-ordinate with road authorities and landholder to develop a strategy for managing Tooheys Rd during construction (including temporary relocation of Tooheys Road) and in the long term. • intersection of Hue Hue Road and the Buttonderry pit top mine access road to be a Type B rural layout with a left turn auxiliary lane as well as a right hand turn lane from Hue Hue Road into the proposed access road.	Surface related impacts • Impacts on road operation due to construction and operational traffic	5	B	M	
2	C	1	2.03 Bridges associated with F3	Environmental effects to bridges	Bridges on F3 • Small movements predicted & liaison with RTA to address potential impacts as part of SMP. • Predicted movements, to be provided to the RTA, so that a structural assessment of the bridges can be undertaken based on the predicted far-field horizontal movements. • It may be necessary to undertake some preventive measures, if the bridge movement joints and bearings were not able to tolerate the predicted differential movements.	Subsidence related impacts • potential for far field effects on F3 bridges. Very small movements predicted & can be managed in consultation with RTA.	4	D	L	

System	Sub-system	Hazard	Step in process	Hazards	Planned Control Measures	Predicted Impacts of the Proposed Project (after implementation of the Planned Controlled Measures)	Consequence	Likelihood	Residual Risk	Further Actions
2	C	2	2.03 Bridges associated with subsidence area	Environmental effects to bridges	Bridges in mine area • Prepare & implement Plan of Management to address any subsidence impacts to bridges in subsidence area. To be done as part of SMP process. • MSB to address repairs if necessary	Once mitigation in place, impacts negligible	4	D	L	
2	D	1	2.04 Tunnels	Environmental effects to tunnels	• No tunnels impacted by mining or surface facilities					
2	E	1	2.05 Culverts	Environmental effects to culverts	• Culverts identified in subsidence study & predications made. • Repairs covered by MSB	• Potential for damage to culverts due to subsidence requiring repairs • Changes to water flows due to subsidence affecting the ability of culverts to manage runoff waters are not expected to be significant.	4	D	L	
2	F	1	2.06 Water Infrastructure in subsidence area	Environmental effects on: • Gosford-Wyong Water Supply Scheme (Mardi Dam, Wyong Weir, Proposed Mangrove Creek Pipeline)	• Mining area does not include any significant public water reticulation systems. • No mining under Mangrove Creek Dam, Mardi Dam, Wyong River, Ourimbah Creek, Porters Creek Wetland or related infrastructure • The predicted movements along the proposed route have been provided to the designers of the pipeline. • Proposed Mangrove Creek Pipeline designed in line with current subsidence predictions.	Gosford-Wyong Water Supply Infrastructure impacts: • no far field impacts predicted • Current design of the proposed pipeline can accommodate predicted movements • No likelihood of significant damage to local distribution network water pipeline and associated connections due to mine subsidence.	4	E	L	
2	F	2	2.06 Water Infrastructure in subsidence area	Environmental effects to Water supply infrastructure within the mining area	• Treelands Drive Reservoir – low subsidence and no impacts predicted. No mitigation measures required.	• Unlikely to experience any adverse impacts	4	D	L	
2	F	3	2.06 Water Infrastructure in regional area	Environmental effects to Hunter water supply pipeline	• No controls needed as no predicted impacts	• No impacts anticipated	5	E	L	
2	F	4	2.06 Gas Infrastructure	Environmental effects to Gas Infrastructure	• Sydney-Newcastle oil & gas pipeline located to the east of the F3 Freeway - no impacts predicted so no control measures required	• No impacts anticipated	5	E	L	
2	F	5	2.06 Sewerage Infrastructure	Environmental effects to on site waste water systems (No public sewage infrastructure to be impacted)	• Preparation of Property Subsidence Management Plans including on site waste water disposal systems • MSB to repair any damage	• Potential for impacts of a minor nature, including leaking pipe joints, which can be readily repaired	4	D	L	
2	G	1	2.07 Liquid Fuel Pipelines	No hazards identified as no liquid fuel pipelines affected						
2	H	1	2.08 Electricity Transmission Lines or Associated Plants	Environmental effects to 330 kV transmission lines – suspension & tension towers **Note**: assessment based on assumption that putting supply at risk is not an option.	• Subsidence predictions developed • Mining will only proceed if approval obtained from DII (Mineral Resources) & TransGrid • Detail design co-ordination and post-approval process will address protection of transmission line (SMP process). Predicted movements at the transmission towers to be reviewed by TransGrid so that a detailed structural analysis of the towers can be undertaken. • Mitigative measures where required such as - cable sheaths, cruciform structures - Strengthening of the tension towers - Installation of additional temporary towers or poles, but this may be difficult to achieve within the existing easement - Realignment or re-routing of the transmission lines, but this may be difficult based on the surrounding land use - Direct burying the transmission line cables, providing approvals can be obtained from the land owners and that the engineering and safety constraints can be overcome, and - Providing coal barriers beneath the tension towers. • it is currently proposed to establish a subsidence management committee with officers from the WACJV, TransGrid and the Mine Subsidence Board to with a view to avoid sterilising coal in these cases where cruciform solutions would not work (ie where two high angle tension towers occur that are not due to be mined within the first 20 years). As tension towers have been constructed in many countries overseas to minimise the effects of subsidence, it is expected that replacement towers could be installed to support these transmission lines.	• based on preliminary calculations, it is believed that mitigation works can be undertaken to allow the safe operations at all the towers in the Study Area except two high angle tension towers, which are not planned to be mined within the first 20 years. Management for these towers will be addressed in consultation with a subsidence management committee. • Potential for significant damage to Electricity transmission lines due to mine subsidence is unlikely due to requirement for consultative management with authorities and need to demonstrate low impact and electricity supply security to obtain approval for mining extraction in the area. Thus potential for outages on 330 kV lines is low. (for further information refer to MSEC, 2009)	2	E	M	
2	H	2	2.08 Electricity Transmission Lines or Associated Plants	Environmental effects to 132 kV Transmission lines	• Unlikely to be significantly impacted so no control measures required	• no significant impacts predicted.	5	E	L	

System	Sub-system	Hazard	Step in process	Hazards	Planned Control Measures	Predicted Impacts of the Proposed Project (after implementation of the Planned Controlled Measures)	Consequence	Likelihood	Residual Risk	Further Actions
2	H	3	2.08 Electricity Transmission Lines or Associated Plants	Environmental effects to Local overhead lines	• Address in SMP process. Readily managed. • some remedial measures likely to be required, including some adjustments of the cable catenaries, pole tilts and the consumer cables. • Management strategy to be developed in consultation with Energy Australia	• With management measures, minor impacts can be addressed with remedial measures and consequently, no significant impacts predicted.	4	D	L	
2	I	1	2.09 Telecommunication Lines or Associated Plants	Environmental effects to Telecommunication Lines or Associated Plants • optic fibre cables • Copper underground services • Cellular Mobile Telephone Services (CMTS) sites • GSM Tower	• Management plans addressing each item of infrastructure to be prepared as part of SMP process. Impacts readily managed. • GSM tower built to MSB requirements	• Damage to Local Network and Fibreoptic telecommunication lines due to mine subsidence predicted to be low and manageable.	3	D	M	
2	J	1	2.10 Water Tanks, Water or Sewage Treatment Works	Environmental effects to Water Tanks, Water or Sewage Treatment Works • Treelands Drive Reservoir tanks (located just inside the eastern extent of the general Study Area)	• Treelands Drive Reservoir – low subsidence and no impacts predicted. No mitigation measures required.	• Unlikely to experience any adverse impacts	4	D	L	
	K	1	2.11 Dams, Reservoirs or Associated Works	Environmental effects to Dams, Reservoirs or Associated Works • Mardi Dam (outside subsidence zone) • Mangrove Creek Dam (outside subsidence zone)	• No mining under Mangrove Creek Dam, Mardi Dam, Wyong River, Ourimbah Creek, Porters Creek Wetland or related infrastructure	• No impacts to infrastructure nor water quality in storages are likely	5	E	L	
2	L	1	2.12 Air Strips	Environmental effects to air strips	• No air strips within the mining area or directly affected by surface facilities. • Warnervale air strip in vicinity of surface facilities. Facilities designed in accordance with airport obstacle limitation surface (OLS) requirements. • Aerodrome operators to be notified prior to construction for any specific requirements for the use of cranes on site. • Co-ordination with relevant authorities during detail design stage.	Facilities meet requirements of OLS criteria and control measures and will include consultations with relevant authority for any specific requirements. Resultant environmental impact level is low.	4	D	L	
2	M	1	2.13 Any Other Public Utilities	Environmental effects to Any Other Public Utilities • Buttonderry Waste Management Facility (outside mining area)	• W2CP planning for co-operative land use management with Buttonderry tip and other potential land uses in the Council property (eg. W2CP provision of access)	No impacts predicted				
			3 - PUBLIC AMENITIES							
3	A	1	3.01 Hospitals	No hospitals within the mining area or affected by surface facilities.						
3	B	1	3.02 Places of Worship	No places of worship within the mining area or affected by surface facilities.						
3	C	1	3.03 Schools affected by subsidence	Environmental effects to Schools Jilliby Public School in mining area.	Jilliby Public School is located in the subsidence study area but not above the longwalls. The school is at a sufficient distance from the longwalls not to experience noticeable subsidence.	Unlikely to experience any significant impacts	5	E	L	
3	D	1	3.04 Shopping Centres	No shopping centres within the mining area or affected by surface facilities		.				

System	Sub-system	Hazard	Step in process	Hazards	Planned Control Measures	Predicted Impacts of the Proposed Project (after implementation of the Planned Controlled Measures)	Consequence	Likelihood	Residual Risk	Further Actions
3	E	1	3.05 Community Centres	Scout Camp located in subsidence study area. Dooralong Hall and Wyong Creek Halls outside subsidence area.	Scout Camp located in subsidence study area but not above longwalls. The camp is at a sufficient distance from the longwalls not to experience noticeable subsidence.	Unlikely to experience any significant impacts	5	E	L	
3	F	1	3.06 Office Buildings	No office buildings within the mining area or affected by surface facilities.						
3	G	1	3.07 Swimming Pools	No public swimming pools within the mining area or affected by surface facilities.						
3	H	1	3.08 Bowling Greens	No bowling greens within the mining area or affected by surface facilities.						
3	I	1	3.09 Ovals or Cricket Grounds	No existing ovals or cricket grounds within mining area or affected by surface facilities						
3	J	1	3.10 Race Courses	No race courses within the mining area or affected by surface facilities.						
3	K	1	3.11 Golf Courses	No golf courses within the mining area or affected by surface facilities.						
3	L	1	3.12 Tennis Courts	No public tennis courts within the mining area or affected by surface facilities. Privately owned courts.						
3	M	1	3.13 Visual Amenity	Environmental effects to visual impacts of infrastructure	• Choice of building colours to blend into the natural surrounds • Undertake measures to provide landscape mounding and screen plantings to improve the visual character of the surface development sites of the project including: - Vegetation screening between the Tooheys Road site and the F3 Freeway and along Hue Hue Road; - Planting of native vegetation along noise control bunding - Landscaping around buildings and carparks • rail spur will be proposed to be located adjacent to the existing power line easement to minimise impacts of new clearing • Where practicable, workshop doors will be orientated so as to reduce light spill to any light-sensitive adjacent properties and land uses. • At night, work will be restricted to reduce noise impacts which will also reduce potential direct lighting effects from vehicular sources such as dozer or truck headlights and flashing beacons • Rehabilitation plans to be developed	Following implementation of proposed control measures, visual impacts will limited to low to medium levels.	4	D	L	
3	N	1	3.14 Any other amenities considered relevant	Environmental effects to any other amenities considered relevant • Jilliby cemetery	No impacts on Jilliby Cemetery so no control measures required					
			4 - FARM LAND AND FACILITIES							
4	A	1	4.01 Agricultural Utilisation or Agricultural Suitability of Farm Land	Environmental effects to agricultural Utilisation or Agricultural Suitability of Farm Land	• Flood management plan, incl evacuation planning • Addressed Property Subsidence Management Plan and other post-approval processes (SMP/Extraction Plan, other)	Changes to Agricultural utilisation due to mine subsidence. Subsidence considered highly unlikely to significantly affect agricultural activities.	5	E	L	

System	Sub-system	Hazard	Step in process	Hazards	Planned Control Measures	Predicted Impacts of the Proposed Project (after implementation of the Planned Controlled Measures)	Consequence	Likelihood	Residual Risk	Further Actions
4	B	1	4.02 Farm Buildings or Sheds	Environmental effects to farm Buildings or Sheds	• Management required as part of SMP process. • Individual Property Subsidence Management Plan to be prepared for each property addressing farm buildings and sheds (compensation / remediation / protection addressed in PSMP), in consultation with landowners. • Structural inspections to be conducted • MSB make good repairs as required	Potential for damage to infrastructure due to mine subsidence. Farm buildings / sheds may require repair. Impacts readily managed – short to medium term impacts to landholders	4	D	L	
4	C	1	4.03 Gas or Fuel Storages	No significant gas or fuel storages						
4	D	1	4.04 Poultry Sheds	No significant poultry sheds within the mining area or affected by surface facilities.						
4	E	1	4.05 Glass Houses	No significant glasshouses within the mining area or affected by surface facilities. Some greenhouses & hothouses but these not constructed with glass walls and roofs						
4	F	1	4.06 Hydroponic Systems	No known hydroponic systems within the study area						
4	G	1	4.07 Irrigation Systems	Environmental effects to Irrigation Systems	• Irrigation systems present	Unlikely to be affected by subsidence	4	D	L	
4	H	1	4.08 Fences	Environmental effects to Fences	• MSB make good repairs as required	Damage to fences due to mine subsidence unlikely to be affected.	4	D	L	
4	I	1	4.09 Farm Dams	Environmental effects to Farm Dams	• Dam inspections prior to and after mining. • In the event of subsidence damage, W2CP will remediate the damage and reinstate the dam in conjunction with the Mines Subsidence Board. If required, an alternative water supply will be provided to the dam owner until the dam can be reinstated and water supply is restored.	Damage to Farm dams due to mine subsidence. Farm dams require repair.	4	D	L	
4	J		4.10 Wells or Bores	Environmental effects to Wells or Bores • 12 bores within subsidence zone	• Commitment to ensure that no landholder's water supply capacity within the mining area will be significantly affected • Monitoring of mine waters & groundwaters to verify model predictions • Provision of water to landholders if required • Repairs if required	• Possible temporary minor loss of yield until groundwater levels rebound, in which case supply will be made good. Long term yield unlikely to be affected. • Mechanical damage to be repaired in accordance with property subsidence management plans • Reduction and reversal of leakage induced by deep depressurisation of Wallarah-Great Northern Seam is not predicted to impact creek flows or existing bores/wells located in the alluvium in a significant way	4	D	L	
4	K		4.11 Any Other Significant Features	None identified						
			5 - INDUSTRIAL, COMMERCIAL AND BUSINESS ESTABLISHMENTS							
5	A		5.01 Factories	No factories within the mining area or affected by surface facilities.						
5	B		5.02 Workshops	No workshops within the mining area or affected by surface facilities.						
5	C		5.03 Business or Commercial Establishments or Improvements	Environmental effects to Business or Commercial Establishments or Improvements Disused quarry, Turf farms, equestrian establishments, cattle properties, nursery, forestry operations, etc.	• Mine plan design and subsidence management to meet subsidence guidelines and surface constraints. Property mine subsidence management plans to be developed for all landholders, in consultation with landholder, which will address site enterprise issues through monitoring and remedial measures. • Restrict access to disused quarry while it is being mined beneath & develop management plan to address potential for rock fall.	Potential impacts considered to be readily manageable in consultation with landholders.	4	C	M	

System	Sub-system	Hazard	Step in process	Hazards	Planned Control Measures	Predicted Impacts of the Proposed Project (after implementation of the Planned Controlled Measures)	Consequence	Likelihood	Residual Risk	Further Actions
5	D		5.04 Gas or Fuel Storages or Associated Plants	Environmental effects to minor Gas or Fuel Storages associated with rural properties	• Property subsidence management plans will address property specific issues	Potential impacts considered to be readily manageable in consultation with landholders. Any impacts are expected to be of a minor nature, including minor gas leaks, which could be easily repaired.	4	D	L	
5	E		5.05 Waste Storages or Associated Plants	No waste storages or associated plant above mining area.						
5	F		5.06 Buildings, Equipment or Operations that are Sensitive to Surface Movements	There are no known buildings, equipment or operations that are sensitive to surface movements within the mining area or affected by surface facilities						
5	G		5.07 Surface Mining (Open Cut) Voids or Rehabilitated Areas	Environmental effects to Surface Mining (Open Cut) Voids or Rehabilitated Areas Disused Quarry: No significant impacts anticipated while quarry not operational.	• Preparation of a Property Subsidence Management Plan or equivalent to address potential risks in the currently disused quarry. This will include restricting access to disused quarry while it is being mined beneath & developing a management plan to address potential for rock fall.	Potential impacts low with management plan in place.	5	D	L	
5	H		5.08 Mine Infrastructure Including Tailings Dams or Emplacement Areas	No existing mine infrastructure Including Tailings Dams or Emplacement Areas in study area						
5	I		5.09 Any Other Industrial, Commercial or Business Features	None known						
			6 - AREAS OF ARCHAEOLOGICAL OR HERITAGE IMPORTANCE							
6	A	1	6.01 Areas of Archaeological Significance in the Subsidence Area	Environmental effects to Aboriginal heritage: • Six known archaeological sites and more expected to exist above mining area. • No specific heritage surveys were undertaken for this EA, however certain areas were identified as having potential for sites to be present.	• Additional targeted survey over areas of highest potential if project approved for inclusion in SMP.	Impacts in subsidence area • Damage to Aboriginal heritage sites due to mine subsidence. Full impact potential assessed in detail following further survey and will be subject to planned control measures and management regime.	4	D	L	Site Aboriginal Heritage Management Plan to be prepared prior to construction commencing.
6	A	2	6.01 Aboriginal Heritage in the Surface Infrastructure Study Area	Environmental effects to Aboriginal heritage: • Two Potential Archaeological Deposits (PADs) present along Wallarah Creek in Tooheys Rd site • No sites identified in Buttonderry or Western Shaft areas	• Pit top facilities redesigned to minimise effects of crossing Wallarah Creek • Archaeological investigation to be undertaken over PAD sites in the vicinity of Wallarah Creek where avoidance is not possible. These will be in the form of test excavations to determine the presence, nature, extent and significance of potential Aboriginal site material. The test excavation programme has already been designed and can be found in Section 4.9.1a of the heritage report for surface infrastructure. • This test excavation programme will provide the necessary data to feed into design of further management measures (i.e. salvage or monitoring). • Potential off-set area for formal conservation of three sites as • Thee Indigenous sites were located at the Hue Hue Road offset area along Wallarah Creek and its tributaries. The preferred management of these sites and indeed the entire creek line which is delineated as an area of archaeological sensitivity is to see the area formally conserved through a mechanism such as a covenant on the title of the land.	Areas affected by surface facilities • Damage to the PAD sites which may (once tested) prove to have some significance, although this will in turn be managed into salvage.	5	E	L	Site Aboriginal Heritage Management Plan to be prepared prior to construction commencing.

System	Sub-system	Hazard	Step in process	Hazards	Planned Control Measures	Predicted Impacts of the Proposed Project (after implementation of the Planned Controlled Measures)	Consequence	Likelihood	Residual Risk	Further Actions
6	A	3	6.01 Areas of European Heritage Significance in the Subsidence Area	Environmental effects to European heritage: • 12 potential items in subsidence area; • 3 listed items in subsidence area.	• Significance assessments still remain to be applied to the list of potential heritage locations. Such assessments should be undertaken through applying the NSW Heritage Office criteria, and if necessary, undertaking landholder consultation and as well as investigation through historical societies, Shire Council etc. This will enable a better understanding of the potential impacts of the project to the heritage values /significance of these locations and allow the development of appropriate mitigative measures. • With regard to the three items on the Wyong LEP that will be impacted by the potential subsidence effects longwall mining in the W2CP subsidence study area (a silo, a house and a school) further assessment and the development of appropriate mitigative measures will be required. As these items are all privately owned, impacts to them will also be addressed in the PSMP. Consultation with the Wyong Shire Council and the heritage Office may also be required.	Impacts in subsidence area: • Property subsidence management plans to address those private homes identified as potential heritage sites. • Remedial action required for other sites (e.g. silo).	5	E	L	Site European Heritage Management Plan to be prepared prior to construction commencing.
6	A	4	6.01 Areas of European Heritage Significance (in surface facility areas)	Environmental effects to Areas of Archaeological Significance • No items identified in areas for surface facilities	• As no items of non-Indigenous heritage value were recorded there are no specific recommendations regarding non-Indigenous heritage items.	• There are none.				
			7 - ITEMS OF ARCHITECTURAL IMPORTANCE							
7	A	1	7.01 Items of Architectural Significance		No items of architectural importance within the mining area or affected by surface facilities.					
			8 - PERMANENT SURVEY CONTROL MARKS							
8	A	1	8.01 Permanent Survey Control Marks	Environmental effects to Permanent Survey Control Marks	Base line assessment completed, known sites of the survey control marks within the area. SMP will address management of survey marks. • Completed SMP to include consideration of Permanent Survey Control Marks and the monitoring programs • Liaise with Land and Property Information (LPI) until mining has ceased and Permanent Survey Control Marks can be re-established	Movement of Permanent Survey Control Marks due to mine subsidence. Readily managed.	4	D	L	Liaise with authorities to update survey control marks
			9 - RESIDENTIAL ESTABLISHMENTS							
9	A	1	9.01 Houses	Environmental effects to houses	• Predictions achieved through computer modelling techniques developed by Strata Control Technology Pty Ltd used in conjunction with empirical modelling methods developed by Mine Subsidence Engineering Consultants Pty Ltd • Mine design developed in recognition of the Hue Hue & Wyong Mine Subsidence Districts • within the Hue Hue Mine Subsidence District, the maximum predicted total strains and tilts at the completion of mining, are consistent with criteria prescribed for that district • Mine layout modifications in “subsidence protection zones” including Yarramalong & Dooralong Valleys and Hue Hue rural residential area. Measures include shorter/narrower longwalls & reduced coal extraction height • Repairs to be undertaken by MSB & appropriate compensation made where necessary • Development of a scientifically sound and defensible subsidence prediction model. • Calibration of the model based on actual mining results from other operations. • Alterations made to the mine plan to ensure subsidence limits can be met. • Running of the model on the revised mine plan to verify that subsidence limits can be met. • Modelling results show that required subsidence limits can be achieved. Subsidence Management Plan process to be undertaken including one on one liaison with affected landholders via Property Subsidence Management Plans	• Very unlikely that any house will become unsafe. • Very small chance that a few houses will experience severe impacts (<0.5%) (See MSEC report) • Some houses will experience moderate impacts • Some houses will experience minor impacts • Damage to Houses and property improvements due to mine subsidence. Houses and property improvements require repair. Owners emotional stress associated with uncertainly of events.	3	D	M	Note: While a moderate risk technically, due to the potential for public concern, senior management must be involved in pro-actively manage this issue.

System	Sub-system	Hazard	Step in process	Hazards	Planned Control Measures	Predicted Impacts of the Proposed Project (after implementation of the Planned Controlled Measures)	Consequence	Likelihood	Residual Risk	Further Actions
					• Inspection prior to and after mining • Subsidence monitoring to be carried out once coal extraction has begun to verify the impacts and that subsidence limits are being met. • Inspection of damage to verify the cause and repair if necessary. To be undertaken through the mine subsidence board. • Mine plan can be modified if impacts are greater than predicted					
9	B	1	9.02 Flats or Units	No flats or units within mining area or affected by surface facilities						
9	C	1	9.03 Caravan Parks	No caravan parks within mining area or affected by surface facilities						
9	D	1	9.04 Retirement or Aged Care Villages	No retirement or aged care villages within mining area or affected by surface facilities						
9	E	1	9.05 Associated Structures such as Workshops, Garages, On-Site Waste Water Systems, Water or Gas Tanks, Swimming Pools or Tennis Courts	Environmental effects to Associated Structures such as Workshops, Garages, On-Site Waste Water Systems, Water or Gas Tanks, Swimming Pools or Tennis Courts	• Property subsidence management plans will be undertaken and will address these • On site waste water systems may be temporarily affected but repairable as part of Property Subsidence Mgmt Plan actions • W2CP will install first flush systems on rural residential rain water tanks, at the request of landowners located within 500 metres of the project disturbance boundary at time of construction.	Various structures located in mining area – to be managed as part of Property Management Plan process.	4	D	L	Review and manage as part of Property Subsidence Management Plans
9	F	1	9.06 Any Other Residential Features of relevance	Environmental effects to Any Other Residential Features of relevance None identified						
			10 - ANY OTHER ITEM OF IMPORTANCE							
10	A	1	10.01 Any Other Item of Importance	• No other items of importance identified.						

ATTACHMENT B

RISK RANK ORDER

System	Sub-system	Hazard	Hazards	Consequence	Likelihood	Residual Risk	Further Actions
1	A	1	Environmental effects to Catchment Areas or Declared Special Areas. • Mine is located within the Wyong River catchment area (supply to Mardi Dam)	4	E	L	
1	D	1	Environmental effects to springs Isolated springs. Geological dip is to southwest and springs expected to be most prevalent on south facing slopes mainly in hilly forested areas.	5	C	L	
1	E	1	Environmental effects to Seas or Lakes • Budgewoi Lake • Tuggerah Lake (outside subsidence area)	5	E	L	
1	I	1	Environmental effects to steep slopes within the subsidence area	5	C	L	
1	L	1	Environmental effects to Swamps, Wetlands or Water Related Ecosystems • Water related ecosystems within mining area	5	D	L	
1	L	2	Environmental effects to Swamps, Wetlands or Water Related Ecosystems • Unnamed wetland to north of Tooheys Road site	5	D	L	
1	M	1	Environmental effects to Threatened or Protected Species • No critically endangered ecological populations affected • No endangered ecological populations affected • one endangered, six vulnerable and three regionally significant flora species that have potential to be affected either directly or indirectly • 10 species of threatened and 3 species of regionally significant mammals, 1 species of regionally significant reptile, 2 threatened and regionally significant frogs and 2 threatened and 3 regionally significant species of birds recorded in the study areas, with a further 8 mammals, 3 birds, 2 frogs and 1 insect potentially present. • Four Endangered Ecological Communities above the mining area subject to changed flooding regimes	5	D	L	
1	M	2	Environmental effects to Threatened or Protected Species • No critically endangered ecological populations affected • No endangered ecological populations affected • one endangered, six vulnerable and three regionally significant flora species that have potential to be affected either directly or indirectly • 10 species of threatened and 3 species of regionally significant mammals, 1 species of regionally significant reptile, 2 threatened and regionally significant frogs and 2 threatened and 3 regionally significant species of birds recorded in the study areas, with a further 8 mammals, 3 birds, 2 frogs and 1 insect potentially present.	5	D	L	The project has been determined as a controlled action and therefore additional species are to be included in the EA for assessment in accordance with the bilateral agreement for approval under the EPBC Act.
1	Q	1	Environmental effects to Natural Vegetation / Ecology	5	C	L	

System	Sub-system	Hazard	Hazards	Consequence	Likelihood	Residual Risk	Further Actions
1	Q	2	Environmental effects to Natural Vegetation / Ecology from Surface infrastructure. Population of squirrel gliders has been identified along Wallarah Creek in the past (1995) but has not been re-recorded since. • see OzArk ecology report	4	D	L	
1	S	1	Environmental effects to Air quality	4	D	L	
1	U	1	Environmental effects to soils due to subsidence	5	D	L	• detailed rehabilitation plans should they be required • Refinement of monitoring program in association with landholders (dependant on permission to access)
1	U	2	Environmental effects to soils from surface infrastructure	5	C	L	
1	V	1	Environmental effects from excessive energy usage	4	D	L	Conduct an energy efficiency audit each three years after the commencement of mining
1	W	1	Environmental effects from greenhouse gas emissions	4	D	L	Monitor greenhouse emissions & mitigation measures Coal mine methane & utilisation strategy to be developed within 3 years of longwall operations following monitoring experience
2	C	1	Environmental effects to bridges	4	D	L	
2	C	2	Environmental effects to bridges	4	D	L	
2	E	1	Environmental effects to culverts	4	D	L	
2	F	1	Environmental effects on: • Gosford-Wyong Water Supply Scheme (Mardi Dam, Wyong Weir, Proposed Mangrove Creek Pipeline)	4	E	L	
2	F	2	Environmental effects to Water supply infrastructure within the mining area	4	D	L	
2	F	3	Environmental effects to Hunter water supply pipeline	5	E	L	
2	F	4	Environmental effects to Gas Infrastructure	5	E	L	
2	F	5	Environmental effects to on site waste water systems (No public sewage infrastructure to be impacted)	4	D	L	
2	H	2	Environmental effects to 132 kV Transmission lines	5	E	L	
2	H	3	Environmental effects to Local overhead lines	4	D	L	
2	J	1	Environmental effects to Water Tanks, Water or Sewage Treatment Works • Treelands Drive Reservoir tanks (located just inside the eastern extent of the general Study Area)	4	D	L	
	K	1	Environmental effects to Dams, Reservoirs or Associated Works • Mardi Dam (outside subsidence zone) • Mangrove Creek Dam (outside subsidence zone)	5	E	L	
2	L	1	Environmental effects to air strips	4	D	L	
3	C	1	Environmental effects to Schools Jilliby Public School in mining area.	5	E	L	

System	Sub-system	Hazard	Hazards	Consequence	Likelihood	Residual Risk	Further Actions
3	E	1	Scout Camp located in subsidence study area. Dooralong Hall and Wyong Creek Halls outside subsidence area.	5	E	L	
3	M	1	Environmental effects to visual impacts of infrastructure	4	D	L	
4	A	1	Environmental effects to agricultural Utilisation or Agricultural Suitability of Farm Land	5	E	L	
4	B	1	Environmental effects to farm Buildings or Sheds	4	D	L	
4	G	1	Environmental effects to Irrigation Systems	4	D	L	
4	H	1	Environmental effects to Fences	4	D	L	
4	I	1	Environmental effects to Farm Dams	4	D	L	
4	J		Environmental effects to Wells or Bores • 12 bores within subsidence zone	4	D	L	
5	D		Environmental effects to minor Gas or Fuel Storages associated with rural properties	4	D	L	
5	G		Environmental effects to Surface Mining (Open Cut) Voids or Rehabilitated Areas Disused Quarry: No significant impacts anticipated while quarry not operational.	5	D	L	
6	A	1	Environmental effects to Aboriginal heritage: • Six known archaeological sites and more expected to exist above mining area. • No specific heritage surveys were undertaken for this EA, however certain areas were identified as having potential for sites to be present.	4	D	L	Site Aboriginal Heritage Management Plan to be prepared prior to construction commencing.
6	A	2	Environmental effects to Aboriginal heritage: • Two Potential Archaeological Deposits (PADs) present along Wallarah Creek in Tooheys Rd site • No sites identified in Buttonderry or Western Shaft areas	5	E	L	Site Aboriginal Heritage Management Plan to be prepared prior to construction commencing.
6	A	3	Environmental effects to European heritage: • 12 potential items in subsidence area; • 3 listed items in subsidence area.	5	E	L	Site European Heritage Management Plan to be prepared prior to construction commencing.
8	A	1	Environmental effects to Permanent Survey Control Marks	4	D	L	
9	E	1	Environmental effects to Associated Structures such as Workshops, Garages, On-Site Waste Water Systems, Water or Gas Tanks, Swimming Pools or Tennis Courts	4	D	L	Review and manage as part of Property Subsidence Management Plans
1	B	1	Subsidence effects to the mining area, associated with subsiding areas in the vicinity of: • Wyong River • Jilliby Jilliby Creek • Little Jilliby Jilliby Creek • Hue Hue Creek • Minor tributaries Effects can include Increased levels of ponding, flooding or scouring; changes to stream alignment; fracturing of the bedrock in the floors of valleys; surface water flow diversions to the shallow sub-strata; changes to water quality and release of strata gas.	4	B	M	
1	B	2	Environmental effects to • Wallarah Creek • Buttonderry Creek	4	C	M	

System	Sub-system	Hazard	Hazards	Consequence	Likelihood	Residual Risk	Further Actions
			• Small unnamed creeks				
1	C	1	Environmental effects to aquifers and known groundwater conditions namely • regional hard rock strata, within which the coal seam provides limited groundwater storage and the overburden materials act as aquitards or acquicludes (flow rates within system very low: 0.036 – 3.6 mm/yr; brackish to saline). • shallow weathered rock (increased but limited groundwater transmission & storage capacity). • unconsolidated alluvial aquifers within valleys. Rainfall driven, with a shallow water table 2-10 m below ground surface (flow rates within alluvium typically 36 – 3600 mm/yr; fresh to saline).	5 5 5 5	A C B C	M L M L	Comment: Note that '5AM' relates to effects while '5CL' is the environmental consequence associated with this effect
1	H	1	Environmental effects to Cliffs or Pagodas • Cliffs are located within the unused quarry • Other cliffs identified are small and predicted not to be impacted	2	E	M	Cliff in unused quarry requires management plan to address safety and access issues when mining occurs.
1	K	1	Environmental effects to Land Prone to Flooding or Inundation • Yarramalong Valley floodplain • Dooralong Valley floodplain	4	C	M	• SMP to contain specific management strategies for structures that are deemed to be at risk • Prepare & implement individual property subsidence management plans
1	K	2	Environmental effects to Land Prone to Flooding or Inundation • Yarramalong Valley floodplain • Dooralong Valley floodplain	4	C	M	Further specific measures may be identified and agreed during consultative negotiations for individual property subsidence management plans.
1	S	2	• Environmental effects to odour	4	C	M	
1	T	1	Environmental effects to Acoustic Amenity (Noise)	3	C	M	
2	B	1	Environmental effects to Roads (All Types • Local roads above mining area – sealed and unsealed	4	B	M	
2	B	2	Environmental effects to other roads • F3 Freeway • Wallarah Interchange • Motorway Link Rd / Tooheys Road intersection • Sparks Rd / Hue Hue Rd intersection • Local roads	5	B	M	
2	H	1	Environmental effects to 330 kV transmission lines – suspension & tension towers **Note**: assessment based on assumption that putting supply at risk is not an option.	2	E	M	

System	Sub-system	Hazard	Hazards	Consequence	Likelihood	Residual Risk	Further Actions
2	I	1	Environmental effects to Telecommunication Lines or Associated Plants • optic fibre cables • Copper underground services • Cellular Mobile Telephone Services (CMTS) sites • GSM Tower	3	D	M	
5	C		Environmental effects to Business or Commercial Establishments or Improvements Disused quarry, Turf farms, equestrian establishments, cattle properties, nursery, forestry operations, etc.	4	C	M	
9	A	1	Environmental effects to houses	3	D	M	Note: While a moderate risk technically, due to the potential for public concern, senior management must be involved in pro-actively manage this issue.

ATTACHMENT C

CONSEQUENCE ORDER

System	Sub-system	Hazard	Hazards	Consequence	Likelihood	Residual Risk	Further Actions
1	H	1	Environmental effects to Cliffs or Pagodas • Cliffs are located within the unused quarry • Other cliffs identified are small and predicted not to be impacted	2	E	M	Cliff in unused quarry requires management plan to address safety and access issues when mining occurs.
2	H	1	Environmental effects to 330 kV transmission lines – suspension & tension towers **Note**: assessment based on assumption that putting supply at risk is not an option.	2	E	M	
1	T	1	Environmental effects to Acoustic Amenity (Noise)	3	C	M	
2	I	1	Environmental effects to Telecommunication Lines or Associated Plants • optic fibre cables • Copper underground services • Cellular Mobile Telephone Services (CMTS) sites • GSM Tower	3	D	M	
9	A	1	Environmental effects to houses	3	D	M	Note: While a moderate risk technically, due to the potential for public concern, senior management must be involved in pro-actively manage this issue.
1	B	1	Subsidence effects to the mining area, associated with subsiding areas in the vicinity of: • Wyong River • Jilliby Jilliby Creek • Little Jilliby Jilliby Creek • Hue Hue Creek • Minor tributaries Effects can include Increased levels of ponding, flooding or scouring; changes to stream alignment; fracturing of the bedrock in the floors of valleys; surface water flow diversions to the shallow sub-strata; changes to water quality and release of strata gas.	4	B	M	
1	A	1	Environmental effects to Catchment Areas or Declared Special Areas. • Mine is located within the Wyong River catchment area (supply to Mardi Dam)	4	E	L	
1	Q	2	Environmental effects to Natural Vegetation / Ecology from Surface infrastructure. Population of squirrel gliders has been identified along Wallarah Creek in the past (1995) but has not been re-recorded since. • see OzArk ecology report	4	D	L	
1	S	1	Environmental effects to Air quality	4	D	L	
1	V	1	Environmental effects from excessive energy usage	4	D	L	Conduct an energy efficiency audit each three years after the commencement of mining

1	W	1	Environmental effects from greenhouse gas emissions	4	D	L	Monitor greenhouse emissions & mitigation measures Coal mine methane & utilisation strategy to be developed within 3 years of longwall operations following monitoring experience
2	C	1	Environmental effects to bridges	4	D	L	
2	C	2	Environmental effects to bridges	4	D	L	
2	E	1	Environmental effects to culverts	4	D	L	
2	F	1	Environmental effects on: • Gosford-Wyong Water Supply Scheme (Mardi Dam, Wyong Weir, Proposed Mangrove Creek Pipeline)	4	E	L	
2	F	2	Environmental effects to Water supply infrastructure within the mining area	4	D	L	
2	F	5	Environmental effects to on site waste water systems (No public sewage infrastructure to be impacted)	4	D	L	
2	H	3	Environmental effects to Local overhead lines	4	D	L	
2	J	1	Environmental effects to Water Tanks, Water or Sewage Treatment Works • Treelands Drive Reservoir tanks (located just inside the eastern extent of the general Study Area)	4	D	L	
2	L	1	Environmental effects to air strips	4	D	L	
3	M	1	Environmental effects to visual impacts of infrastructure	4	D	L	
4	B	1	Environmental effects to farm Buildings or Sheds	4	D	L	
4	G	1	Environmental effects to Irrigation Systems	4	D	L	
4	H	1	Environmental effects to Fences	4	D	L	
4	I	1	Environmental effects to Farm Dams	4	D	L	
4	J		Environmental effects to Wells or Bores • 12 bores within subsidence zone	4	D	L	
5	D		Environmental effects to minor Gas or Fuel Storages associated with rural properties	4	D	L	
6	A	1	Environmental effects to Aboriginal heritage: • Six known archaeological sites and more expected to exist above mining area. • No specific heritage surveys were undertaken for this EA, however certain areas were identified as having potential for sites to be present.	4	D	L	Site Aboriginal Heritage Management Plan to be prepared prior to construction commencing.
8	A	1	Environmental effects to Permanent Survey Control Marks	4	D	L	
9	E	1	Environmental effects to Associated Structures such as Workshops, Garages, On-Site Waste Water Systems, Water or Gas Tanks, Swimming Pools or Tennis Courts	4	D	L	Review and manage as part of Property Subsidence Management Plans
1	B	2	Environmental effects to • Wallarah Creek • Buttonderry Creek • Small unnamed creeks	4	C	M	

1	K	1	Environmental effects to Land Prone to Flooding or Inundation • Yarramalong Valley floodplain • Dooralong Valley floodplain	4	C	M	• SMP to contain specific management strategies for structures that are deemed to be at risk • Prepare & implement individual property subsidence management plans
1	K	2	Environmental effects to Land Prone to Flooding or Inundation • Yarramalong Valley floodplain • Dooralong Valley floodplain	4	C	M	Further specific measures may be identified and agreed during consultative negotiations for individual property subsidence management plans.
1	S	2	• Environmental effects to odour	4	C	M	
2	B	1	Environmental effects to Roads (All Types • Local roads above mining area – sealed and unsealed	4	B	M	
5	C		Environmental effects to Business or Commercial Establishments or Improvements Disused quarry, Turf farms, equestrian establishments, cattle properties, nursery, forestry operations, etc.	4	C	M	
1	D	1	Environmental effects to springs Isolated springs. Geological dip is to southwest and springs expected to be most prevalent on south facing slopes mainly in hilly forested areas.	5	C	L	
1	E	1	Environmental effects to Seas or Lakes • Budgewoi Lake • Tuggerah Lake (outside subsidence area)	5	E	L	
1	I	1	Environmental effects to steep slopes within the subsidence area	5	C	L	
1	L	1	Environmental effects to Swamps, Wetlands or Water Related Ecosystems • Water related ecosystems within mining area	5	D	L	
1	L	2	Environmental effects to Swamps, Wetlands or Water Related Ecosystems • Unnamed wetland to north of Tooheys Road site	5	D	L	
1	M	1	Environmental effects to Threatened or Protected Species • No critically endangered ecological populations affected • No endangered ecological populations affected • one endangered, six vulnerable and three regionally significant flora species that have potential to be affected either directly or indirectly • 10 species of threatened and 3 species of regionally significant mammals, 1 species of regionally significant reptile, 2 threatened and regionally significant frogs and 2 threatened and 3 regionally significant species of birds recorded in the study areas, with a further 8 mammals, 3 birds, 2 frogs and 1 insect potentially present. • Four Endangered Ecological Communities above the mining area subject to changed flooding regimes	5	D	L	
1	M	2	Environmental effects to Threatened or Protected Species • No critically endangered ecological populations affected • No endangered ecological populations affected • one endangered, six vulnerable and three regionally significant flora species that have potential to be affected either directly or indirectly	5	D	L	The project has been determined as a controlled action and therefore additional species are to be included in the EA for assessment in accordance with the bilateral agreement for approval under the EPBC Act.

			• 10 species of threatened and 3 species of regionally significant mammals, 1 species of regionally significant reptile, 2 threatened and regionally significant frogs and 2 threatened and 3 regionally significant species of birds recorded in the study areas, with a further 8 mammals, 3 birds, 2 frogs and 1 insect potentially present.				
1	Q	1	Environmental effects to Natural Vegetation / Ecology	5	C	L	
1	U	1	Environmental effects to soils due to subsidence	5	D	L	• detailed rehabilitation plans should they be required • Refinement of monitoring program in association with landholders (dependant on permission to access)
1	U	2	Environmental effects to soils from surface infrastructure	5	C	L	
2	F	3	Environmental effects to Hunter water supply pipeline	5	E	L	
2	F	4	Environmental effects to Gas Infrastructure	5	E	L	
2	H	2	Environmental effects to 132 kV Transmission lines	5	E	L	
	K	1	Environmental effects to Dams, Reservoirs or Associated Works • Mardi Dam (outside subsidence zone) • Mangrove Creek Dam (outside subsidence zone)	5	E	L	
3	C	1	Environmental effects to Schools Jilliby Public School in mining area.	5	E	L	
3	E	1	Scout Camp located in subsidence study area. Dooralong Hall and Wyong Creek Halls outside subsidence area.	5	E	L	
4	A	1	Environmental effects to agricultural Utilisation or Agricultural Suitability of Farm Land	5	E	L	
5	G		Environmental effects to Surface Mining (Open Cut) Voids or Rehabilitated Areas Disused Quarry: No significant impacts anticipated while quarry not operational.	5	D	L	
6	A	2	Environmental effects to Aboriginal heritage: • Two Potential Archaeological Deposits (PADs) present along Wallarah Creek in Tooheys Rd site • No sites identified in Buttonderry or Western Shaft areas	5	E	L	Site Aboriginal Heritage Management Plan to be prepared prior to construction commencing.
6	A	3	Environmental effects to European heritage: • 12 potential items in subsidence area; • 3 listed items in subsidence area.	5	E	L	Site European Heritage Management Plan to be prepared prior to construction commencing.
1	C	1	Environmental effects to aquifers and known groundwater conditions namely • regional hard rock strata, within which the coal seam provides limited groundwater storage and the overburden materials act as aquitards or acquicludes (flow rates within system very low: 0.036 – 3.6 mm/yr; brackish to saline). • shallow weathered rock (increased but limited groundwater transmission & storage capacity). • unconsolidated alluvial aquifers within valleys. Rainfall driven, with a shallow water table 2-10 m below ground surface (flow rates within alluvium typically 36 – 3600 mm/yr; fresh to saline).	5 5 5 5	A C B C	M L M L	Comment: Note that '5AM' relates to effects while '5CL' is the environmental consequence associated with this effect

2	B	2	Environmental effects to other roads • F3 Freeway • Wallarah Interchange • Motorway Link Rd / Tooheys Road intersection • Sparks Rd / Hue Hue Rd intersection • Local roads	5	B	M	

ATTACHMENT D

RISK TREATMENT SCHEDULE

System	Sub-system	Hazard	Hazards	Consequence	Likelihood	Residual Risk	Further Actions	Responsible	Date
1	B	1	Environmental effects to the mining area, including the • Wyong River • Jilliby Jilliby Creek • Little Jilliby Jilliby Creek • Myrtle Creek • Armstrong Creek • Youngs Gully • Calmans Gully • Splash Gully • Hughes Gully.	4 3	B E	M M	Confirm documentation adequately covers these	Rob Byrnes	End October 2009
1	H	1	Environmental effects to Cliffs or Pagodas • Cliffs are located within the unused quarry • Other cliffs identified are small and predicted not to be impacted	2	E	M	• Cliff in unused quarry requires management plan to address safety and access issues when mining occurs.	Rob Byrnes	Prior to mining underneath the quarry.

System	Sub-system	Hazard	Hazards	Consequence	Likelihood	Residual Risk	Further Actions	Responsible	Date
1	K	1	Environmental effects to Land Prone to Flooding or Inundation • Yarramalong Valley floodplain • Dooralong Valley floodplain	4	C	M	• SMP to contain specific management strategies for structures that are deemed to be at risk • Prepare & implement individual property subsidence management plans	Rob Byrnes	During the preparation of the SMP and Property Subsidence Management Plans
1	K	2	Environmental effects to Land Prone to Flooding or Inundation • Yarramalong Valley floodplain • Dooralong Valley floodplain	4	C	M	• Further specific measures may be identified and agreed during consultative negotiations for individual property subsidence management plans.	Rob Byrnes	During the preparation of the SMP and Property Subsidence Management Plans
1	M	2	Environmental effects to Threatened or Protected Species • No critically endangered ecological populations affected • No endangered ecological populations affected • one endangered, six vulnerable and three regionally significant flora species that have potential to be affected either directly or indirectly • 10 species of threatened and 3 species of regionally significant mammals, 1 species of regionally significant reptile, 2 threatened and regionally significant frogs and 2 threatened and 3 regionally significant species of birds recorded in the study areas, with a further 8 mammals, 3 birds, 2 frogs and 1 insect potentially present.	5	D	L	• The project has been determined as a controlled action and therefore additional species are to be included in the EA for assessment in accordance with the bilateral agreement for approval under the EPBC Act.	Rob Byrnes / Phil Cameron	October 2009

System	Sub-system	Hazard	Hazards	Consequence	Likelihood	Residual Risk	Further Actions	Responsible	Date
1	U	1	Environmental effects to soils due to subsidence	5	D	L	• detailed rehabilitation plans should they be required • Refinement of monitoring program in association with landholders (dependant on permission to access)	Rob Byrnes	During SMP process
1	V	1	Environmental effects from excessive energy usage	4	D	L	• Conduct an energy efficiency audit each three years after the commencement of mining	Rob Byrnes	2 years after commencement of mining
1	W	1	Environmental effects from greenhouse gas emissions	4	D	L	• Monitor greenhouse emissions & mitigation measures • Coal mine methane & utilisation strategy to be developed within 3 years of longwall operations following monitoring experience	Rob Byrnes	2 years after commencement of mining
2	L	1	Environmental effects to air strips	4	D	L	• Co-ordination with relevant authorities during detail design stage.	Ron Hansen	During detail design & prior to construction
6	A	1	Environmental effects to Aboriginal heritage: • Six known archaeological sites and more expected to exist above mining area. • No specific heritage surveys were undertaken for this EA, however certain areas were identified as having potential for sites to be present.	4	D	L	• Site Aboriginal Heritage Management Plan to be prepared prior to construction commencing.	Rob Byrnes / Jodie Benton	Prior to commencement of construction
6	A	2	Environmental effects to Aboriginal heritage: • Two Potential Archaeological Deposits (PADs) present along Wallarah Creek in Tooheys Rd site • No sites identified in Buttonderry or Western Shaft areas	5	E	L	• Site Aboriginal Heritage Management Plan to be prepared prior to construction commencing.	Rob Byrnes / Jodie Benton	Prior to commencement of construction

System	Sub-system	Hazard	Hazards	Consequence	Likelihood	Residual Risk	Further Actions	Responsible	Date
6	A	3	Environmental effects to European heritage: • 12 potential items in subsidence area; • 3 listed items in subsidence area.	5	E	L	• Site European Heritage Management Plan to be prepared prior to construction commencing.	Rob Byrnes / Jodie Benton	Prior to commencement of construction
8	A	1	Environmental effects to Permanent Survey Control Marks	4	D	L	• Liaise with authorities to update survey control marks	Rob Byrnes	Following completion of mining
9	A	1	Environmental effects to houses	3	D	M	• Note: While a moderate risk technically, due to the potential for public concern, senior management must be involved in pro-actively manage this issue.	Ron Hansen	During mining
9	E	1	Environmental effects to Associated Structures such as Workshops, Garages, On-Site Waste Water Systems, Water or Gas Tanks, Swimming Pools or Tennis Courts	4	D	L	• Review and manage as part of Property Subsidence Management Plans	Rob Byrnes	During the preparation of the SMP and Property Subsidence Management Plans

ATTACHMENT E

RISK ASSESSMENT METHODOLOGY

Qualitative Risk Analysis

This Risk Analysis has been performed using Qualitative Risk Analysis techniques and has been performed in compliance with Australian Standards AS4360 and the Department of Mineral Resource Guideline MDG1010.

The Risk Assessment has followed the WRAC (Workplace Risk Assessment and Control) principals as outlined in the guideline.

The Qualitative approach succeeds by using local expert knowledge and relevant historical data.

This system of analysis uses a participative approach which is very powerful for identifying potential hazard scenarios.

The following steps outline; the systematic identification of hazards, ranking of risks, and identification of new and/or improved controls; that will be used in the Risk Assessment session.

1. Introduce Team to Risk Assessment Plan document.
   This includes the scope and method of the Risk Assessment.

2. Break system being assessed down into discrete sub-systems.

3. Identify and add potential deviation steps.

4. Review each sub-system and identify loss scenarios,
   (Potential Incidents and Accidents)

5. For those hazards evaluate the risk using the risk rank method by.
   Determining the probability, consequence, and risk rank of each loss scenario.

6. Identify existing controls for each hazard.

7. Specify additional controls required to control the hazard(s).

8. Close Risk Assessment

9. Document and distribute to the team for proof reading.

10. Verification of the assessment by a nominated person. (if performed)

ESTABLISH THE CONTEXT

When establishing the context thought is given to:

1. The strategic context of the organisation and its relationship with the environment. Identifying both internal and external stakeholders. This step focuses on the environment in which the organisation operates.
2. The organisational context is to be understood. The capabilities, goals and objectives and the strategies in place to achieve them.
3. The process that is to be analysed in the organisation and determine the goals, objectives and scope of the analysis. Consideration is given to costs and benefits that are required. The resources required are also determined. The analysis boundaries are also determined.
4. Develop the Risk Evaluation Criteria. Determine risk acceptability and risk treatment. These issues may be based on operational, environmental, financial, legal, social or humanitarian issues.
5. Define the structure of the analysis that is to be performed.

IDENTIFY HAZARDS

Identification of all the Hazards to be Managed. To correctly apply this step a well structured systematic process must be used as any identified hazards missed at this point in the analysis will mean that no controls will be implemented to reduce or eliminate the hazard and its associated risks.

Identify

1. What Can Happen
2. How and Why it Can Happen

Checklists, Flowcharts and Brainstorming are some methods that can be used to achieve hazard identification.

RISK ANALYSIS

The main objectives of an analysis is to separate minor risks from major risks and to provide data to assist in the evaluation and treatment of hazards.

Risk Analysis involves considering the following

1. Likelihood of the Hazard occurring
2. Consequences if the Hazard does occur
3. Determining any Existing Controls

The combination of the Likelihood and the Consequence determines the level of the risk involved.

RISK EVALUATION

Evaluation involves comparing the level of risk found during the analysis with a previously established risk criteria.

The output of this part of the process is a list of prioritised hazards for further action.

If the resulting hazards fall into the low or acceptable risk categories they may be accepted with minimal further treatment. Although, low and acceptable hazards should be monitored and periodically reviewed to ensure that they remain acceptable.

If hazards do not fall into the low or acceptable risk category then they should be treated using other options.

RISK TREATMENT

Risk Treatment involves identifying the range of options for treating risks, assessing the options and preparing risk treatment plans and of course implementing them.

Risk Treatment may be in one of the following forms.

1. Risk Avoidance. Decide not to procede with the activity.
2. Reduce Likelihood. Reduce the chance of the risk occurring.
3. Reduce the Risk Consequences. Reduce the consequence if the risk occurs.
4. Transfer the Risk. Involve other parties to bear or share the risks. This may reduce the hazard to the organisation, however, the risk may not be managed effectively as it still exists.
5. Retain (or accept) the Risk. Plans should be put in place to manage the risks

Risk Treatment Options should be assessed on the extent of any additional benefits or opportunities created. A number of options may be considered and applied either individually or in a combination.

Risk Treatment Plans should be developed to identify responsibilities, schedules, budgets and performance measures and the review process that is to be put in place.

MONITOR AND REVIEW

It is essential to monitor the effectiveness of the risk management system and the risk treatment implementation.

Risks and the effectiveness of control measures need to be monitored to ensure that the changing environments do not alter risk priorities. Few risks remain static.

Factors effecting Likelihood and Consequence change as do factors regarding suitability of controls.

COMMUNICATIONS AND CONSULTATION

Communication and consultation are important during the entire Risk Management process. It is important to develop a communication plan for both internal and external stakeholders.

This should be a two way consultation not a one way flow of information.

Effectiveness internal and external communications is important to ensure that those responsible for implementing risk management understand the basis on which all decisions have been made and why particular actions are required.

ADDITIONAL INFORMATION

To enable participants to fully understand the Risk Management and Risk Assessment Process it is recommended that they read copies of:

1. Risk Management Handbook for the Mining Industry MDG1010:1997

2. The combined Australian and New Zealand Standard AS/NZS 4360:1999 (Risk Management)

3. The combined Australian and New Zealand Standard AS/NZS 3931:1998 (Risk Analysis of Technology Systems - Application Guide).

   This last Standard is also in compliance with the
   International Standard IEC 60300-3-9:1995
   (Application Guide - Section 9: Risk Analysis of Technological Systems).

ATTACHMENT F

RISK RANK METHOD

RISK RANK METHOD

For each event, the likelihood (a letter A to E) and Consequence (a number 1 to 5) is selected. If an event effects more than one area of consequence (eg. effects people and operations), the highest rant number is always selected

Likelihood Likelihood examples – to be used as a guide only

Table 2 – Likelihood Guidelines

A	Almost certain	Expected - The unwanted impact/event is predicted to occur frequently; occurrences likely in order of one or more times per year & likely to reoccur within 1 year
B	Likely	Will probably occur - The unwanted impact/event is predicted to occur infrequently; occurrences in order of less than once per year & is likely to reoccur within 5 years
C	Possible	Could occur at some time - The unwanted impact/event is predicted to occur at W2CP at some time (such as in particular flood levels up to 1in100 yrs); or could happen within 10 years
D	Unlikely	Not expected to occur - The unwanted impact/event is predicted to be unlikely at W2CP despite similar effects having occurred in the industry under similar conditions to W2CP; or could happen within 20 years.
E	Rare	Exceptional circumstances only - The unwanted impact/event is demonstrably never likely to occur in the case of W2CP or will be only a very remote possibility

Consequences Consequences examples – to be used as a guide only

People
- 1 - Multiple fatalities
- 2 - Single fatality, permanent total disabilities.
- 3 - Serious bodily injury or health effects – major lost workday case / permanent disability
- 4 - Minor injury or health effects – restricted work or minor lost workday case
- 5 - Slight injury or health effects – first aid/ minor medical treatment level

Environmental
- 1 - Regional Ecosystem damage, Major rehab failure, Mine closure, Lease cancellation
- 2 - Local Ecosystem damage, Legal / statutory breach. Major (unplanned) restoration/rehabilitation required
- 3 - Major cleanup, License breach, Business disruption at site level. Non-company houses made floodprone.
- 4 - Minor cleanup, No legal breach, Minimal impact, Minor non-conformance
- 5 - Environmental nuisance, No clean up, Aesthetic impact only

Assets & Commercial			
1	-	>AUS $15M	> 6 Months
2	-	AUS $1.5M to $15M	< 6 Months
3	-	AUS $150,000 to $1.5M	< 1 Week
4	-	AUS $10,000 to $150,000	No lost production
5	-	< AUS $10,000	No lost production

Reputation
- 1 - International impact - international pubic concern
- 2 - National impact – national public concern
- 3 - Considerable impact – regional public concern
- 4 - Limited impact – some local public concern
- 5 - Slight impact - public awareness may exist but no public concern

Table 3 – Risk Ranking Table

LIKELIHOOD	CONSEQUENCE				
	1	2	3	4	5
A	1	2	6	10	15
B	3	4	9	14	19
C	5	8	13	18	22
D	7	12	17	21	24
E	11	16	20	23	25

The preliminary evaluation assumptions and results shall be documented and defined into the following risk categories.

Table 4 – Guidelines for Risk Control Measures & Barriers

Risk Ranking		Guidelines for Risk Control Barriers
1-5	Extreme	**Needs senior management attention - detailed action plan required** Critical Condition(s) Noted: Specific element of project proposal requires refinement/revision to improve project merits.
6-13	High	**Needs senior management attention – proactively manage & monitor** Significant potential impacts noted requiring additional control and/or project refinement; Needs senior management attention for urgent proactive action to consider the need for any project revision as well as to enhance management & monitoring proposals; Risk of adverse consent conditions if unsatisfactorily resolved.
14-20	Medium	**Specify management responsibility – actively monitor & manage** Medium level residual impacts identified which would benefit from additional attention to project refinement or enhanced control commitments or capability, at least during the ongoing assessment process (such as by PAC), to avoid the risk of unnecessarily stringent consent conditions.
21-25	Low	**Manage by routine procedures & monitor** Low risk level residual impacts considered to be adequately managed by routine design, construction and operational arrangements, including monitoring.

Consequences Consequences examples – Further details for environmental consequences….

Environmental

1 - Extreme: Major and irreversible regional ecosystem damage or environmental impact resulting in mine closure and lease cancellation

2 - Highly Significant: Minor regional or significant and irreversible local ecosystem damage or environmental impact with no offset or compensation possible; Major (unplanned) restoration/rehabilitation required; Major non-compliance leading to Tier 2 prosecution;

3 - Significant: Unplanned ecosystem damage or environmental impact; Non-company houses made flood-prone (1:100yr flood overfloor); Remediation/rehabilitation required; Land use significantly impaired for an extended period and limited mitigation capability.

4 - Minor, Non-Significant: Minor impact, localised and remediable; impact, Minor non-conformance such as failure to collect routine monitoring sample; Persistent, ongoing environmental nuisance; Some minor impact on land use but which can be mitigated or compensated.

5 - Minimal Impact: Environmental nuisance, localised and temporary, aesthetic impact only

Housing impact classification based on extent of repairs required.

Repair Category	Extent of Repairs
Nil	No repairs required
R0 **Adjustment**	One or more of the following, where the damage does not require the removal or replacement of any external or internal claddings or linings:- - **Door** or **window** jams or swings, or - Movement of **cornices**, or - Movement at external or internal **expansion joints**.
R1 **Very Minor Repair**	One or more of the following, where the damage can be repaired by filling, patching or painting without the removal or replacement of any external or internal brickwork, claddings or linings:- - Cracks in **brick mortar** only, or isolated cracked, broken, or loose **bricks** in the external façade, or - Cracks or movement < 5 mm in width in any external or internal wall **claddings**, **linings**, or **finish**, or - Isolated cracked, loose, or drummy floor or wall **tiles**, or - Minor repairs to any **services** or **gutters**.
R2 **Minor Repair**	One or more of the following, where the damage affects a small proportion of external or internal claddings or linings, but does not affect the integrity of external brickwork or structural elements:- - Continuous cracking in **bricks** < 5 mm in width in one or more locations in the total external façade, or - Slippage along the **damp proof course** of 2 to 5 mm anywhere in the total external façade, or - Cracks or movement ≥ 5 mm in width in any external or internal wall **claddings**, **linings**, **finish**, or - Several cracked, loose or drummy floor or wall **tiles**, or - Replacement of any **services**.
R3 **Substantial Repair**	One or more of the following, where the damage requires the removal or replacement of a large proportion of external brickwork, or affects the stability of isolated structural elements:- - Continuous cracking in **bricks** of 5 to 15 mm in width in one or more locations in the total external façade, or - Slippage along the **damp proof course** of 5 to 15 mm anywhere in the total external façade, or - Loss of bearing to isolated walls, piers, columns, or other load-bearing elements, or - Loss of stability of isolated structural elements.
R4 **Extensive Repair**	One or more of the following, where the damage requires the removal or replacement of a large proportion of external brickwork, or the replacement or repair of several structural elements:- - Continuous cracking in **bricks** > 15 mm in width in one or more locations in the total external façade, or - Slippage along the damp proof course of 15 mm or greater anywhere in the total external façade, or - Relevelling of building, or - Loss of stability of several structural elements.
R5 **Re-build**	Extensive damage to house where the MSB and the owner have agreed to rebuild as the cost of repair is greater than the cost of replacement.