BULLI SEAM OPERATIONS

APPENDIX N
ENVIRONMENTAL RISK ASSESSMENT

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Illawarra Coal Holdings Pty Ltd
Bulli Seam Operations

Environmental Risk Assessment

***Prepared for*:**	**Illawarra Coal Holdings Pty Ltd**		
Prepared by:	***SP Solutions Director***		
Date of Team Review:	**24 April 2009**		
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EXECUTIVE SUMMARY

This Environmental Risk Assessment (ERA) identifies risks associated with key potential environmental issues associated with the Bulli Seam Operations (the Project). The Project is located approximately 25 kilometres north-west of Wollongong in New South Wales (NSW), and involves the continuation of underground mining operations at the Appin Mine and West Cliff Colliery.

On 18 March 2009, a team consisting of Illawarra Coal Holdings Pty Ltd (ICHPL) personnel and specialist consultants participated in a facilitated ERA workshop. The scope of the workshop was:

> *To identify key potential environmental issues for further assessment in the Environmental Assessment.*

The ERA workshop included:

1. Establishing the context including review of supporting information and objectives.
2. Identifying risks via a brainstorming session.
3. Identifying risks using a modified hazard and operability (HAZOP) analysis approach.
4. Analysis of identified risks and nomination of key potential environmental issues.
5. Ranking of the risks, including consideration of mitigation measures.

Key Potential Environmental Issues

Key potential environmental issues were identified by the ERA team using a voting system, whereby team members voted on what they considered to be the key issues. The key potential environmental issues identified by the ERA (Table ES-1) were considered significant issues for further assessment in the Environmental Assessment (EA).

The key potential environmental issues identified in the ERA are addressed in appropriately detailed assessments in the Main Report of the EA and the specialist's reports (where relevant) included as appendices to the EA, as follows:

- Subsidence Assessment (Appendix A);
- Groundwater Assessment (Appendix B);
- Surface Water Assessment (Appendix C);
- Aquatic Ecology Assessment (Appendix D);
- Terrestrial Flora Assessment (Appendix E);
- Terrestrial Fauna Assessment (Appendix F);
- Aboriginal Cultural Heritage Assessment (Appendix G);
- Non-Aboriginal Heritage Assessment (Appendix H);
- Noise Impact Assessment (Appendix I);
- Air Quality Impact Assessment (Appendix J);
- Road Transport Assessment (Appendix K);
- Socio-Economic Assessment (Appendix L);
- Preliminary Hazard Analysis (Appendix M);

- Upland Swamp Risk Assessment (Appendix O);
- Stream Risk Assessment (Appendix P);
- Aboriginal Heritage Site Risk Assessment (Appendix Q); and
- Major Cliff Line Risk Assessment (Appendix R).

The corresponding Appendix and/or section of the EA where the key potential environmental issues are addressed is provided in Table ES-1.

Table ES-1 – Key Potential Environmental Issues to be Further Assessed in the EA

Ref	Source	Description of Issue	EA Appendix/Section
BS014	Brainstorming	Water loss from a stream	Appendices B and C and Section 5
BS039	Brainstorming	Subsidence impacts on houses (community)	Appendix A and Section 5
BS019	Brainstorming	Subsidence impacts on road and/or rail infrastructure	Appendix A and Section 5
BS055	Brainstorming	Loss of flora and fauna habitat (coal wash emplacement)	Appendices D, E and F and Section 5
BS084	Brainstorming	Pool reduction impacts to aquatic ecology (including threatened species)	Appendices C and D and Section 5
BS002	Brainstorming	Changes to surface water and groundwater interactions	Appendices B and C and Section 5
BS037	Brainstorming	Cliff instability - impacts on community infrastructure	Appendices A and R and Section 5
BS045	Brainstorming	Potential loss of terrestrial fauna habitats (cliff deterioration etc.)	Appendix F and Section 5
BS052	Brainstorming	Swamp deterioration (vegetation composition and health, hydrology, fire susceptibility and erosion)	Appendices A, B, C, E and O and Section 5
BS072	Brainstorming	Transport/traffic volume increases	Appendix K and Section 5
BS017	Brainstorming	Impacts on third order streams and above or other significant stream features	Appendices C and P and Section 5
BS022	Brainstorming	Surface cracking	Appendix A and Section 5
BS023	Brainstorming	Rock falls and cliff instabilities	Appendices A and R and Section 5
BS024	Brainstorming	Subsidence impacts on surface infrastructure	Appendix A and Section 5
BS074	Brainstorming	Subsidence impacts on non-Aboriginal heritage items	Appendices A and H and Section 5

Risk Ranking

In addition to the identification of key potential environmental issues for further assessment in the EA, risk ranking was undertaken by the ERA team on potential loss scenarios primarily based on the identified key potential environmental issues. A summary of the risk ranking results is presented in Table ES-2.

With the consideration of potential controls, all of the potential loss scenarios were ranked within the 'Medium - As Low As Reasonably Practicable' (ALARP) or the 'Low' range by the ERA team.

Table ES-2 – Risk Ranking

Incident	Potential Loss Scenario	Risk Ranking[1]
Airborne contaminants leaving site.	Contaminant levels at receptors within guidelines and no complaints.	M – 15
	Levels exceed acceptable level. Concerns acknowledged and addressed.	M – 15
	All controls fail - leading to significant dust levels which cannot be easily fixed - and with prosecutions and legal actions (property acquisition and compensation).	L – 18/21
Subsidence movements on the surface impacting houses and other buildings.	Damage to houses and other buildings in line with predictions.	M – 15
	More extensive damage to houses and other buildings - accepted by determining authority.	L – 18
	All controls fail and an unacceptable level of damage to houses and other buildings occurs.	L – 16
Subsidence movements on the surface cracking stream beds.	Diversion of water into subterranean flows in line with predictions.	M – 10/15
	More extensive damage to flora and fauna accepted by determining authority.	L – 18
	Unacceptable and ongoing level of damage to stream bed - outside ability to rehabilitate.	L – 21
Subsidence movements on the surface – impacts to infrastructure.	Impact to infrastructure (e.g. gas pipeline) in line with predictions.	M – 15
	More extensive damage to infrastructure - accepted by determining authority.	L – 17
	Unacceptable level of damage to infrastructure.	L – 20
Audible noise at sensitive receivers.	Audible noise within criteria and no complaints.	M – 15
	Audible noise generating complaints/non compliant results.	L – 19
	Remediation costs to alleviate noise.	L – 22
	Noise which cannot be fixed - property acquisition.	L – 18
Subsidence movements on the surface impacting aquatic ecology.	Diversion of water into subterranean flows in line with predictions - with short-term loss of habitat.	M – 15
	Longer term draining of surface pools and loss of individuals (with repopulation once water levels recover).	L – 18
	Long-term wider scale draining of surface pools and permanent loss of individuals.	L – 21
Clearing of vegetation and fauna (Stage 4 Emplacement).	Approved clearance of flora and fauna and localised loss of individuals of an individual species.	M – 15
	Damage to greater than expected species/individuals.	L – 21
	Unsuccessful rehabilitation and ongoing off-site environmental degradation.	L – 20/23
Subsidence movements on the surface cracking base of headwater “upland” swamps.	Very minor aesthetic impacts of cracks in swamps that recharge in next rain event.	L – 19
	Depressed groundwater levels in swamps for a limited period of time – some stressing of wet footed plant species and departure of individuals (e.g. ground-dwelling parrots).	L – 18
	Indefinite groundwater depression and ecosystem changes to a drier vegetation community.	L – 21
Subsidence movements on the surface cracking base of valley infill swamps.	Very minor aesthetic impacts of cracks in swamps that recharge in next rain event.	L – 19
	Depressed groundwater levels in swamps for a limited period of time – some stressing of wet footed plant species and departure of ground-dwelling parrots.	L – 18
	Indefinite groundwater depression and ecosystem changes to a drier vegetation community and sediment removal.	L – 21

Table ES-2 – Risk Ranking (Continued)

Incident	Potential Loss Scenario	Risk Ranking[1]
Subsidence movements on the surface causing water loss from Reservoirs or weir pools.	Diversion of water into subterranean flows in line with predictions - no measurable water loss.	M – 15
	Measurable loss of water from reservoirs/weirs accepted by determining authority.	L – 18
	Unacceptable and ongoing loss of water from reservoirs/weirs - outside ability to rehabilitate.	L – 16
Subsidence movements on the surface causing cliff falls.	Damage to cliffs in line with predictions.	M – 15
	More extensive damage to cliffs causing impacts on community infrastructure (e.g. Aboriginal heritage and/or flora/fauna habitat) - accepted by determining authority.	L – 18
	All controls fail and unacceptable level of damage to surface features.	L – 21
Increase in volume of coal haulage transport and mine traffic on roads.	Increase in traffic on roads within predictions and no mine related traffic incidents/accidents.	M – 15
	Traffic levels and incidents (non-fatality crashes) exceed acceptable level. Concerns acknowledged and addressed.	M – 14
	All controls fail - leading to significant traffic levels and accidents (fatalities) on haulage routes and local roads - prosecutions and legal actions.	L – 17

[1] Risk - Ranking basis 1 (highest risk) to 25 (lowest risk). Risk rankings defined as 1 to 6 – High; 7 to 15 - Medium (or ALARP) and 16 to 25 - Low.

1 INTRODUCTION

This Environmental Risk Assessment (ERA) identifies risks associated with key potential environmental issues associated with the Bulli Seam Operations Project (the Project). The Project is located approximately 25 kilometres north-west of Wollongong in New South Wales (NSW), and involves the continuation of underground mining operations at the Appin Mine and West Cliff Colliery. A full description of the Project is provided in Section 2 of the Main Report of the EA.

1.1 *Aim and Objectives*

The aim of the ERA workshop was:

> *To identify key potential environmental issues for further assessment in the Environmental Assessment.*

The primary objectives of this ERA were to:

(1) identify the key potential environmental issues associated with the Project; and

(2) assess the level of risk for a selection of potential loss scenarios primarily based on the key potential environmental issues.

The ERA team identified the following items as desired outcomes from the process:

(1) identification of key potential environmental issues to be addressed in the EA; and

(2) a document suitable for inclusion in the EA and aligned to Australian Standard/New Zealand Standard (AS/NZS) 4360 *Risk Management* (Standards Australia, 2004).

1.2 *Client*

The client for the ERA is Illawarra Coal Holdings Pty Ltd (ICHPL).

1.3 *Scope*

The scope of the ERA was developed in accordance with the Director-General's Environmental Assessment Requirements (EARs) for the Project, which states the following:

> *The Environmental Assessment of the project must include:*
> *….*
> - *a risk assessment of the potential environmental impacts of the project, identifying the key issues for further assessment.*

1.4 *Clarifying Points*

The team discussion of the scope raised the following clarifying points:

- Internal safety issues for the mining operation were not intended to be covered.
- Business issues were not a primary focus for the team.

- The geographical extent of the Project area was understood to include the Project Application Area incorporating the extent of longwall mining areas (i.e. West Cliff Area 5, Appin Area 7, Appin West [Area 9], Appin Area 8, Appin Areas 2 and 3 Extended and North Cliff), the Appin East, Appin West and West Cliff pit tops (including all ventilation shafts) and existing underground workings associated with the Appin Mine and West Cliff Colliery (Figure 1).

Further to the above, the following clarifying points are made:

- Detailed engineering-focussed risk assessments for major infrastructure will be addressed through specific risk forums as required. This ERA scope does not cover engineering risks associated with subsidence of infrastructure.
- Separate to the EA and Part 3A approval process, ICHPL will prepare an application for NSW Dams Safety Committee approval in accordance with the *Risk Management Policy Framework for Dam Safety* (Dams Safety Committee, 2006) prior to any mining within Notification Areas for Prescribed Dams (e.g. Cataract Dam and Broughtons Pass Weir).

1.5 *Risk Assessment Process*

The risk assessment process was based on the framework provided on Figure 2 (based on AS/NZS 4360:2004, *Risk Management Handbook for the Mining Industry MDG1010* [NSW Department of Primary Industries (DPI), 1997] and Handbook (HB) 203: 2006 *Environmental Risk Management – Principles and Process*).

A list of definitions is provided in Attachment 1.

1.6 *Resourcing, Schedule and Accountabilities*

The following resources were allocated in order to effectively conduct the ERA:

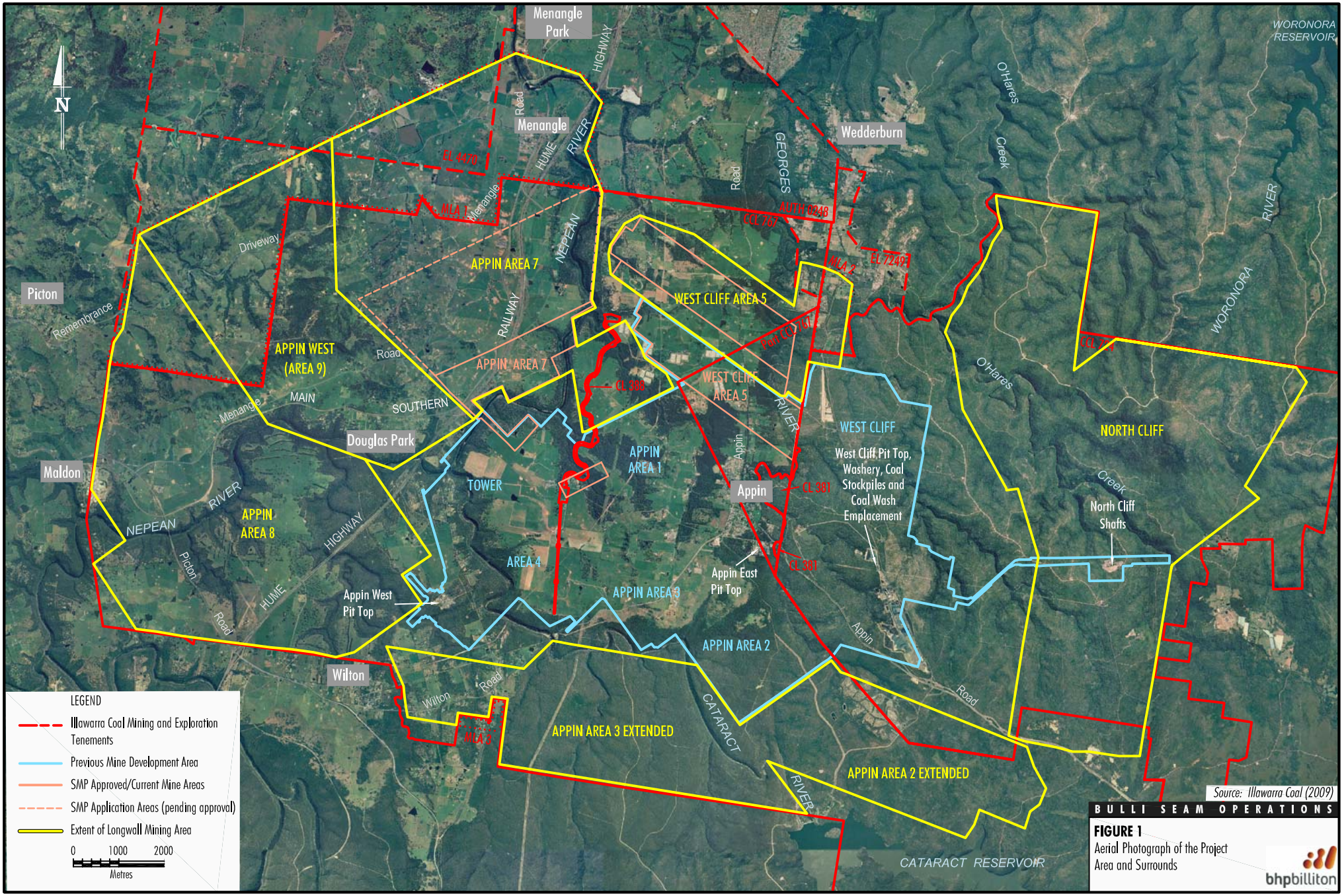
1. team of personnel with suitable experience and knowledge of coal mining operations, subsidence effects and environmental issues in the area associated with the Project;
2. external facilitator for the risk assessment and write-up of results;
3. conference room with equipment for conduct of the ERA team workshop; and
4. aerial photographs, drawings, the EARs for the Project and other supporting information.

The outcomes of the ERA and associated accountabilities should be integrated into the overall ICHPL management systems so that they are effectively reviewed, implemented and monitored to ensure the outcomes are sought.

1.7 *Method*

1.7.1 Framework

Figure 2 outlines the overall framework utilised for the ERA. This framework is further discussed in Section 1.7.2 with respect to the key steps involved in the ERA.



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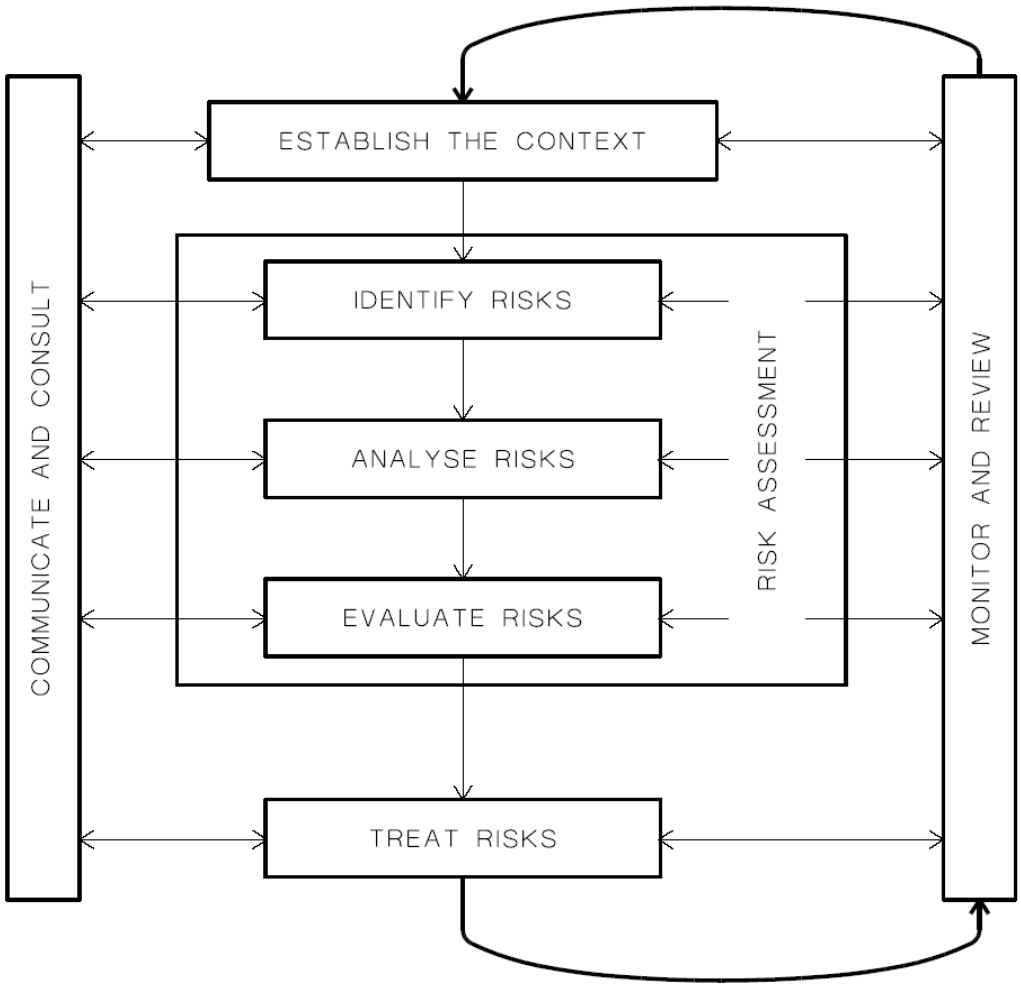

Figure 2 – Risk Management Process (AS/NZS 4360:2004)

1.7.2 Key Steps

The key steps in the risk assessment process were confirmed with ICHPL prior to the ERA team workshop and included:

1. confirm the scope of the ERA;
2. list the key assumptions on which the ERA is based;
3. review available data on the Project including reports, plans and procedures (prior to the workshop);
4. conduct team-based risk review that:
   a) detailed descriptions of the tasks to be undertaken and the proposed method;
   b) identified hazards and assessed the level of risk; and
   c) developed a list of recommended controls to treat the risk (through prevention, monitoring, first response and recovery strategies);
5. prepare a draft report in accordance with AS/NZS 4360:2004 and MDG1010 *Risk Management Handbook for the Mining Industry* (DPI, 1997) standards for review by ICHPL personnel and ERA team members;
6. incorporate comments from ICHPL and the ERA team; and
7. finalise the report and issue as controlled copy for ongoing use.

With respect to the overall framework (Figure 2), steps 1 to 3 above represent the 'establish the context' phase and step 4 represents the 'identify risks', 'analyse risks', 'evaluate risks' and 'treat risks' phases.

As described in Section 1.6, the outcomes of the ERA and associated accountabilities should be integrated into the overall ICHPL management systems so that they are effectively reviewed, implemented and monitored to ensure the outcomes are sought.

1.7.3 External Facilitation

The team was facilitated through the process by ***SP Solutions*** – a company specialising in Risk Assessment and risk management programmes. The facilitator, Peter Standish, is experienced with underground mining and familiar with subsidence related issues and aspects of environmental monitoring and remediation.

The team was encouraged and "challenged" to identify a wide range of environmental impacts or hazards including consideration of far-field impacts (i.e. those impacts affecting the off-site environment). Other key issues taken into consideration were human and organisational error.

It is important to understand that the outcomes of this ERA:

1. are process driven;
2. challenge current thinking and may not necessarily appear appropriate or reflect "pre-conceived" ideas; and
3. are the result of the team assembled to review the topic and not the result of any one individual or organisation.

2 ESTABLISH THE CONTEXT

2.1 *Organisational Context*

The proponent is ICHPL (a wholly owned subsidiary of BHP Billiton Pty Ltd), owner of the Appin Mine and West Cliff Colliery.

The Project involves the continuation of longwall coal mining operations at the Appin Mine and West Cliff Colliery.

2.2 *Project Summary*

The main activities associated with development of the Project would include:

- continued development of underground mining operations within existing coal leases and new mining leases to facilitate a total run-of-mine (ROM) coal production rate of up to 10.5 million tonnes per annum (Mtpa);
- ongoing exploration activities within existing exploration tenements;
- upgrade of the existing West Cliff Washery to support the increased ROM coal production;
- continued mine gas drainage and capture for beneficial utilisation at the West Cliff Ventilation Air Methane Project and Appin-Tower Power Project;
- continued generation of electricity by the existing Appin-Tower Power Project (owned and operated by Energy Development Limited) utilising coal bed methane drained from the Bulli Seam;
- upgrade of existing surface facilities and supporting infrastructure (e.g. service boreholes, ventilation shafts, gas drainage equipment, waste water treatment and waste water disposal);
- continued and expanded placement of coal wash at the West Cliff Coal Wash Emplacement;
- continued road transport of ROM coal from the Appin East pit top to the West Cliff Washery;
- continued road transport of ROM coal from Appin East pit top and West Cliff pit top via the public road network to the Dendrobium Washery at Port Kembla;
- continued road transport of product coal from the West Cliff Washery via the public road network to BlueScope Steelworks, Port Kembla Coal Terminal, Corrimal and Coalcliff Coke Works and other customers;
- ongoing surface monitoring and rehabilitation (including rehabilitation of mine related infrastructure areas that are no longer required) and remediation of subsidence effects; and
- other associated minor infrastructure, plant, equipment and activities.

2.3 *Risk Management Context*

This ERA has been conducted in accordance with the EARs for the Project (Section 1.3).

In addition, the ERA was cognisant of the following documents:

- AS/NZS 4360:2004 *Risk Management* (Standards Australia, 2004);
- HB 203:2006 *Environmental Risk Management – Principles and Process* (Standards Australia, 2006);
- *Risk Management Handbook for the Mining Industry* (DPI, 1997); and
- *Risk Management Policy Framework for Dam Safety* (Dams Safety Committee, 2006)[1].

A Preliminary Assessment Workshop was conducted at ICHPL's office in Port Kembla on 5 November 2007 (ICHPL, 2007). The workshop assessed the potential impacts relevant to a mining operation at 10.5 Mtpa including mining areas, coal wash emplacement and upgrades to the West Cliff Washery. The key potential environmental impacts identified in the workshop relating to the Project were also considered in this ERA.

2.4 *Risk Criteria*

The risk criteria utilised is to reduce the risk to As Low As Reasonably Practicable (ALARP) or lower. Figure 3 schematically shows the three risk management zones *viz*. intolerable, ALARP and tolerable. The middle zone is referred to as the ALARP zone.

Flying is an example of a risk considered by most people to be a tolerable risk; whilst smoking is generally considered to be an activity which cannot be justified on any grounds from a risk perspective. This can be considered quantitatively where smoking equates to a risk of 1 in 5,000 – 1 in 5,000 smokers who consume over 20 cigarettes a day will die each year from a smoking related illness whereas flying in a commercial aircraft is a risk of 1 in 100,000 – some 20 times safer. This is shown graphically in Figure 3. Intolerable items such as smoking are at the top of the pyramid where much lower risks such as flying sit at the lower end of the ALARP zone (close to tolerable).

The risk ranking matrices used during the ERA workshop are presented in Section 4.1 of this ERA.

[1] Separate to the EA and Part 3A approval process, the Risk Management Policy Framework for Dam Safety (Dams Safety Committee, 2006) would be used during the preparation of the application for Dams Safety Committee approval prior to any mining within Notification Areas for Prescribed Dams (e.g. Cataract Dam and Broughtons Pass Weir).

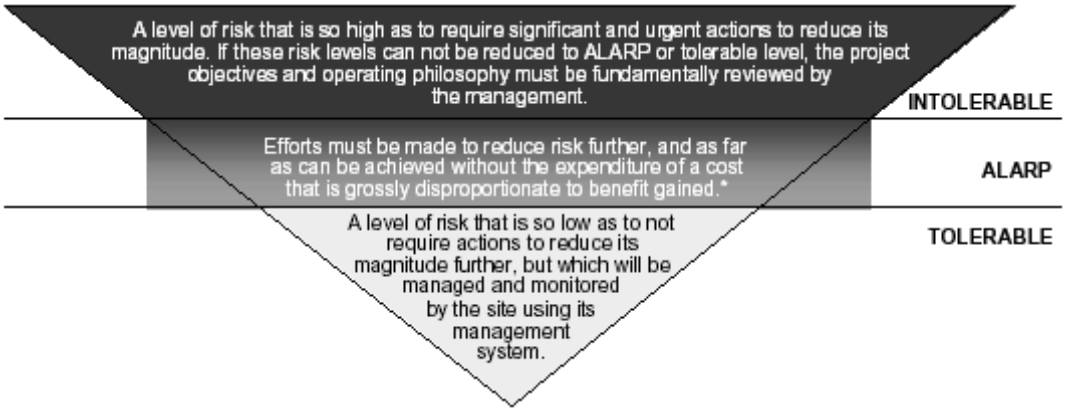

Figure 3 – Risk Criteria "ALARP"

3 IDENTIFY RISKS

3.1 *Overview*

The identification of risks involved the use of risk assessment "tools" appropriate for identifying potential losses associated with the Project. The tools used were:

- Introduction – Before the potential issues were brainstormed it was important that the whole team had a good understanding of the Project – and this was confirmed by the facilitator.
- Brainstorming – This was used to draw out the main issues using the understanding, relevant experience and knowledge of the team. This session also used prompt words to build on the experience base of the team and identify any potential environmental issues and potential loss scenarios.
- Modified Hazard and Operability (HAZOP) analysis – this involved the review of key words (drawn from the EARs for the Project and retrospective analysis of environmental/community related incidents) and aerial photographs, and the consequent identification of potential environmental issues at each location during each phase of operation.

3.2 *The Team*

The team met for the ERA workshop in Wollongong on 18 March 2009. A team based approach was utilised in order to have an appropriate mix of skills and experience to identify the potential environmental issues and potential loss scenarios. Details of the team members and their relevant qualifications and experience are included in Table 1.

Table 1 – Review Team

Name	Company and Position	Relevant Qualifications and Experience
Arthur Waddington	Director – Mine Subsidence Engineering Consultants Pty Ltd (MSEC)	BEng, CPEng MICE, MIEAust, RPEQ: 45 years experience as a civil and structural engineer; 30 years experience in mine subsidence.
Peter De Bono	MSEC Associate	BEng (Civil): over 20 years experience as a civil engineer: 3 years experience in mine subsidence.
Michael Pearson	Director – Heritage Management Consultants	PhD (archaeology): 30 years experience in heritage assessment.
Arthur White	Director - Biosphere Environmental Consultants	BSc (Hons) PhD (Bioscience): 30 years experience in fauna survey and assessment.
Dan Roberts	Director – Bio-analysis	BSc and PhD (Aquatic Ecology): over 25 years experience in aquatic ecosystem assessment.
Colin Bower	Consultant Botanist, Principal - FloraSearch	BSc (Hons) PhD: 16 years experience in flora survey and vegetation analysis.
Judith Cox	Senior Air Quality Engineer - PAE Holmes	BEng (Hons): 10 years experience in air quality modelling and assessment.
Rob Bullen	Director - Wilkinson Murray	PhD (Acoustics): 30 years experience in environmental noise assessment.

Table 1 – Review Team (Continued)

Name	Company and Position	Relevant Qualifications and Experience
Tony Marszalek	Principal Engineer - Gilbert & Associates	BEng (Civil) (Hons), Master of EngSc: 23 years in water resource consultancy.
Gary Brassington	Bulli Seam Operations Approvals Manager – ICHPL	B AppSc (Natural Systems Management): 18 years experience in environmental management in the mining industry.
Hank Pinkster*	Manager Rehabilitation and Infrastructure – ICHPL	MBA Wollongong University, 1st, 2nd & 3rd Class Certificates of Competency: 31 years mining industry experience.
Bruce Blunden	Manager Environmental Approvals– ICHPL	B Nat Res (Hons), M Eng (Agric), PhD (Env Eng): 20 years experience in environmental and natural resource management, research and regulation.
Aaron Hagenbach	Senior Environmental Manager - Resource Strategies	BEng (Chemical): 11 years experience in environmental management and project approvals and environmental management in relation to the mining industry.
Clive Berry	Project Manager - Resource Strategies	BEng (Env): 9 years experience in project approvals and environmental management in relation to the mining industry.
Josh Peters	Project Manager – Resource Strategies	B Env Sc: 9 years experience in environmental management and project approvals in the resources industry.
Jacob Dellit	Project Manager - Resource Strategies	BEng (Env): 3 years experience in environmental management and project approvals and environmental management in relation to the mining industry.
Peter Standish	SP Solutions - Facilitator	PhD, BEng (Hon), Dip Bus Mgt, Risk Analysis Trained, Certificate of Competence as a manager: 27 years experience in underground and open cut mining operations with operating, managerial and contract management experience; involved in reviewing environmental conditions and applications for 5 years; conducting risk analyses for 12 years.
Aaron Smith	SP Solutions - Senior Consultant - Co-Facilitator	B Env Sc (Water Management), Cert IV OH&S, Cert IV Trainer and Assessor, Mines Rescue, OHS and Environmental Lead Auditor (RABQSA): 9 years experience in open cut and underground mining operations and civil construction projects; with SP Solutions for 5 years.

***** Attended for the 'establish the context' phase and initial brainstorming only.

3.3 *RISK IDENTIFICATION*

3.3.1 Brainstorming

The brainstorming process is intended to allow for a relatively unstructured, free flowing series of issues and ideas to be generated. It is enhanced through the use of key word association processes based on work by Edward de Bono and is intended to generate a wide range of data on losses, controls and general issues related to the Project area.

No "filtering" of the data is allowed during the process – and the reader should be conscious of the intent of not missing a potential "left field" loss when reading through the material.

Issues identified during the brainstorming session are presented in Table 2-1 in Attachment 2.

3.3.2 Modified HAZOP

The next "tool" applied with the team was that of a modified HAZOP. In this process the aerial photograph (e.g. Figure 1) was referred to along with a consideration of the phases of operation and the potential impacts that could arise.

This process was filtered and no additional items were added that were not already adequately identified through the brainstorming process.

The generic key words used in the process (generally based on the headings in the EARs for the Project) were:

- Subsidence;
- Groundwater;
- Surface Water;
- Geochemistry;
- Terrestrial Fauna;
- Terrestrial Flora;
- Aquatic Ecology;
- Road Transport;
- Noise;
- Air Quality;
- Visual;
- Socio-Economic;
- Aboriginal Cultural Heritage; and
- Non-Aboriginal Heritage.

Each of these key words were considered for specific phases of the operation – construction, operation and decommissioning and the aerial photograph was "broken down" into key operating areas:

- Project Application Area including:
  - extent of longwall mining area; and
  - pit tops and ventilation shafts.
- Regional Area (e.g. transport routes).

While vigorous discussion was held no significant additional issues were raised.

3.3.3 Additional Risks Identified

The specialist in each field of study was also given the opportunity to raise any additional risks they saw as appropriate that had not been previously raised in the brainstorming or modified HAZOP processes. This led to the generation of the additional risks presented in Table A2-2 of Attachment 2 – Additional Issues Raised by Specialists during the Workshop.

3.3.4 Identification of Key Potential Environmental Issues

The key potential environmental issues were identified through a 'voting' system whereby team members voted on what they considered to be the key issues. The identified key environmental issues are listed in Table 2. Key potential environmental issues are those issues with five or more assigned 'votes', with the key potential environmental issues listed in order of number of votes received.

Table 2 – Key Potential Environmental Issues

Ref	Source	Description of Issue/Loss scenario
BS014	Brainstorming	Water loss from a stream
BS039	Brainstorming	Subsidence impacts on houses (community)
BS019	Brainstorming	Subsidence impacts on road and/or rail infrastructure
BS055	Brainstorming	Loss of flora and fauna habitat (coal wash emplacement)
BS084	Brainstorming	Pool reduction impacts to aquatic ecology (including threatened species)
BS002	Brainstorming	Changes to surface water and groundwater interactions
BS037	Brainstorming	Cliff instability - impacts on community infrastructure
BS045	Brainstorming	Potential loss of terrestrial fauna habitats (cliff deterioration etc.)
BS052	Brainstorming	Swamp deterioration (vegetation composition and health, hydrology, fire susceptibility and erosion)
BS072	Brainstorming	Transport/traffic volume increases
BS017	Brainstorming	Impacts on third order streams and above or other significant stream features
BS022	Brainstorming	Surface cracking
BS023	Brainstorming	Rock falls and cliff instabilities
BS024	Brainstorming	Subsidence impacts on surface infrastructure
BS074	Brainstorming	Subsidence impacts on non-Aboriginal heritage items

The key potential environmental issues identified in the ERA will be addressed in appropriately detailed assessments in the Main Report of the EA and the following specialists reports (where relevant), included as appendices to the EA, as follows:

- Subsidence Assessment (Appendix A);
- Groundwater Assessment (Appendix B);
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- Upland Swamp Risk Assessment (Appendix O);
- Stream Risk Assessment (Appendix P);
- Aboriginal Heritage Site Risk Assessment (Appendix Q); and
- Major Cliff Line Risk Assessment (Appendix R).

3.3.5 Referred Issues

Where issues raised during the ERA workshop brainstorming were: outside the scope of the ERA; outside of the Project scope; and/or beyond the control of ICHPL, and therefore not considered to be key potential environmental issues, these “referred issues” were considered to warrant consideration in the development of the EA and were directed to the overall ICHPL management systems. The referred issues are listed in Attachment 3.

3.3.6 Risk and Control Charting

To aid in the risk ranking process for potential loss scenarios, Risk and Control Charts were developed by the ERA team. These show the basic cause(s), preventative control(s), incident, reactive control(s) and ultimate outcomes from the incident, and are presented in Attachment 4.

4 ANALYSE RISKS

4.1 *Probability and Maximum Reasonable Consequence*

Potential loss scenarios (primarily based on the identified key potential environmental issues) were ranked for risk by the ERA team. A tabular analysis was used for this risk ranking process, based on the probability and consequence of a loss scenario occurring as decided by the ERA team.

The following definition of risk was used:

- the combination of the probability of an unwanted event occurring; and
- the maximum reasonable consequences should the event occur.

Tables 3, 4, 5 and 6 present the ERA matrix tools that were utilised for ranking risks.

Table 3 – Qualitative Measures of Probability

Rank (P)	Probability	Descriptor
A	Almost Certain	Happens often
B	Likely	Could easily happen
C	Possible	Could happen and has occurred elsewhere
D	Unlikely	Hasn't happened yet but could
E	Rare	Conceivable, but only in extreme circumstances

Table 4 – Qualitative Measures of Maximum Reasonable Consequence[2]

Ref (C)	Consequence	Comment
1	Extreme environmental harm	e.g. widespread catastrophic impact on environmental values of an area.
2	Major environmental harm	e.g. widespread substantial impact on environmental values of an area.
3	Serious environmental harm	e.g. widespread and considerable impact on environmental values of an area.
4	Material environmental harm	e.g. localised and considerable impact on environmental values of an area.
5	Minimal environmental harm	e.g. minor impact on environmental values of an area.

[2] **Notes: Maximum Reasonable Consequence:** – The worst-case consequence that could reasonably be expected, given the scenario and based upon experience at the operation and within the mining industry.

The terms localised and widespread were defined for the team session as:

- localised – any effect or impact wholly contained within the Project; and
- widespread – any effect or impact extending beyond the Project.

Table 5 – Quantitative Measures of Maximum Reasonable Consequence

	Asset/Infrastructure
1	More than $1billion (B) loss or production delay
2	$100M to $1B loss or production delay
3	$5 million (M) to $100M loss or production delay
4	$250 thousand (k) to $5M loss or production delay
5	Less than $250k loss or production delay

Table 6 – Risk Ranking Table

Consequence (C)	Probability (P)					
		A	B	C	D	E
	1	1 (H)	2 (H)	4 (H)	7 (M)	11 (M)
	2	3 (H)	5 (H)	8 (M)	12 (M)	16 (L)
	3	6 (H)	9 (M)	13 (M)	17 (L)	20 (L)
	4	10 (M)	14 (M)	18 (L)	21 (L)	23 (L)
	5	15 (M)	19 (L)	22 (L)	24 (L)	25 (L)

Notes:

L = Low; M = Moderate, H = High

Risk Numbering:
1 = highest risk, 25 = lowest risk

Legend:

Risk Levels:

	Tolerable
	ALARP – As low as reasonably practicable
	Intolerable

4.2 *Risk and Control Chart Models*

Risk ranking was undertaken by the ERA team on potential loss scenarios primarily based on the key potential environmental issues identified and is presented in Table 7.

Table 7 – Risk Ranking

Incident	Potential Loss Scenario	Risk Ranking[1]
Airborne contaminants leaving site.	Contaminant levels at receptors within guidelines and no complaints.	M – 15
	Levels exceed acceptable level. Concerns acknowledged and addressed.	M – 15
	All controls fail - leading to significant dust levels which cannot be easily fixed - and with prosecutions and legal actions (property acquisition and compensation).	L – 18/21
Subsidence movements on the surface impacting houses and other buildings.	Damage to houses and other buildings in line with predictions.	M – 15
	More extensive damage to houses and other buildings - accepted by determining authority.	L – 18
	All controls fail and an unacceptable level of damage to houses and buildings occurs.	L – 16
Subsidence movements on the surface cracking stream beds.	Diversion of water into subterranean flows in line with predictions.	M – 10/15
	More extensive damage to flora and fauna accepted by determining authority.	L – 18
	Unacceptable and ongoing level of damage to stream bed - outside ability to rehabilitate.	L – 21
Subsidence movements on the surface – impacts to infrastructure.	Impact to infrastructure (e.g. gas pipeline) in line with predictions.	M – 15
	More extensive damage to infrastructure - accepted by determining authority.	L – 17
	Unacceptable level of damage to infrastructure.	L – 20
Audible noise at sensitive receivers.	Audible noise within criteria and no complaints.	M – 15
	Audible noise generating complaints/non compliant results.	L – 19
	Remediation costs to alleviate noise.	L – 22
	Noise which cannot be fixed - property acquisition.	L – 18
Subsidence movements on the surface impacting aquatic ecology.	Diversion of water into subterranean flows in line with predictions - with short-term loss of habitat.	M – 15
	Longer term draining of surface pools and loss of individuals (with repopulation once water levels recover).	L – 18
	Long-term wider scale draining of surface pools and permanent loss of individuals.	L – 21
Clearing of vegetation and fauna (Stage 4 Emplacement).	Approved clearance of flora and fauna and localised loss of individuals of an individual species.	M – 15
	Damage to greater than expected species/individuals.	L – 21
	Unsuccessful rehabilitation and ongoing off-site environmental degradation.	L – 20/23
Subsidence movements on the surface cracking base of headwater “upland” swamps.	Very minor aesthetic impacts of cracks in swamps that recharge in next rain event.	L – 19
	Depressed groundwater levels in swamps for a limited period of time – some stressing of wet footed plant species and departure of individuals (e.g. ground-dwelling parrots).	L – 18
	Indefinite groundwater depression and ecosystem changes to a drier vegetation community.	L – 21

Table 7 – Risk Ranking (Continued)

Incident	Potential Loss Scenario	Risk Ranking[1]
Subsidence movements on the surface cracking base of valley infill swamps.	Very minor aesthetic impacts of cracks in swamps that recharge in next rain event.	L – 19
	Depressed groundwater levels in swamps for a limited period of time – some stressing of wet footed plant species and departure of ground-dwelling parrots.	L – 18
	Indefinite groundwater depression and ecosystem changes to a drier vegetation community and sediment removal.	L – 21
Subsidence movements on the surface causing water loss from Reservoirs or weir pools.	Diversion of water into subterranean flows in line with predictions - no measurable water loss.	M – 15
	Measurable loss of water from reservoirs/weirs accepted by determining authority.	L – 18
	Unacceptable and ongoing loss of water from reservoirs/weirs - outside ability to rehabilitate.	L – 16
Subsidence movements on the surface causing cliff falls.	Damage to cliffs in line with predictions.	M – 15
	More extensive damage to cliffs causing impacts on community infrastructure (e.g. Aboriginal heritage and/or flora/fauna habitat) - accepted by determining authority.	L – 18
	All controls fail and unacceptable level of damage to surface features.	L – 21
Increase in volume of coal haulage transport and mine traffic on roads.	Increase in traffic on roads within predictions and no mine related traffic incidents/accidents.	M – 15
	Traffic levels and incidents (non-fatality crashes) exceed acceptable level. Concerns acknowledged and addressed.	M – 14
	All controls fail - leading to significant traffic levels and accidents (fatalities) on haulage routes and local roads - prosecutions and legal actions.	L – 17

[1] Risk - Ranking basis 1 (highest risk) to 25 (lowest risk). Risk rankings defined as 1 to 6 – High; 7 to 15 - Medium (ALARP) and 16 to 25 - Low.

5 MONITOR AND REVIEW

5.1 *Nominated Co-ordinator*

The nominated client review facilitator is Gary Brassington (ICHPL), Bulli Seam Operations Approvals Manager.

In addition to the various studies undertaken as part of the EA, ICHPL should co-ordinate the inclusion of the key potential environmental issues into the overall ICHPL management systems.

5.2 *Communication and Consultation*

Consultation, involvement of personnel (ICHPL and their specialists) and communication of the process and outcomes of the ERA are intended to be achieved by the inclusion of this ERA and the relevant specialist assessments addressing the key potential environmental issues in the EA and the overall ICHPL management systems.

6 CONCLUDING REMARKS

The risk assessment process conducted by the ERA team was aligned with AS/NZS 4360:2004 and MDG1010, with the intention of identifying the key potential environmental issues for further assessment in the EA.

An appropriately detailed assessment of the key potential environmental issues are included in the EA appendices/sections as presented in Table 8.

Table 8 – Key Potential Environmental Issues to be Further Assessed in the EA

Ref	Source	Description of Issue	EA Appendix/Section
BS014	Brainstorming	Water loss from a stream	Appendices B and C and Section 5
BS039	Brainstorming	Subsidence impacts on houses (community)	Appendix A and Section 5
BS019	Brainstorming	Subsidence impacts on road and/or rail infrastructure	Appendix A and Section 5
BS055	Brainstorming	Loss of flora and fauna habitat (coal wash emplacement)	Appendices D, E and F and Section 5
BS084	Brainstorming	Pool reduction impacts to aquatic ecology (including threatened species)	Appendices C and D and Section 5
BS002	Brainstorming	Changes to surface water and groundwater interactions	Appendices B and C and Section 5
BS037	Brainstorming	Cliff instability - impacts on community infrastructure	Appendices A and R and Section 5
BS045	Brainstorming	Potential loss of terrestrial fauna habitats (cliff deterioration etc.)	Appendix F and Section 5
BS052	Brainstorming	Swamp deterioration (vegetation composition and health, hydrology, fire susceptibility and erosion)	Appendices A, B, C, E and O and Section 5
BS072	Brainstorming	Transport/traffic volume increases	Appendix K and Section 5
BS017	Brainstorming	Impacts on third order streams and above or other significant stream features	Appendices C and P and Section 5
BS022	Brainstorming	Surface cracking	Appendix A and Section 5
BS023	Brainstorming	Rock falls and cliff instabilities	Appendices A and R and Section 5
BS024	Brainstorming	Subsidence impacts on surface infrastructure	Appendix A and Section 5
BS074	Brainstorming	Subsidence impacts on non-Aboriginal heritage items	Appendices A and H and Section 5

The risk rankings indicate that the potential loss scenarios ranked by the ERA team primarily based on the identified key potential environmental issues were within the “Medium - ALARP” or the “Low” range.

The outcomes of the ERA should be integrated into the overall ICHPL management systems so that they are effectively reviewed, implemented and monitored.

SP Solutions would like to thank all of the personnel who contributed to the ERA.

7 REFERENCES

Dams Safety Committee (2006) Risk Management Policy Framework for Dam Safety.

Department of Primary Industries (1997) Risk Management Handbook for the Mining Industry, MDG1010. May 1997.

Illawarra Coal Holdings Pty Ltd (2007) Bulli Seam Operations Preliminary Assessment Workshop.

Standards Australia (2004) AS/NZS 4360 Risk Management.

Standards Australia (2006) HB 203:2006 Environmental Risk Management – Principles and Process.

ATTACHMENT 1 – DEFINITIONS

Term	Explanation
ALARP	"As Low As Reasonably Practicable". The level of risk between tolerable and intolerable levels that can be achieved without expenditure of a disproportionate cost in relation to the benefit gained.
AS/NZS 4360	Australian Standard on Risk Management (see references).
ICHPL	Illawarra Coal Holdings Pty Ltd – the Project Proponent.
Cause	A source of harm.
Control	An intervention by the proponent intended to either Prevent a Cause from becoming an incident or to reduce the outcome should an incident occur.
EARs	Director-General's Environmental Assessment Requirements.
MDG1010	Department of Primary Industries guideline on risk management (see references).
Outcome	The end result following the occurrence of an incident. Outcomes are analogous to impacts and have a risk ranking attached to them.
Personnel	Includes all people working in and around the site (e.g. all contractors, sub-contractors, visitors, consultants, project managers etc.).
Practicable	The extent to which actions are technically feasible, in view of cost, current knowledge and best practices in existence and under operating circumstances of the time.
Residual Risk	The risk associated with an unwanted event after consideration of the existing control measures is taken into account.
Review	An examination of the effectiveness, suitability and efficiency of a system and its components.
Risk	The combination of the potential consequences arising from a specified hazard together with the likelihood of the hazard actually resulting in an unwanted event.

ATTACHMENT 2 - ISSUE IDENTIFICATION RESULTS

The output from the team's "brainstorming" is presented in Table 2-1. This list has been sorted according to the Incident Type – which were drawn, in part, from the EARs received for the Project.

Table 2-1 – Brainstorming Results

Ref	Source	Description of Event/Issue
Soil and Water (Groundwater)		
BS001	Brainstorming	Reduction of groundwater resource
BS002	Brainstorming	Changes to surface water and groundwater interactions
BS003	Brainstorming	Impacts on groundwater quality
BS004	Brainstorming	Impacts to groundwater dependent ecosystems
Soil and Water (Surface Water)		
BS005	Brainstorming	Changes to surface water flow regimes (flooding)
BS006	Brainstorming	Iron staining in water courses
BS006	Brainstorming	Water quality impacts on water harvesting
BS007	Brainstorming	Water loss from a reservoir or weir pool
BS008	Brainstorming	Water quality and flow impacts on environmental flows
BS009	Brainstorming	Subsidence impacts on weirs
BS010	Brainstorming	Goaf gas drainage impacts on water quality
BS011	Brainstorming	Cumulative water quality impacts from previously mined areas
BS012	Brainstorming	Water quality impacts from site water discharges
BS013	Brainstorming	Water quality impacts associated with releases or spills from Brennans Creek Dam
BS014	Brainstorming	Water loss from a stream
BS015	Brainstorming	Increased erosion from impacts to streams
BS016	Brainstorming	Change in discharge regime from Brennans Creek Dam
BS017	Brainstorming	Impacts on third order streams and above or other significant stream features
BS018	Brainstorming	Impacts on stream flow regime
BS108	Brainstorming	Possibility of increased make up requirements from Sydney Water
Subsidence		
BS019	Brainstorming	Subsidence impacts on road and/or rail infrastructure
BS020	Brainstorming	Subsidence impacts on Cataract Dam wall
BS021	Brainstorming	Far field subsidence effects (horizontal strains)
BS022	Brainstorming	Surface cracking
BS023	Brainstorming	Rock falls and cliff instabilities
BS024	Brainstorming	Subsidence impacts on surface infrastructure
BS025	Brainstorming	Exacerbation of subsidence effects due to earthquakes
BS026	Brainstorming	Subsidence impacts on shafts
BS097	Brainstorming	Effects on survey control marks
Noise		
BS027	Brainstorming	Air and noise impacts from West Cliff coal wash emplacement
BS028	Brainstorming	Noise impacts from surface facilities (e.g. pit tops and vent shafts)
BS029	Brainstorming	Traffic noise associated with the Project
BS030	Brainstorming	Blasting effects related to the construction of surface infrastructure
BS031	Brainstorming	Air and noise emissions during construction and operation of ventilation shafts
BS032	Brainstorming	Noise and vibration impacts caused by mining induced seismicity
BS033	Brainstorming	Construction air and noise impacts

Table 2-1 – Brainstorming Results (Continued)

Ref	Source	Description of Event/Issue
		Socio-Economic
BS034	Brainstorming	Positive social and economic benefits (jobs)
BS035	Brainstorming	Potential for change in surface fire frequency (bushfire)
BS036	Brainstorming	Water quality impacts on the community
BS037	Brainstorming	Cliff instabilities – impacts on community infrastructure
BS038	Brainstorming	Cliff instabilities – impacts on safety
BS039	Brainstorming	Subsidence impacts on houses (community)
BS040	Brainstorming	Impacts to hazardous infrastructure
BS041	Brainstorming	Road transport impacts on safety
BS042	Brainstorming	Goaf gas drainage impacts on safety (e.g. fires)
BS043	Brainstorming	Vibration impacts – excavation and heavy vehicle movements
BS044	Brainstorming	Consequential damage of an environmental impact (flow on effects to community)
BS109	Brainstorming	Socio-economic contribution of mine
		Terrestrial Fauna
BS045	Brainstorming	Potential loss of terrestrial fauna habitats (cliff deterioration, etc.)
BS046	Brainstorming	Pool reduction impacts on iconic species
BS047	Brainstorming	Impacts on fauna caused by changes to the hydrological regime
BS048	Brainstorming	Gas drainage impacts on fauna
BS049	Brainstorming	Introduction or spread of weeds/feral animals
BS050	Brainstorming	Impacts on fauna due to night lighting
BS051	Brainstorming	Noise impacts on fauna
		Flora
BS052	Brainstorming	Swamp deterioration (vegetation composition and health, hydrology, fire susceptibility and erosion)
BS053	Brainstorming	Cliff instabilities - impacts on flora
BS054	Brainstorming	Air quality (dust) impacts on flora including threatened species (e.g. coal wash emplacement)
BS055	Brainstorming	Loss of flora and fauna habitat (coal wash emplacement)
BS056	Brainstorming	Impacts on flora (including threatened species and Endangered Ecological Communities caused by changes to the hydrological regime
BS057	Brainstorming	Impacts on riparian vegetation caused by changes to the hydrological regime and gas emissions
BS058	Brainstorming	Clearing of flora from surface activities
BS059	Brainstorming	Goaf gas drainage impacts on flora
		Air Quality
BS060	Brainstorming	Air quality and odour impacts from coal stockpiles
BS061	Brainstorming	Dust (amenity and health/safety)
BS062	Brainstorming	Greenhouse gas emissions (scope 1, 2 and 3)
BS063	Brainstorming	Cumulative air quality effects associated with construction and rehabilitation of Stage 3 and Stage 4 emplacements
BS064	Brainstorming	Road transport contribution to greenhouse gas
BS065	Brainstorming	Coal haulage and traffic dust
BS066	Brainstorming	Vent shaft odour and dust impacts
BS067	Brainstorming	Odour from fugitive sources (gas release)
BS068	Brainstorming	Greenhouse gas fugitive emissions
BS069	Brainstorming	Reduction in air quality from gas drainage/flaring/Vamps
BS070	Brainstorming	Cumulative effects of climate change
		Road Transport
BS071	Brainstorming	Road deterioration
BS072	Brainstorming	Transport/traffic volume increases

Table 2-1 – Brainstorming Results (Continued)

Ref	Source	Description of Event/Issue
Non-Aboriginal Heritage		
BS073	Brainstorming	Old ICHPL infrastructure becomes heritage listed during the Project life
BS074	Brainstorming	Subsidence impacts on non-Aboriginal heritage items
BS075	Brainstorming	Impacts on non-Aboriginal heritage associated with rehabilitation/remediation
Visual		
BS076	Brainstorming	Gas releases to streams (aesthetics)
BS077	Brainstorming	Aesthetic/visual impacts caused by subsidence
BS078	Brainstorming	Cliff instabilities - impacts on visual amenity
BS079	Brainstorming	Staining of surface water and channels
BS080	Brainstorming	Impacts to visual amenity from surface facilities
Aboriginal Cultural Heritage		
BS081	Brainstorming	Subsidence effects on Aboriginal heritage items
BS082	Brainstorming	Cliff instabilities causing impacts to Aboriginal heritage items
Aquatic Ecology		
BS083	Brainstorming	Loss of aquatic habitat due to cracking of stream
BS084	Brainstorming	Pool reduction impacts on aquatic ecology (including threatened species)
BS085	Brainstorming	Water quality impacts on aquatic ecology
BS086	Brainstorming	Impacts on aquatic ecology caused by changes in flora communities
BS087	Brainstorming	Gas release impacts on aquatic ecology
BS088	Brainstorming	Coal dust impacts on aquatic ecology
BS089	Brainstorming	Loss of stream connectivity and impacts on aquatic ecology, flora and fauna
Other		
BS090	Brainstorming	Hazardous waste and disposal impacts
BS091	Brainstorming	Impacts related to ongoing exploration
BS092	Brainstorming	Remediation/rehabilitation activities and associated disturbance

Table 2-2 below presents additional issues by specialists raised during the ERA workshop.

Table 2-2 – Additional Issues Raised by Specialists during the Workshop

Ref	Source	Issue
BS093	Close out	Impacts on fauna caused by reduction of pools
BS094	Close out	Visual amenity from coal dust on roads
BS095	Close out	Impacts on threatened flora and fauna species and heritage items (coal wash emplacement)

ATTACHMENT 3 – REFERRED ISSUES

Referred issues identified during the ERA team's "brainstorming" are presented in Table 3-1.

Table 3-1 – Referred Issues

Ref	Source	Description of Issue
BS096	Brainstorming	Subsidence mitigation techniques (control)
BS098	Brainstorming	Uncertainty surrounding community expectations
BS099	Brainstorming	Regional/local developments not identified
BS100	Brainstorming	Potential changes in coal product requirements
BS101	Brainstorming	Potential advancement in mining technology
BS102	Brainstorming	Integration of environmental assessment
BS103	Brainstorming	Uncertainties regarding approvability where mine planning process is not finalised (infrastructure)
BS104	Brainstorming	Uncertainty of impact modelling (all)
BS105	Brainstorming	Mine layout and design to manage subsidence effects
BS106	Brainstorming	Mine water treatment capacity (Reverse Osmosis plant) due to increased groundwater inflows
BS107	Brainstorming	Insufficient stand-off of rivers and streams
BS110	Brainstorming	Potential that in valley swamps have not all been identified for assessment
BS111	Brainstorming	Certainty of moisture and silt content of coal rejects materials for assessment
BS112	Brainstorming	Sensitive receivers not identified
BS113	Brainstorming	Potential inconsistency of information provided to consultants
BS114	Brainstorming	Urban expansion and interaction with the Project

ATTACHMENT 4 – RISK AND CONTROL CHARTS

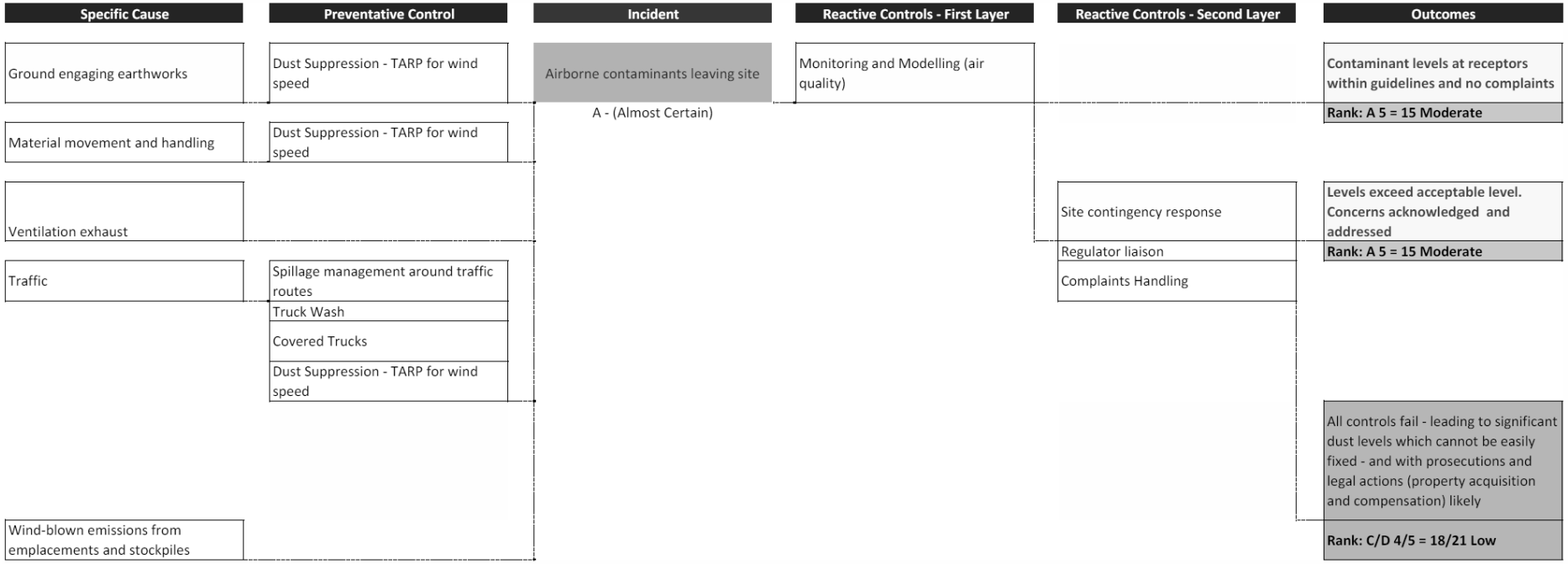

Figure 4-1 - Airborne Contaminants (Dust)

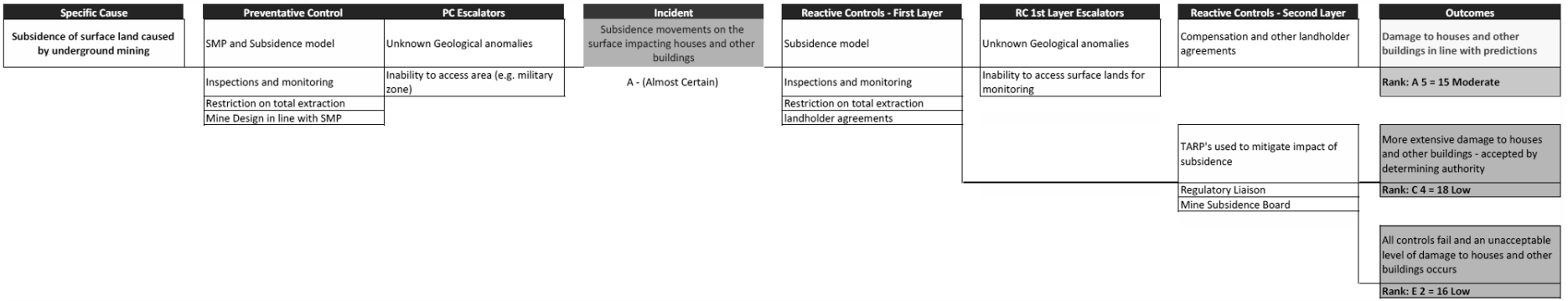

Figure 4-2 – Subsidence Impacts on 3rd Party Residences

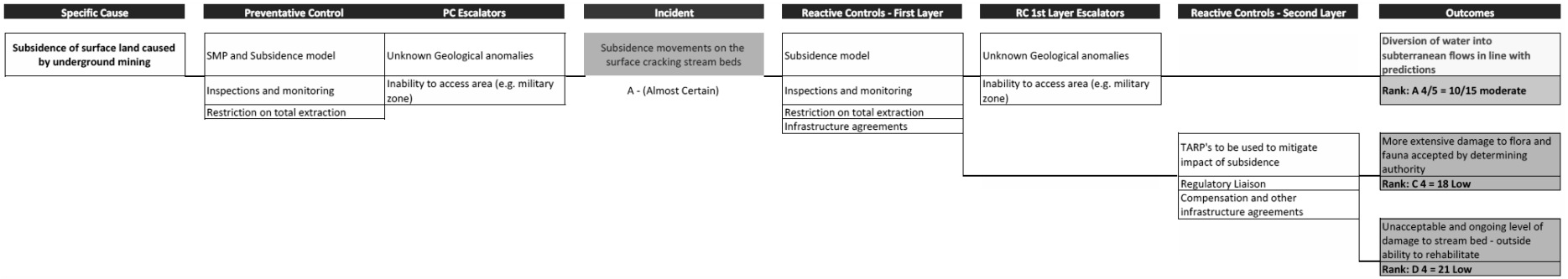

Figure 4-3 – Subsidence Impacts on Surface Streams

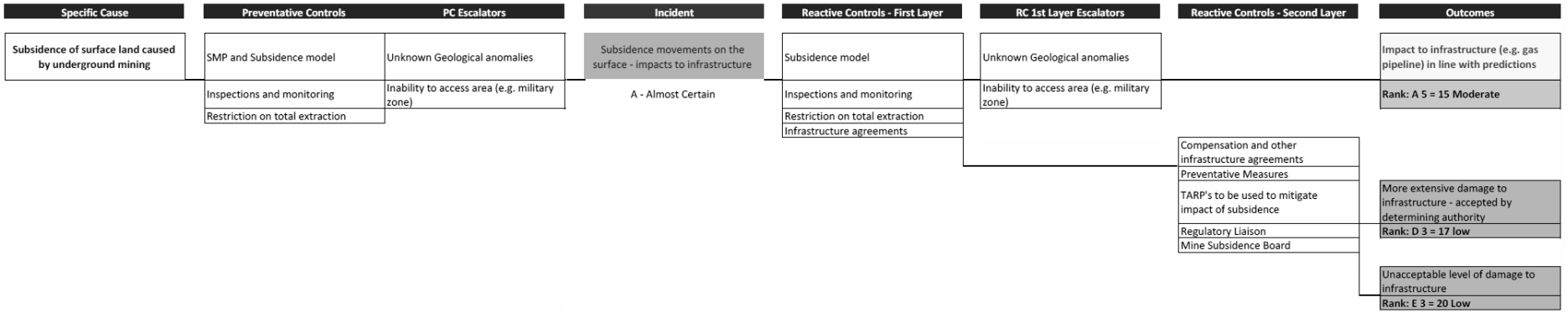

Figure 4-4 – Subsidence Impact on 3rd Party Infrastructure

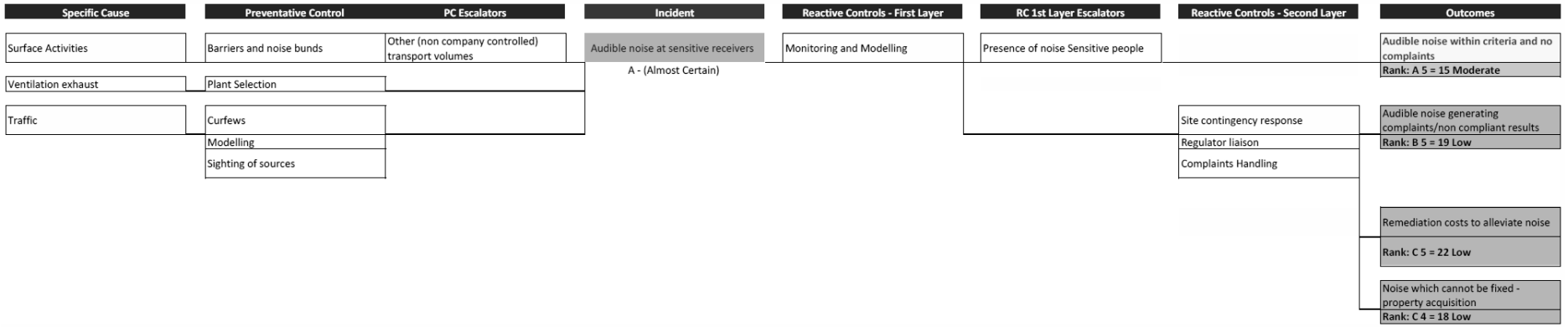

Figure 4-5 – Audible Noise Impacts

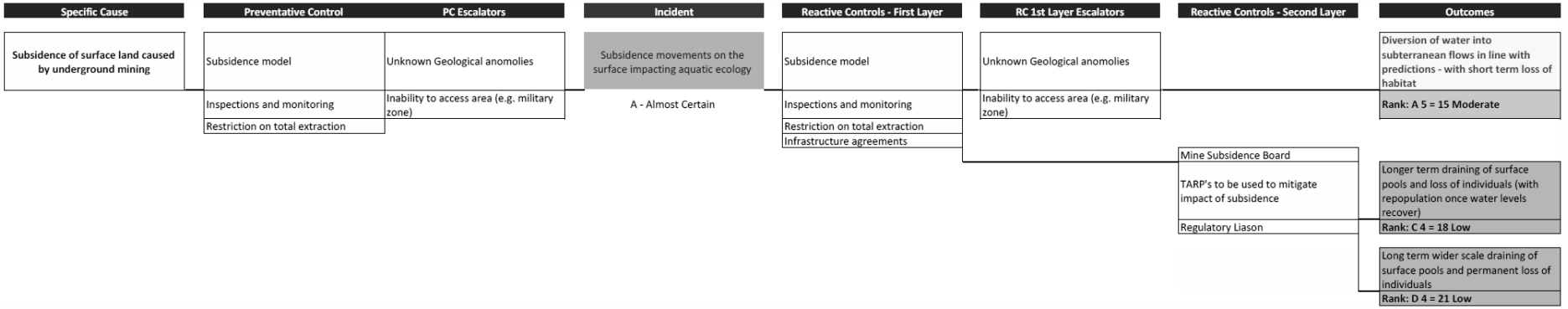

Figure 4-6 – Subsidence Impacts on Aquatic Ecology

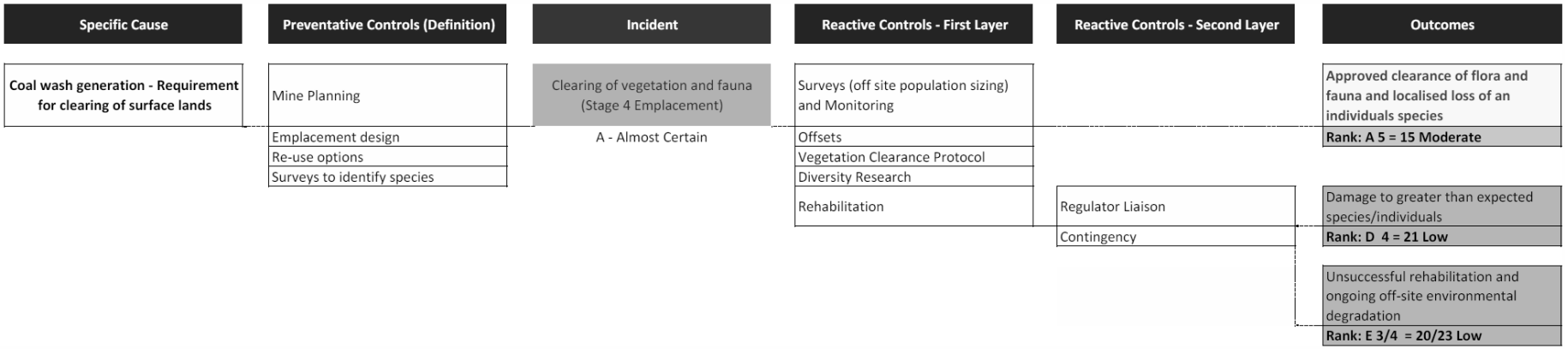

Figure 4-7 – Clearing of Vegetation and Fauna (Stage 4 Emplacement)

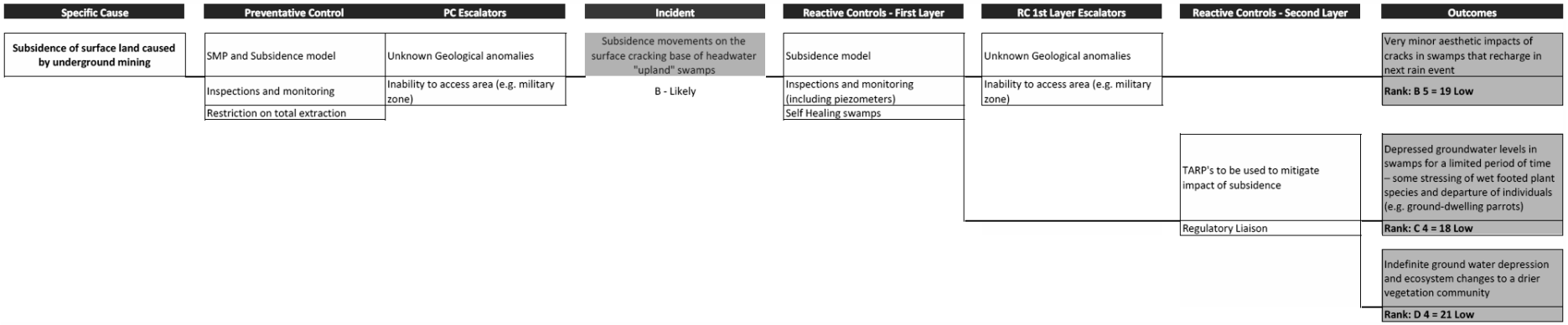

Figure 4-8 – Subsidence Impacts on Headwater Upland Swamps

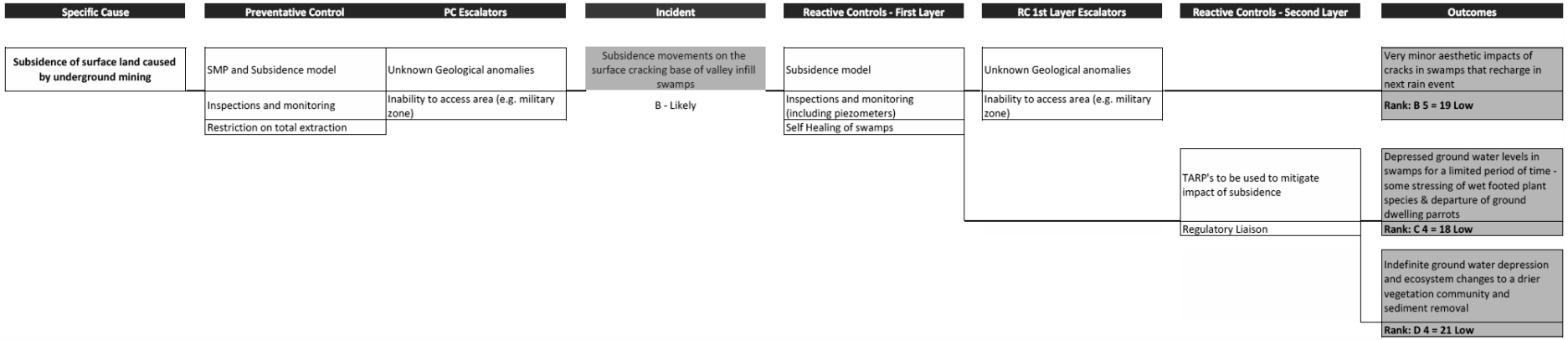

Figure 4-9 – Subsidence Impacts on in-Valley Swamps

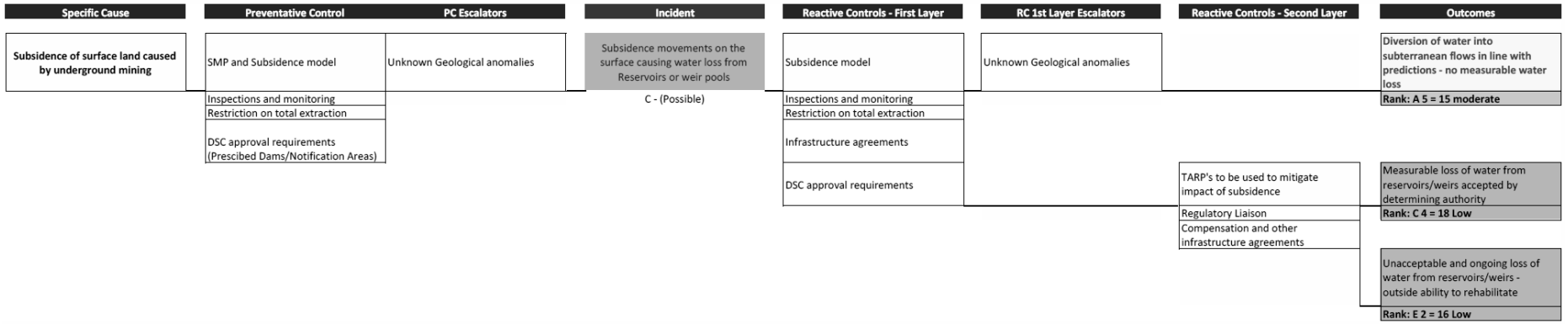

Figure 4-10 – Subsidence Impacts on Reservoirs/Weir Pools

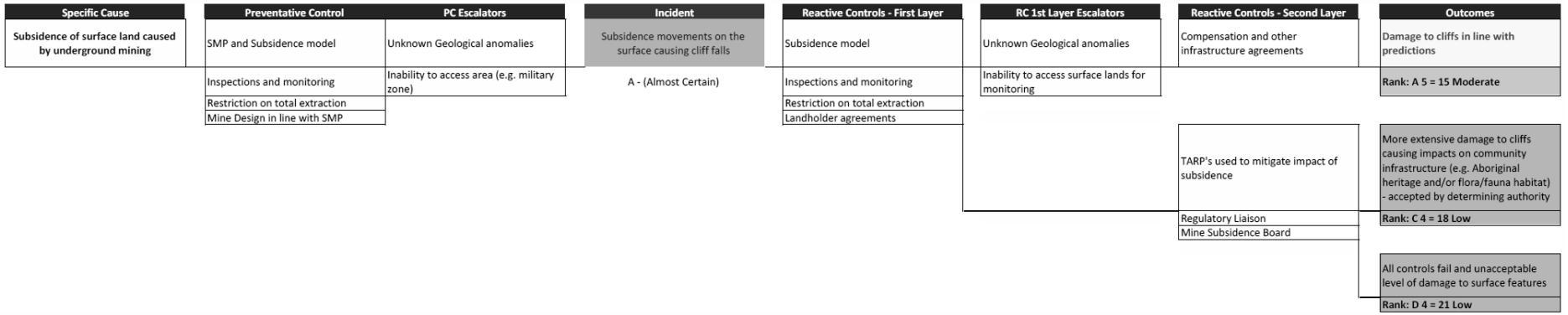

Figure 4-11 – Subsidence Impacts on Cliffs

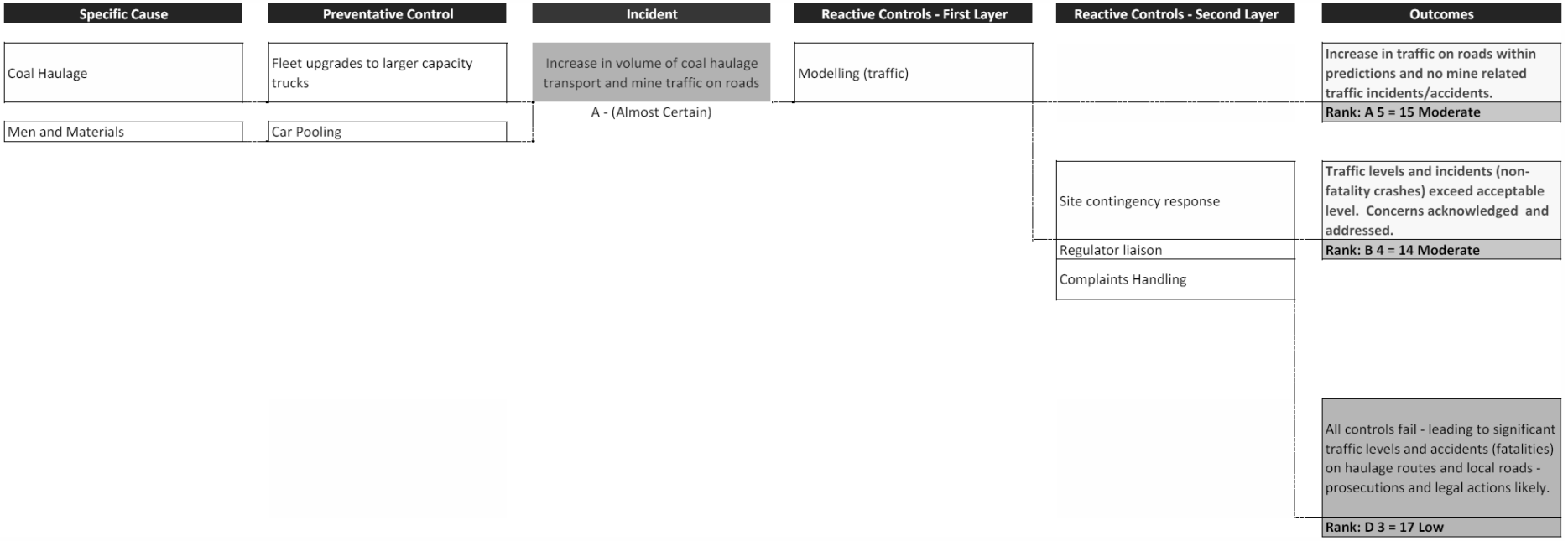

Figure 4-12 – Increased Transport and Traffic Volumes

About Your Report

Your report has been developed on the basis of your unique and specific requirements as understood by ***SP Solutions*** and only applies to the subject matter investigated. Your report should not be used or at a minimum it MUST be reviewed if there are any changes to the project and Key Assumptions. ***SP Solutions*** should be consulted to assess how factors that have changed subsequent to the date of the report affect the report's recommendations. ***SP Solutions*** cannot accept responsibility for problems that may occur due to changed factors if they are not consulted.

To avoid misuse of the information contained in the report it is recommended you confer with ***SP Solutions*** before passing your report on to another party who may not be familiar with the background and the purpose of the report. Your report should not be applied to any project other than that originally specified at the time the report was issued.

Costly problems can occur when other design professionals develop their plans based on misinterpretations of the report. To help avoid misinterpretations of the report, retain ***SP Solutions*** to work with other professionals who are affected by the report. Have ***SP Solutions*** explain the report implications to professional affected by them and then review plans and specifications produced to see how they have incorporated the report findings.

The report as a whole presents the findings of the site specific assessment and the report should not be copied in part of altered in any way.

SP Solutions is familiar with a variety of techniques and approaches that be used to identify and reduce a broad range of risks over the life of projects and operations. It is common that not all approaches will be necessarily dealt in your report due to concepts proposed, recommendations by the team at the time or the scope determined by you. Speak with ***SP Solutions*** to develop alternative approaches to problems that may be of genuine benefit both in time and cost.

Reporting relies on:

- interpretation of factual information based on judgement and opinion;
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