ENVIRONMENTAL RISK ANALYSIS

APPENDIX J

NEWCASTLE COAL INFRASTRUCTURE GROUP COAL EXPORT TERMINAL

Newcastle Coal Infrastructure Group

Environmental Risk Analysis

***Prepared for*:**	***Newcastle Coal Infrastructure Group (NCIG)***		
Prepared by:	**SP Solutions**		
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EXECUTIVE SUMMARY

This Environmental Risk Analysis (ERA) identifies risks associated with key potential environmental impacts and mitigation measures for the construction and operation of the proposed Newcastle Coal Infrastructure Group (NCIG) Coal Export Terminal (CET) (the Project). The Project is located on Kooragang Island in Newcastle, New South Wales (NSW). The Project includes the construction and operation of a 66 million tonnes per annum (Mtpa) CET, including associated rail and coal handling infrastructure and wharf/shiploading facilities on the south arm of the Hunter River.

On 28 April 2006, a team of NCIG personnel and technical specialists conducted a facilitated risk analysis in accordance with the scope included in the Environmental Assessment requirements for the Project (Department of Planning, 2006):

> *"General Environmental Risk Analysis – notwithstanding the above key assessment requirements, the Environmental Assessment must include an environmental risk analysis to identify potential environmental impacts associated with the project (construction and operation), proposed mitigation measures and potentially significant residual environmental impacts after the application of proposed mitigation measures. Where additional key environmental impacts are identified through this environmental risk analysis, an appropriately detailed impact assessment of these additional key environmental impacts must be included in the Environmental Assessment."*

The scope identified the key environmental risk groups for the construction and operation of the Project followed by review and risk analysis (with current controls [ie. those controls already proposed by NCIG] in place) of scenarios for each key risk group.

The ERA workshop included:

1. Establishing the context including review of supporting information and definition of the scope.
2. Identifying risks via a brainstorming session.
3. Developing fault trees and identifying the key environmental risk groups.
4. Ranking of the highest risks in each of the key environmental risk groups, including consideration of mitigation measures.
5. Further analysis of fault trees to identify additional mitigation measures for the Project.

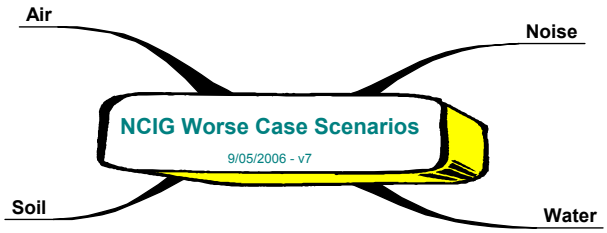
Dredging operations were deemed to be outside of the scope as they are the subject of a separate Development Consent but the scope covers the use and placement of materials sourced from dredging activities.

In the background information provided to the team the relative "fit" of the Project to the other coal loading activities on the island was noted. Some NCIG infrastructure would be located on land that has been used in the past as an industrial landfill. Therefore, analysis of risks pertaining to the environment was undertaken mindful of the disturbed nature of the Project area and that the Project is consistent with surrounding land uses.

Key Risk Groups

As shown on Figure 1, the team identified the following "key risk groups" for the facility that are intended to be the subject of further studies in the Project Environmental Assessment.

Figure 1 – Key Environmental Risk Groups



Risk rankings represent the team's perception of the level of risk and are estimated according to the "rules" for selecting a consequence and probability. The scenario deemed "worst case" for each of the key risk groups was then ranked (i.e. the key environmental impacts). For the key risk groups the team identified the key environmental impacts for the Project outlined in Table ES-1.

Table ES-1
Key Environmental Impacts

Key Environmental Risk Group	Scenario	Risk Ranking[1]	Mitigation Measures
Soil	Loss of habitat in the area to be cleared for construction, most significantly in the area of Big Pond (including an Endangered Ecological Community).	Medium (ALARP) 10	Flora and Fauna Management Plan and Vegetation Clearance Protocol including – minimisation of disturbance areas, strategies for fauna management and protocols for threatened species (a vegetation offset strategy was not incorporated within the mitigation measures).
Noise	Noise generated (particularly at night) potentially leading to off-site annoyance (non-compliance with anticipated Project noise criteria), sleep disturbance and fauna specific impact (although fauna are habituated and unlikely to be affected by normal Project noise).	Medium (ALARP) 15	Low noise design specifications, operating protocols (including maintenance regimes and prompt detection of faults) and Noise Monitoring Programme (including noise monitoring, complaints response protocols and triggers for the implementation of noise mitigation measures) (a noise barrier at sections of the rail loop was not incorporated within the mitigation measures).
Air	Coal dust generated from operations potentially leading to off-site health and amenity impacts and species specific effects.	Low 19	Water sprays, enclosures (conveyors and transfer points) and Air Quality Monitoring Programme (including air quality monitoring, complaints response protocols and triggers for the implementation of dust mitigation measures).
Water	Flow of sediment laden or contaminated water entering Deep Pond affecting the ecology of Deep Pond (which includes an endangered species).	Low 22	Contaminant controls (eg. silt fences and settling ponds) and appropriate construction processes.
	Impact on the Hunter River resulting from contaminated sediments and low pH water flowing from the site.	Low 24	Site drainage systems including settling ponds, monitoring of licensed discharges and containment of site water (design for zero discharge – 1 in 100 year containment).

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

Note: The outcomes of the risk ranking process are documented in full in Appendix 7.1.

An appropriately detailed impact assessment of the above key environmental impacts will be included in the Project Environmental Assessment.

The risk criteria utilised is to reduce the risk to As Low As Reasonably Practicable (ALARP)[1]. Risks deemed to be a 'low' ranking are considered to be acceptable given the proposed mitigation measures.

[1] "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 the key environmental impacts in relation to soil and noise noted above fall into the ALARP category, it is understood that NCIG will work with the relevant specialists (Dr David Goldney [soil – flora and fauna issues] and Heggies Australia [noise]) to develop additional mitigation measures. These additional mitigation measures will be documented in the Environmental Assessment.

With respect to the key environmental impacts, the issues raised will be addressed in the following reports included as appendices to the Project Environmental Assessment:

- Appendix A Construction, Operation and Road Transport Noise Impact Assessment.
- Appendix B Air Quality Impact Assessment.
- Appendix D Land Contamination and Groundwater Assessment.
- Appendix E Flora Assessment.
- Appendix F Fauna Assessment.

1 INTRODUCTION

This Environmental Risk Analysis (ERA) identifies risks associated with key potential environmental impacts and mitigation measures for the construction and operation of the proposed Newcastle Coal Infrastructure Group (NCIG) Coal Export Terminal (CET) (the Project). The Project is located on Kooragang Island in Newcastle, New South Wales (NSW). The Project includes the construction and operation of a 66 million tonnes per annum (Mtpa) CET, including associated rail and coal handling infrastructure and wharf/shiploading facilities on the south arm of the Hunter River.

1.1 Objectives

The primary objectives of this ERA were to:

(1) identify the key environmental risk groups for the Project;

(2) identify key potential environmental impacts for construction and operation of the Project;

(3) assess the groups of issues/risks for level of risk; and

(4) identify mitigation measures for addressing each group/area of risk and the residual risk after the application of these measures.

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

(1) identification of key environmental impacts to be addressed in the Environmental Assessment;

(2) a consolidated list of recommended actions; and

(3) a document suitable for inclusion in the Environmental Assessment and aligned to Australian Standard (AS) 4360 *Risk Management* (Standards Australia, 2004).

1.2 Client and Team Leader

The client for the ERA is NCIG. The NCIG Project Manager and overall team leader for the risk analysis is *Rob Eaglesham, Project Manager, NCIG*.

1.3 Scope

The ERA was conducted to address the following Environmental Assessment requirement issued by the Department of Planning (DoP) (DoP, 2006):

> *General Environmental Risk Analysis – notwithstanding the above key assessment requirements, the Environmental Assessment must include an environmental risk analysis to identify potential environmental impacts associated with the project (construction and operation), proposed mitigation measures and potentially significant residual environmental impacts after the application of proposed mitigation measures. Where additional key environmental impacts are identified through this environmental risk analysis, an appropriately detailed impact assessment of these additional key environmental impacts must be included in the Environmental Assessment.*

Other clarifying aspects of the ERA are outlined below. This list was utilised to identify any issues that needed to be addressed.

Timing	This ERA covers - construction, operation and closure of the CET.
Geography	From the coal delivery point on site to the discharge of coal to vessels. Note – this excludes dredging but covers use and placement of material sourced from dredging activities.
Process/Function	An initial 33 month construction phase is expected for a Project capacity of 33 Mtpa. The timing of further development of the Project capacity up to 66 Mtpa would depend on coal market demand and would be undertaken concurrently with operations at 33 Mtpa. The Project would be a single process operation (ie. can only load coal).
Other	ERA intended to address the NSW Department of Planning's Environmental Assessment requirements.

1.4 Resourcing, Schedule and Accountabilities

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

(1) team of personnel with suitable experience and understanding of potential environmental impacts related to the Project;

(2) external facilitator/scribe for the ERA and write-up of results;

(3) meeting room with electronic equipment for the team based session; and

(4) copies of the Environmental Assessment requirements, drawings and other reports relevant to the topic.

The outcomes of the ERA and associated accountabilities are to be integrated into the overall NCIG Management Systems so that they are effectively reviewed, implemented and monitored to ensure the outcomes sought.

1.5 Definitions

The following definitions may assist the reader to interpret this report.

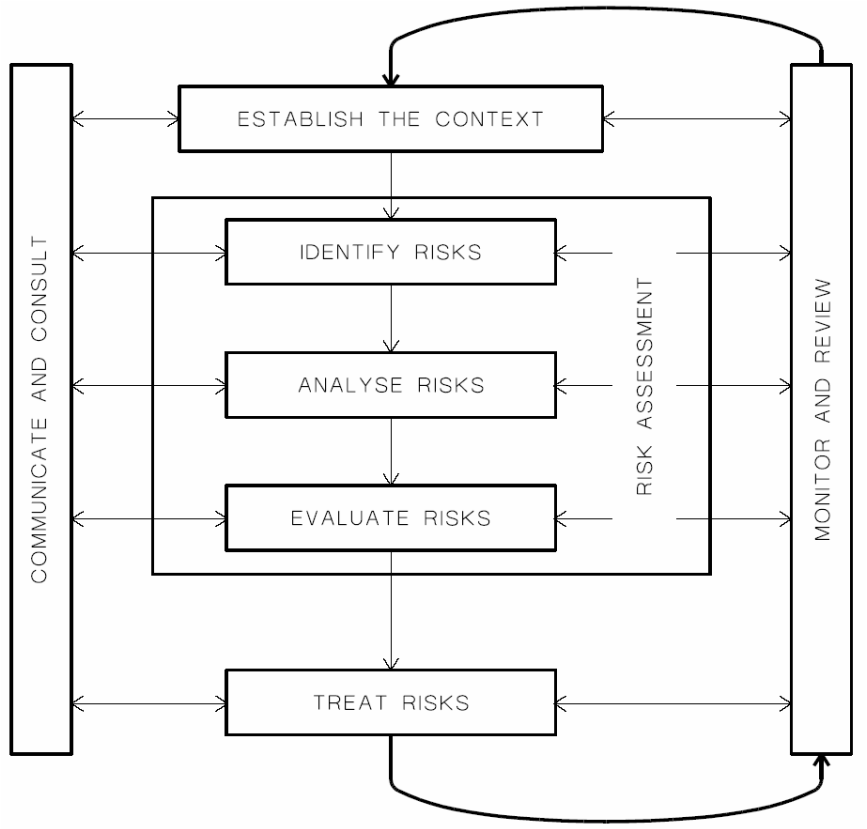
Term	***Explanation***
ALARP	"As Low As Reasonably Practicable". The level of risk between tolerable and intolerable levels that can be achieved without expenditure of a disproportionate cost in relation to the benefit gained.
Competency	A combination of attributes such as knowledge, skills, abilities and attitudes underlying some aspect of successful professional performance.
Final Risk	The level of risk remaining after both existing and recommended additional controls have been effectively implemented.
Hazard	A thing or a situation with potential to cause loss including injury or illness to a person.
HSE	Health, Safety and Environment.
Inherent Risk	The risk associated with an unwanted event before any consideration of the existing controls is taken into account.
Inspection	A regular check of workplace equipment, working environment and practices, to identify hazards and deficiencies.
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.
Unwanted Event	The undesired or unwanted events that could arise from a hazard i.e. manifestation of harm or potential harm to people, damage to property and the environment and loss to process as a result of a hazard.

1.6 Method

1.6.1 Framework

Figure 2 outlines the overall framework utilised for the ERA. This framework is further discussed in Section 1.6.2 with respect to the key steps involved in the ERA.

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



1.6.2 Key Steps

The key steps in the process were confirmed with NCIG prior to the team session 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. write draft report to AS4360 and MDG1010 *Risk Management Handbook for the Mining Industry* (NSW Department of Mineral Resources, 1997) standards for review by NCIG personnel and team members;
6. incorporate comments from NCIG and the team; and
7. finalise 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 1.4, the outcomes of the ERA will be integrated into the overall NCIG Management Systems so that they are effectively reviewed, implemented and monitored to ensure the outcomes sought.

1.6.3 External Facilitation

The team was facilitated through the process by ***SP Solutions*** – a company specialising in risk based review and risk management programs. The facilitator, Peter Standish, is experienced in coal handling operations and the major hazards therein.

The team was encouraged and "challenged" to identify a wide range of environmental impacts or hazards including consideration of far-field impacts (ie. 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 risk-based review:

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 NCIG which is a group of six coal companies including: BHP Billiton (Hunter Valley Energy Coal); Centennial Coal; Excel Coal Limited; Donaldson Coal; Whitehaven Coal; and Felix Resources (formerly White Mining).

The Project involves the construction and operation of a 66 Mtpa capacity CET, two parallel rail spurs from the Kooragang Island mainline, five rail sidings and two rail loops.

2.2 Project Summary

The Project would be implemented by NCIG and construction is scheduled to commence in the first quarter of 2007. The Project includes:

- foundation preparation/capping of a rail corridor traversing the existing KIWEF for the development of the rail spurs, rail sidings and rail loops;
- construction of rail spurs, rail sidings and rail loops, rail overpass, train unloading stations and connecting conveyors;
- re-use of dredged materials from the south arm of the Hunter River as preload and engineering fill for construction of the coal storage area, rail corridor and wharf facilities;
- construction of a coal storage area including coal stockpiles, conveyors, transfer points and combined stacker/reclaimers;
- construction of wharf facilities, shiploaders, conveyors and buffer bins;
- development of water management infrastructure including site drainage works, stormwater settlement ponds, primary and secondary settling ponds, site water pond, water tanks and stockpile spray system;
- installation of electricity supply, reticulation and control systems;
- development of access roads and internal roads;
- construction of administration and workshop buildings;
- other associated minor infrastructure, plant, equipment and activities; and
- operation of the CET up to a capacity of 66 Mtpa, including the unloading of coal trains from the Kooragang Island mainline, the stockpiling of coal, and the loading of coal to ships via the wharf facilities and shiploaders.

The Project would have capacity to export up to 66 Mtpa of coal.

2.3 Risk Management Context

The ERA has been conducted to address the relevant Environmental Assessment requirement (Section 1.3).

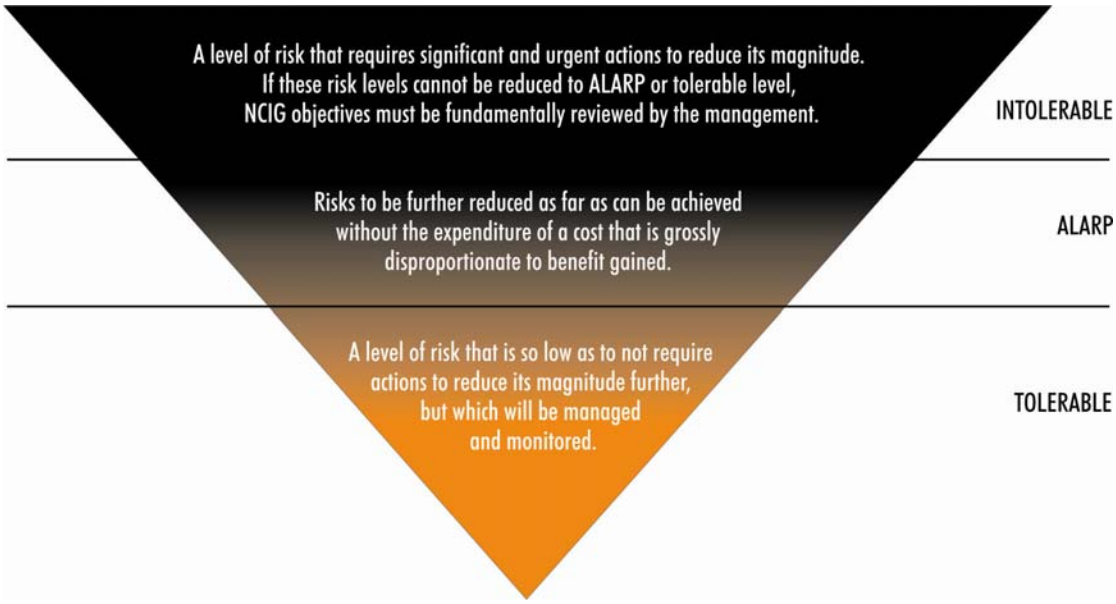
2.4 Risk Criteria

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 are presented in Section 4.3.

Figure 3 – Risk Criteria "ALARP"



3 IDENTIFY RISKS

3.1 The Team

The team met on the 28 April 2006 at the Connell Hatch office, Military Rd Neutral Bay. The team comprised an appropriate array of skills and experience relevant to the ERA subject matter. Details of the team members and their relevant qualifications and experience are included in Table 1 below.

Table 1 – Review Team

Name	Company and Position	Qualifications and Relevant Experience
Rob Yeates[1]	NCIG Project Director	B Eng, MBA and PhD 30 years coal industry experience.
Rob Eaglesham	NCIG Project Manager	B Sc. (Mechanical Engineering) (Hons) 40 years experience in Project development, predominantly in industrial projects.
Steve Davis	NCIG Engineering Manager	B Eng (Mechanical) 30 years experience in engineering/project development.
Andrew Woolaston	Connell Hatch – Project Manager	B Eng (Civil) 25 years experience in project management. 3 years prior experience on PWCS stage 1 and 1.5 years on PWCS stage 3A.
Costa Vasili	Connell Hatch – Engineering Manager	B Eng. (Electrical) 27 years experience including 16 years in materials handling.
Glenn Thomas	Heggies Australia – Director	B Sc. (Environmental Science) Noise and ventilation consultant.
Shane Lakmaker	Holmes Air Sciences – Environmental Scientist	B Sc. (Atmospheric Science) Air quality consulting, Air dispersion modelling.
Dr David Goldney	Western Research Institute, Charles Sturt University/Principal Consulting Ecologist	B Sc., Dip Ed, PhD, DSc, MEIA. Dr Goldney is a Visiting Professor at Charles Sturt University and a consulting ecologist. Dr Goldney has conducted research and published in an extensive range of disciplines including conservation biology, environmental management and environmental impact assessment. 35 years experience.
Fiona Robinson	RCA Australia – land contamination/ groundwater	B Eng (Environmental). Contaminated sites. Hydrogeology.
Luci David	Enesar Consulting Pty Ltd	B Sc. 13 years experience environmental impact assessment (approvals); environmental management.
Josh Hunt	Resource Strategies – Principal Project Manager	B Eng (Civil) Project management and environmental planning experience for approximately 12 years.
Clive Berry	Resource Strategies – Environmental Project Manager	B Eng (Environmental) Project management and environmental planning experience for approximately 5 years.
Lucas Burns	Resource Strategies – Environmental Project Assistant	B Eng (Environmental) Environmental Project Assistant for 1 year.
Peter Standish	Safe Production Solutions - Facilitator	PhD, B Eng (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.
Adam Higgins	Safe Production Solutions - Technical scribe	Masters OH&S, B Sc (Exercise) for 3 years. Involved in University risk and OH&S study for 18 months. 18 months with SP conducting training courses, accident investigations and risk assessments.

[1] Attended for the conclusion of the ERA and the overview of outcomes.

3.2 Identified Hazards and Issues from Risk Analysis Tools

The identification of risks involved the use of risk analysis "tools" appropriate for identifying environmental impacts. The tools used were:

- Overview Session – established the context and team scope before the issues were brainstormed.
- Brainstorming – used to draw out the main issues using the understanding, relevant experience and knowledge of the team.
- High level fault tree/affinity diagrams – used to group and look in more detail at particular environmental impacts.
- Control Analysis – using Layers of Protection Analysis (LOPA) techniques.

The risk analysis tools are described further below.

3.2.1 Brainstorming

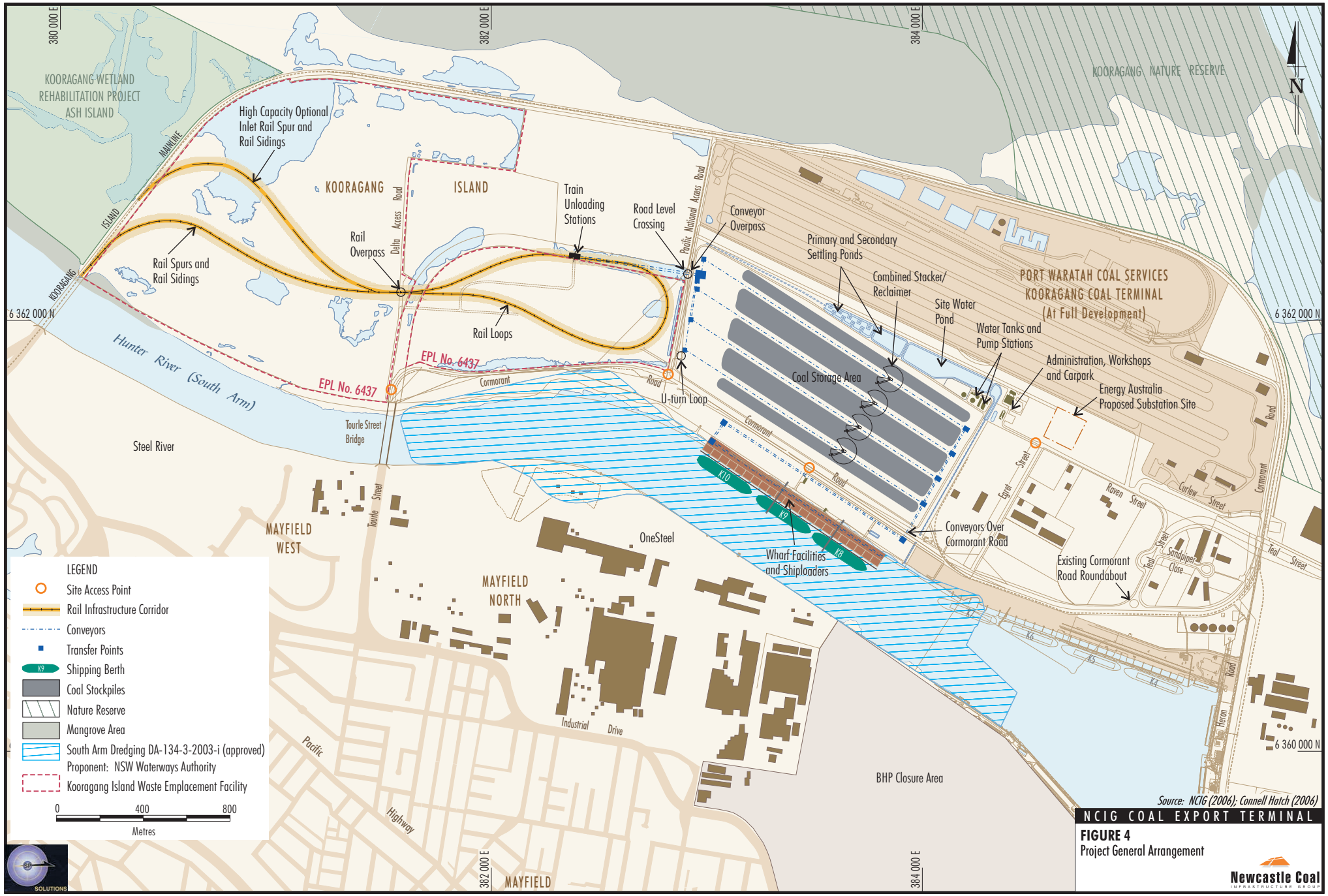
The key word association process is based on work by Edward de Bono and is intended to generate a wide range of data on losses, controls and general issues related to the subject areas.

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.

As part of the general identification of losses process, an aerial photograph and plan view of the site were considered.

Figure 4 presents a similar plan to the one used during the workshop. The plan was used by picking out key site locations and using a range of prompt words to try and identify potential environmental impacts. Terms such as dust, water, noise, vibration and habitat were used as part of this process.

The results from the brainstorming can be found in **Appendix 7.2**.



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3.2.2 Logic Tree/Affinity Diagrams

The team first identified the "key risk groups" for environmental loss, followed by logical components within each of the "key risk groups". The way in which each group (air, noise, water and soils) is "broken down" is presented in the diagrams from Figures 5 to 8.

Each of the "limbs" of the logic tree were then converted to a textual description and considered in the control table development (Appendix 7.3).

A sample of the output (presented in full in Table 9, Appendix 7.2) is presented in Table 2 below. It can be noted in Table 2 that the first issues represent the top left "limb" where Air is connected to Dust – to Construction and Closure – to Excavation (refer to Figure 5).

Table 2 – Sample Logic Tree Output

Ref	Source	Details
IS103	Logic Trees	Impact on Air from Dust due to Construction and closure in particular Excavation
IS104	Logic Trees	Impact on Air from Dust due to Construction and closure in particular Filling
IS105	Logic Trees	Impact on Air from Dust due to Construction and closure in particular Stockpiling
IS106	Logic Trees	Impact on Air from Dust due to Construction and closure in particular Wind erosion
IS107	Logic Trees	Impact on Air from Dust due to Construction and closure in particular Vehicle movement
IS108	Logic Trees	Impact on Air from Dust due to Operation in particular Unloading
IS109	Logic Trees	Impact on Air from Dust due to Operation in particular Stacking
IS110	Logic Trees	Impact on Air from Dust due to Operation in particular Reclaiming
IS111	Logic Trees	Impact on Air from Dust due to Operation in particular Ship loading
IS112	Logic Trees	Impact on Air from Dust due to Operation in particular Vehicle movement
IS113	Logic Trees	Impact on Air from Dust due to Operation in particular Maintenance tasks
IS114	Logic Trees	Impact on Air from Dust due to Operation in particular Wind erosion
IS115	Logic Trees	Impact on Air from Contaminants due to Construction and closure in particular Excavation
IS116	Logic Trees	Impact on Air from Contaminants due to Construction and closure in particular Filling

Figure 5 – Air Key Risk Group Scenarios

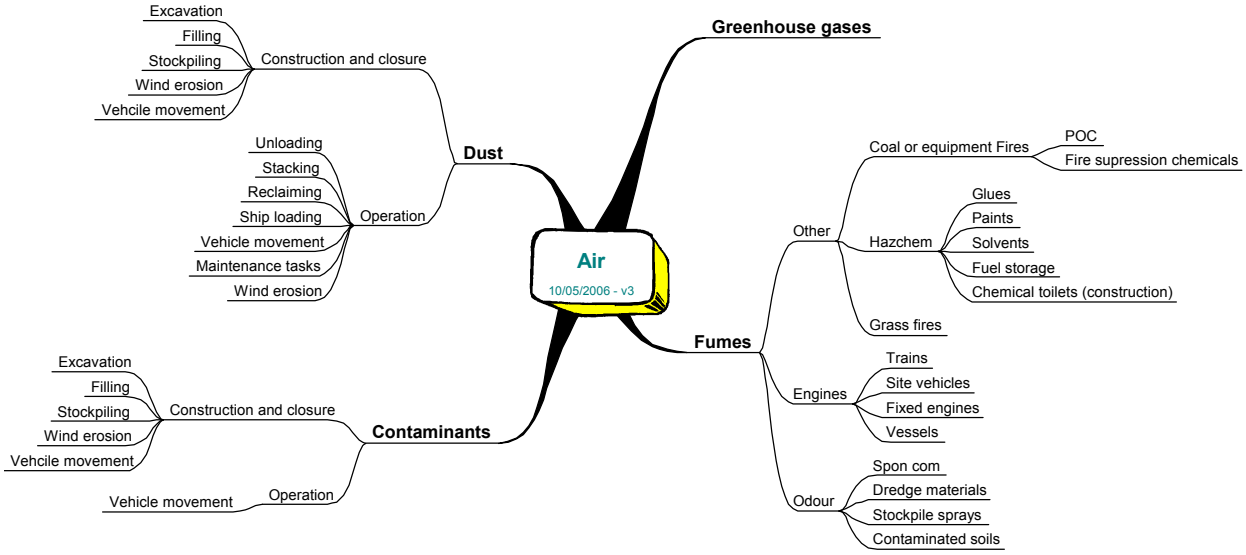


Figure 6 – Noise Key Risk Group Scenarios

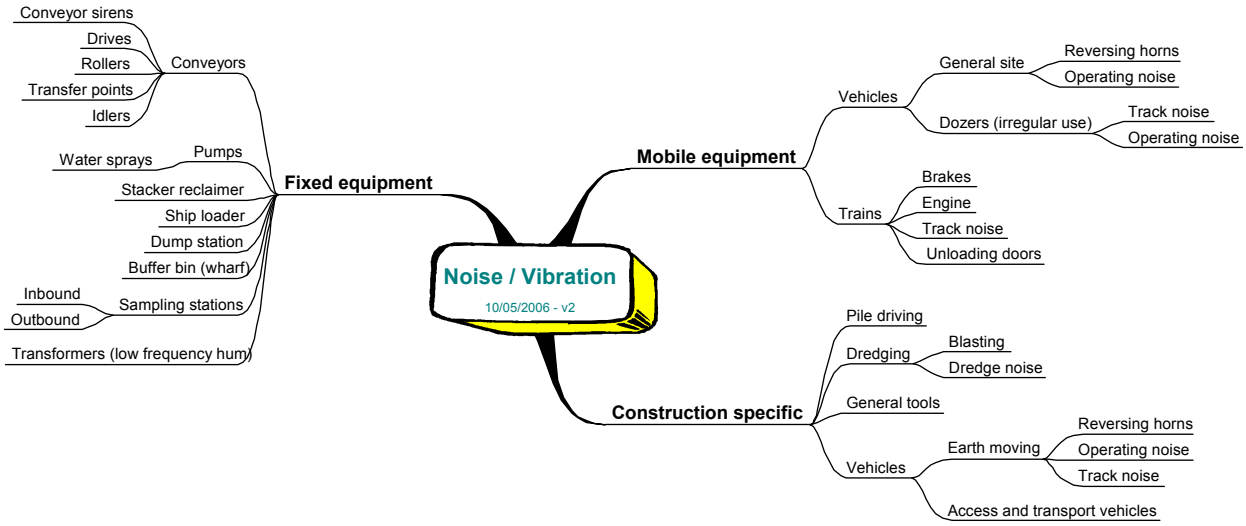


Figure 7 – Water Key Risk Group Scenarios

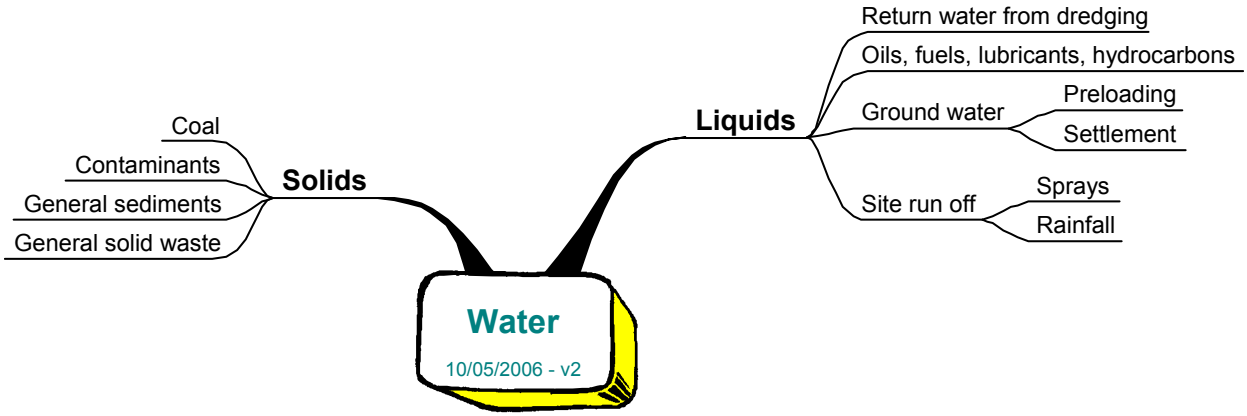
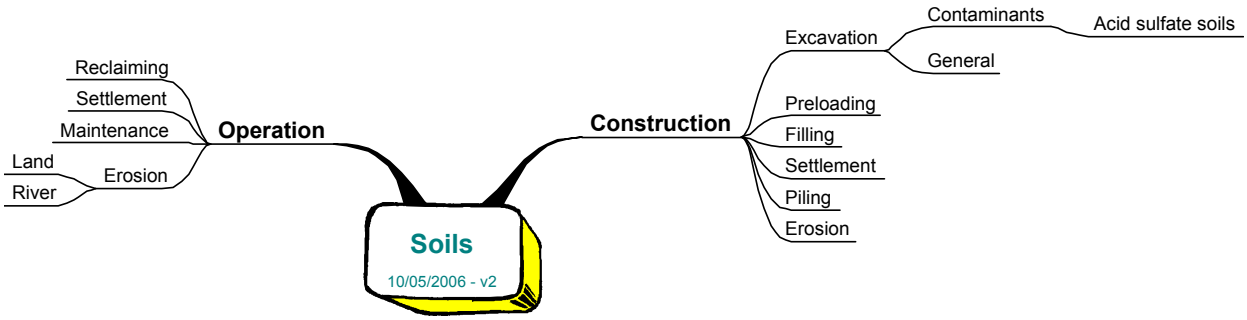


Figure 8 – Soils Key Risk Group Scenarios



The team also examined areas that were deemed by the team to be outside the scope of the ERA, and which are referred to NCIG for consideration in the Environmental Assessment. Figures 9 and 10 present the logic trees developed for socio-economics and transport, respectively.

Figure 9 – Socio-economic Factors Grouped (referred to NCIG)

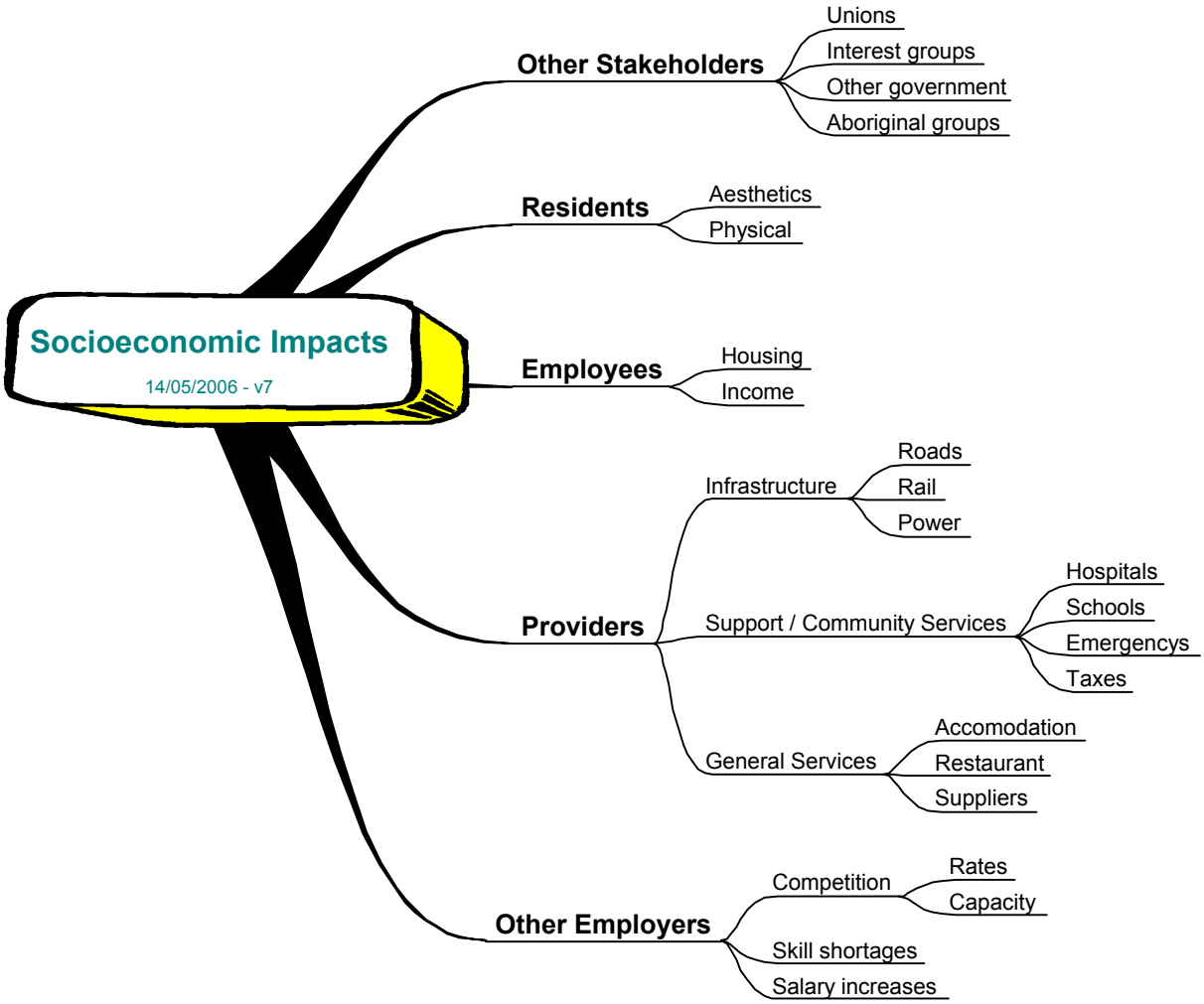
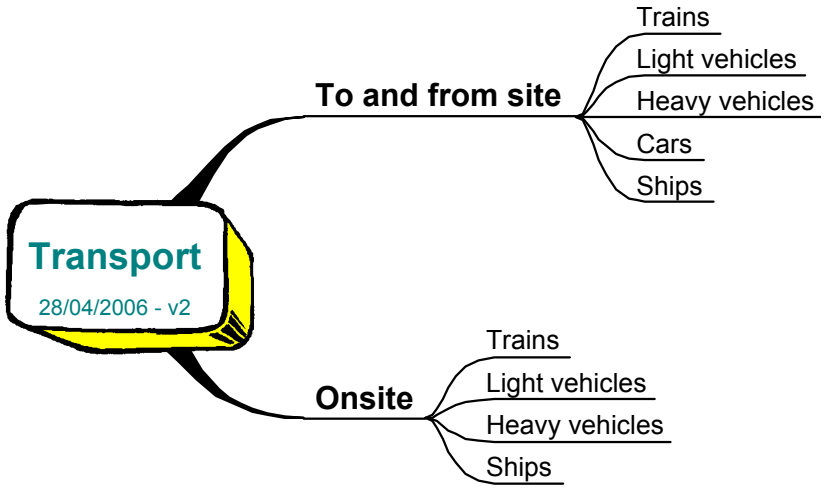


Figure 10 – Transport Related Issues (referred to NCIG)



3.3 Referred Issues

Referred Issues are those issues that were raised throughout the hazard identification stages of the ERA that were felt by the team to be beyond the scope of the ERA or were considered to warrant particular consideration in the development of the Environmental Assessment.

All referred issues are directed to NCIG. The referred issues/items from the ERA are listed in Table 3 below:

Table 3 – Referred Issues

Ref	Description of Hazard/Issue
IS092	Impacts of the CET on the surrounding ecosystem function to be considered in the development of the Environmental Assessment.
IS093	Construction vibration impacts to be considered in the development of the Environmental Assessment.
IS095	The information captured in the "socio-economic" and "transport" logic trees (Figures 9 and 10) to be considered in the development of the Environmental Assessment.
IS101	Fauna impacts from on-site traffic to be considered in the development of the Environmental Assessment.
General	NCIG to confirm that the impact of traffic has been addressed appropriately in the Environmental Assessment.

3.4 Assumptions

Several assumptions have been applied to the ERA by the team. Any changes to these assumptions as well as new relevant information should trigger a review of these assumptions. The assumptions are as follows:

- off-site coal rail transport issues are addressed by the Australian Rail Track Corporation (ARTC); and
- all ship movements in the port are under the control of the Newcastle Port Corporation.

4 ANALYSE RISKS

4.1 Type of Issue

The issues identified throughout the brainstorming and during the development of logic trees were reviewed for their type and were classified as either:

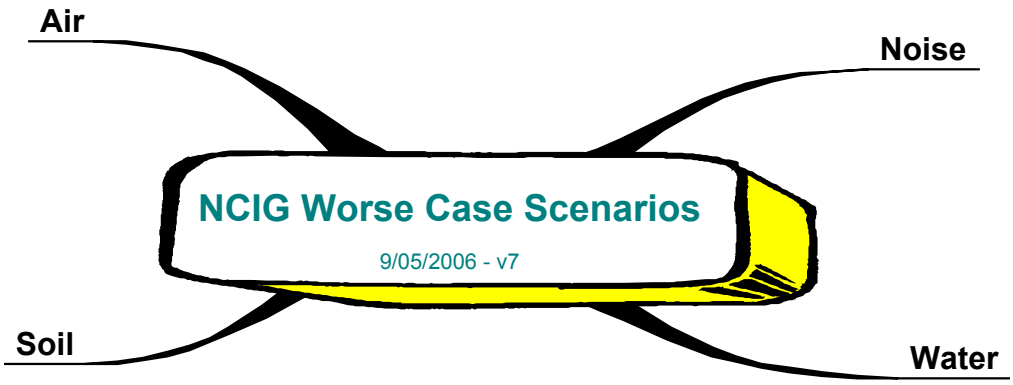
- hazards (for consideration by the team);
- referred issues (which lie outside the scope of the ERA);
- background information (on the site and processes);
- controls (which are not a risk requiring analysis); or
- assumptions (on which the risk analysis and identification of risks is based).

Sorting the issues by their type allows the "Hazards" to be grouped for easier management and assists in the identification of suitable controls.

4.2 Grouping Hazards

An affinity diagram of the subject area allowed the hazards to be collected into logical groups. This tree is a logic tool that takes a "top" unwanted event and considers what contributes to its occurrence. By limiting the analysis process to a high level (that is near the top of the "tree") it is possible to define groups within which the risks (identified by other means) should fit. The tree for the NCIG environmental risks is presented below in Figure 11.

Figure 11 – Key Environmental Risk Groups



4.3 Probability and Maximum Reasonable Consequence

A matrix style analysis was next used to risk rank the key environmental impacts identified. The key environmental impacts (or 'worst-case' scenarios) for each group (ie. air, soil, noise and water) were identified by the team following consideration of all of the scenarios generated from the various methodologies employed (ie. including brain-stormed items). Current controls previously identified by NCIG during pre-development studies were detailed to mitigate the risk. The underlying thinking behind ranking these issues with controls in place was that it more correctly reflects the level of threat that the CET will pose and it also allows for the criticality of controls to be highlighted.

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

Table 4 – Qualitative Measures of Probability

Event	Likelihood	Description	Probability
A	Almost Certain	Happens often	More than 1 event per month
B	Likely	Could easily happen	More than 1 event per year
C	Possible	Could happen and has occurred elsewhere	1 event per 1 to 10 years
D	Unlikely	Hasn't happened yet but could	1 event per 10 to 100 years
E	Rare	Conceivable, but only in extreme circumstances	Less than 1 event per 100 years

Table 5 – Qualitative Measures of Maximum Reasonable Consequence

	People	Environment	Asset/Production
1	Multiple fatalities	Extreme environmental harm (eg. widespread catastrophic impact on environmental values of an area)	More than $500k loss or production delay
2	Permanent total disabilities, single fatality	Major environmental harm (eg. widespread substantial impact on environmental values of an area)	$100 to $500k loss or production delay
3	Major injury or health effects (eg. major lost workday case/permanent disability)	Serious environmental harm (eg. widespread and significant impact on environmental values of an area)	$50 to $100k loss or production delay
4	Minor injury or health effects (eg. restricted work or minor lost workday case)	Material environmental harm (eg. localised and significant impact on environmental values of an area)	$5 to $50k loss or production delay
5	Slight injury or health effects (eg. first aid/minor medical treatment level)	Minimal environmental harm (eg. interference or likely interference to an environmental value)	Less than $5k loss or production delay

Table 6 – Risk Ranking Table

Consequence	Probability				
	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
Rank numbering: 1 – highest risk; 25 – lowest risk

Legend – Risk levels:

	Tolerable
	ALARP – As low as reasonably practicable
	Intolerable

For the key environmental risk groups (Section 4.2) the team identified the key environmental impacts for the Project outlined in Table 7.

Table 7 – Key Environmental Impacts

Key Environmental Risk Group	Scenario	Risk Ranking[1]	Mitigation Measures
Soil	Loss of habitat in the area to be cleared for construction, most significantly in the area of Big Pond (including an Endangered Ecological Community).	Medium (ALARP) 10	Flora and Fauna Management Plan and Vegetation Clearance Protocol including – minimisation of disturbance areas, strategies for fauna management and protocols for threatened species (a vegetation offset strategy was not incorporated within the mitigation measures).
Noise	Noise generated (particularly at night) potentially leading to off-site annoyance (non-compliance with anticipated Project noise criteria), sleep disturbance and fauna specific impact (although fauna are habituated and unlikely to be affected by normal Project noise).	Medium (ALARP) 15	Low noise design specifications, operating protocols (including maintenance regimes and prompt detection of faults) and Noise Monitoring Programme (including noise monitoring, complaints response protocols and triggers for the implementation of noise mitigation measures) (a noise barrier at sections of the rail loop was not incorporated within the mitigation measures).
Air	Coal dust generated from operations potentially leading to off-site health and amenity impacts and species specific effects.	Low 19	Water sprays, enclosures (conveyors and transfer points) and Air Quality Monitoring Programme (including air quality monitoring, complaints response protocols and triggers for the implementation of dust mitigation measures).
Water	Flow of sediment laden or contaminated water entering Deep Pond affecting the ecology of Deep Pond (which includes an endangered species).	Low 22	Contaminant controls (eg. silt fences and settling ponds) and appropriate construction processes.
	Impact on the Hunter River resulting from contaminated sediments and low pH water flowing from the site.	Low 24	Site drainage systems including settling ponds, monitoring of licensed discharges and containment of site water (design for zero discharge – 1 in 100 year containment).

The outcomes of the risk ranking process are documented in full in Appendix 7.1.
An appropriately detailed impact assessment of the above key environmental impacts will be included in the Project Environmental Assessment.

As the key environmental impacts in relation to soil and noise noted above fall into the 'As Low as Reasonably Practicable' category, it is understood that NCIG will work with the relevant specialists (Dr David Goldney [soil – flora and fauna issues] and Heggies Australia [noise]) to develop additional mitigation measures. These additional mitigation measures will be documented in the Environmental Assessment.

With respect to the key environmental impacts, the issues raised will be addressed in the following reports included as appendices to the Project Environmental Assessment:

- Appendix A Construction, Operation and Road Transport Noise Impact Assessment.
- Appendix B Air Quality Impact Assessment.
- Appendix D Land Contamination and Groundwater Assessment.
- Appendix E Flora Assessment.
- Appendix F Fauna Assessment.

4.4 Issues Table

Table 9 in Appendix 7.2 shows all identified issues.

4.5 Risk Treatment Plans

Detailed Risk Treatment Plans are summarised in Tables 10 to 14 in **Appendix 7.3**.

These plans were prepared considering the principals of the hierarchy of controls and quality management. The team were challenged to identify elimination or engineering controls (i.e. 'hard' controls). A confirming check was made to ensure that the key elements of prevention, monitoring, first response and recovery were represented.

4.6 Ongoing Treatment

As part of the ongoing risk management, existing controls (ie. those currently planned by NCIG) should be assessed and recommendations for amendments or additions made where these existing controls are deemed unacceptable or inadequate.

At a minimum, there should be a focus on prevention of loss and monitoring to ensure that controls are appropriate and effective at all times. Monitoring also includes the early detection of the signs of potential loss so that appropriate responses can be employed before an unwanted event. If there are only some soft controls in place to manage a hazard, any ongoing work should identify additional hard controls wherever possible.

4.7 Resources and Funding

Resources and funding to implement the risk treatment plans have been allowed for by NCIG. Any variation to the recommended risk treatment plan must be documented with justification and explanation of any proposed changes. This may include additional cost benefit analysis of treatment options before controls are finally agreed and implemented.

4.8 Additional Controls

In addition to those controls noted in **Appendix 7.3**, additional controls with respect to water management during construction and operation of the CET were devised by NCIG in a report entitled *Kooragang Island Coal Export Terminal Review of Civil and Earthworks Impacts on the NCIG Site* (NCIG, 2006). NCIG (2006) includes a review of risks with respect to water management issues. The risk review was undertaken by the NCIG management team and the Connell Hatch study team (*ibid.*).

The key outcomes and specific additional controls are documented here to augment controls presented in **Appendix 7.3** (particularly Tables 12 and 14).

This report concluded

> *"NCIG review of the sub soil and groundwater risks associated with construction and operation of the new CET indicate that they are residual risks but that these are within tolerable limits. Mitigation strategies are considered as back up for risk event occurrences."*

A summary of the mitigation measures outlined in NCIG (2006) that are additional to those considered during the ERA workshop is provided below:

- any groundwater that is dewatered from the Project excavations and is not considered suitable for re-use would be temporarily stored in dedicated cells with low permeability liners (e.g. compacted clay or geo-membrane) before being treated for re-use and/or removed from site by an appropriately licensed contractor;
- the use of piled foundations together with a jet-grouted base and secant pile and/or diaphragm sub-surface perimeter walls for construction of the train unloading stations and associated conveyors to minimise groundwater inflow or connection;
- incorporation of a low permeability capping layer into the rail embankment formation to minimise infiltration;
- establishment of groundwater bores to monitor groundwater levels, movement and water quality around the perimeter of the coal storage area and along the rail infrastructure corridor;
- development of an Site Water Management Plan which describes groundwater monitoring programme, management triggers, investigation procedures and details of contingency measures; and
- if the groundwater monitoring programme indicates the need, the implementation of groundwater management contingency measures such as:
  - localised temporary pumping of groundwater for subsequent detention, dilution, evaporation, treatment and/or disposal by an appropriately licensed contractor (depending on water quality and quantity); and/or
  - the construction of localised sub-surface groundwater barriers (e.g. bentonite filled trench or geo-membrane) to control groundwater migration.

5 CONCLUDING REMARKS

The risk analysis process conducted by the team was aligned with the AS 4360 -2004 *Risk Management*.

The objective of the process was to identify key environmental impacts associated with the Project. These risks were then grouped, and the most significant item in each group ranked using the NCIG ERA matrix tools (Section 7.3). An appropriately detailed impact assessment of these key environmental impacts will be included in the Project Environmental Assessment. Controls and actions were then identified in order to reduce the level of those risks to "As Low As Reasonably Practicable".

The "targeted" risk rankings indicate that the risks should be minimised to "As Low As Reasonably Practicable" after the rigorous application, verification and validation of the controls identified (both current and additional). Any variation to the recommended risk treatment plan must be documented with justification and explanation of any proposed changes.

6 REFERENCES

Department of Planning (2006) *NCIG Kooragang Coal Export Terminal Environmental Assessment Requirements under Part 3A of the Environmental Planning and Assessment Act 1979*.

NSW Department of Mineral Resources (1997) *Risk Management Handbook for the Mining Industry*. MDG1010, May 1997.

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

7 APPENDICES

7.1 Risk Rankings

Table 8 shows the Risk Rankings for the key potential environmental impacts in each Group, and the corresponding identified Existing Controls and Recommended Actions to improve existing controls or implement new controls. The risk ranking matrices are presented in Tables 4, 5 and 6.

Table 8 – Risk Ranking of Groups

Ref	Source	Description of Hazard/Issue#	Type	Category/ Group	Existing Controls *	Consequence	Probability	Rank (1 to 25)
IS091	Grouping	Loss of habitat in the area to be cleared for construction, most significantly in the area of Big Pond (including an Endangered Ecological Community).	Hazard	Soil	Flora and Fauna Management Plan and Vegetation Clearance Protocol including – minimisation of disturbance areas, strategies for fauna management and protocols for threatened species (a vegetation offset strategy was not incorporated within the mitigation measures).	4	A	**10 Med. ALARP**
IS088	Grouping	Noise generated (particularly at night) potentially leading to off site annoyance (non-compliance with anticipated Project noise criteria), sleep disturbance and fauna specific impact (although fauna are habituated and unlikely to be affected by normal project noise).	Hazard	Noise	Low noise design specifications, operating protocols (including maintenance regimes and prompt detection of faults) and Noise Monitoring Programme (including noise monitoring, complaints response protocols and triggers for the implementation of noise mitigation measures) (a noise barrier at sections of the rail loop was not incorporated within the mitigation measures).	5	A	**15 Med. ALARP**
IS087	Grouping	Coal dust generated from operations potentially leading to offsite health and amenity impacts and species specific effects.	Hazard	Air	Water sprays, enclosures (conveyors and transfer points) and Air Quality Monitoring Programme (including air quality monitoring, complaints response protocols and triggers for the implementation of dust mitigation measures).	5	B	**19 Low**
IS090	Grouping	Flow of sediment laden or contaminated water entering Deep Pond affecting the ecology of Deep Pond (which includes an endangered species).	Hazard	Water	Contaminant controls (eg. silt fences and settling ponds) and appropriate construction processes.	5	C	**22 Low**
IS089	Grouping	Impact on the Hunter River resulting from contaminated sediments and low pH water flowing from the site.	Hazard	Water	Site drainage systems including settling ponds, monitoring of licensed discharges and containment of site water (design for zero discharge – 1 in 100 year containment).	5	D	**24 Low**

* Controls already planned by NCIG.

\# It is envisaged that an appropriately detailed impact assessment of these key environmental impacts will be included in the Environmental Assessment.

7.2 Issues and Risk Treatments

Table 9 – Complete Listing of Identified Hazards (Sorted by Group)

Ref	Source	Description of Hazard/Issue	Type	Category/ Group	Controls (from LOPA[1]) (Treatments)
IS003	Brainstorm	Fire	Hazard	Air	1.2.2.3 Fire control; and 1.1.3.2 Off-site Emergency Response
IS016	Brainstorm	Odour	Hazard	Air	1.1.1.6 Hazchem Management Plan; and 1.1.3.2 Emergency Response
IS028	Brainstorm	Continuing drought / poor water supply for dust suppression	Hazard	Air	Maintenance of sufficient water at all times.
IS034	Brainstorm	Spontaneous combustion of stockpiles	Hazard	Air	Spontaneous Combustion Management Plan including stockpile management and spray controls
IS045	Brainstorm	Dust control on wide coal stockpiles	Hazard	Air	1.2.2.1 Spray controls
IS048	Brainstorm	Diesel emission	Hazard	Air	1.2.1.9 Fuel monitoring
IS054	Brainstorm	Hazardous materials impacts on site	Hazard	Air	1.1.1.6 Hazchem Management Plan; and 1.1.3.2 Emergency Response
IS060	Brainstorm	Diesel fumes from trains when unloading	Hazard	Air	1.2.1.9 Fuel monitoring
IS069	Brainstorm	Moisture monitors - radiation sources	Hazard	Air	1.1.1.6 Hazchem Management Plan
IS087	Grouping	Coal dust generated from operations potentially leading to offsite health and amenity impacts and species specific effects	Hazard	Air	1.3.2.1 Trigger controls for dust generation
IS103	Logic Trees	Impact on Air from Dust due to Construction and closure in particular Excavation	Hazard	Air	1.1.1.5 Excavation Management Plan
IS104	Logic Trees	Impact on Air from Dust due to Construction and closure in particular Filling	Hazard	Air	1.1.1.5 Excavation Management Plan
IS105	Logic Trees	Impact on Air from Dust due to Construction and closure in particular Stockpiles	Hazard	Air	1.2.1.1 Sprays; 1.1.1.2 Stockpile geometry; and 1.3.1.2 Stockpile management
IS106	Logic Trees	Impact on Air from Dust due to Construction and closure in particular Wind erosion	Hazard	Air	1.1.1.5 Construction Management Plan
IS107	Logic Trees	Impact on Air from Dust due to Construction and closure in particular Vehicle movement	Hazard	Air	Traffic Management processes
IS108	Logic Trees	Impact on Air from Dust due to Operation in particular Unloading	Hazard	Air	1.2.1.1 Sprays, etc. (no specific control)
IS109	Logic Trees	Impact on Air from Dust due to Operation in particular Stacking	Hazard	Air	1.2.1.1 Sprays; 1.1.1.2 Stockpile geometry; and 1.3.1.2 Stockpile management
IS110	Logic Trees	Impact on Air from Dust due to Operation in particular Reclaiming	Hazard	Air	1.2.1.1 Sprays; 1.1.1.2 Stockpile geometry; and 1.3.1.2 Stockpile management

Ref	Source	Description of Hazard/Issue	Type	Category/ Group	Controls (from LOPA[1]) (Treatments)
IS111	Logic Trees	Impact on Air from Dust due to Operation in particular Ship loading	Hazard	Air	1.2.1.1 Water sprays
IS112	Logic Trees	Impact on Air from Dust due to Operation in particular Vehicle movement	Hazard	Air	Traffic Management processes
IS113	Logic Trees	Impact on Air from Dust due to Operation in particular Maintenance tasks	Hazard	Air	3.3.1.1 Maintenance procedures
IS114	Logic Trees	Impact on Air from Dust due to Operation in particular Wind erosion	Hazard	Air	1.2.1.1 Sprays
IS115	Logic Trees	Impact on Air from Contaminants due to Construction and closure in particular Excavation	Hazard	Air	1.1.1.5 Construction Management Plan (including consideration of excavations)
IS116	Logic Trees	Impact on Air from Contaminants due to Construction and closure in particular Filling	Hazard	Air	1.1.1.5 Construction Management Plan (including consideration of excavations)
IS117	Logic Trees	Impact on Air from Contaminants due to Construction and closure in particular Stockpiling	Hazard	Air	1.1.1.2 Stockpile geometry; and 1.3.1.2 Stockpile management
IS118	Logic Trees	Impact on Air from Contaminants due to Construction and closure in particular Wind erosion	Hazard	Air	1.1.1.5 Construction Management Plan (including consideration of excavations)
IS119	Logic Trees	Impact on Air from Contaminants due to Construction and closure in particular Vehicle movement	Hazard	Air	Traffic Management processes
IS120	Logic Trees	Impact on Air from Contaminants due to Operation	Hazard	Air	1.2.1.1 Water sprays
IS121	Logic Trees	Impact on Air from Contaminants due to Operation in particular Vehicle movement	Hazard	Air	Traffic Management processes
IS122	Logic Trees	Impact on Air from Fumes due to Other[2] in particular Coal or equipment Fires	Hazard	Air	1.2.2.3 Fire control; and 1.1.3.2 Off-site Emergency Response
IS123	Logic Trees	Impact on Air from Fumes due to Other[2] in particular Coal or equipment Fires and specifically Product of Combustion	Hazard	Air	1.2.2.3 Fire control; and 1.1.3.2 Off site Emergency Response
IS124	Logic Trees	Impact on Air from Fumes due to Other[2] in particular Coal or equipment Fires and specifically Fire suppression chemicals	Hazard	Air	1.1.1.6 Hazchem Management Plan
IS125	Logic Trees	Impact on Air from Fumes due to Other[2] in particular Hazchem and specifically Glues	Hazard	Air	1.1.1.6 Hazchem Management Plan
IS126	Logic Trees	Impact on Air from Fumes due to Other[2] in particular Hazchem and specifically Paints	Hazard	Air	1.1.1.6 Hazchem Management Plan
IS127	Logic Trees	Impact on Air from Fumes due to Other[2] in particular Hazchem and specifically Solvents	Hazard	Air	1.1.1.6 Hazchem Management Plan
IS128	Logic Trees	Impact on Air from Fumes due to Other[2] in particular Hazchem and specifically Fuel storage	Hazard	Air	1.1.1.6 Hazchem Management Plan
IS129	Logic Trees	Impact on Air from Fumes due to Other[2] in particular Hazchem and specifically Chemical toilets (construction)	Hazard	Air	1.1.1.6 Hazchem Management Plan

Ref	Source	Description of Hazard/Issue	Type	Category/ Group	Controls (from LOPA[1]) (Treatments)
IS130	Logic Trees	Impact on Air from Fumes due to Other[2] in particular Grass fires	Hazard	Air	1.2.2.3 Fire control; and 1.1.3.2 Off-site Emergency Response
IS131	Logic Trees	Impact on Air from Engines due to Trains	Hazard	Air	No particular control – not NCIG responsibility
IS132	Logic Trees	Impact on Air from Engines due to Site vehicles	Hazard	Air	Engine Maintenance
IS133	Logic Trees	Impact on Air from Engines due to Fixed engines	Hazard	Air	Engine Maintenance
IS134	Logic Trees	Impact on Air from Engines due to Vessels	Hazard	Air	No particular control – not NCIG responsibility
IS135	Logic Trees	Impact on Air from Odour due to Spon com	Hazard	Air	1.2.2.3 Fire control; and 1.1.3.2 Off-site Emergency Response
IS136	Logic Trees	Impact on Air from Odour due to Dredge materials	Hazard	Air	2.1.1.5 Soil Management Plan
IS137	Logic Trees	Impact on Air from Odour due to Stockpile sprays	Hazard	Air	1.1.2.2 Audit of air monitoring
IS138	Logic Trees	Impact on Air from Odour due to Contaminated soils	Hazard	Air	2.1.1.5 Soil Management Plan
IS001	Brainstorm	Dust/noise	Hazard	Noise	1.2.1.1 Water sprays 3.3.1.1 Regular noise monitoring with linkage to site maintenance procedures
IS017	Brainstorm	Vibration particularly from construction	Hazard	Noise	3.2.1.5 Machine and plant controls
IS040	Brainstorm	Noise impacts on native animals	Hazard	Noise	3.3.1.3 Day time works - plus habituated fauna
IS046	Brainstorm	Dozer usage on stockpiles - noise emissions	Hazard	Noise	3.3.1.2 Minimal dozer use
IS062	Brainstorm	Hazardous areas (electrical)	Hazard	Noise	3.3.1.1 Regular noise monitoring with linkage to site maintenance procedures
IS065	Brainstorm	Rail noise	Hazard	Noise	3.2.1.1 Noise barriers
IS068	Brainstorm	Increase traffic noise	Hazard	Noise	3.3.1.1 Regular noise monitoring with linkage to site maintenance procedures
IS088	Grouping	Noise generated (particularly at night) potentially leading to off site annoyance, sleep disturbance and fauna specific impact. (Although they are habituated and less likely to be affected by normal noises)	Hazard	Noise	3.3.1.1 Regular noise monitoring with linkage to site maintenance procedures
IS094	Close out	Transfer points will not be inside closed buildings	Hazard	Noise	3.3.1.1 Regular noise monitoring with linkage to site maintenance procedures
IS139	Logic Trees	Impact on Noise/Vibration from Mobile equipment due to Vehicles in particular General site	Hazard	Noise	3.3.1.1 Regular noise monitoring with linkage to site maintenance procedures
IS140	Logic Trees	Impact on Noise/Vibration from Mobile equipment due to Vehicles in particular General site and specifically Reversing horns	Hazard	Noise	3.3.1.1 Regular noise monitoring with linkage to site maintenance procedures; and 3.2.1.6 Equipment sirens specified for frequency and tone

Ref	Source	Description of Hazard/Issue	Type	Category/ Group	Controls (from LOPA[1]) (Treatments)
IS141	Logic Trees	Impact on Noise/Vibration from Mobile equipment due to Vehicles in particular General site and specifically Operating noise	Hazard	Noise	3.3.1.1 Regular noise monitoring with linkage to site maintenance procedures
IS142	Logic Trees	Impact on Noise/Vibration from Mobile equipment due to Vehicles in particular Dozers (irregular use) and specifically Track noise	Hazard	Noise	Daytime use; and 3.3.1.2 Stockpile management
IS143	Logic Trees	Impact on Noise/Vibration from Mobile equipment due to Vehicles in particular Dozers (irregular use) and specifically Operating noise	Hazard	Noise	Daytime use; and 3.3.1.2 Stockpile management
IS144	Logic Trees	Impact on Noise/Vibration from Mobile equipment due to Trains in particular Brakes	Hazard	Noise	3.2.1.1 Noise barriers
IS145	Logic Trees	Impact on Noise/Vibration from Mobile equipment due to Trains in particular Engine	Hazard	Noise	3.2.1.1 Noise barriers
IS146	Logic Trees	Impact on Noise/Vibration from Mobile equipment due to Trains in particular Track noise	Hazard	Noise	3.2.1.1 Noise barriers
IS147	Logic Trees	Impact on Noise/Vibration from Mobile equipment due to Trains in particular Unloading doors	Hazard	Noise	3.2.1.1 Noise barriers (ie. rail unloader within building)
IS148	Logic Trees	Impact on Noise/Vibration from Fixed equipment due to Conveyors in particular Conveyor sirens	Hazard	Noise	3.2.1.6 Directional equipment sirens
IS149	Logic Trees	Impact on Noise/Vibration from Fixed equipment due to Conveyors in particular Drives	Hazard	Noise	3.2.1.1 Noise barriers; and 3.1.1.1 Low noise specifications
IS150	Logic Trees	Impact on Noise/Vibration from Fixed equipment due to Conveyors in particular Rollers	Hazard	Noise	3.1.1.1 Low noise specifications
IS151	Logic Trees	Impact on Noise/Vibration from Fixed equipment due to Conveyors in particular Transfer points	Hazard	Noise	3.1.1.1 Low noise specifications
IS152	Logic Trees	Impact on Noise/Vibration from Fixed equipment due to Conveyors in particular Idlers	Hazard	Noise	3.1.1.1 Low noise specifications; and 3.2.2.1 Maintenance
IS153	Logic Trees	Impact on Noise/Vibration from Fixed equipment due to Pumps in particular Water sprays	Hazard	Noise	3.3.1.1 Regular noise monitoring with linkage to site maintenance procedures
IS154	Logic Trees	Impact on Noise/Vibration from Fixed equipment due to Stacker reclaimer	Hazard	Noise	3.3.1.1 Regular noise monitoring with linkage to site maintenance procedures
IS155	Logic Trees	Impact on Noise/Vibration from Fixed equipment due to Ship loader	Hazard	Noise	3.1.1.1 Low noise specifications; and 3.1.1.8 Scheduling of activities
IS156	Logic Trees	Impact on Noise/Vibration from Fixed equipment due to Dump station	Hazard	Noise	3.2.1.1 Noise barriers (ie. rail unloader within building)
IS157	Logic Trees	Impact on Noise/Vibration from Fixed equipment due to Buffer bin (wharf)	Hazard	Noise	3.1.1.1 Low noise specifications

Ref	Source	Description of Hazard/Issue	Type	Category/ Group	Controls (from LOPA[1]) (Treatments)
IS158	Logic Trees	Impact on Noise/Vibration from Fixed equipment due to Sampling stations	Hazard	Noise	3.1.1.1 Low noise specifications
IS159	Logic Trees	Impact on Noise/Vibration from Fixed equipment due to Sampling stations (Inbound)	Hazard	Noise	3.1.1.1 Low noise specifications
IS160	Logic Trees	Impact on Noise/Vibration from Fixed equipment due to Sampling stations (Outbound)	Hazard	Noise	3.1.1.1 Low noise specifications
IS161	Logic Trees	Impact on Noise/Vibration from Fixed equipment due to Transformers (low frequency hum)	Hazard	Noise	3.1.1.1 Low noise specifications
IS162	Logic Trees	Impact on Noise/Vibration from Construction specific due to Pile driving	Hazard	Noise	3.1.1.2 Construction management
IS163	Logic Trees	Impact on Noise/Vibration from Construction specific due to Dredging in particular Blasting	Hazard	Noise	Not part of the Project.
IS164	Logic Trees	Impact on Noise/Vibration from Construction specific due to Dredging in particular Dredge noise	Hazard	Noise	Not part of the Project.
IS165	Logic Trees	Impact on Noise/Vibration from Construction specific due to General tools	Hazard	Noise	3.1.1.2 Construction management
IS166	Logic Trees	Impact on Noise/Vibration from Construction specific due to Vehicles in particular Earth moving and specifically Reversing horns	Hazard	Noise	Daytime use of equipment 3.1.1.2 Construction management 3.2.1.6 Directional equipment sirens
IS167	Logic Trees	Impact on Noise/Vibration from Construction specific due to Vehicles in particular Earth moving and specifically Operating noise	Hazard	Noise	Daytime use of equipment 3.1.1.2 Construction management
IS168	Logic Trees	Impact on Noise/Vibration from Construction specific due to Vehicles in particular Earth moving and specifically Track noise	Hazard	Noise	Daytime use of equipment 3.1.1.2 Construction management
IS169	Logic Trees	Impact on Noise/Vibration from Construction specific due to Vehicles in particular Access and transport vehicles	Hazard	Noise	Daytime use of equipment 3.1.1.2 Construction management
IS004	Brainstorm	Excavation	Hazard	Soil	1.1.1.5 Excavation Management Plan
IS005	Brainstorm	Green and golden bell frogs	Hazard	Soil	2.3.1.1 Relocation; and 1.1.1.5 Excavation Management
IS006	Brainstorm	Threatened species	Hazard	Soil	2.3.1.1 Relocation; and 1.1.1.5 Excavation Management
IS011	Brainstorm	Coal spillage from coal overpass	Hazard	Soil	2.1.1.1 Environmental Management Plan – facilitating appropriate design
IS018	Brainstorm	Waste disposal problems	Hazard	Soil	2.1.1.1 Environmental Management Plan

Ref	Source	Description of Hazard/Issue	Type	Category/ Group	Controls (from LOPA[1]) (Treatments)
IS020	Brainstorm	Geotech issues - settlement slope stability	Hazard	Soil	2.1.1.5 Soil Management Plan; and 2.1.1.1 Environmental Management Plan – facilitating appropriate design
IS021	Brainstorm	Construction on contaminated land	Hazard	Soil	2.1.1.5 Soil Management Plan; and 2.1.1.1 Environmental Management Plan
IS025	Brainstorm	Floods and structural change	Hazard	Soil	2.1.1.1 Environmental Management Plan
IS027	Brainstorm	Bringing in off site construction material and impacts	Hazard	Soil	2.1.1.5 Soil Management Plan; and 2.1.1.1 Environmental Management Plan
IS032	Brainstorm	Bank stability - including southern bank	Hazard	Soil	2.1.1.1 Environmental Management Plan– facilitating appropriate design
IS035	Brainstorm	Reduction of wetland area	Hazard	Soil	2.1.1.1 Environmental Management Plan
IS037	Brainstorm	Two threatened ecological communities	Hazard	Soil	2.3.1.1 Relocation; and 1.1.1.5 Excavation Management
IS038	Brainstorm	Intro of exotic animals	Hazard	Soil	2.1.1.1 Environmental Management Plan
IS051	Brainstorm	Rehabilitation of site D with rail and other vessels	Hazard	Soil	2.1.1.1 Environmental Management Plan
IS056	Brainstorm	Hazards coming from poor design / construction process	Hazard	Soil	2.1.1.1 Environmental Management Plan
IS061	Brainstorm	Broader extent of contaminated fill (dredging)	Hazard	Soil	2.1.1.5 Soil Management Plan; and 3.1.1.2 Construction management
IS066	Brainstorm	LPC related losses	Hazard	Soil	2.1.1.1 Environmental Management Plan
IS070	Brainstorm	Nesting in "created" habitats	Hazard	Soil	2.3.1.1 Relocation; and 1.1.1.5 Excavation Management
IS075	Brainstorm	Construction and operation impacts on Ash Island and general habitat	Hazard	Soil	2.1.1.1 Environmental Management Plan
IS077	Brainstorm	Bank erosion caused by shipping vessel	Hazard	Soil	2.1.1.1 Environmental Management Plan– facilitating appropriate design
IS078	Brainstorm	Impacts of North bank mangroves	Hazard	Soil	2.1.1.1 Environmental Management Plan
IS079	Brainstorm	Coal spillage along the track	Hazard	Soil	2.1.1.1 Environmental Management Plan
IS091	Grouping	Loss of habitat in the area cleared for construction, most significantly in the area of Big Pond (EEC)	Hazard	Soil	2.3.1.1 Relocation; and 1.1.1.5 Excavation Management
IS099	Close out	There are a series of species listed in document from department of planned which are unlikely to be onsite but were supposed to be considered	Hazard	Soil	2.1.1.1 Environmental Management Plan
IS182	Logic Trees	Impact on Ground Disturbance from Construction due to Excavation	Hazard	Soil	2.1.1.1 Environmental Management Plan; and 1.1.1.5 Excavation Management Plan

Ref	Source	Description of Hazard/Issue	Type	Category/ Group	Controls (from LOPA[1]) (Treatments)
IS183	Logic Trees	Impact on Ground Disturbance from Construction due to Preloading	Hazard	Soil	2.1.1.1 Environmental Management Plan
IS184	Logic Trees	Impact on Ground Disturbance from Construction due to Filling	Hazard	Soil	2.1.1.1 Environmental Management Plan
IS185	Logic Trees	Impact on Ground Disturbance from Construction due to Settlement	Hazard	Soil	2.1.1.1 Environmental Management Plan
IS186	Logic Trees	Impact on Ground Disturbance from Construction due to Piling	Hazard	Soil	2.1.1.1 Environmental Management Plan
IS187	Logic Trees	Impact on Ground Disturbance from Construction due to Erosion	Hazard	Soil	2.1.1.1 Environmental Management Plan
IS188	Logic Trees	Impact on Ground Disturbance from Operation due to Reclaiming	Hazard	Soil	2.1.1.1 Environmental Management Plan
IS189	Logic Trees	Impact on Ground Disturbance from Operation due to Settlement	Hazard	Soil	2.1.1.1 Environmental Management Plan
IS190	Logic Trees	Impact on Ground Disturbance from Operation due to Maintenance	Hazard	Soil	2.1.1.1 Environmental Management Plan
IS191	Logic Trees	Impact on Ground Disturbance from Operation due to Erosion in particular Land	Hazard	Soil	2.1.1.1 Environmental Management Plan
IS192	Logic Trees	Impact on Ground Disturbance from Operation due to Erosion in particular River	Hazard	Soil	2.1.1.1 Environmental Management Plan
IS002	Brainstorm	Contaminated water run off	Hazard	Water	4.1.1.1 Environmental Management Plan – facilitating appropriate design
IS012	Brainstorm	Coal spillage - ship loading	Hazard	Water	4.1.1.1 Environmental Management Plan – facilitating appropriate design
IS013	Brainstorm	Loss of TX oil - sub tanks to river	Hazard	Water	4.1.1.1 Environmental Management Plan– facilitating appropriate design; and Hydro-Carbon spill response
IS026	Brainstorm	Failure of site water management system	Hazard	Water	4.1.1.1 Environmental Management Plan
IS030	Brainstorm	Ground water quality impacts	Hazard	Water	4.1.1.1 Environmental Management Plan, and monitoring
IS033	Brainstorm	Flooding of river and site	Hazard	Water	4.1.1.1 Environmental Management Plan and water management structures
IS041	Brainstorm	Spills and leachate into freshwater areas	Hazard	Water	4.1.1.1 Environmental Management Plan
IS042	Brainstorm	Changed hydrological impacts on site ecology	Hazard	Water	4.1.1.1 Environmental Management Plan, and relocation
IS050	Brainstorm	Releases while bunkering ships and / or ship related losses	Hazard	Water	4.1.1.1 Environmental Management Plan
IS053	Brainstorm	On site diesel fuel storage / spillage	Hazard	Water	4.1.1.2 Environmental Management Plan– facilitating appropriate design; and Hydro-Carbon spill response
IS057	Brainstorm	River pollution from dredging	Hazard	Water	4.1.1.1 Environmental Management Plan
IS058	Brainstorm	River pollution from piling / bank stabilisation	Hazard	Water	4.1.1.1 Environmental Management Plan

Ref	Source	Description of Hazard/Issue	Type	Category/ Group	Controls (from LOPA[1]) (Treatments)
IS072	Brainstorm	Mobilising of ground water from construction / super incumbent loading	Hazard	Water	4.1.1.1 Environmental Management Plan
IS074	Brainstorm	Failure of site sewer main	Hazard	Water	4.1.1.1 Environmental Management Plan
IS086	Brainstorm	Net water usage on site and water re-use	Hazard	Water	4.1.1.1 Environmental Management Plan
IS089	Grouping	Impact on the Hunter River resulting from contaminated sediments and low pH water flowing from the site	Hazard	Water	4.1.1.1 Environmental Management Plan
IS090	Grouping	Flow of sediment laden or contaminated water entering Deep Pond and managing the ecology of Deep Pond which includes an endangered species	Hazard	Water	4.1.1.1 Environmental Management Plan
IS170	Logic Trees	Impact on Water from Liquids due to Return water from dredging	Hazard	Water	4.1.1.1 Environmental Management Plan
IS171	Logic Trees	Impact on Water from Liquids due to Oils, fuels, lubricants, hydrocarbons	Hazard	Water	4.1.1.1 Environmental Management Plan
IS172	Logic Trees	Impact on Water from Liquids due to Ground water	Hazard	Water	4.1.1.1 Environmental Management Plan
IS173	Logic Trees	Impact on Water from Liquids due to Ground water in particular Preloading	Hazard	Water	4.1.1.1 Environmental Management Plan
IS174	Logic Trees	Impact on Water from Liquids due to Ground water in particular Settlement	Hazard	Water	4.1.1.1 Environmental Management Plan
IS175	Logic Trees	Impact on Water from Liquids due to Site run off	Hazard	Water	4.1.1.1 Environmental Management Plan
IS176	Logic Trees	Impact on Water from Liquids due to Site run off in particular Sprays	Hazard	Water	4.1.1.1 Environmental Management Plan
IS177	Logic Trees	Impact on Water from Liquids due to Site run off in particular Rainfall	Hazard	Water	4.1.1.1 Environmental Management Plan
IS178	Logic Trees	Impact on Water from Solids due to Coal	Hazard	Water	4.1.1.1 Environmental Management Plan
IS179	Logic Trees	Impact on Water from Solids due to Contaminants	Hazard	Water	4.1.1.1 Environmental Management Plan
IS180	Logic Trees	Impact on Water from Solids due to General sediments	Hazard	Water	4.1.1.1 Environmental Management Plan
IS181	Logic Trees	Impact on Water from Solids due to General solid waste	Hazard	Water	4.1.1.1 Environmental Management Plan

[1] Level of Protection Analysis
[2] Refer to Figure 5

7.3 Consolidated Control Framework and Commitments

Table 6 contains all the controls identified by the team during the ERA. Some of these tasks are "general practice" for operators of similar facilities – while others are marked as "Commitments" that NCIG will implement.

The table below contains all of the controls – grouped according to their area of operation. The logic of the controls is one of providing a depth of defence to prevent an unwanted event from occurring. To achieve this "depth" controls are in place in each of the system[2] areas of: Controlled Work Environment (CWE) which is the area where senior management act to set the framework for an operation; Equipment – the plant deployed at the facility; Procedures – the documented methods for conducting works, and; People – the employment, training and supervision of personnel who work at the facility.

Further to having controls present in each system area – the nature of the controls should reflect a process that addresses four key types of application:

1. Prevention – controls to stop the threat being realised.
2. Monitoring – to confirm that the preventative controls continue to work and that the underlying threat is not changing.
3. First Response – controls to react to changes in the threat or the security of controls (including complaints handling).
4. Recovery – methods to minimise a loss should a worst case event occur.

Table 6 has numbered controls – and the numbers represent the threat being addressed and the nature of their control in the first three numbers. The last number in the set of four "counts" the number of controls in a particular area of application to provide a unique reference for each. So in the sequence *a.b.c.d* *a* indicates the group – 1 = Air Quality, 2 = Soil, 3 = Noise and 4 = Water. *b* indicates the area of control application with 1 = CWE, 2 = Equipment, 3 = Procedures and 4 = People and *c* indicates the manner of control application – 1 = Prevent / Monitor, 2 = First Response and 3 = Recovery. As mentioned *d* is a reference to the number of the control in the *a.b.c* grouping.

For example, 1.1.3.1 is Group Air Quality, Area CWE, Application – Recovery and it is the first control in this grouping. The complete suite of controls – shown in the control management framework is presented in Tables 6 to 10 below.

[2] As defined by Prof Bill Nertney following a study of a large number of organisational accidents in the US energy sector.

Table 10 – Identified Control Commitments

Type of Control	Control Reference		Commitment Information (by whom and when)
Engineering – Monitoring	1.1.1.1	Design of a fully automated control system linked to a weather station	NCIG, prior to operations commencing
Management Plan – Prevention	1.1.1.3	Air quality monitoring management plan	NCIG, prior to commencement of construction
Management Plan – Prevention	1.1.1.5	Management system for excavation works in contaminated areas	NCIG, prior to commencement of construction
Management Plan – First Response	1.1.2.1	Link critical wind speed monitoring to other triggers	NCIG, within 3 months of construction commencing
Management Plan – Complaints Handling	1.1.3.1	Complaints handling processes on site	NCIG, within 3 months of construction commencing
Engineering – Prevention	1.2.1.3	Wind monitoring linked to spray operation	NCIG, prior to operations commencing
Engineering – Prevention	1.2.1.5	Bunding and tree corridor along Cormorant road and wind / dust break	NCIG, within 12 months of construction commencing
Engineering – Prevention	1.2.1.6	Use of renewable energies for environmental monitoring devices	NCIG, within 3 months of construction commencing
Management Plan – Prevention	1.3.1.2	Stockpile management procedures (can consolidate piles as allowed by customers)	NCIG, within 3 months of operations commencing
Management Plan – First Response	1.3.2.1	Trigger points on dust make modifying production behaviours	NCIG, within 3 months of operations commencing
Training – Prevention	1.4.1.2	Training in operating tasks that includes environmental parameters	NCIG, within 3 months of operations commencing
Management Plan – Prevention	2.1.1.1	Environmental management plan	NCIG, prior to commencement of construction
Management Plan – Prevention	2.1.1.2	Flora and Fauna management plan	NCIG, prior to commencement of construction
Management Plan – Prevention	2.1.1.5	Soil management plan	NCIG, prior to commencement of construction
Management Plan – Prevention	2.1.1.7	Erosion and sediment control plan	NCIG, prior to commencement of construction
Management Plan – Prevention	2.2.1.1	Sediment control structures	NCIG, within 3 months of construction commencing
Management Plan – Prevention	2.3.2.1	SMP register for soil movements and any treatments required	NCIG, prior to commencement of construction
Training – Prevention	2.4.1.1	Construction crew trained in environmental issues for site	NCIG, prior to commencement of construction
Management Plan – Prevention	3.1.2.1	Auditing of noise quality monitoring management plan for conformance and effectiveness	NCIG, within 3 months of construction commencing
Engineering – Prevention	3.2.1.3	Bunding with trees adjacent to coal stockpiles along Cormorant Road	NCIG, within 12 months of construction commencing
Engineering – Prevention	3.3.1.1	Regular noise monitoring with linkage to site maintenance procedures	NCIG, within 3 months of operations commencing
Procedure – Prevention	4.3.1.1	Decontamination procedure for leaving site D	NCIG, prior to commencement of construction

Table 11 – Air Quality Controls

	Preventative/Monitoring Controls	First Response/Monitoring	Recovery
Controlled Work Environment (CWE)	1.1.1.1 Design of a fully automated control system linked to a weather station 1.1.1.2 Orientation of stockpiles to align with prevailing winds 1.1.1.3 Air quality monitoring management plan 1.1.1.4 Greenhouse gas audits and power effectiveness 1.1.1.5 Management system for excavation works in contaminated areas 1.1.1.6 Hazchem management plan and meeting the Dangerous Goods Codes 1.1.1.7 Review use of bio-diesel for site	1.1.2.1 Link critical wind speed monitoring to other triggers 1.1.2.2 Auditing of Air quality monitoring management plan for conformance and effectiveness 1.1.2.3 Energy auditing	1.1.3.1 Complaints handling processes on site 1.1.3.2 Link to off site Emergency Response for handling exposure of unknown contaminants and items
Equipment	1.2.1.1 Water sprays 1.2.1.2 Enclosures 1.2.1.3 Wind monitoring linked to spray capacity 1.2.1.4 Dust deposition gauges around site 1.2.1.5 Bunding and tree corridor along Cormorant road and wind / dust break 1.2.1.6 Use of renewable energies for monitoring devices 1.2.1.7 Water carts for road dust control 1.2.1.8 Stack separation 1.2.1.9 Equipment authorisation system for qualitative fuel monitoring	1.2.2.1 Manual override on water sprays 1.2.2.2 Maintenance of plant and efficient use of diesel 1.2.2.3 Fire protection system on site and ability to move hot coal	1.2.3.1 Consider the ability to address chronic dust problems with coagulant sprays 1.2.3.2 Link to off site Emergency Response for handling exposure of unknown contaminants and items
Procedure	1.3.1.1 Increased intensity of spraying based on weather conditions	1.3.2.1 Trigger points on dust make modifying production behaviours	1.3.3.1 Review the ability to address acute dust movement (e.g. road sweeps)

	Preventative/Monitoring Controls	First Response/Monitoring	Recovery
	1.3.1.2 Stockpile management procedures (can consolidate piles as allowed by customers) 1.3.1.3 Procedures for use of fume generating chemicals	1.3.2.2 Feedback protocols	1.3.3.2 Link to off site Emergency Response for handling exposure of unknown contaminants and items 1.3.3.3 Emergency Response plans for fumes
People	1.4.1.1 Induction for site and personnel 1.4.1.2 Training in operating tasks that includes environmental parameters	1.4.2.1 Supervision of personnel	

Table 12 – Soil Controls

	Preventative/Monitoring Controls	First Response/Monitoring	Recovery
Controlled Work Environment (CWE)	2.1.1.1 Environmental Management Plan 2.1.1.2 Flora and Fauna Management Plan 2.1.1.3 Engagement of environmental manager for NCIG 2.1.1.4 Major contractors environmental managers 2.1.1.5 Soil management plan 2.1.1.6 Link to Aboriginal groups for specific excavation areas 2.1.1.7 Erosion and sediment control plan	2.1.2.1 Consider establishing link to WIRES for injured fauna recovery	2.1.3.1 Potential application of offsets 2.1.3.2 Formal links with Newcastle Port Corporation
Equipment	2.2.1.1 Sediment control structures 2.2.1.2 Deep pond weir 2.2.1.3 Bank stabilisation construction and inspection regime	2.2.2.1 Earthmoving capacity to repair / improve structures	2.2.3.1 Ability to clean up spills beyond structures 2.2.3.2 Hand fill storage locations for contaminated soils (Soils Management Plan [SMP])
Procedure	2.3.1.1 Review potential for fauna relocation 2.3.1.2 SMP - acid sulphate, dredge material suitability and site D management requirements	2.3.2.1 Monitor for success 2.3.2.2 SMP register for soil movements and any treatments required	2.3.3.1 Link to off site Emergency Response for handling exposure of unknown contaminants and items
People	2.4.1.1 Construction crew trained in environmental issues for site 2.4.1.2 Access to external expertise	2.4.2.1 Supervision of personnel	2.4.3.1 Discipline systems

Table 13 – Noise Controls

	Preventative/Monitoring Controls	First Response/Monitoring	Recovery
Controlled Work Environment (CWE)	3.1.1.1 Low noise design specifications 3.1.1.2 Management system for construction (day time only) 3.1.1.3 Design validation testing 3.1.1.4 On site acceptance testing during commissioning 3.1.1.5 Commitment to review improved technology at each stage of construction 3.1.1.6 Review alternatives to blasting 3.1.1.7 Review times for dredging 3.1.1.8 Day time only scheduled deliveries 3.1.1.9 Site speed limits	3.1.2.1 Auditing of noise quality monitoring management plan for conformance and effectiveness 3.1.2.2 Examine the ability to link critical wind speed monitoring to noise triggers	3.1.3.1 Complaints handling processes
Equipment	3.2.1.1 Noise barriers 3.2.1.2 Review construction of sound barriers on rail loop and other locations 3.2.1.3 Bunding tree and corridor 3.2.1.4 Sonar level indicators to prevent buffer bins running empty 3.2.1.5 Machine and auditing and approval process and audits during construction 3.2.1.6 Directional conveyor and equipment sirens and specified for frequency and tone	3.2.2.1 Maintenance of plant	3.2.3.1 Critical spares for changing out noisy items
Procedure	3.3.1.1 Regular noise monitoring with linkage to site maintenance procedures 3.3.1.2 Stockpile management procedures (dozer usage minimised) 3.3.1.3 Major noise generating maintenance tasks day time only	3.3.2.1 Consider developing trigger points on noise make modifying production behaviours 3.3.2.2 Feedback protocols	
People	3.4.1.1 Induction for site and personnel 3.4.1.2 Training in operating tasks that includes environmental parameters	3.4.2.1 Supervision of personnel	3.4.3.1 Corrective action facilities in HR

Table 14 – Water Controls

	Preventative/Monitoring Controls	First Response/Monitoring	Recovery
Controlled Work Environment (CWE)	4.1.1.1 Environmental Management Plan 4.1.1.2 Flora and Fauna Management Plan 4.1.1.3 Cleanliness for incoming construction equipment and PPE to avoid contamination from other sites 4.1.1.4 Engagement of environmental manager for NCIG 4.1.1.5 Major contractors to have environmental managers 4.1.1.6 SMP 4.1.1.7 Erosion and Sediment Control Plan 4.1.1.8 Water management plan - (site run off, water sprays)	4.1.2.1 Water Management Plan 4.1.2.2 Link to Newcastle council and Department of Environment and Conservation (DEC) (for discharge) 4.1.2.3 Link to drain users Port Waratah Coal Services (PWCS) and Blue Circle	4.1.3.1 Potential application of offsets 4.1.3.2 Formal links with Newcastle Port Corporation
Equipment	4.2.1.1 Sediment control structures 4.2.1.2 Deep pond weir (protecting disclosed) 4.2.1.3 Bores and piezometers for monitoring groundwater 4.2.1.4 Intercepting wick drains for groundwater 4.2.1.5 Flow monitoring	4.2.2.1 Earthmoving capacity to repair/improve structures 4.2.2.3 Ability to seek off site expertise and equipment to control release if required 4.2.2.4 Settling ponds	4.2.3.1 Ability to clean up spills beyond structures
Procedure	4.3.1.1 Decontamination procedure for leaving site D 4.3.1.2 SMP - acid sulphate, dredge material suitability and site D management requirements 4.3.1.3 Hazchem procedures and bunding 4.3.1.4 Water quality monitoring	4.3.2.1 Monitor for success in final settling pond 4.3.2.2 Waste Management Plan (WMP) register for any discharges and treatments required	4.3.3.1 Link to off site Emergency Response for handling exposure of unknown contaminants and items
People	4.4.1.1 Construction crew trained in environmental issues for site 4.4.1.2 Access to external expertise	4.4.2.1 Supervision of personnel	4.4.3.1 Discipline systems

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