Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Environmental Management Plan – Mine

March 2014

Table of contents

Table index

Figure index

1. Introduction

1.1 Project Background

The Carmichael Coal Mine and Rail Project was declared a 'significant project' under the *State Development and Public Works Organisation Act 1971* (SDPWO Act) and as such, an Environmental Impact Statement (EIS) is required for the Project. The Project is also a 'controlled action' and requires assessment and approval under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

On 24 May 2011, the Coordinator-General issued the Final Terms of Reference (TOR) for the EIS (State of Queensland, 2011). The TOR set out the general and specific matters the project proponent must address when preparing the EIS. This document addresses Section 8 of the Final TOR relevant to the Project which required Adani to develop an Environmental Management Plan (EMP) for the Project. This EMP has been developed specifically to manage environmental requirements for the Project (Mine).

The EIS, submitted in December 2012, assessed the environmental, social and economic impacts associated with developing a 60 million tonne (product) per annum (Mtpa) thermal coal mine in the northern Galilee Basin, approximately 160 kilometres (km) north-west of Clermont, Central Queensland, Australia. Coal from the Project will be transported by rail to the existing Goonyella and Newlands rail systems, operated by Aurizon Operations Limited (Aurizon). The coal will be exported via the Port of Hay Point and the Point of Abbot Point over the 60 year (90 years in the EIS) mine life.

Project components are as follows:

- The Project (Mine): a greenfield coal mine over EPC 1690 and the eastern portion of EPC 1080, which includes both open cut and underground mining, on mine infrastructure and associated mine processing facilities (the Mine) and the Mine (offsite) infrastructure including a workers accommodation village and associated facilities, a permanent airport site, an industrial area and water supply infrastructure
- The Project (Rail): a greenfield rail line connecting to mine to the existing Goonyella and Newlands rail systems to provide for the export of coal via the Port of Hay Point (Dudgeon Point expansion) and the Port of Abbot Point, respectively including:
  - Rail (west): a 120 km dual gauge portion running west from the Mine site east to Diamond Creek
  - Rail (east): a 69 km narrow gauge portion running east from Diamond Creek connecting to the Goonyella rail system south of Moranbah
  - Quarries: The use of five local quarries to extract quarry materials for construction and operational purposes

1.2 Environmental Management for the Carmichael Coal Mine and Rail Project

This EMP (Mine) has been prepared to support an environmental impact assessment process for the Carmichael Coal Project under the EPBC Act and SDPWO Act. As such, the EMP reflects the findings and recommendations of studies undertaken for the EIS, and provides a framework for management of identified impacts and implementation of recommendations made. The EMP will be further developed as detailed design of the Project continues and to achieve compliance with conditions of approvals obtained.

Environmental management for the Project (Mine) will operate within an Environmental Management System (EMS) framework, in accordance with the ISO 14001: 2004 EMS standard.

In relation to site and project specific requirements, this EMS will apply on a site-specific and project-specific basis and is managed by the Environmental function on each site and overseen by the relevant area managers.

For projects and operating sites, the EMS requires:

- The establishment of systems and arrangements to ensure compliance with the Adani Mining EMS Management Standards.
- Utilising Adani Mining EMS Compliance Guidelines for the development and implementation of procedures.
- Contributing to the implementation and on-going operation of the EMS.

In regards to ongoing environmental management, the Carmichael Coal Project has been split into three components for the purposes of preparing environmental management plans:

- Mining activities, being all activities carried out within the mining leases. Environmental management of these activities is covered in this EMP (Mine)
- Off-site infrastructure, including workers accommodation village, dedicated airport, off-site industrial area and associated infrastructure such as water supply, storage and transfer infrastructure. Environmental management of these activities is covered in the EMP (Offsite).
- Railway activities, associated maintenance facilities and Quarries. Environmental management of these activities is covered in the EMP (Rail).

Each environmental management plan covers:

- Design and pre-construction requirements
- Construction phase activities
- Operation activities
- Decommissioning.

Closure and rehabilitation requirements have been identified and included in separate Closure and Rehabilitation Strategy Plans for the Mine, Offsite Infrastructure, Rail and Quarries.

Depending on the selected contracting strategy for the construction and operation phases, contractors and subcontractors may be required to prepare stand-alone environmental management plans for those aspects of the project under their control. Such plans will be required to be consistent with this EMP.

As required by the continual improvement approach to environmental management, this EMP is a dynamic document and will be updated as required to reflect:

- Changing significance of impacts and hazards associated with the mining activity
- Changes in legal and other obligations
- Learnings and corrective actions from monitoring activities.

Reviews of the EMP and management review requirements are set out in Section 5.

As the Carmichael Coal Project has a proposed operating life of 60 years, it is likely that significant changes in legislation, policy and available techniques in relation to environmental management will occur during the life of the Project. Annual review of the EMP will ensure that changes are adopted.

2. Project Description

2.1 Project location

The Project (Mine) is located in the northern part of the Galilee Basin, Central Queensland. The Mine will be developed over EPC1960 (incorporating Mining Lease Application (MLA) 70441) and part of EPC1080 (incorporating MLA 70506 and 70505), located approximately 160 km north-west of the town of Clermont.

2.2 Onsite Infrastructure

Onsite Infrastructure is described as that within EPC1690 and EPC1080 and includes all infrastructure within the boundary of the mining tenement.

The Mine and onsite infrastructure includes:

- 6 Open cut Mines (located within EPC1690 and part of EPC1080)
- 5 Underground Mines (located within EPC1690)
- Mine Infrastructure Areas (MIAs) (located within EPC1690 and EPC1080)
- Out of pit waste rock dumps (mostly located within EPC1080 and EPC1690)
- Mine water management dams (located within EPC1690 and EPC1080)
- Office, workshop and other facilities
- Power and water distribution

The open cut mine has a capacity of 40 Mtpa (product) and will be located along the east of EPC1690 and part of EPC1080. The open cut mine will be predominantly truck shovel/excavator operation, supplemented if required by draglines, bucket wheel excavators and dozers for primary waste removal. A total of 6 open cut pits will be progressively mined. During the early stage of development of each pit, overburden will be transported to out of pit dumps on EPC1080, where it will be profiled and rehabilitated, and a proportion will be used to re-profile the high-wall of the final voids.

The underground mines will operate concurrently with the open cut pits, to provide for coal blending and ensure continuity of production. The underground mine comprises five independent underground longwall mines, producing 20 Mtpa (product), commencing from drifts located down dip of the final high-wall of the open cut mine. Each underground mine is serviced by above ground infrastructure.

The mine infrastructure area and out of pit dumps are located predominantly in EPC1080. All run of mine (ROM) coal will be transported by truck and/or overland conveyor to a centralised coal handling facility, where the high-ash (greater than 30 per cent ash) portion will be washed for blending with the bypass coal (un-washed coal). Coal will be stockpiled prior to loading on trains for transportation by rail.

The channel and riparian zone of the Carmichael River will be preserved and the adjacent pits protected from flooding events by a levee.

Figure 2-1 shows the proposed mine and associated infrastructure.

The Mine infrastructure includes the following areas:

- Mine service areas
- Power supply
- Fuel supply and storage
- Water supply and management
- Mine water management
- Roads
- Transport facilities
- Waste disposal facilities
- Communications
- medical facilities
- Enabling infrastructure.

Temporary mine infrastructure includes the following:

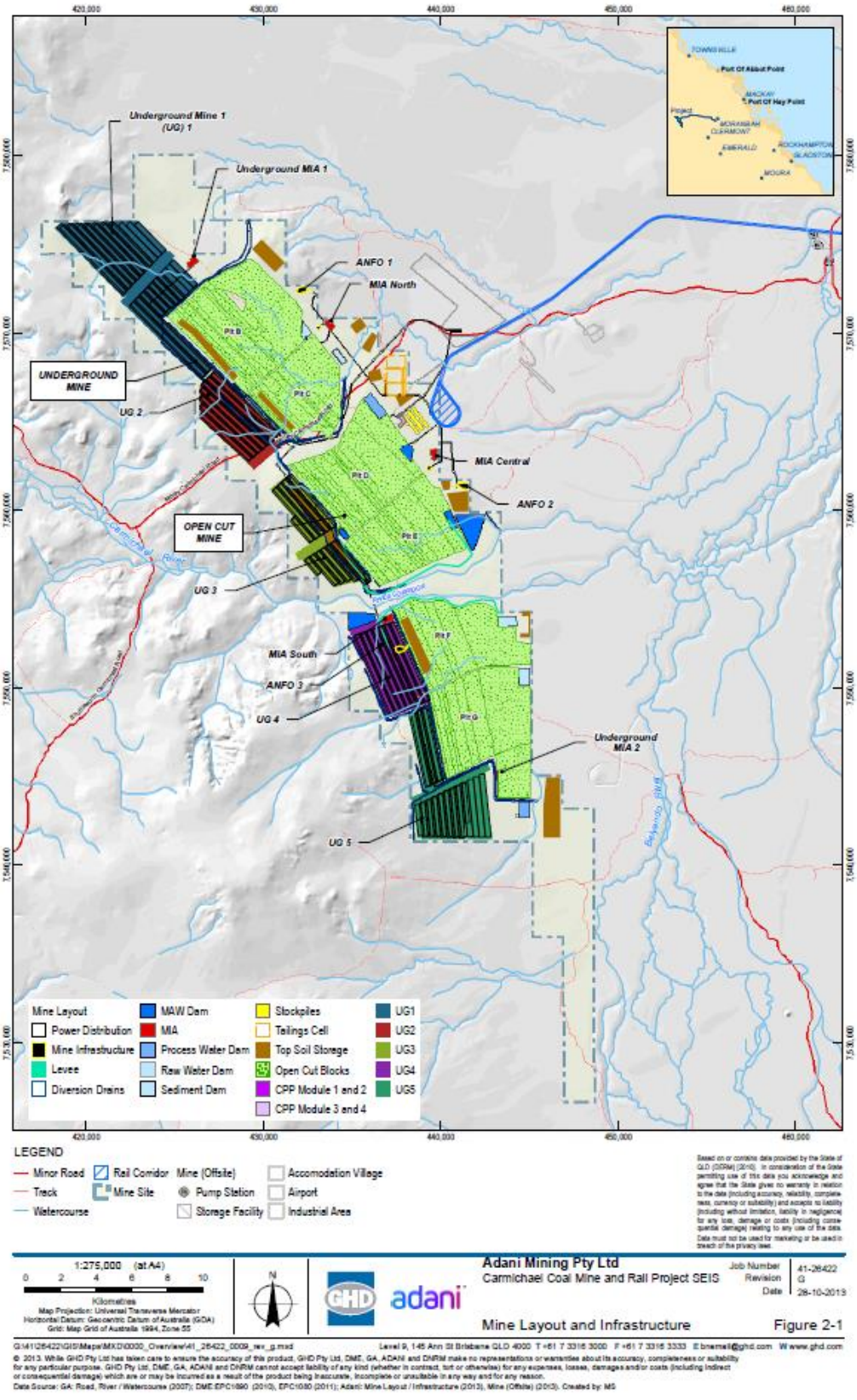
- Moray-Carmichael Road realignment within the mine lease boundaries
- Construction and operational water
- Laydown areas/hardstands
- Temporary explosive magazines
- Temporary operations power
- Enabling works fleet construction area
- Enabling works MIA North (Pit B and Pit C)
- Enabling works MIA Central (Pit D and Pit E)
- Fencing and security
- Construction roads and access roads
- Development haul roads
- Local disturbed area sediment and erosion control
- Waste transfer station

Permanent mine infrastructure includes the following:

- Permanent MIA north (Pit B and Pit C)
- Permanent MIA central (Pit D and Pit E)
- Permanent MIA south (Pit F and Pit G)
- Underground Mine MIA’s
- Central administration area
- North ANFO (Pit B and Pit C)
- Central ANFO (Pit D and Pit E)
- South ANFO (Pit F and Pit G)

- Coal handling and processing plant (CHPP)
- Railings and reject disposal
- Earthworks and road works
- Power
- Communications fibre network only
- CHPP controls
- Water management inclusive of raw water, mine affected water, sediment affected water and process water
- Flood management.

Figure 2-1 – Mine Layout and Infrastructure



2.2.1 Mining Activities and Staging

The Project (Mine) life cycle consists of construction, operation and closure and decommissioning. Rehabilitation occurs progressively throughout operations. The construction and early operation stages overlap so that production can commence as soon as possible.

Table 2-1 provides an overview of Mining Activities and Staging.

Table 2-1 Mine Stage Plan Overview

Year(s)	Activities
2014	Commence construction of workers accommodation village stage 1 & 2
	Commence construction of permanent airport
	Commence construction of power, construction water supply and other external services
	Construction of flood harvesting infrastructure
	Commence construction of open cut facilities including Pits B/C and D/E MIA's, Site Fencing, Water Storage Dams and Temporary Roads.
2015	Commence B ,D & E Pit box-cut
	Complete Pit B Diversion Drains
	Construct Carmichael River Northern Flood Protection Levies
	Commence construction of workers accommodation village stage 3 & 4
	Complete construction of Permanent Airport
	Construct Additional Stages of Flood Harvesting Facilities
2016	Commence C Pit box cut
	Produce first coal from open cut B, D & E Pits
	Complete open cut facilities for Pit B/C and D/E MIA, ROM and Overland Conveyors
	Complete B,D&E Pits HV Roads and HV Power Distribution
	Complete Coal Handling and Processing Plant Modules 1&2 and Tailings Cell
	Complete Product Handling and Train Load-out Facility
	Commence construction of workers accommodation village stage 5
2017	First Coal Production from open cut C Pit
	Construct Underground Mine 1 MIA facilities
	Complete C Pit water diversion drain and HV Roads

Year(s)	Activities
2018	Commence development and longwall operations of underground mine UG 1
	Complete Coal Handling and Processing Plant Modules 3 & 4
2019	Complete development operations in UG1 and commence Longwall operations
	Construct coal processing plant (CPP) Bypass systems
2020 – 2024	2021– Construct Carmichael River southern flood protection levee
	2021 – Construct Carmichael River Crossing
	2021 – Commence development of underground mine UG 5
	2021 – Dragline 1 commences in D Pit
	2021 – Commence G Pit
	2022 – Commence development of underground mines UG 4 and 5
	2022 – Commence open cut facilities for Pit F/G and UG 4, MIA, ROM and Overland Conveyors
	2023 – Complete open cut facilities for Pit F / G, Water Management
	2021 – Commence minor rehabilitation of out of pit spoil emplacement
2025 – 2029	2026 - Commence F Pit
	2026 – Commence longwall operation of underground mine UG 5
	2026 – Complete UG 5 MIA
	2027 – Commence longwall operation of underground mine UG 4
	2027 – Complete UG 4 overland conveyors and facilities
	2028 – Commence development of underground mine UG 3
	2028 – Complete expansion of Pit D/E MIA for UG 3
	2029 – Rehabilitation works on Pits B, C, D, E out of pit spoil emplacement
2030 – 2034	2030 – Complete UG 5 Infrastructure
	2030 – Complete UG 1 Longwall Operations
2035 – 2039	2035 – Commence development of underground mine UG 2
	2035 – Commence UG 2 MIA
	2036 – Commence longwall operation of underground mine UG 3

Year(s)	Activities
	2036 – Complete UG3 Infrastructure
2040 – 2044	2040 – Commence longwall operation of underground Mine 2
	2040 – Complete UG2 Infrastructure
	2040 – Complete UG 4 Longwall Operations
2045 – 2049	No additional Pits Commenced
	2045 – Complete UG 5 Longwall Operations
2050 – 2060	2051 – Complete UG 3 Longwall Operations
	2051 – Complete mining in C Pit commence final rehabilitation.
	2053 – Complete mining in E Pit commence final rehabilitation.
	2059 – Complete UG 2 Longwall Operations
2061 – 2072	2061 – Complete mining in D Pit commence final rehabilitation
	2068 – Complete mining in G Pit commence final rehabilitation
	2069 – Complete mining in F Pit commence final rehabilitation
	2070 – Decommission Southern ROMs
	2071 – Complete mining in B Pit commence final rehabilitation.
	2071 – Decommission Southern ROMs
	2071 + – Rehabilitate mine site

3. Environmental Management Framework

3.1 Environment and Sustainability Policy

Adani is committed to the protection of the environment and to the sustainable management of its operations and activities. Adani operates an established Health, Safety and Security (HSS) Management System and will develop and implement an Environmental Management System (EMS) to support the construction and operation of the Project. These systems will be developed to comply with relevant legislative standards for operation of coal mines within Queensland, and comprise an Environment and Sustainability Policy and EMS Management Standards. A copy of Adani's Environment and Sustainability Policy is attached in Volume 4 Appendix A of the EIS.

The EMS will guide environmental management for the Project (Mine) by providing a framework to prevent or minimise environmental harm, ensure compliance and promote continuous improvement. Key components of the system will include:

- Responsibility, authority and commitment
- Planning, objectives and legal obligations
- Training and competence
- Documentation, document control and records
- Incidents and performance measurement
- Communication, consultation and involvement
- Emergency preparedness and response
- Reviews, audits and inspections.

All contractors and staff involved in the Project (Mine) will be required to adhere to Adani's Environment and Sustainability Policy and the key requirements of the EMS.

3.2 Planning for Environmental Management

Environmental management requires a continuous process of:

- Identification of impacts and risks to the environment from the mining activity and setting targets for environmental performance and protection of environmental values
- Developing and implementing controls and management actions to achieve targets
- Monitoring and reporting on the effectiveness of controls and management actions in protecting environmental values and meeting objectives
- Reviewing and updating systems, processes and corrective actions through a focus on continual improvement.

This cycle, known as the plan-do-check-review cycle is shown in Figure 3-1.

Figure 3-1 – Plan-Do-Check-Review Cycle

Sub plans (in Section B) developed for this EMP reflect this process by presenting:

- Legislative framework relevant to the particular element
- Information on key environmental values and sensitivities potentially impacted by the mining activity
- A summary of impacts potentially arising from construction and operation
- Preliminary performance outcomes in relation to management of impacts on the environmental values
- Management controls for the design, construction and operation phases of the mining activity
- A program of monitoring against performance indicators and suggested corrective actions in the event that monitoring indicates that performance requirements have not been met.

These sub plans sit within an overall framework of continuous review and improvement of environmental performance.

This EMP reflects the general requirements of an environmental management system. Mapping of contents against ISO14001 requirements is provided in Table 3-1.

Table 3-1 Mapping against EMS Requirements

ISO 14001 Requirement	How addressed
PLANNING	
Environmental policy	Section 3.1 contains Adani's Environment and Sustainability Policy.
Roles and responsibilities	Section 3.3 identifies roles and responsibilities of individuals during design, preconstruction, construction and operation.
Environmental aspects and impacts	Section B: Environmental Management Sub Plans. Environmental values and potential impacts of construction and operation of the Carmichael Coal Mine are set out in the sub-plans for each element.
Legal and other obligations	Overarching legal and other obligations are in Section 3.4. Sub-plans for each element also include legislation relevant to these elements. Conditions of approvals not yet issued will be incorporated into the legal and other obligations register.
Objectives and targets	Section 3.5 identifies Performance Outcomes and Indicators. Performance outcomes are also identified in sub-plans for each element. Monitoring requirements also include performance indicators for each monitoring requirement.
Environmental Management Program	An environmental management program has not yet been developed for the Carmichael Coal Mine.
IMPLEMENTATION	
Operational control and procedures	Operational controls are set out in the individual sub-plans for each element.
Training and competency	Training and competency requirements are included in Section 3.7.
Documentation and records	Documentation and record keeping is addressed in Section 3.9. Management controls in each sub-plan also specify evidence requirements in relation to implementation of each control.
CHECKING	
Checks and inspections	Requirements for checks and inspections are set out in Section 4.2.
Monitoring	Monitoring requirements are set out in the sub-plans for each element.

ISO 14001 Requirement	How addressed
Auditing	Auditing requirements are provided in Section 4.3.
ACTING	
Corrective actions	Corrective action requirements are set out in Section 3.6.
Management review	Management review requirements are set out in Section 5.1.

3.3 Roles and Responsibilities

3.3.1 Overview

Adani Compliance Guidelines set out requirements for assigning roles and responsibilities in relation to environmental management.

Preliminary roles and responsibilities for design and pre-construction, construction and operation phases are presented in Sections 3.3.2, 3.3.3 and 3.3.4. These will be revised once organisational structures for each phase of the Project and mining activity are confirmed.

In accordance with the guideline:

- Position descriptions will contain responsibilities and accountabilities for environmental compliance and management
- Performance against environmental compliance and management requirements will be part of the annual performance review and linked to remuneration and promotion of managers.

3.3.2 Design and Pre-Construction

Table 3-2 Roles and Responsibilities – design and pre-construction

Role	Responsibility
CEO	Approve and endorse Environment and Sustainability Policy. Ensure that adequate resources are available to comply with the Environment and Sustainability Policy.
Adani Senior Management	Ensure compliance with all legal requirements including requirements of EPBC approval, environmental authority and other approvals. Ensure that requirements of this EMP are incorporated into engineering and procurement processes, and that these processes do not conflict with environmental performance requirements. Ensure that adequate resources are available to meet all compliance requirements and implement the requirements of this EMP. Demonstrate a visible and pro-active commitment to environmental issues as per Adani Guideline CG-128 Management Commitment.

Role	Responsibility
Adani Contract Management and Procurement Team	Ensure that procurement and contracting strategies reflect environmental performance requirements and requirements of Adani Guidelines CG-022 Contractor's Management and CG-021. Procurement. Ensure that specifications and contracts include performance requirements in relation to energy and water efficiency and other measures to reduce resource consumption and waste generation. Incorporate environmental performance requirements into contracts. Ensure that contractors hold necessary approvals and authorisations, particularly in relation to waste management services. Review environmental performance credentials of potential contractors. Demonstrate a visible and pro-active commitment to HSS issues as per Adani Guideline CG-128 Management Commitment.
Design Manager	Ensure that design requirements set out in this EMP and any other design requirements needed to meet conditions of approval are incorporated into design. Consider safety in design and minimisation of environmental impacts in design. Demonstrate a visible and pro-active commitment to HSS issues as per Adani Guideline CG-128 Management Commitment.
Design Leads	Develop design checklists to reflect design requirements set out in this EMP and maintain records of compliance with design requirements.
Environmental Manager and Advisors	Provide advice to management, procurement and design teams in relation to environmental requirements. Conduct regular audits and checks of environmental performance. Manage technical studies and research activities relating to environmental assessment and management of the Project. Maintain and further develop the EMP.
Stakeholder Manager	Manage external relations with landholders and other stakeholders. Coordinate investigation and response to complaints and incidents involving members of the public.

3.3.3 Construction

Table 3-3 Roles and Responsibilities – Construction

Role	Responsibility
CEO	Approve and endorse Environment and Sustainability Policy. Ensure that adequate resources are available to comply with the Environment and Sustainability Policy. Demonstrate a visible and pro-active commitment to HSS issues as per Adani Guideline CG-128 Management Commitment.
Adani Senior Management	Ensure compliance with all legal requirements including requirements of EPBC approval, environmental authority and other approvals. Ensure that adequate resources are available within Adani and contractors to meet all compliance requirements and implement the requirements of this EMP. Monitor close-out of corrective actions. Review outcomes of incident investigations. Demonstrate a visible and pro-active commitment to environmental issues as per Adani Guideline CG-128 Management Commitment.
Adani Contract Management Team	Manage environmental performance requirements in contracts, including penalties in the event on non-compliance. Demonstrate a visible and pro-active commitment to HSS issues as per Adani Guideline CG-128 Management Commitment.
Adani Environmental Manager and Team	Provide advice to Adani management teams and personnel in relation to environmental requirements. Integrate environmental management requirements into work procedures and practices. Conduct audits and checks of compliance and environmental performance of contractors. Monitor and report on compliance against all project approvals and commitments. Communicate environmental obligations and requirements to construction staff. Manage technical studies and research activities relating to environmental assessment and management of the Project. Raise corrective actions for any non-compliance with this EMP or in response to results of incident investigations. Conduct incident investigations. Report to Adani on environmental performance including compliance, non-

Role	Responsibility
	compliance and incidents and near misses with potential or actual environmental harm. Further develop the EMP.
Construction Managers and Supervisors	Implement all relevant requirements of this EMP. Integrate environmental management requirements into work procedures and practices. Provide initial responses to emergencies involving potential environmental impacts. Participate in incident investigations.
Construction Workers and all other Staff	Comply with all relevant requirements of this EMP.
Contractor Environmental Managers and Officers	Assist and support managers, supervisors and workers in implementing the EMP and achieving environmental compliance. Conduct monitoring, auditing and reporting activities required in this EMP. Assist with incident response and investigation where required to manage and address environmental impacts of incidents. Conduct induction training and tool box talks on environmental topics. Compile monthly and quarterly environmental reports.
Stakeholder Manager	Manage external relations with landholders and other stakeholders. Coordinate investigation and response to complaints and incidents involving members of the public.

3.3.4 Operation

Table 3-4 Roles and Responsibilities – Operation

Role	Responsibility
CEO	Approve and endorse Environment and Sustainability Policy. Ensure that adequate resources are available to comply with the environmental policy Environment and Sustainability Policy. Assign authorities and responsibilities for environmental compliance and performance. Demonstrate a visible and pro-active commitment to HSS issues as per Adani Guideline CG-128 Management Commitment.

Role	Responsibility
Mine General Manager	Implement Environment and Sustainability Policy. Ensure compliance with all legal requirements including requirements of EPBC approval, environmental authority and other approvals. Monitor actioning and close out of non-conformances. Ensure that adequate resources are available within Adani and contractors to meet all compliance requirements and implement the requirements of this EMP. Ensure that all personnel and contractors understand environmental authorities, responsibilities and requirements. Incorporate environmental performance and compliance requirements into job descriptions and performance reviews. Demonstrate a visible and pro-active commitment to HSS issues as per Adani Guideline CG-128 Management Commitment Reward outstanding performance in relation to environmental performance.
Mine Area Managers	Ensure that requirements of this EMP are incorporated into all aspects of site operation and maintenance and are implemented. Integrate environmental management requirements with work procedures and practices. Raise corrective actions for any non-compliance with this EMP or in response to results of incident investigations Conduct incident investigations. Demonstrate a visible and pro-active commitment to HSS issues as per Adani Guideline CG-128 Management Commitment.
Procurement Manager	Ensure that specifications include performance requirements in relation to energy and water efficiency and other measures to reduce resource consumption and waste generation. Ensure that contractors hold necessary approvals and authorisations, particularly in relation to waste management services. Review environmental performance credentials of potential contractors. Demonstrate a visible and pro-active commitment to HSS issues as per Adani Guideline CG-128 Management Commitment. Meet requirements of Adani Guideline GE-021 Procurement in relation to purchasing.

Role	Responsibility
Mine Supervisors	Comply and ensure compliance with all requirements of this EMP. Raise corrective actions for any non-compliance with this EMP or in response to results of incident investigations. Coordinate initial response to incidents with potential or actual environmental harm.
Employees and Contractors	Comply with all requirements of this EMP.
Adani Environmental Manager and Team	Provide advice to Adani managers and personnel in relation to environmental requirements. Assist and support managers, supervisors and workers in implementing the EMP and achieving environmental compliance. Conduct monitoring, auditing and reporting activities required in this EMP. Monitor and report on compliance against all project approvals and commitments. Communicate environmental obligations and requirements to construction and operational staff. Lead and assist with incident response and investigation where required to address environmental impacts of incidents. Conduct induction training and tool box talks on environmental topics. Compile monthly and quarterly environmental reports. Conduct audits and checks of compliance and environmental performance of contractors. Track changes in legislation, policy and other obligations and ensure these are incorporated into environmental compliance and management requirements and communicated to relevant managers and staff. Manage technical studies and research activities relating to environmental assessment and management of the Project. Review, update and further develop the EMP.
Stakeholder Manager	Manage external relations with landholders and other stakeholder. Coordinate investigation and response to complaints and incidents involving members of the public.

3.4 Legal and other Obligations

3.4.1 Overview

Adani Compliance Guideline CG-002 sets out system requirements in relation to legal and other obligations.

These obligations have been detailed through the Carmichael Coal EIS (Volume 4 Appendix D) and Supplementary EIS (SEIS) (Volume 4 Appendix C).

Evaluation of compliance with legal and other obligations will be undertaken through regular compliance audits and a quarterly review of changes in legal and other obligations will be undertaken.

Relevant legislation has been identified in sub plans in this EMP.

3.4.2 Applicable Legislation and Policies

Applicable legislation, policies and other statutory instruments are shown in Table 3-3. Current versions of federal legislation can be obtained from http://www.austlii.edu.au/au/legis/cth/consol_act/.

Current versions of Queensland legislation can be obtained from http://www.legislation.qld.gov.au/acts_sls/acts_sl.htm.

Table 3-3 Summary of Relevant Environmental Legislation – Mining Activities

Title	Relevance to the Mining Activity
Commonwealth Legislation	
Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)	The EPBC Act implements Australia's obligations to protect and conserve biodiversity and heritage under a range of international treaties and agreements. In relation to projects, the Act requires assessment and approval of actions that may have a significant impact on a range of Matters of National Environmental Significance (MNES), including (as relevant to the Carmichael Coal Project) threatened species and ecological communities, migratory species, World Heritage areas and national heritage places. The Carmichael Coal Project has been declared a controlled action on 6 January 2011 due to the likely potential impacts on MNES (EPBC Referral 2010/5736). Assessment is to be under a bilateral agreement in place with the Queensland government. Activities associated with the Project may not commence until approval is granted under the EPBC Act. Once approval is granted, this EMP will need to be updated to incorporate actions required to achieve compliance with approval conditions.
Native Title Act 1993 (NT Act)	The Commonwealth NT Act objectives are to: • Provide for recognition and protection of Native Title • Establish ways in which future dealings affecting Native Title may proceed and to set standards for those dealings. • Establish a mechanism for determining claims to Native Title • Provide for, or permit, the validation of past acts, and the intermediate period act, invalidated because of the existence of Native Title. Adani is progressing negotiations with the Wangan and Jagalingou People (registered claims (QUD85/04, QC04/6). It is expected that this agreement will contain actions for Adani in relation to Native Title.
Aboriginal and Torres Strait Islander Heritage Protection Act 1984	The *Aboriginal and Torres Strait Islander Heritage Protection Act* preserves and protects nominated areas and objects in Australia and in Australian waters which are of particular significance to Aboriginals in accordance with Aboriginal tradition. There are no such areas of objects within or adjacent to the proposed mine, and hence, requirements of this Act are not relevant to the mining activity.

Title	Relevance to the Mining Activity
National Greenhouse and Energy Reporting Act 2007	The *National Greenhouse and Energy Reporting Act 2007* sets up a range of reporting mechanisms to assist the Australian Government in understanding greenhouse gas emissions and energy consumption by corporations. This information is used to monitor emissions profiles, inform government policy, programs and other initiatives and meet National and international reporting obligations. Adani will be required to report under the *National Greenhouse and Energy Reporting Act 2007*.
National Environment Protection Council Act 1994	The *National Environment Protection Act 1994* establishes the National Environment Protection Council (now known as the Environment Protection and Heritage Council). The Council is responsible for developing national environment protection measures (NEPM). The National Environment Protection (National Pollutant Inventory) Measure 1998 requires organisations to report on emissions of certain pollutants. Requirements relevant to Carmichael Coal Mine are discussed in Section 6
Clean Energy Act 2011	The *Clean Energy Act 2011* establishes a mechanism for carbon pricing and trading. Adani will be required to trade carbon on the basis of coal production.
Energy Efficiency Opportunities Act 2006	The *Energy Efficiency Opportunities Act* (EEO Act) applies to businesses that use more than 0.5 PJ of energy per year. Participants in the program are required to assess their energy use and report publicly on the results of the assessment and the business response. Decisions on energy efficiency opportunities remain at the discretion of the business.
Queensland Legislation	
State Development and Public Works Organisation Act 1971 (SDPWO Act)	The SDPWO Act provides for State planning and development through a coordinated system of public works organisation and also provides for coordinated environmental assessment that benefits the State. The SDPWO Act is administered by the Coordinator-General, who is appointed under that Act. The Project was declared a 'significant project' under the SDPWO Act. In December 2012, the *Economic Development Act 2012* amended the SDPWO Act, including changing the name for project subject to the environmental impact statement process. Projects declared as 'significant projects' were renamed as 'coordinated projects'. The Project is now a 'coordinated project' due to the amendments and an EIS was prepared to meet the environmental coordination requirements for projects. The Coordinator-General will draft a report evaluating the EIS and SEIS that includes draft conditions. This EMP will be updated in accordance with the Coordinator-General's report.

Title	Relevance to the Mining Activity
Environmental Protection Act 1994 (EP Act)	The EP Act places emphasis on managing Queensland's environment within the principles of ecologically sustainable development. While concerned with all aspects of ecologically sustainable development, regulations, policies and other requirements under the EP Act focus on protection of air quality, acoustic quality and water quality as well as on waste management and land contamination. Hazardous waste dams are also regulated under the EP Act. The EP Act sets up a process for environmental approval of mining activities on mining leases and other mining tenure established under the *Mineral Resources Act 1989* (MR Act). Where a project is a 'coordinated project' under the SDPWO Act, the EP Act provides for approval of an environmental authority. Activities may not commence within the mining lease until an environmental authority is in approved, and must then take place in accordance with conditions of the environmental authority. This EMP will be updated to incorporate conditions of the environmental authority once it has been approved. The EP Act also imposes a 'General Environmental Duty' requiring all individuals and organisations to take all reasonable and practical measures to avoid environmental harm.
Environmental Protection Regulation 2008 (EP Regulation)	Schedule 2 of the EP Regulation lists 57 Environmentally Relevant Activities including waste disposal and sewage treatment. The regulations also provide a regulatory regime for minor issues involving environmental nuisance such as noise.
Environmental Protection (Waste Management) Regulation 2000	The *Environmental Protection (Waste Management) Regulation 2000*, implements various waste management matters covered by the EP Act. Relevant to the Carmichael Coal Mine, this regulation sets up a system for tracking of certain wastes that are hazardous to the environment. The system tracks wastes from the point of generation to the point of disposal through a docket system.
Environmental Protection (Water) Policy 2009 (EPP Water)	The EPP (Water) establishes environmental values in relation to water resources. The EPP and also sets up frameworks for water quality guidelines and prescribes specific water quality objectives for a number of basins in Queensland. Specific water quality objectives have not yet been prescribed for the Burdekin Basin, and hence, water quality objectives default to the objectives required to protect the environmental values of waters.
Environmental Protection (Noise) Policy 2008 (EPP Noise)	The EPP Noise defines environmental values in relation to the acoustic environment and sets acoustic quality objectives.

Title	Relevance to the Mining Activity
Environmental Protection (Air) Policy 2008 (EPP Air)	The EPP Air defines environmental values in relation to air quality and sets ambient air quality objectives.
Mineral Resources Act 1989 (MR Act)	The MR Act covers prospecting, exploration and mining of minerals in Queensland. The Carmichael Coal Mine will take place on mining leases issued under the MR Act. The process for granting a mining lease is linked to the process for issuing of an environmental authority under the EP Act and both the mining lease and environmental authority must be in place before mining and related activities can commence. Adani currently holds exploration permit (coal) 1690 and has an agreement with the holder of exploration permit (coal) 1080 (northern and eastern portions) to carry out exploration activities. This EMP will be updated when the mining lease is issued to reflect relevant conditions.
Waste Reduction and Recycling Act 2011	The legislation establishes a framework for waste management and resource recovery practices in Queensland. The purpose of the new legislation is to promote waste avoidance and reduction and to encourage resource recovery and efficiency. The WRR Act does not impose any particular obligations on Adani in relation to the Carmichael Coal Mine, but does establish frameworks for introduction of a range of waste management strategies and initiatives such as waste levies, product stewardship programs and other resource recovery programs. These may have implications in relation to waste management services required by Carmichael Coal Mine.
Sustainable Planning Act 2009 (SP Act)	The SP Act provides a framework for development assessment and approval in Queensland, bringing together requirements of a range of legislation. Generally, the SP Act does not apply to mining development (exceptions include building standards, which will be complied with).
Water Act 2000 (Water Act)	The Water Act provides for management and sustainable use of freshwater resources in Queensland, including surface waters and groundwater. The approach to sustainable management of water resources is through the development of a Water Resource Plan (WRP) and Resource Operations Plan (ROP) for each basin. The WRP and ROP set out the rules for allocation and use of water resources. The Carmichael Coal Mine is within the area covered by the *Water Resource (Burdekin Basin) Plan 2007*. Under the Water Act a licence is required for diversion of waterways and interfering with flow by impoundment of a waterway.

Title	Relevance to the Mining Activity
Water Resource (Burdekin Basin) Plan 2007.	WRPs set out the requirements for sustainable management of water resources, when water may be taken with and without an allocation and matters to be considered when granting allocations.
Fisheries Act 1994	This Act regulates activities such as fishing, development in fish habitat areas, and damage to and destruction of marine plants in Queensland. There are no requirements under this Act that are relevant to the Carmichael Coal Mine.
Aboriginal Cultural Heritage Act 2003 (ACH Act)	The *Aboriginal Cultural Heritage Act 2003* establishes a 'cultural heritage duty of care', which requires that a person who carries out an activity must take all reasonable and practicable measures to ensure the activity does not harm Aboriginal cultural heritage. In order to discharge this duty of care, Adani has entered into cultural heritage management agreements with Wangan and Jagalingou People which contains measures for monitoring and managing cultural heritage items.
Nature Conservation Act 1992 (NC Act) *Nature Conservation (Protected Plants) Conservation Plan 2000* *Nature Conservation (Wildlife Management) Regulation 2006*	The objective of the NC Act is to conserve nature which is to be achieved by an integrated and comprehensive conservation strategy for the whole of Queensland, involving amongst other things the protection of native wildlife and its habitat. A permit under the NC Act will be required for clearing of all native plants. A permit will also be required if a confirmed breeding place for a native animal is to be disturbed. The *Nature Conservation (Protected Plants) Conservation Plan 2000* sets out certain requirements in relation to permits to clear native plants. The *Nature Conservation (Wildlife Management) Regulation 2006* sets out requirements in relation to permits for tampering with breeding places A permit is also required for fauna spotters involved in vegetation clearing activities to authorise taking of native animals that may require relocation.
Vegetation Management Act 1999 (VM Act)	The VM Act sets up a process for classifying remnant vegetation and for protecting and conserving remnant vegetation and associated ecological and biodiversity values. As permits under the VM Act are assessable development under the SP Act, a permit to clear native vegetation is not required under this Act (but is under the NC Act). However, the system set up under the VM Act for classifying remnant vegetation is relevant to the project as this classification is used within the Biodiversity Offsets Policy to determine biodiversity values requiring offsets.

Title	Relevance to the Mining Activity
Strategic Cropping Land Act 2011 (SCL Act)	The SCL Act protects areas identified as strategic cropping land, being areas of high quality agricultural land. There are no such areas within the Carmichael Coal Mine.
Queensland Heritage Act 1992	The *Queensland Heritage Act 1992* provides for the conservation and protection of places and items of historical and/or non-Indigenous cultural heritage. There are no places protected under this Act within the Carmichael Coal Mine.
Land Protection (Pest and Stock Route Management) Act 2002	The purpose of the *Land Protection (Pest and Stock Route Management) Act 2002* (LP Act) is to provide for pest management and for land and stock route network management. Under the LP Act landholders are required to manage certain declared weeds. The Project (Mine) will impact on one stock route, details are provided in SEIS Volume 4 Appendix C1.
Clean Energy Act 2008	Applies to business using more than 30 TJ of energy, but less than 500TJ.

3.4.3 Licences, Permits and Approvals

Adani is currently seeking approval for the Carmichael Coal Mine under the EPBC Act and SDPWO Act. This EMP has been prepared in support of these approval applications.

If these key approvals are issued, then Adani will be required to obtain a range of additional environmental approvals and permits as set out in Volume 1 Section 4 and Volume 4 Appendix C of the SEIS Table 3-4. As permits and approvals are issued, Table 3-4 and relevant sub-plans in this EMP will be updated to reflect conditions of approval.

Table 3-4 Approvals Register

Legislation	Approval or Permit	Trigger
EPBC Act	Approval to undertake a controlled action	Potentially significant impacts on MNES
SDPWO Act	Coordinator-General's report	Declaration of the Carmichael Coal Mine as a Significant Project for which an EIS is required.
EP Act	Environmental authority	Conduct of a mining activity, and other environmentally relevant activities carried out on a mining lease.
EP Act	Registration certificate	Operator of a mining activity or an environmentally relevant activity
MR Act	Mining lease	Conduct of a mining activity
NC Act	Permit to take protected plants	Clearing of native vegetation

Legislation	Approval or Permit	Trigger
NC Act	Permit to take protected animals	Handling of native fauna encountered prior to or during vegetation clearing
NC Act	Permit to tamper with a breeding place	Required if any confirmed animal breeding places are disturbed by the mining activity
Water Act	Licence to interfere with flow by impounding water	Required if impoundment of any watercourse, lake or spring is to occur.
Water Act	Licence to take groundwater	Mine dewatering

The environmentally relevant activities (ERAs) that will be conducted as part of this mining activity are shown in Table 3-5.

Table 3-5 Environmentally Relevant Activities

ERA	Details	Quantity
CHPP		
8(1)(d)(i) Chemical storage Storing the following total quantity of other chemicals in containers of at least 10m^3— 200 tonnes or more, if they are solids or gases. 8(1)(d)(ii) Chemical storage Storing the following total quantity of other chemicals in containers of at least 10m^3— 200m^3 or more, if they are liquids.	Magnetite storage	900 t
	Flocculant storage	50 t
Three (3) Mine Infrastructure Areas – Open Cut Note – Quantities / thresholds are per Mine Infrastructure Area		
8(1)(d)(i) Chemical storage Storing the following total quantity of other chemicals in containers of at least 10m^3— 200 tonnes or more, if they are solids or gases. 8(1)(d)(ii) Chemical storage Storing the following total quantity of other chemicals in containers of at least 10m^3— 200m^3 or more, if they are liquids.	Bullet tanks and relocatable double-skin storage tanks including the following chemicals	
	Engine oil	80,000 L
	Hydraulic oil	80,000 L
	Differential oil	80,000 L
	Transmission oil	40,000 L
	Coolant	40,000 L
	Grease container	1,500 kg
	Fuel (diesel in single steel tank)	3.5 ML
56(1) Regulated waste	Waste oil	80,000 L

ERA	Details	Quantity
storage Operating a facility for receiving and storing regulated waste for more than 24 hours.	Waste coolant	40,000 L
63(1)(a) Sewage Treatment Operating 1 or more sewage treatment works at a site that have a total daily peak design capacity of at least 21EP.	Sewage treatment plant	160 equivalent persons
Two (2) Mine Infrastructure Areas – Underground Note – Quantities / thresholds are per Mine Infrastructure Area		
8(1)(d)(i) Chemical storage Storing the following total quantity of other chemicals in containers of at least 10m^3— 200 tonnes or more, if they are solids or gases. 8(1)(d)(ii) Chemical storage Storing the following total quantity of other chemicals in containers of at least 10m^3— 200m^3 or more, if they are liquids.	Bullet tanks and relocatable double-skin storage tanks including the following chemicals	
	Engine oil	80,000 L
	Hydraulic oil	80,000 L
	Differential oil	80,000 L
	Transmission oil	40,000 L
	Waste oil	80,000 L
	Coolant	40,000 L
	Solcenic Concentrate	150,000 L
	Solcenic Mixed Fluid	300,000
	Waste coolant	40,000 L
	Grease container	1,500 kg
	Fuel (diesel in single steel tank)	1 ML
	Stone dust	100 t
56(1) Regulated waste storage Operating a facility for receiving and storing regulated waste for more than 24 hours.	Waste oil	80,000 L
	Waste coolant	40,000 L
63(1)(a) Sewage Treatment Operating 1 or more sewage treatment works at a site that have a total daily peak	Sewage treatment plant	500 equivalent persons

ERA	Details	Quantity
design capacity of at least 21EP.		
Three explosives facility and compound areas		
8(1)(d)(i) Chemical storage Storing the following total quantity of other chemicals in containers of at least $10m^3$— 200 tonnes or more, if they are solids or gases. 8(1)(d)(ii) Chemical storage Storing the following total quantity of other chemicals in containers of at least $10m^3$— $200m^3$ or more, if they are liquids.	Ammonium nitrate storage capacity Ammonium nitrate emulsion storage	750 t 2 x 50 kL bullet tanks
Quarrying activities on the Project (Mine) site		
16(1)(b) Extractive and Screening Activities Extracting, other than by dredging, a total of 5000t or more of material, in a year, from an area.	Two quarry material extraction areas on mine site.	1 million tonnes per year from the proposed locations specific to quarry extraction. Also, crushing the overburden in pit or in the over burden dumps from the in from the coal mine pit extraction will be carried out.

3.4.4 Other Obligations

A range of other obligations are in place under legislation and are shown in Table 3-6.

Table 3-6 Other Obligations Register

Legislation	Obligation
EP Act	Notification of notifiable activities
NGER Act	Reporting of greenhouse gas emissions
EEO Act	Reporting of energy use and opportunities to reduce
Native Title Act	Indigenous land use agreement in place and implemented
NEPC Act	National Pollutant Inventory reporting
ACH Act	Cultural heritage management plan
LP Act	Management of Class 1 and 2 declared weeds

Legislation	Obligation
EP Act	Authorised officers under the EP Act must be allowed entry to the mine on request and must be given all reasonable assistance.
Queensland *Clean Energy Act 2008*	Conduct of an energy audit and preparation of an energy savings plan. Publication of information on energy savings plan
Forestry Act 1959	Notify DNRM of forest and quarry products on State land within the mining lease

3.5 Performance Outcomes and Indicators

Performance outcomes and indicators are identified in each of the environmental management sub-plans within this EMP under Section B.

These objectives and targets have been developed in accordance with Adani Management Standard ST-02 Planning, Objectives and Legal Obligations. They aim to be:

- Specific to the project
- Quantified and measurable
- Realistic and achievable
- Focused on continual improvement
- Consistent with, and related to, Adani's Environment and Sustainability Policy and the Adani Management Standards
- Periodically reviewed and, if required, revised.

Performance indicators will be reviewed annually as part of the EMP annual review.

3.6 Corrective Actions

Adani Compliance Guideline CG-005 Corrective and Preventative Action require that Adani implements a corrective action process consisting of the following steps:

- Identification of a problem (failure or deficiency);
- Root cause analysis to identify causes and determine solutions;
- Decision as to the appropriate action;
- Application and documentation of corrective or preventative action; and
- Follow-up and evaluation.

Corrective actions in relation to environmental management may arise from:

- Recommendations and outcomes of incident investigation reports, including investigations into incidents, near misses and non-compliances.
- Reviews of monitoring results indicating that performance requirements are not being met and/or that trends indicate that environmental degradation may be occurring.
- Checks and inspections (note that minor corrective actions identified through checks and inspections will generally be resolved on the spot).
- Identification of hazards or improvement opportunities (see also CG-009 Hazard Notification and HSE Improvement).
- Audit recommendations.

- Complaints.

Corrective actions will be raised through Adani's notification system or through a separate corrective action register if required for contractors not operating under Adani's systems. Completion and close out of corrective actions will be reported at Mine management meetings.

3.7 Training, Competency and Awareness

3.7.1 Overview

System requirements in relation to training and competency are set out in Adani Compliance Guideline CG-003 Training and Competency. In accordance with the compliance guideline, a training needs assessment will be undertaken once organisational structures are confirmed for each of the construction and operation phases of the mining activity. Interim requirements are set out in this Section.

Trainers will hold appropriate accreditations or be otherwise appropriately qualified and experienced in the training topic to deliver the training. The provision of training will be in accordance with the Adani's Management Standard ST-03 - Training and Competence.

3.7.2 Induction Training

All employees and contractors other than short term visitors will receive environmental induction training on commencement, and then annual environmental awareness training, covering:

- An overview of environmental values of the site
- Key environmental impacts and risks associated with construction/operation
- Legislative and other responsibilities, including the general environmental duty
- How to conduct task-based environmental risk assessment
- Work permit requirements in relation to any non-routine works
- Waste management and minimisation, including segregation and storage of wastes
- Erosion and sediment control and protection of watercourses
- Fauna interactions
- Weed hygiene requirements
- Aboriginal cultural heritage awareness
- Storage and handling of environmentally hazardous materials
- Spill prevention and response
- Fire prevention and response
- Energy and water conservation
- Incident notification and reporting requirements.

A visitor induction will be given to visitors and short term contractors not engaging in ground-disturbing activities covering:

- General compliance obligations
- Key environmental risks and impacts
- Management and minimisation of waste

- Work permit requirements
- Incident reporting and response.

3.7.3 Construction Training Matrix

A preliminary training matrix has been developed for construction activities and is shown in Table 3-7.

Table 3-7 Preliminary Construction Training and Competency Matrix

Training	CEO	Adani Senior Project management	Adani Contract Management Team	Adani Environmental Manager and Team	Construction Managers and Supervisors	Construction Workers and all other staff	Contractor Environmental Managers and	Emergency Response Teams	Visitors
General induction	M	M	M	M	M	M	M		
Short induction								AR	M
Adani EMS	M	M	M	M	M		M	AR	
Legal and other obligations	M	M		M	M		M	M	
Degree qualification – environmental management				M			M		
Dangerous goods storage and handling				M	M	AR	M	M	
Waste management and minimisation			M	M	M	AR	M		
Spill prevention and response				M	M	M	M	M	
Fire fighting				AR	AR	AR	AR	M	
Vegetation clearing and in-stream work procedures				M	M	M	M		

Training	CEO	Adani Senior Project management	Adani Contract Management Team	Adani Environmental Manager and Team	Construction Managers and Supervisors	Construction Workers and all other staff	Contractor Environmental Managers and	Emergency Response Teams	Visitors
Erosion and sediment control				M	M	M	M		
Energy and water conservation, including vehicle operation to minimise energy consumption			M	M	M	AR	M		
Cultural heritage awareness and monitoring		M		M	M	M	M		
Work permit requirements		M		M	M	M	M		
Introductory training – new or substantially amended procedures		AR	AR	AR	AR	AR	M		
Weed management			M	M	M	M	M		
Tool box talks – environmental topics including minor changes to compliance and management requirements and procedures	AR	M	M	M	M	M	M		AR

M = mandatory
AR = As relevant to work requirements

3.7.4 Operations Training Matrix

A preliminary training matrix has been developed for operation activities and is shown in Table 3-8.

Table 3-8 Operation Training and Competency Matrix

Training	CEO	Mine General Manager	Mine Area Managers	Procurement Manager	Mine supervisors	Employees and contractors	Environmental Managers and Officers	Emergency Response Teams	Visitors
General induction	M	M	M	M	M	M	M	M	
Annual environmental awareness training		M	M	M	M	M	M	M	
Short induction									M
Adani EMS		M	M	AR	M		M	M	
Legal and other obligations	M	M	M	AR	M	AR	M	M	
Degree qualification – environmental management							M		
Dangerous goods storage and handling		AR	M		AR	AR	M	M	
Waste management and minimisation		M	M	M	M	M	M		
Spill prevention and response		M	M		M	M	M	M	
Fire fighting		AR	AR		AR	AR	AR	M	

Training	CEO	Mine General Manager	Mine Area Managers	Procurement Manager	Mine supervisors	Employees and contractors	Environmental Managers and Officers	Emergency Response Teams	Visitors
Vegetation clearing and in-stream work procedures			M		M	AR	M		
Erosion and sediment control			M		M	AR	M		
Energy and water conservation, including vehicle operation to minimise energy consumption		M	M	M	M	AR	M		
Cultural heritage awareness and monitoring		M	M		AR	AR	M		
Work permit requirements		M	M		M	M	M		
Weed Management			M		M	M	M		
Tool box talks – environmental topics including minor changes to compliance and management requirements and procedures	AR	M	M	M	M	M	M	M	M
Pest and Weed Management			M		M	M	M		
Introductory training – new or substantially amended procedures		M	M	M	M	M	M		

M = mandatory

AR = As relevant to work requirements

3.8 Communication and Reporting

3.8.1 External

External reporting is expected to be required in response to legislative requirements. Initial reporting requirements are set out in Table 3-9 and this will be updated based on conditions of approval.

Table 3-9 External Environmental Reporting Requirements

Reporting Trigger	Report Content	Report Recipient	Adani Responsibility
Annual return under environmental authority	Compliance with environmental authority requirements	Department of Environment and Heritage Protection (DEHP)	General Manager Environment
NGER	Energy consumption	Clean Energy Regulator	General Manager Environment
NPI	Pollutant emissions	DEHP	General Manager Environment
Incidents causing actual or potential environmental harm	Incident investigation and corrective actions	DEHP	Environmental Manager

The Social Impact Management Plan (SIMP) contains a broader stakeholder engagement plan, including:

- Engagement with local and regional emergency services representatives
- Complaints and inquiries.

In accordance with the *Corporations Act 2001*, Adani's annual report will include compliance with environmental requirements.

3.8.2 Internal – Adani Corporate

Corporate communications will take place in accordance with management system requirements.

3.8.3 Internal – Site

Within the Carmichael Coal Mine, communications regarding environmental matters will include:

- Environmental compliance, incidents, initiatives and corrective actions as agenda items in all management meetings
- Regular toolbox talks on environmental matters
- Environmental inductions and other training as described in Section 3.7
- Incorporation of environmental risk assessment and management into all risk assessment activities

- Posting of information on environmental issues, impacts and performance on noticeboards
- Inclusion of environmental performance and issues in weekly, monthly and annual reports.

3.9 Documentation, Document Control and Records

Document control in relation to environmental management will be through the site EMS as set out in CG-008 Documentation and Document Control. This EMP and all associated sub plans, documents and registers will be controlled documents subject to unique document identifiers and version control. The corrective action register will be managed through a database to ensure that updates on the status of corrective actions are available to managers and supervisors.

Other documentation and records to be retained will include:

- Incident investigation reports
- Completed site checklists
- Records of training and induction
- Audit reports
- All monitoring records.

Monitoring records in relation to the environmental authority must be retained for five years and must be available for provision to the administering authority within 10 business days of any request.

The document control and records management system will meet the requirements of Adani's Management Standard ST-04 Documentation, Document Control and Records.

3.10 Work Permits

In accordance with CG-036 Work Permits, any non-routine activities that might adversely affect the environment must not be performed without a work permit.

Non-routine works which have potential to cause environmental harm may include:

- Any ground disturbing activity
- Activities involving use of environmentally hazardous substances
- Activities in areas of native vegetation
- Activities in or immediately adjacent to streams and watercourses
- Activities within or adjacent to Category A or B environmentally sensitive areas
- Activities that might generate hazardous wastes or large quantities of non-hazardous wastes
- Activities carried out in close proximity to residential dwellings.

The following matters will be covered as part of the process of issue of a work permit:

- Any legislative approval requirements and whether these approvals are in place
- Conditions of approvals or permits that might apply to the activity
- Whether there are any cultural heritage, flora or fauna monitoring requirements

- Opportunities to minimise waste generation or energy consumption
- Measures to prevent environmental impacts, including:
  - Impacts on environmentally sensitive areas
  - Accidental clearing of vegetation
  - Erosion and sediment release
  - Accidental release of hazardous substances to land, water or air
  - Measures to prevent noise or dust emissions exceeding the environmental authority or other legislated requirements
  - Improper disposal of waste
- Any requirements in relation to incident response, such as spill kits and personal protective equipment (PPE).

During construction, environmental and approval requirements will be part of a quality system to ensure that all relevant approvals and other requirements are in place before construction commences.

4. Monitoring and Reporting

4.1 Summary of Environmental Monitoring Requirements

Environmental monitoring requirements are set out in each sub-plan within this EMP. Table 4-1 provides a contextual summary of the required monitoring programs across the various Project phases.

Table 4-1 Summary of Monitoring Requirements

Element	Pre-construction	Construction	Operation
Meteorology	✓	✓	✓
Air quality		✓	✓
Greenhouse gas and energy		✓	✓
Noise and vibration		✓	✓
Surface water	✓	✓	✓
Groundwater	✓	✓	✓
Mine waste			✓
General and hazardous waste		✓	✓
Terrestrial ecology	✓	✓	✓
Aquatic ecology	✓	✓	✓
Scenic amenity		✓	✓
Erosion and sediment control		✓	✓
Contaminated land		✓	✓
Topsoil management		✓	✓
Cultural heritage	✓	✓	✓
Subsidence areas			✓
Transport		✓	✓
Weeds and pests	✓	✓	✓

4.2 Checks and Inspections

4.2.1 Design and Preconstruction

During the design and pre-construction phase, monthly reviews will be undertaken against requirements of this EMP. A design checklist will be developed to document how design and pre-construction requirements have been met.

4.2.2 Construction and Operations

A formal site inspection will be conducted weekly by Adani's environmental team. Inspections will be carried out to assess project activities against compliance requirements set out in the environmental authority and this EMP.

Inspections will be documented on a checklist that will record whether the performance requirement for each item was achieved and corrective actions required achieving the performance requirement. Where the non-conformance does not present a significant risk of environmental harm, and can be corrected promptly, the corrective action will be closed out on the checklist. Where the risk of environmental harm is more significant and/or the corrective action cannot be undertaken promptly, the action will be recorded in the corrective action register.

Where an incident or near miss is observed during checks, the incident investigation and reporting procedure will be followed.

Environmental inspection processes will meet the requirements of Adani's Management Standard ST-18 Reviews, Audits and Inspections.

4.3 Audits

4.3.1 Overview

Adani Compliance Guideline CG-004 Audits and Assessment sets out requirements for audits of performance. An audit program has been developed to meet these requirements.

The following standards may be relevant to auditing activities:

- AS/NZS ISO 14012-1996 Guidelines for Environmental - Qualification Criteria for Environmental Auditors
- AS/NZS ISO 14015-2003 Environmental Management – Environmental Assessment of Sites and Organizations
- AS/NZS ISO/IEC 17021:2011 Conformity assessment - Requirements for bodies providing audit and certification of management systems
- AS/NZS ISO 19011-2003 Guidelines for Quality and/or Environmental Management Systems Auditing
- ISO 19011:2011 Guidelines for auditing management systems.

Draft audit reports will be reviewed by the Environmental Manager. Once an audit report is finalised:

- Audit reports will be circulated to the mine manager and area managers
- Recommendations will be entered into the corrective action register
- Findings will be discussed at management meetings

- Where relevant, findings will be presented as tool box talks
- Reports and findings will be tabled at management reviews
- Any non-compliances that are required to be reported under legislation or conditions of approval will be reported.

Audits may be carried out in conjunction with audits for the off-site infrastructure.

4.3.2 Construction

Auditing during construction will depend on the contracting strategy selected and whether contractors and subcontractors operate under Adani's management systems or the contractor's own environmental management system.

If contractors/subcontractors are utilising their own EMS, Adani will conduct audits on a six monthly basis, or for shorter duration contracts, at least once during the contract duration. These audits will cover:

- Contractor's compliance with legal and other obligations
- Whether contractor's management plans have appropriately identified environmental impacts and risks
- Whether roles, responsibilities and training and competency requirements have been identified and followed
- Whether adequate management and control strategies are in place to achieve compliance with legal requirements and performance requirements documented in this EMP
- Whether management and control strategies are being implemented
- Monitoring approaches and outcomes, and identification and implementation of corrective actions
- Adequacy of record keeping and reporting.

It would also be expected that contractors will have internal and external audit programs.

If contractors and subcontractors are utilising Adani's management system, system compliance audits will be conducted based on agreed and approved audit requirements.

4.3.3 Operation

Environmental audit processes will meet the requirements of Adani's Management Standard ST-18 Reviews, Audits and Inspections. A preliminary audit schedule for the Carmichael Coal Mine off-site infrastructure has been developed and is shown in Table 4-2. Where audit outcomes and recommendations require corrective actions, these will be entered into the corrective action register.

Table 4-2 Preliminary Audit Schedule

Audit Type	Scope	Frequency
System audit	Audit against Adani EMS system requirements ISO 14001 accreditation audit	As agreed with certification body, externally no less than annually

Audit Type	Scope	Frequency
Compliance audit	Confirm that legal and other obligations have been correctly and fully identified and that appropriate management and control strategies are in place and being implemented to meet requirements, including conditions of approval.	Bi-annual or if significant legislative changes occur
Waste audit	Review waste generation types and quantities and waste management practices and identify opportunities to further minimise waste generation or to reduce the environmental impacts associated with waste management.	Bi-annual
Energy audit	Review energy consumption and identify opportunities to reduce energy consumption and/or associated greenhouse gas emissions. If greenhouse gas emission reduction programs are in place, review progress against commitments made. The audit must meet the requirements of AS/NZS 3598-2000 Energy Audits and requirements under the NGER Act and any other legislative requirements in relation to energy consumption and greenhouse gas emission reporting.	Annual
Environmental monitoring review	Review results of environmental monitoring activities. Identify whether environmental performance requirements are achieved, and whether degradation of values or resources has occurred that may be attributable to the mining activity. Identify further investigations and/or corrective actions.	Annual
General environmental audit	Environmental impacts and risks have been correctly identified Management controls are effective in managing the impacts and risks identified EMP is consistent with environmental authority conditions Environmental management requirements are being implemented and evidence is available.	Six monthly

5. Reviews

5.1 Management Review

Adani's management system requires management reviews to be carried out at least twice per year (CG-011 Management Review). Participants are to include Adani's senior management team.

In relation to the environmental component of the management review, the management review will examine:

- Adequacy and effectiveness of the EMP
- Compliance with Adani management system
- Opportunities for improvement
- Opportunities for waste minimisation.

Inputs to the management review will include:

- Results of monitoring and audits
- Status of achievement of performance requirements and indicators
- Summary of environmental incidents, non-compliances and complaints
- Status of corrective actions
- Communications and complaints
- Follow up of actions from previous management review
- Significant changes affecting environmental management, including legislation and policy changes.

Decisions and actions arising from the management review will be documented and actions will be entered into the corrective action register.

5.2 EMP Reviews

5.2.1 Annual Review

The EMP will be reviewed at least annually and updated to reflect:

- Changes in legislative requirements (including conditions of approvals)
- Environmental performance
- Outcomes of audits
- Outcomes of incident investigations
- Changes in external and internal policies, standards and guidelines
- Changes in requirements of Adani management system
- Any organisation changes such as changes in organisational structure
- Outcomes of the management review.

The review will ensure the continuing suitability, adequacy and effectiveness of the EMP and the Adani Management System. The review will include assessing opportunities for improvement.

Intermediate updates may also be undertaken in response to corrective actions or other changes that need to be addressed urgently.

Amendments to the EMP will be communicated to all staff through management meetings and tool box talks.

5.2.2 Review of Legal and Other Obligations

Legal and other obligations will be reviewed quarterly and whenever a major legislation or policy change occurs. The EMP will be updated as required to maintain compliance and any new requirements will be communicated to managers and staff through management meetings, special communications and tool box talks.

6. Air Quality

6.1 Legislative Framework

Air quality is managed through a framework established under the *Environmental Protection Act 1994*:

- The EP Act includes general objectives in relation to preserving environmental values in relation to air quality
- Under the EP Act, the *Environmental Protection (Air) Policy 2008* (EPP (Air)) is established and sets out objectives in relation to air quality
- Under the EP Act, mining activities are required to hold an environmental authority. In issuing an environmental authority, the regulator must have regard to the extent to which the activity meets the objectives established under the EPP (Air). The environmental authority will then contain conditions in relation to air quality.

Occupational exposure to air contaminants is managed through the *Coal Mining Safety and Health Act 1999* (CMSH Act) and is not discussed further in this EMP.

The Commonwealth government has also established non-statutory air quality standards in the National Environmental Protection Measure (Ambient Air Quality).

The national pollutant inventory is established through a national environmental protection measure under the Federal *National Environment Protection Council Act 1994*. Carmichael Coal mine will trigger thresholds for reporting a range of air emissions under this scheme.

6.2 Environmental Values

Broad environmental values in relation to air quality are established in the EPP (Air):

a. The qualities of the air environment that are conducive to protecting the health and biodiversity of ecosystems; and

b. The qualities of the air environment that are conducive to human health and wellbeing; and

c. The qualities of the air environment that are conducive to protecting the aesthetics of the environment, including the appearance of buildings, structures and other property; and

d. The qualities of the air environment that are conducive to protecting agricultural use of the environment.

In relation to the proposed mining activity, the key contaminant of concern is particulate matter. Relevant air quality objectives in relation to particulate matter at sensitive receptors is shown in Table 6-1.

Table 6-1 Ambient Air Quality Objectives (1) and the Criterion for Dust Deposition

Pollutant	Objective	Averaging period
Total suspended particulates	90 µg/m^3	Annual
Particulate matter <10 µm (PM_{10})	50 µg/m^3	24 hour
Dust deposition	120 mg/m^2/day	Monthly

(1) From EPP Air

The proposed mine is located in an isolated rural area with a small number of sensitive receptors as follows:

- Workers Accommodation Village (Adani) 12 km east of the ML boundary
- Bygana homestead 4.9 km east of the ML boundary
- Lignum homestead 1.4 km east of the ML boundary
- Mellaluka homestead 9.8 km south of the ML boundary
- Doongmabulla homestead 6.6 km west of the ML boundary
- Carmichael homestead 11.8 km west of the ML boundary.

Particulate matter levels in the area are typical of moderate-low rainfall rural areas. Sources of atmospheric dust include windblown erosion (crustal dust) and smoke from fires.

Background conditions

There is a lack of publically available datasets that concern particulate matter levels in the general region of the Galilee Basin. Further east there is some data on existing and proposed projects in the Bowen Basin. There is also some data available from monitoring undertaken by the Government regulator, the Department of Environment and Heritage Protection (DEHP), at west Mackay and Townsville on the coast. Available data assessed were concerned with PM_{10} and dust deposition rates. Comparable background information for TSP and the finer $PM_{2.5}$ dust fractions were derived by use of suitable ratios found for agricultural-use dominated dust sources. Table 6-2 presents those levels chosen for the Project.

Table 6-2 Background air quality

Background levels		Reference
PM_{10} levels	70th percentile statistic of 11.0 µg/m^3	Caval Ridge Air Quality Impact Assessment Report (URS 2009)
	26 µg/m^3	PAE-Holmes, 2011
	75th percentile of 16.2 µg/m^3	DERM, 2011
TSP	22 µg/m^3	NPI 2012, Table 2, p,16
Respirable particle fraction of $PM_{2.5}$	3.3 µg/m^3	NEPC, 2002, p.5

Background levels		Reference
Dust deposition	Annual average range of 0.09 to 1.6 g/m^2/month	Ensham Central Project (Katestone, 2006) within the Bowen Basin

Outcomes of modelling of Project impacts on air quality are provided in SEIS Volume 4, Appendix L.

6.3 Potential Impacts

6.3.1 Construction

Table 6-3 Potential Environmental Impacts – Construction

Activity	Potential Environmental Impact
Vegetation clearing and earthworks	Particulate levels are not expected to exceed air quality and dust deposition objectives at sensitive receptors during construction

6.3.2 Operations

Table 6-4 Potential Environmental Impacts – Operation

Activity	Potential Environmental Impact
Mining, hauling and stockpiling of coal	Particulate levels are not expected to exceed air quality and dust deposition objectives at sensitive receptors during operation PM_{10} and $PM_{2.5}$ objectives may be exceeded at the off-site industrial area and airport at some stages of mining. It is possible that Lignum homestead may be affected by dust as the mine extends southwards. It is possible that $PM_{2.5}$ levels may be exceeded at Doongmabulla homestead at some stages of mining

6.4 Performance Outcome

Meet EPP (Air) objectives for dust emission at sensitive receptors as per Table 6-1.

Not cause nuisance from dust deposition at sensitive receptors.

6.5 Proposed Controls

6.5.1 Design, Procurement and Pre-construction

Table 6-5 Air Quality – Design, Procurement and Pre-construction

Control	Responsibility	Timing	Evidence
Install a meteorological monitoring station.	Environmental Manager	Prior to commencement of construction	Meteorological station in place
Plan construction activities and sequencing such that the area of exposed soils is minimised.	Construction Manager	Prior to commencement of construction	Earthworks schedule
Design temporary and permanent stockpiles (topsoil, spoil and coal) to minimise cross sectional area presented to the prevailing wind direction wherever space permits.	Design Manager	Prior to finalisation of detailed design	Design checklist
Design dust suppression systems for coal stockpiles (ROM and product).	Design Manager	Prior to finalisation of detailed design	Design checklist
Include coal spillage detectors and train wash systems at the train load out.	Design Manager	Prior to finalisation of detailed design	Design checklist
Include partial enclosure on, crushers and train load out.	Design Manager	Prior to finalisation of detailed design	Design checklist
Identify obligations for national pollutant inventory (NPI) reporting and ensure that mechanisms are in place to collect required data.	Environmental Manager	Prior to commencement of construction	Monitoring records

6.5.2 Construction

Table 6-6 Air Quality – Construction Controls

Control	Responsibility	Timing	Evidence
Regularly service vehicles, plant and equipment such that exhaust systems and fuel consumption comply with manufacturers' specifications.	Construction Manager	As per manufacturer's specifications	Vehicle logs
Stabilise topsoil stockpiles if left in place for longer than four weeks. Methods may include covering and planting of native grasses or sterile grasses.	Construction Manager	Ongoing	Topsoil management register Visual inspection
Utilise water sprays to control dust on access tracks, work areas and stockpiles. Water may be sourced from raw water supply or treated wastewater.	Construction Manager	Ongoing	Visual inspection

6.5.3 Operations

Table 6-7 Air Quality – Operation Controls

Control	Responsibility	Timing	Evidence
Operate coal stockpile dust suppression systems such that observed dust generation is minimised.	Mine Manager	Ongoing	Visual inspection
Stabilise topsoil stockpiles if left in place for longer than four weeks. Methods may include covering and planting of native grasses or sterile grasses.	Mine Manager	Ongoing	Topsoil management register
Use chemical sprays or sealants on unsealed haul roads where possible.	Mine Manager	Ongoing	Visual inspection
Utilise water spray mobile plant to control dust on haul roads, access tracks,	Mine Manager	Ongoing	Visual inspection

Control	Responsibility	Timing	Evidence
work areas and stockpiles. Water may be sourced from mine affected water (MAW), process water, raw water supply or treated wastewater.			
Progressively rehabilitate disturbed areas and ex-pit stockpiles as per rehabilitation plan.	Mine Manager	Ongoing	Rehabilitation register
During high wind speed conditions avoid blasting if possible.	Mine Manager	In high wind conditions	Visual inspection
Record emissions required to be reported under the NPI reporting scheme on the waste register.	Mine Manager	Ongoing	Waste register

6.6 Monitoring and Corrective Action

Table 6-8 Air Quality Monitoring and Corrective Action

Monitoring action	Responsibility	Frequency	Performance Requirement	Potential Corrective Action
Dust deposition monitoring at three downwind and one upwind location, with locations to be moved as mining progresses	Environmental Manager	Ongoing, data collected monthly	Dust deposition does not exceed 120 mg/m^2/day (monthly average)	Investigate potential causes. Develop mitigation measures to address dust deposition. This may include actions taken at the receptor location. Monitor ambient dust levels to check that residential receptors are not exposed to respirable dust levels in excess of EPP (Air) objectives.
Ambient air quality (PM_{10}) at the workers accommodation village, a	Environmental Manager	Continual as mining approaches	$PM_{2.5}$ and PM_{10} as per Table 6-1	Investigate possible causes using an interactive dust emissions model. Develop mitigation measures to address ambient

Monitoring action	Responsibility	Frequency	Performance Requirement	Potential Corrective Action
suitable upwind location and downwind location on the boundary, to be moved as mining progresses.		these locations		dust levels. This may include actions taken at the receptor location.
Visually monitor coal stockpiles for dust lift off	Supervisors Environmental officers	Ongoing	Dust lift off is not travelling beyond the lease boundary Water sprays are in operation and effective	Re-configure water spray system to achieve better coverage. Increase application of water sprays. Reduce vehicle speeds on haul roads.
Visually monitor spoil stockpiles for dust lift off	Supervisors Environmental Officers	Ongoing	Dust lift off is not travelling beyond the lease boundary Water sprays are in operation and effective	Re-configure water spray system to achieve better coverage. Increase application of water sprays. Stabilise surfaces through temporary or permanent revegetation.
Visually monitor haul roads for dust lift off	Supervisors Environmental Officers	Ongoing	Dust lift off is not travelling beyond the lease boundary Chemical suppressants or sealants are regularly applied Water trucks are actively applying water	Increase application of chemical suppressants or sealants. Increase water application from water trucks. Reduce vehicle speeds on haul roads.

Monitoring action	Responsibility	Frequency	Performance Requirement	Potential Corrective Action
Visually monitor minor access roads and other disturbed areas for dust lift off	Supervisors Environmental Officers	Ongoing	Dust lift off is not travelling beyond the lease boundary Water trucks are actively applying water	Increase application of water through water trucks. Rehabilitate or stabilise surfaces.
Monitor meteorological conditions (temperature, wind, rainfall)	Environmental Officer	Ongoing	NA	None required
Review meteorological data for changes from baseline or trends	Environmental Officer	Annual	Significant changes from baseline	If significant changes or trends are emerging, check design aspects that respond to meteorological conditions, including sizing and operation of water management systems. Make adjustments as necessary to address climate changes.
Inspect train loading	Train Load Out Supervisor	Each train	Wagons are not overloaded External aspects of trains and wagons do not generate dust	Remove overloaded material. Adjust settings on automated load out equipment. Clean trains/wagons.
Monitor air emissions as required under the NPI scheme	Environmental Manager	Annual	NPI report is submitted	NA

7. Greenhouse Gas Emissions

7.1 Legislative Framework

The legislative framework relevant to energy, carbon and greenhouse gas management includes:

- Commonwealth *Clean Energy Act 2011* – establishes the carbon pricing mechanism and deals with assistance for emissions intensive trade-exposed industries and the coal fired electricity generation sector
- Commonwealth *Energy Efficiency Opportunities Act 2006* – sets out requirements for large energy using businesses, and allows for regulations to provide detailed requirements for assessment, reporting, verification and other elements of the Australian Government energy efficiency program
- Commonwealth *National Greenhouse and Energy Reporting Act 2007* establishes a national system for reporting greenhouse gas emissions, energy consumption and production by corporations from 1 July 2008
- Queensland *Clean Energy Act 2008* – an Act to improve the efficiency and management of the use of energy, and the conservation of energy, in relation to particular businesses and other activities.

7.2 Environmental Values

Environmental values in relation to greenhouse gas emissions are not site specific, but rather, relate to global accumulation of greenhouse gases at levels that may cause climate change.

7.3 Potential Impacts

7.3.1 Construction

Table 7-1 Potential Environmental Impacts – Construction

Activity	Potential Environmental Impact
Operation of vehicles, plant and equipment using diesel or electricity	Emissions of greenhouse gases to the atmosphere
Waste generation	Loss of embodied energy and resources
Vegetation clearing	Release of carbon stored in vegetation
Wastewater treatment	Release of methane

7.3.2 Operations

Table 7-2 Potential Environmental Impacts – Operation

Activity	Potential Environmental Impact
Operation of vehicles, plant and equipment using diesel or electricity	Emissions of greenhouse gases to the atmosphere
Waste generation	Loss of embodied energy and resources
Vegetation clearing	Release of carbon stored in vegetation
Use of explosives	Release of carbon dioxide
Wastewater treatment	Release of methane
Overburden removal and exposure of coal to atmosphere	Release of methane
Underground mining	Release of methane

7.4 Performance Outcome

Minimise the greenhouse gas emissions intensity arising from construction and operation of the Carmichael coal mine.

7.5 Proposed Controls

7.5.1 Design, Procurement and Pre-construction

Table 7-3 Greenhouse Gas Emissions – Design, Procurement and Preconstruction Controls

Control	Responsibility	Timing	Evidence
Consider the following guidelines and rating schemes when designing buildings, infrastructure and other components of the mine: • Building Code of Australia requirements, including insulation, building materials and energy efficiency • National Australian Built Environment Rating System (NABERS) • Australian Green Infrastructure Council rating scheme • Green Building Council of Australia rating scheme.	Design Manager	During design	Design checklist Building and infrastructure specifications
Incorporate fuel and material efficiency requirements into the procurement strategy, including: • Appropriate sizing, maintenance and selection of equipment • Purchase of equipment where this leads to reduced greenhouse gas emissions over the equipment life • Minimisation of packaging • Consideration of the energy efficiency ratings of equipment.	Procurement team	During procurement of equipment, plant and vehicles	Equipment, plant and vehicle specifications
Consider fuel consumption when planning transportation of materials and minimise transport distances wherever possible.	Procurement team	During procurement of equipment, plant and	Equipment, plant and vehicle specifications

Control	Responsibility	Timing	Evidence
		vehicles	
Consider use of green power from the grid or on-site renewable energy generation.	Design Manager	During design	Design checklist Building and infrastructure specifications
Register Carmichael Coal Mine with the National Greenhouse and Energy Reporting scheme.	Environmental Manager	Prior to commencement of mining activities	Registration
Register Carmichael Coal Mine in the Liable Entities Database.	Environmental Manager	Prior to commencement of mining activities	Registration

7.5.2 Construction

Table 7-4 Greenhouse Gas Emissions – Construction Controls

Control	Responsibility	Timing	Evidence
Driver and operator training in relation to efficient operation of vehicles, plant and equipment.	Construction Manager	As required	Training register
Operation of vehicles, plant and equipment to minimise diesel consumption and wear and tear on parts.	All staff	Ongoing	Diesel fuel consumption
Regularly service vehicles, plant and equipment such that exhaust systems and fuel consumption comply with manufacturers' specifications.	Construction Manager and Contractors	Ongoing	Vehicle maintenance records

Control	Responsibility	Timing	Evidence
Minimise transportation distances within the site wherever possible.	Construction Manager and Contractors	Ongoing	Diesel fuel consumption
Operate and maintain air conditioning systems in accordance with manufacturer's instructions and Guide to Best Practice Maintenance & Operation of HVAC Systems for Energy Efficiency (Council of Australian Governments National Strategy on Energy Efficiency January 2012).	Construction Manager and Contractors	Ongoing	Maintenance records
Select vehicle size for worker transport to match group size and use buses for transporting larger groups.	Construction Manager and Contractors	Ongoing	Diesel fuel consumption

7.5.3 Operations

Table 7-5 Greenhouse Gas Emissions – Operational Controls

Control	Responsibility	Timing	Evidence
Driver and operator training in relation to efficient operation of vehicles, plant and equipment.	Mine Manager	As required	Training register
Operation of vehicles, plant and equipment to minimise diesel consumption and wear and tear on parts.	All staff	Ongoing	Diesel fuel consumption
Regularly service vehicles, plant and equipment such that exhaust systems and fuel consumption comply with manufacturers' specifications.	Area Managers	Ongoing	Vehicle maintenance records
Minimise transportation distances within the site wherever possible.	Area Managers	Ongoing	Diesel fuel consumption

Control	Responsibility	Timing	Evidence
Operate and maintain air conditioning systems in accordance with manufacturer's instructions and Guide to Best Practice Maintenance & Operation of HVAC Systems for Energy Efficiency (Council of Australian Governments National Strategy on Energy Efficiency January 2012).	Area Managers	Ongoing	Maintenance records
Select vehicle size for worker transport to match group size and use buses for transporting larger groups.	Area Managers	Ongoing	Diesel fuel consumption
Prepare and submit NGER reports.	Environmental Manager	Annually	Report
Prepare and submit reports under Queensland *Clean Energy Act 2008.*	Environmental Manager	Annually	Report
Purchase carbon units under the emissions trading scheme or offset emissions. Surrender carbon units to the Clean Energy Regulator.	CEO	Annually	Carbon credits

7.6 Monitoring and Corrective Action

Table 7-6 Greenhouse Gas Emissions - Monitoring and Corrective Action

Monitoring action	Responsibility	Frequency	Performance Requirement	Corrective Action
Conduct energy audits	Environmental Manager	Annual or as required by legislation	Continuous improvement in energy use reduction	Review results and identify opportunities to reduce energy consumption and greenhouse gas emissions.
Monitor all scope 1 emissions: • Diesel consumption (litres) • Explosives use (mass used) • Wastewater treatment (volume treated) • Fugitive methane emissions (per tonne of coal mined) • Vegetation cleared (are and type)	Environmental Manager	Annually	Accurate and auditable account of all scope 1 emissions	Improve monitoring and estimation methods.
Monitor scope 2 emissions (electricity consumption)	Environmental Manager	Annually	Accurate and auditable account of all scope 2 emissions	NA

8. Noise and Vibration

8.1 Legislative Framework

Ambient and environmental noise is managed through a framework established under the *Environmental Protection Act 1994*:

- The EP Act includes general objectives in relation to preserving environmental values in relation to air quality.
- Under the EP Act, the *Environmental Protection (Noise) Policy 2008* (EPP (Noise)) is established and sets out objectives in relation to ambient noise levels and the acoustic environment.
- Under the EP Act, mining activities are required to hold an environmental authority. In issuing an environmental authority, the regulator must have regard to the extent to which the activity protects the acoustic environment as defined in the EPP (Noise). The environmental authority will then contain conditions in relation to air quality.
- The EP Act also contains some requirements in relation to noise nuisance, however these are unlikely to be applicable at this location given the absence of sensitive receptors.

Occupational exposure to noise is managed through the *Coal Mining Safety and Health Act 1999* (CMSH Act) and is not discussed further in this EMP.

8.2 Environmental Values

Environmental values for the acoustic environment that are to be protected or enhanced are established in the EPP (Noise) as follows:

a. *The qualities of the acoustic environment that are conducive to protecting the health and biodiversity of ecosystems; and*

b. *The qualities of the acoustic environment that are conducive to human health and wellbeing, including by ensuring a suitable acoustic environment for individuals to do any of the following—*

   (i) Sleep;
   (ii) Study or learn;
   (iii) Be involved in recreation, including relaxation and conversation; and

c. *The qualities of the acoustic environment that are conducive to protecting the amenity of the community.*

Sensitive receptors within or in close proximity to the Project (Mine), as outlined in the EPP (Noise) include dwellings and protected areas identified under the NC Act. The proposed mine is located in an isolated rural area with a small number of sensitive receptors as follows:

Dwellings (within 15 km of Project (Mine)):

- Workers Accommodation Village (Adani) — 12 km east of the ML boundary
- Bygana homestead — 4.9 km east of the ML boundary
- Lignum homestead — 1.4 km east of the ML boundary
- Mellaluka homestead — 9.8 km south of the ML boundary

- Doongmabulla homestead 6.6 km west of the ML boundary
- Carmichael homestead 11.8 km west of the ML boundary.

Protected areas under the NC Act (within 15 km of the Project (Mine)):

- Bygana West Nature Refuge- occurs within and east of the southern part of the Project (Mine)
- Doongmabulla Mound Springs Nature Refuge- approximately 10 km west of the centre of the Project (Mine).

The existing noise environment is consistent with the quiet rural setting with background noise levels as shown in Table 8-1.

Table 8-1 Summary of Background Noise

Location	Background L_{A90} dB(A)			Ambient L_{Aeq} dB(A)		
	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)
Doongmabulla Homestead	31	31	27	48	41	43

Outcomes of modelling of Project impacts on air quality are provided in SEIS Volume 4, Appendix N.

8.3 Potential Impacts

8.3.1 Construction

Table 8-2 Potential Environmental Impacts – Construction

Activity	Potential Environmental Impact
Civil works during construction	Noise levels are predicted to be below guideline noise levels (WHO level 55db(A)). Livestock and native animals are not expected to be affected by noise.
Construction related traffic	Noise from construction-related traffic is predicted to be within guideline levels but incremental increases in traffic noise levels may be perceptible at locations close to Gregory Developmental Road and along the Moray-Carmichael Road.
Pile driving, rock breaking and heavy equipment operation	Vibration levels are not predicted to affect any sensitive receptors.

8.3.2 Operations

Table 8-3 Potential Environmental Impacts – Operation

Activity	Potential Environmental Impact
Mining operations	Noise criteria (day and/or night) may be exceeded at the Mine Workers Accommodation Village, otherwise noise related impacts are not expected at any sensitive receptors. Low frequency noise is not predicted to cause problems. Impacts of noise on livestock are not predicted. Livestock and native animals are not expected to be affected by noise.
Operation related traffic	Noise from operation-related traffic is predicted to be within guideline levels but incremental increases in traffic noise levels may be perceptible at locations close to Gregory Developmental Road and along the Moray-Carmichael Road.
Blasting	Airblast overpressure levels from blasting may approach criteria at the Lignum and Doongmabulla homesteads when blasting occurs near the mine boundary. Ground vibration levels associated with blasting are not expected to affect any sensitive receptors or structures.

8.4 Performance Outcome

Impacts from noise are managed to meet acoustic quality objectives at homesteads surrounding the mine. Acoustic quality objectives are set as follows:

Table 8-4 Table Noise Acoustic Quality Objectives

Noise level dB(A)	Monday to Sunday		
	7 am – 6 pm	6 pm – 10 pm	10 pm – 7 am
Noise measured at a 'Noise sensitive place'			
LA_{10}, adj, 15 mins	41	41	33
LA_{1}, adj, 15 mins	46	46	35

Impacts from airblast overpressure are managed to meet acoustic quality objectives and avoid disturbance to homesteads surrounding the mine.

8.5 Proposed Controls

8.5.1 Design, Procurement and Pre-construction

Table 8-5 Noise and Vibration – Design, Procurement and Preconstruction Controls

Control	Responsibility	Timing	Evidence
Ensure buildings and other structures at the off-site industrial area and within the mining lease are designed to withstand predicted airblast overpressure and ground vibration levels associated with blasting.	Design Manager	During detailed design	Design checklist

8.5.2 Construction

Table 8-6 Noise and Vibration Construction Controls

Control	Responsibility	Timing	Evidence
If a noise or vibration complaint is received, follow the complaints and inquiries procedure set out in Section 24.	Stakeholder Manager	As required	Incident register

8.5.3 Operations

Table 8-7 Noise and Vibration Operational Controls

Control	Responsibility	Timing	Evidence
If a noise or vibration complaint is received, follow the complaints and inquiries procedure set out in Section 24.	Stakeholder Manager	As required	Incident register
Provide notification to landholders of upcoming blasting activities within one kilometre of the lease boundary or five kilometres of homesteads on a weekly	Stakeholder Manager	Weekly when blasting	Community consultation register

Control	Responsibility	Timing	Evidence
basis	(notified by Mine Manager)		
Prior to blasting within one kilometre of the lease boundary, establish a flyrock exclusion zone within adjacent properties and check with landholders that the area is not occupied by humans Blast clearance zones are applied for all blasts.	Stakeholder Manager (notified by Mine Manager)	When blasting	Community consultation register

8.6 Monitoring and Corrective Action

Table 8-8 Noise and Vibration monitoring and Corrective Action

Monitoring action	Responsibility	Frequency	Performance Requirement	Corrective Action
Undertake noise or vibration monitoring in response to a complaint (from any sensitive receptor).	Environmental Manager	In response to a complaint	Noise levels do not exceed objectives in Table 8-4	Implement noise attenuation or mitigation measures. Measures may include those in AS2436:2010 *Guide to noise and vibration control on construction, demolition and maintenance sites*. Measures may also be taken at the sensitive receptor with agreement from the complainant. A range of management measures that can be implemented include: - Selection of quieter equipment or maintenance and modification of equipment to reduce noise emissions when operating

Monitoring action	Responsibility	Frequency	Performance Requirement	Corrective Action
				in proximity to noise sensitive receptors - Grading haul roads to remove potholes and bumps - Use of broadband reversing alarms (audible movement alarms) rather than standard tonal reversing alarms - Partial or full enclosure of noisy stationary plant items - Use of earth mounds to block noise
Airblast overpressure monitoring at lease boundary and/or closest sensitive receptor.	Mine Manager	During initial blasting activities in proximity to these locations	Airblast overpressure does not exceed 115 dB(linear)	Consider the following mitigation measures: • Reduce maximum instantaneous charge using delays, reduced hole diameter and/or deck loading • Change the burden and spacing by altering the drilling pattern and/or delay layout, or altering the hole inclination • Ensuring stemming depth and type is adequate • Avoid blasts during temperature inversions or heavy cloud conditions • Relocate residents for the period of blasting.
Check for structural damage at sensitive receptors	Mine Manager	After blasting in proximity to these	No further structural damage	Make good any verified damage in consultation with the landholder.

Monitoring action	Responsibility	Frequency	Performance Requirement	Corrective Action
		receptors or on receipt of a complaint	compared to dilapidation survey report	

9. Surface Water

9.1 Legislative Framework

There are two key pieces of legislation that govern surface water resources in Queensland.

The EP Act establishes the frameworks for managing water quality such that environmental values in relation to water quality are protected. This includes:

- The *Environmental Protection (Water) Policy 2008* which:
  - Identifies environmental values and management goals for Queensland waters (surface water and groundwater)
  - Establishes water quality goals and guidelines for waters
  - Provides guidance on making consistent, equitable and informed decisions about waters
  - Includes requirements for monitoring of ambient water quality.
- Requirements for assessment and approval of activities (environmentally relevant activities) that might result in a discharge to surface waters or other impact on surface waters.
- Provisions in relation to compliance with approval conditions in relation to impacts of activities on surface water resources.
- Specific offences relating to contamination of surface waters.

The *Water Act 2000* (Water Act) regulates the sustainable use of water resources, including allocation of water resources for environmental benefits as well as activities that impact on the integrity of watercourses. Water resource plans (WRPs) define the availability of water for each basin in Queensland, and frameworks and mechanisms for sustainably managing water supply and demand. Resource operations plans then set out rules in relation to the allocation of water resources and other decisions made under the WRP. The Carmichael Coal Mine is within the area covered by the *Water Resource (Burdekin Basin) Plan 2007*.

External; water supply for the Carmichael Coal mine from outside the mining lease is covered in the EMP for off-site infrastructure. Within the mining lease:

- A water licence is required in relation to the diversion of a determined watercourse.

A watercourse is defined in the Water Act as a river, creek or other stream, including a stream in the form of an anabranch or a tributary, in which water flows permanently or intermittently, regardless of the frequency of flow events—

a. In a natural channel, whether artificially modified or not; or

b. In an artificial channel that has changed the course of the stream.(Water Act Section 48).

In practice, DNRM will generally determine which of the waterways and drainage lines on the site constitute a watercourse under the Water Act definition.

By agreement between DEHP and the Department of Energy and Water Supply, dams on a mining lease that contain hazardous substances are administered by DEHP and are included in the environmental authority (Mining Lease). These may include:

- Mine affected water storages
- Tailings management dams
- Some sediment affected water dams.

9.2 Environmental Values

9.2.1 Surface Water Resources

Topography across the mining area typically slopes towards the east and north-east from a north-west to south-east trending ridge line, west of the lease boundary and running parallel to it.

The mining area is bisected by the Carmichael River which is a tributary of the Belyando River in the Suttor-Belyando sub-catchment of the Burdekin River. Tributaries within the Carmichael River catchment include Cattle Creek, Dylingo Creek and Surprise Creek which converge into the Carmichael River just upstream of the Study Area boundary. The river also receives discharge from the Doongmabulla Spring complex eight kilometres to the west of the Study Area. The Carmichael River has an effluent flow path south to Cabbage Tree Creek during flood events. Cabbage Tree Creek is therefore an ephemeral distributary creek of the Carmichael River.

While part of the mining area drains into the Carmichael River, the majority of the mining area drains from west to east in a series of minor, ephemeral watercourses, some of which become discontinuous downstream of the mine but ultimately flow to the Belyando River. Most of these are unnamed. Eight Mile Creek drains part of the mining area north of the Carmichael River.

There are a number of farm dams across the mining area. Some of these capture overland flow, some are in-stream and some are for storing groundwater.

9.2.2 Scheduled Environmental Values

The following environmental values are to be protected:

- Aquatic ecosystems – slightly to moderately disturbed
- Primary industries – irrigation
- Primary industries – stock watering
- Cultural and spiritual values

9.2.3 Water Quality

The water quality in the Carmichael River, upstream and downstream of the proposed mine site along with the ANZECC and ARMCANZ (2000) default trigger values for tropical upland rivers and QWQG are also detailed were used to consider WQOs for commonly monitored water quality parameters. The adopted WQOs (refer Table 9-1) are selected from an assessment of these combined values (refer to Table 4.3.5 of the SEIS Volume 4 Appendix K3).

Table 9-1 Water Quality Objectives Considered for the Assessment

Parameter	Units	Australian Drinking Water Guidelines[##]	Aquatic Ecosystems[#]	Primary Industries*	
			Carmichael River	Irrigation	Stock Watering
Physical parameters					
pH		-	6.5 – 9.0#	-	6.0 – 8.5
Electrical Conductivity	µS/cm	-	Variable release limits	-	16,700
Turbidity	NTU	-	500	2 - 15	-
Biological					
Faecal coliforms	cfu/100 mL	0	-	10 (direct contact) 1,000 (indirect contact)	1,000
Nutrients					
Ammonia as N	µg/L	500 (Aesthetic)	900	-	-
Nitrate (as N)	µg/L	50,000	1100	-	400,000
Nitrogen (Total)	µg/L	-	590**	5,000 – 125,000	-
Total Phosphorus	µg/L	-	200	0.05 - 12	-
Major ions					

Parameter	Units	Australian Drinking Water Guidelines[##]	Aquatic Ecosystems[#]	Primary Industries*	
			Carmichael River	Irrigation	Stock Watering
Fluoride	mg/L	1.5	-	1 - 2	2
Sulphate	mg/L	500		-	1,000
Metals and metalloids*					
Aluminium	mg/L	0.1	0.055	5 - 20	5
Arsenic	mg/L	0.01	0.013*	0.1 - 2	0.5
Boron	mg/L	4	0.37*	0.5	5
Cadmium	mg/L	0.002	0.0002*	0.01 - 0.05	0.01
Chromium (III+VI)	mg/L	0.05 (CrVI)	0.002	0.1 - 1	1
Cobalt	mg/L	-	0.09	0.05 - 0.1	1
Copper	mg/L	2	0.004	0.2 - 5	1
Iron	mg/L	0.3 (Aesthetic)	0.30*	0.2 - 10	-
Lead	mg/L	0.01	0.004*	2 - 5	0.1
Manganese	mg/L	0.5	1.9*	0.2 - 10	-
Mercury	mg/L	0.001	0.00006*	0.002	0.002
Molybdenum	mg/L	0.05	0.034	0.01 - 0.05	0.15

Parameter	Units	Australian Drinking Water Guidelines[##]	Aquatic Ecosystems[#]	Primary Industries*	
			Carmichael River	Irrigation	Stock Watering
Nickel	mg/L	0.02	0.011*	0.2 - 2	1
Selenium	mg/L	0.01	0.010	0.02 - 0.05	0.02
Silver	mg/L	0.1	1.0	-	-
Uranium	µg/L	0.017	1.0	10 - 100	200
Vanadium	mg/L	-	0.010	0.1 - 0.5	-
Zinc	mg/L	3 (Aesthetic)	0.030	2 - 5	20
Polycyclic aromatic hydrocarbons					
Petroleum hydrocarbons (C6-C9)	µg/L	-	20	-	-
Petroleum hydrocarbons (C10-C36)	µg/L		100		

[#] from the QWQG (DERM, 2009a)

[##] from the Australian Drinking Water Guidelines (2011)

* from the ANZECC guidelines (ANZECC and ARMCANZ, 2000), range values for irrigation WQOs represent LTV and short term trigger values (STV)

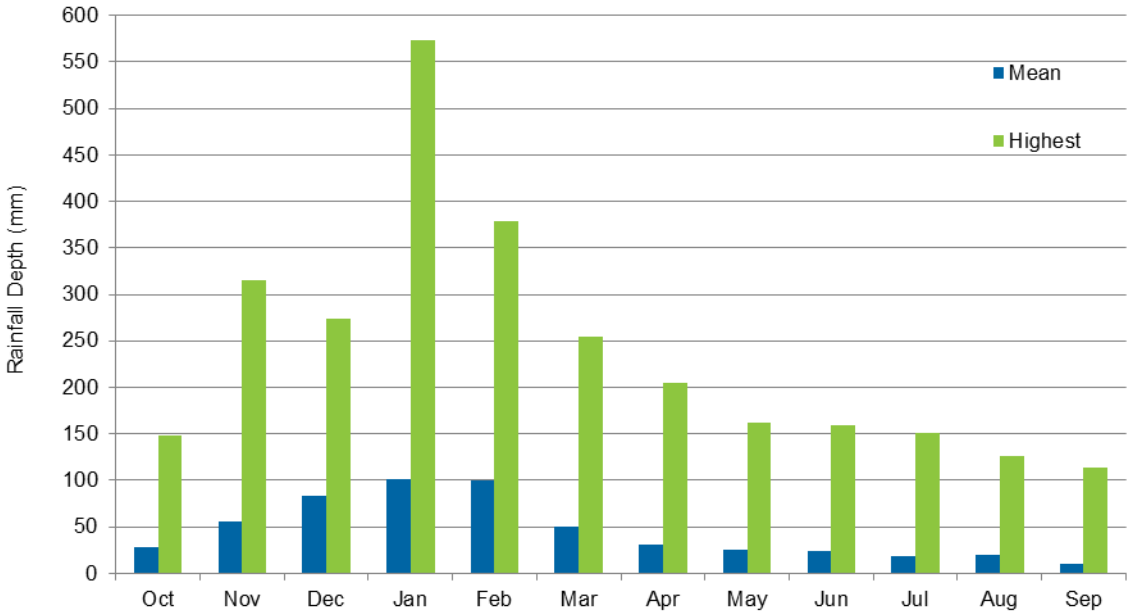
^ 75th percentile for Belyando-Suttor salinity zone (DERM 2009a)

**80th percentile for Carmichael River Data;

9.2.4 Rainfall and Evaporation

Average rainfall in the area is in the order of 550 mm/annum, with the bulk of rain falling in the summer months. Rainfall can vary significantly from year to year. Evaporation far exceeds rainfall, averaging around 1,200 mm/annum.

Figure 9-1 – Monthly Rainfall – Moray Downs Station, 36071 1914 – 2010[1]



9.3 Potential Impacts

Table 9-2 Potential Environmental Impacts – Surface Water Resources

Activity	Potential Environmental Impact
Vegetation clearing, topsoil stripping and general earthworks	Release of sediments to water through erosive processes.
Draining of existing farm dams	Potential for release of poor quality (low dissolved oxygen, high turbidity, high salinity) water to downstream environments.
Ex-pit spoil disposal	Change in surface topography and runoff characteristics. Release of sediments to water through erosive processes. Acidification if acid generating materials are exposed to oxidising conditions. Saline runoff if saline wastes are exposed.

[1] Minimum rainfall values are negligible and so have been excluded at this scale for all charts.

Activity	Potential Environmental Impact
Watercourse diversion	Changes in downstream flows. Replacement of natural watercourses with artificial watercourses.
Underground mining (refer Section 22)	Alteration of surface topography through creation of a series of subsidence troughs running roughly north-south. Interception of overland flows. Ponding in troughs. Potential surface water infiltration to groundwater through subsidence cracks.
Wastewater generation and treatment	If improperly managed, release of nutrients, pathogens and other contaminants to downstream waters.
Dewatering of pits and underground workings	Generation of mine affected water (MAW), discharge of which may cause high salinity and potentially introduce other contaminants to downstream areas.
Operation of MIA, including coal handling and processing and workshops	Generation of MAW, which may contain suspended solids, hydrocarbons and potentially other contaminants.
Mining activities within a floodplain	Flooding of mine workings and subsequent generation of large volumes of flood affected waters.
Structures within a flood plain	Increased afflux and flooding extent and duration upstream. Reduced flood flows downstream.
Storage and handling of hydrocarbons and other environmentally hazardous materials	Contamination of surface water resources.

9.4 Performance Outcome

Environmental values relating to aquatic ecosystems, stock and domestic use and cultural values are maintained.

Discharge and overflow events are undertaken in accordance with the relevant conditions under an environmental authority issued by DEHP.

9.5 Proposed Controls

9.5.1 Mine Water Management System Overview

The mine water management system is based on segregation of water streams into clean, dirty and mine affected streams as follows:

- Clean water streams will be waters that are unaffected by the mining or associated activities, and will include:
  - Water captured from undisturbed areas of the site, or
  - Water from catchments upstream of the proposed mine
  - Runoff from rehabilitated areas once rehabilitation criteria have been achieved with respect to vegetation cover and runoff water quality.
  - Groundwater from any advanced dewatering ahead of open cut or underground mining.
- Dirty water streams will be those that have come into contact with disturbed areas but not into contact with mining activities. This may include:
  - Stormwater runoff from overburden areas where this contains sediment only
  - Stormwater from the MIA area that has not been in contact with coal, vehicle and equipment maintenance workshops, waste storage areas and fuel or chemical storage areas
- Mine affected water streams will consist of
  - Any water from direct dewatering of open cut pits or underground mines
  - Water that has been in contact with coal, including decant water from tailings storage facility, water from the coal processing plant and stormwater from coal stockpiles
  - Treated wastewater from sewage treatment plants
  - Runoff from vehicle and equipment maintenance areas, waste storage areas and fuel or chemical storage areas

Clean water will be managed by diverting around disturbed areas, or conveying through the proposed mine in watercourse diversions.

Dirty water will potentially be contaminated with sediment and will be directed to sediment dams where settlement will occur. Most sediment will be designed to capture flows up to the 1:20 annual exceedance probability rain event. Water from any car parking areas or hardstand areas will also be directed through an oil/water separation system. Water from sediment dams may be used for dust suppression and other uses as required.

9.5.2 Design, Procurement and Pre-construction

Table 9-3 Surface Water – Design, Procurement and Preconstruction Controls

Control	Responsibility	Timing	Evidence
Develop a comprehensive water balance model for the mining operation. Utilise the water balance model to optimise sizing of MAW dams, sediment ponds and discharge infrastructure as well as raw water supply requirements.	Design Manager	Before operation	Model in place
Review water supply against environmental flow objectives for the Belyando Suttor sub-basin and against environmental impacts and of each source and determine optimal configuration that minimise loss of aquatic ecosystem habitat and water resources.	Design Manager	During design	Water supply strategy
Review optimal location for MAW controlled discharge on the Carmichael River. Review should include consideration of: • Availability of sufficient dilution flows to control salinity • Potential effects of discharges from proposed mines upstream of the Carmichael Coal Mine • Ability to achieve high volume discharge by gravity.	Design Manager	Before construction	Design checklist Updated environmental authority (mining)
Seek confirmation from DNRM regarding designation of watercourses under the Water Act.	Environment Manager	Pre-construction	Confirmation on file
Prepare a water management plan in accordance with the guideline *Preparation of Water Management Plans for Mining Activities* (DERM, 2009).	Environment Manager	Pre-construction	Water management plan in place
Review levee designs to ensure correct placement and side slope stability.	Design Manager	When designing levees	Design checklist
Review potential impacts on downstream flows from diversion works and raw water supply and check that environment flow objectives for the Belyando – Suttor sub-basin are met.	Design Manager	Pre-construction	Design checklist
Prepare detailed design for diversions, taking into account:	Design Manager	When designing	Design checklist

Control	Responsibility	Timing	Evidence
• Hydraulic requirements including energy dissipation • Creation of a geomorphologically stable channel • Potential for environmental values to be reinstated • Potential erosion at outlet point Current relevant guidelines are *Watercourse Diversions Guidelines – Central Queensland Mining Industry (*DERM, 2011*)*.		diversions	
Design all watercourse crossings to maintain flow and minimise afflux where this may affect sensitive receptors or infrastructure. See also design controls for aquatic ecology.	Design Manager	When designing crossings	Design checklist
Conduct further modelling to optimise size of sediment basins.	Design Manager	When designing sediment basins	Design checklist
Prepare a Receiving Environment Monitoring Program (REMP), including: • Establishing of background and impact monitoring locations for water and sediment quality • Determination of trigger levels and water quality objectives • A program for routine monitoring of water and sediment quality • A program for continuous monitoring of key parameters that would indicate uncontrolled releases or other mine-related impacts • Procedures for checking results against trigger levels and implementing corrective actions where trigger levels are reached.	Environment Manager	Prior to commencement of construction	REMP in place
Establish water quality and sediment monitoring network upstream and downstream of mining activities. Collect at least 12 months of baseline data and determine water quality objectives and triggers using methods set out in Queensland Water Quality Guidelines (DERM 2009) and Australia and New Zealand Water Quality Guidelines (ANZECC and ARMCANZ, 2000).	Environmental Manager	12 months prior to construction	

Control	Responsibility	Timing	Evidence
Prepare a procedure for controlled discharge of MAW. The procedure should include: • Set water quality objectives in relation to controlled discharge of MAW, including: – Any upper limits on salinity in the receiving water, above which the discharge should cease – Any upper limits on salinity in MAW above discharge should not be allowed – Any other water quality related triggers that may be required to protect environmental values of the receiving water. • Monitoring requirements before, during and after a discharge event • Reporting requirements in relation to a discharge event.	Environmental Manager	Prior to operation	Controlled discharge procedure
Design dams to comply with Manual for Assessing Hazard Categories and Hydraulic Performance of Dams (Queensland DERM 2012) and Guideline Structures which are dams or levees constructed as part of environmentally relevant activities (DEHP 2012).	Design Manager	During detailed design	Design checklist
Submit design plans for tailings storage facility (TSF), MAW dams and sediment dams to the regulatory agency (DEHP).	Design Manager	Prior to constructing a dam	Correspondence
Design all structures to meet the flood design criteria as determined by detailed design and risk assessment.	Design Manager	During detailed design	Design checklist
Design of sewage treatment plans will be undertaken in accordance with the requirements of DEHP's Assessment Guideline: Assessing applications for sewage treatment works (http://www.ehp.qld.gov.au/licences-permits/business-industry/pdf/sewage-treatment-em725.pdf).	Design Manager	During detailed design	Design checklist
Drinking water to comply with the water quality management and planning requirements as outlined in the Australian Guidelines for Water Recycling -	Design Manager	During detailed design	Design checklist

Control	Responsibility	Timing	Evidence
managing health and environmental risks (Phase 1) (2006) and (Phase 2) as released by the National Environmental Protection Council.			

Table 9-4 Indicative Flood Design Criteria

Component	Required Flood Immunity	Comments
Open cut pits and underground mine access portals	1,000 year ARI + 600 mm freeboard	
Carmichael River levees (embankment crest level)	1,000 year ARI + 600 mm freeboard	
Stream diversions and levees	100 year ARI – diversions	
Above ground tailings storage facilities (embankment crest level)	TBC	Based on preliminary hazard assessment using DERM 2012.
Conveyors	100 year ARI	
MIA, CHPP and all stockpiles	100 year ARI + up to 600 mm freeboard	
Internal drainage within MIAs	10-20 year ARI	
Mine affected water storages (embankment crest level)	100 year ARI + 500 mm freeboard	Based on preliminary hazard assessment using DERM 2012.
Overburden Sediment dams	20 year ARI	
Roads used for evacuation	100 year ARI	
Haul roads	From 5 to 100 year ARI	

Component	Required Flood Immunity	Comments
Minor access roads throughout mine site	5 year ARI	
Moray-Carmichael Road realignment and other public roads	20 ARI	Local public roads currently flood in most wet seasons.

9.5.3 Construction and Pre-Mining Works

Table 9-5 Surface Water – Construction Controls

Control	Responsibility	Timing	Evidence
If farm dams are required to be drained: • Test water quality (pH, DO, turbidity and EC) • Utilise water for dust suppression as a first preference • If water cannot be used for dust suppression, then manage as follows: – If EC is less than 1300 us/cm, pH is in the range 6.5-8.5, turbidity is less than 130 NTU and DO is above 4 mg/l, water may be pumped to the downstream watercourse. Pump rate should be such that water does not overflow the channel, scouring does not occur and suspended sediment from the base of the storage is not suspended. Monitor turbidity levels through and cease discharge if turbidity exceeds 50NTU. – If DO is below 4 mg/L, discharge to watercourse may be possible with aeration, however care must be taken not to stir up sediment from the bottom of the storage such that turbidity exceeds 130NTU. – If EC is more than 1300 us/cm, pH is outside the range 6.5-8.5, or turbidity exceeds 50 NTU, consider suitability for irrigation of pasture areas or rehabilitation trials. Water is to be irrigated such that ponding and runoff does not occur. Alternatively, transfer to another storage for later use.	Construction Manager	When draining dams	Water quality data and discharge records, permit to disturb.

Control	Responsibility	Timing	Evidence
Do not take water from the Carmichael River for use during construction.	All	At all times	No water taken from Carmichael River
Do not commence construction of dams until either: • An acknowledgement letter has been received from the regulator (DEHP) in respect of the proposed design and • 28 days has passed since the letter of acknowledgement was received and no further correspondence has been received.	Construction Manager	When constructing a dam	Correspondence from regulator
Obtain certification from a registered professional engineer of Queensland (RPEQ) with appropriate skills in dam design that the dam is constructed in accordance with the design. Submit certification to the regulator (DEHP).	Design Manager	On completion of any dam	Certification

9.5.4 Operations

Table 9-6 Surface Water – Operational Controls

Control	Responsibility	Timing	Evidence
Prepare and implement an operating plan for MAW and sediment dams, or incorporate operating requirements into the Plan of Operations. Operating plan is to include: • Annual dam surveillance inspections when dam is at a low level • Water quality monitoring • Operational requirements in relation to water levels, transfers between storages and reuse of MAW • Requirements for recording mine water management transfers and use • MAW discharge approval parameters.	Mine Manager	Before operating MAW and sediment dam Ongoing	Dam operating plan Monitoring and surveillance records, mine water management records

Control	Responsibility	Timing	Evidence
Transfer all MAW to MAW dams. MAW is not to be placed in sediment basins or directly discharged.	Mine Manager	Ongoing	Mine water management records
Utilise MAW for the following uses in preference to raw water: • Dust suppression • CHPP (except where raw water is required for particular processes) • Vehicle washing.	Area Managers	Ongoing	Mine water management records
When using MAW for dust suppression in areas that drain to sediment basins catchments, apply at a rate that does not cause runoff or ponding.	Area Manager	At all times	Inspection checklist
Review and update Mine Water Management Plan.	Mine Manager	Every five years or more frequently if required to address non-compliance	Updated plan
Review and update REMP.	Environmental Manager	Every five years or more frequently if required to address non-compliance	Updated plan
Include maintenance of the following items in mine maintenance schedule: • Oil water separators • MIA stormwater systems • Pumps and pipes • Controlled discharge infrastructure.	Mine Manager	As per maintenance schedule	Maintenance records

9.6 Monitoring and Corrective Action

Table 9-7 Surface Water Monitoring and Corrective Action

Monitoring action	Responsibility	Frequency	Performance Requirement	Corrective Action
Monitor water quality in MAW dams	Mine Manager	Monthly	To be determined	Commence treatment to address contaminant levels. If necessary, transfer water between MAW dams to ensure that an uncontrolled overflow does not occur.
Monitor the mandatory reporting level in all high and significant hazard dams	Mine Manager	Continuous	Below level specified in environmental authority	Report to regulatory body (DEHP) that mandatory reporting level has been reached. Determine measures to reduce water level to below mandatory reporting level (controlled release, transfer to other dams).
Monitor design storage allowance (DSA) in all high and significant hazard dams	Mine Manager	Annually	DSA is available	Report to DEHP that DSA is not available Take steps to restore DSA
Monitor background and impacted water quality and sediment quality as per REMP	Mine Manager	As per REMP	Below triggers specified in REMP	As specified in REMP

Monitoring action	Responsibility	Frequency	Performance Requirement	Corrective Action
Monitor EC/salinity upstream and downstream of controlled discharge point and at point of discharge	Mine Manager	At least 12 hours prior to discharging and until 12 hours after discharging MAW or groundwater from advanced dewatering	To be determined	Cease discharge if trigger level is reached at downstream monitoring location.

10. Groundwater

10.1 Legislative Framework

There are two key pieces of legislation that govern ground water resources in Queensland.

The EP Act establishes the frameworks for managing water quality such that environmental values in relation to water quality are protected. This includes:

- The *Environmental Protection (Water) Policy 2008* which:
  - Identifies environmental values and management goals for Queensland waters (surface water and groundwater)
  - Establishes water quality goals and guidelines for waters
  - Provides guidance on making consistent, equitable and informed decisions about waters
  - Includes requirements for monitoring of ambient water quality.
- Requirements for assessment and approval of activities (environmentally relevant activities) that might result in impacts on groundwater resources.
- Provisions in relation to compliance with approval conditions in relation to impacts of activities on ground water resources.

The *Water Act 2000* regulates the sustainable use of water resources, including allocation of water resources for environmental benefits as well as activities that impact on the integrity of watercourses. The *Water Regulation 2002* provides for a range of matters required under the Water Act 2000, which allows for proper functioning of the Act. This includes the declaring of catchment area, where regulations will occur to protect the water quality in the catchment. Of relevance to the Project area are the Highlands subartesian area (on plan CAS2055) and the Great Artesian Basin subartesian area (on plan CAS2054).

Water resource plans (WRPs)) are outlined in the *Water Regulation 2002* and define the availability of water for each basin in Queensland, including the Great Artesian Basin (GAB), and frameworks and mechanisms for sustainably managing water supply and demand. Resource operations plans then set out rules in relation to the allocation of water resources and other decisions made under the WRP. The Carmichael Coal Mine is within the area covered by the *Water Resource (Burdekin Basin) Plan 2007* and at the edge of the area covered by the *Water Resource (Great Artesian Basin) Plan 2006*. Water supply for the Carmichael Coal mine from outside the mining lease is covered in the EMP for off-site infrastructure. Within the mining lease, a water licence is required in relation to the extraction of groundwater through mine dewatering and development approvals are required for installation of groundwater bores.

10.2 Environmental Values

A summary of the hydrogeological units present in the Carmichael Coal Mine area is provided in Volume 4 Appendix K1 of the SEIS.

Groundwater from the Moolayembar Formation and Clematis Sandstone is suitable for stock, domestic and irrigation use. Salinity and other constraints affect suitability for use of groundwater from other aquifers, however some extraction from bores in these units for stock and domestic use is known to occur. Groundwater quality is generally suitable for industrial use.

Groundwater flow appears to be typically towards the south-east across the northern and central parts of EPC 1690 in the Dunda Beds, Rewan Group, Permian-age sandstones and siltstones, the AB seam and the D seam. Across southern areas of EPC 1690, interpretation of the data suggests groundwater flow is typically towards the north west in the Permian-age sandstones and siltstones and the AB and D seams.

There is potential for groundwater to discharge to the Carmichael River, particularly towards the western margin of the Mining Area. Data suggests that in the western part of the mine, there is an upward gradient from the Dunda Beds to the overlying alluvium and groundwater levels in the alluvium are typically above the bed of the adjacent Carmichael River.

To the east, it appears that there are upward gradients from the Tertiary deposits to the overlying alluvium but that groundwater levels in the alluvium at and shallow Tertiary deposits are below the bed of the adjacent Carmichael River. This suggests the potential for leakage from the river to groundwater in these areas.

Based on the groundwater level data alone it appears that the Carmichael River may switch from gaining flow from groundwater to losing flow to groundwater between the western and eastern boundaries of the site.

There are several groundwater dependent ecosystems in the area:

- The Doongmabulla Spring complex is located approximately 8 km west of the study area on the eastern margin of the GAB. This complex features around 11-14 springs.
- Two springs on the Mellaluka property, about 10km to the south of the mine area. Geological data is limited in this area and it is not certain which aquifer discharges to these springs.
- Riparian vegetation, particularly mature trees along the Carmichael River (including the EPBC Act listed species waxy cabbage palm (*Livistona lanuginosa*)) and Belyando River appear to be dependent on alluvial groundwater.

10.3 Potential Impacts

10.3.1 Construction

Table 10-1 Potential Environmental Impacts – Construction

Activity	Potential Environmental Impact
Dewatering of excavations	Drawdown of groundwater may occur, however most excavations are relatively shallow with respect to the groundwater levels, relatively small in volume and requiring dewatering only over a short period of time. Hence, impacts are not expected. Disposal of groundwater from dewatering has the potential to cause surface water degradation particularly if salinity is high.
Contamination from spills or leaks of environmentally hazardous substances	Large spills of environmentally hazardous materials, or leaks that are allowed to continue over long periods of time may cause contamination of groundwater. Measures to prevent soil contamination will also address risk to groundwater. Improper irrigation of treated wastewater may cause nutrients to leach to groundwater. Measures for management of irrigation of treated sewage will address this impact.

10.3.2 Operations

Table 10-2 Potential Environmental Impacts – Operation

Activity	Potential Environmental Impact
Mine dewatering	Mine dewatering is predicted to cause groundwater drawdown. Drawdown impacts on Doongmabulla Springs are predicted to be minor. Preliminary drawdown predictions for Mellaluka Springs indicate drawdown of 0.05-0.0.12 m. Drawdown of between 1 and 4m (from west to east) may occur in the vicinity of the Carmichael River. Groundwater flows to the Carmichael River may be reduced by up to seven per cent of groundwater inputs.
Longwall mining and subsidence	Subsidence may cause fracturing in overlying strata with predictions of a free draining fracture zone with a maximum height of up to 200 m forming above each of the mined seams. This will increase vertical hydraulic conductivity between aquifers.
Contamination from spills or leaks of environmentally hazardous substances	Large spills of environmentally hazardous materials or leaks that are allowed to continue over long periods of time may cause contamination of groundwater. Measures to prevent soil contamination set out in Section 18.5 will also address risk to groundwater. Improper irrigation of treated wastewater may cause nutrients to leach to groundwater. Measures for management of irrigation of treated sewage are set out in Section 12.5 will address this impact.

10.4 Performance Outcome

Groundwater users are not adversely impacted in terms of availability of water for stock and domestic use.

Impacts on groundwater dependent ecosystems do not cause unacceptable or unapproved losses of biodiversity values.

10.5 Proposed Controls

10.5.1 Design and Pre-construction

Table 10-3 Groundwater – Design and Preconstruction Controls

Control	Responsibility	Timing	Evidence
Update groundwater model to include additional information on groundwater and geology obtained from monitoring programs.	Environmental Manager	Within 24 months of commencement of mining operations	Revised model
Use monitoring data to set groundwater quality trigger levels.	Environmental Manager	Prior to commencement of operations	Trigger levels in environmental authority
Liaise with adjacent landholders and develop bore monitoring programs to detect changes in bores used for water supply.	Environmental Manager	12 months prior to commencement of mining	Updated groundwater monitoring plan.
Enter into “make good” agreements with surrounding landholders in relation to groundwater impacts.	Stakeholder Manager	Prior to commencement of mining	Agreements in place

10.5.2 Construction

Table 10-4 Groundwater – Construction Controls

Control	Responsibility	Timing	Evidence
Identify presence and quality of groundwater in any areas where excavation is to occur and determine approach to managing groundwater from excavation such that degradation of surface water quality or land does not occur. Document management approach and monitoring requirements in the	Construction Manager	Prior to any excavation more than 2 m below ground level	Work permit details

Control	Responsibility	Timing	Evidence
work permit application.			
Check that work permit applications include appropriate measures for management of groundwater from excavations.	Environmental Manager	Prior to issuing permit	Work permit
Potential impacts on groundwater quality due to the discharge of potentially contaminated runoff will be prevented through the development and operation of a suitable surface water management system and associated management plan (SWMP).	Environmental Manager	Prior to Construction	Approved plan is implemented
Laydown and storage areas must not be placed in the vicinity of creeks or rivers or near to sensitive receptors (i.e. groundwater bores or GDEs).	Construction Manager	Ongoing	Approved site work layout
Prior to the commencement of construction activities the status of each of the existing registered bores that could be significantly affected by the proposed Project (Mine) should be confirmed and a baseline assessment undertaken at each of the active bores in order to establish their pre-operational condition.	Environmental Manager	Prior to Construction	Monitoring program and results

10.5.3 Operations

Table 10-5 Groundwater – Operational Controls

Control	Responsibility	Timing	Evidence
Update groundwater model to include additional information on groundwater and geology obtained from ongoing monitoring programs.	Environmental Manager	Within two years of operations then every five years	Revised model
Re-run groundwater model to test drawdown effects on sensitive receptors, review management, monitoring and mitigation measures and develop	Environmental Manager	Each time model is updated	Updated monitoring, management and

Control	Responsibility	Timing	Evidence
additional measures as required.			mitigation measures

10.6 Monitoring and Corrective Action

Table 10-6 Groundwater Monitoring and Corrective Action

Monitoring action	Responsibility	Frequency	Performance Requirement	Corrective Action
Monitor groundwater flows into Carmichael River and surface flows.	Environmental Manager	As per Environmental Authority	No unapproved reduction in groundwater inflows	Direct diversions to the Carmichael River or release high quality water to the River.
Conduct groundwater quality monitoring across monitoring network for: • pH, DO, turbidity, EC, temperature (field and lab) • Total organic carbon • Major ions • Fluoride and sulfide • Nutrients • Dissolved metals • Hydrocarbons (TPH and BTEX)	Environmental Manager	As per Environmental Authority	Trigger levels set in environmental authority are not exceeded	Repeat monitoring immediately on receiving non-compliant results. If repeat results indicate persistent elevation, raise an incident report and commence incident investigation. Undertake corrective actions as identified in the incident investigation.

Monitoring action	Responsibility	Frequency	Performance Requirement	Corrective Action
Conduct groundwater level monitoring across monitoring network.	Environmental Manager	As per Environmental Authority	Drawdown at Doongmabulla Springs does not exceed trigger level to be determined Drawdown at Mellaluka springs does not exceed trigger level to be determined Drawdown at stock and domestic bores does not affect yield	Implementation of adaptive monitoring program. Mine planning and rehabilitation mitigation measures implemented. Implement make good agreements with landholders.
As Mining Activity progresses, the monitoring network will be updated for inclusion of new bores or exclusion of bores in mined areas.	Environmental Manager	As per Environmental Authority	Ongoing monitoring	Maintain updated monitoring program.
Monitor stygofauna in selected bores.	Environmental Manager	Annually	Ongoing monitoring	Maintain updated monitoring program. Results to be included in the annual groundwater monitoring report.

Table 10-7 Indicative Groundwater Monitoring Network Summary

Groundwater Monitoring Sites	Monitored Unit	Monitoring Purpose
C006P1	Interburden	Levels and quality, vertical gradients between strata
C006P3r	D Seam	
C007P2	AB Seam	Levels and quality, vertical gradients between strata
C007P3	D Seam	
C008P1	Permian Overburden	Levels and quality, vertical gradients between strata
C008P2	AB Seam	
C011P1	Interburden	Levels and quality, vertical gradients between strata
C011P3	D Seam	
C012P1	Permian Overburden	Levels and quality, vertical gradients between strata
C012P2	Tertiary/Permian	
C014P2	AB Seam	Levels and quality (no groundwater encountered in Tertiary-age strata)
C016P2	AB Seam	Levels and quality
C018P1	Permian Overburden	Levels and quality, vertical gradients between strata
C018P2	AB Seam	
C018P3	D Seam	
C020P2	AB Seam	Levels and quality

Groundwater Monitoring Sites	Monitored Unit	Monitoring Purpose
C022P1	Dunda Beds	Levels and quality, geological unit within the Great Artesian Basin
C024P3	D Seam	Levels and quality
C025P1 C025P2	Tertiary Tertiary	Levels and quality, potential connectivity between groundwater and the Carmichael River, vertical gradients
C027P1 C027P2	Alluvium Dunda Beds	Levels and quality, potential connectivity between groundwater and the Carmichael River, vertical gradients
C029P1 C029P2	Alluvium Tertiary	Levels and quality, potential connectivity between groundwater and the Carmichael River, vertical gradients
C032P2	AB Seam	Levels and quality
C034P1 C034P3	Interburden D Seam	Levels and quality, vertical gradients between strata
C035P1 C035P2	Rewan Group AB Seam	Levels and quality, vertical gradients between strata
C9553P1R C553P_V01 C553P_V02 C553P_V03	Dunda Beds D1 Seam AB1 Seam Permian Overburden	Levels, vertical gradients between strata

Groundwater Monitoring Sites	Monitored Unit	Monitoring Purpose
C555P1	Rewan Group	Levels, vertical gradients between strata
C555P_V01	D Seam	
C555P_V02	AB1 Seam	
C555P_V03	Rewan Group	
C556P1	Rewan Group	Levels, vertical gradients between strata
C9556P_V01	D2 Seam	
C9556P_V02	AB1 Seam	
C9556P_V03	Rewan Group	
C558P1	Permian Overburden	Levels, vertical gradients between strata
C558P_V01	D1 Seam	
C558P_V02	Interburden	
C558P_V03	AB1 Seam	
C056C_V01	D1 Seam	Levels, vertical gradients between strata
C056C_V02	AB1 Seam	
C056C_V03	Rewan Group	
HD01	Dunda Beds	Levels (west of EPC 1690)
HD02	Clematis Sandstone	Levels (between EPC 1690 and Doongmabulla Springs)

Groundwater Monitoring Sites	Monitored Unit	Monitoring Purpose
HD03A	Dunda Beds	Levels, vertical gradients between strata (between EPC 1690 and Doongmabulla Springs)
HD03B	Alluvium	

11. Mine Waste Management

11.1 Legislative Framework

Mine waste, including overburden, interburden, rejects and fines is managed under the EP Act. As mine waste is typically disposed of within the mining lease, waste management requirements are included in the environmental authority (mining lease).

11.2 Environmental Values and Characteristics

Mine waste consists of naturally occurring materials, the properties of which can be altered by the mining activity. If not properly managed, mine waste can cause impacts to surface and groundwater quality and hence these environmental values are also relevant in relation to mine waste. As mine waste disposal usually results in a change in landform, scenic amenity is another environmental value associated with mine waste management.

Based on the available results the majority of the overburden and interburden materials (not immediately adjacent to the coal seams) and roof and floor wastes are not likely to be a source of acid immediately after mining. Nor would most of these materials be expected to be an immediate source of salinity; however, some portion could be a source of salinity. The clay materials of the overburden and interburden could have a markedly higher potential to release salts and metals upon contact with water even though the pH may remain alkaline. Typically however, the concentrations of metals in water contacting the waste would be expected to be low while waters remain circumneutral.

11.3 Potential Impacts

If not properly managed, mine waste can cause impacts to surface and groundwater quality. As mine waste disposal usually results in a change in landform, scenic amenity is another environmental value.

All coarse rejects from the CHPP will be disposed in the overburden areas of pits D and E, and incorporated within the backfill. A purpose built tailings dam will be constructed adjacent to the central mine infrastructure and coal processing plant area. Project mine waste generated through mining (overburden) and coal processing (rejects and tailings) has been defined for the SEIS as mining waste (refer to Volume 4 Appendices O1 and O2).

It is planned that following development of the initial open pit boxcut area, all coarse reject materials will be stored as in-pit or out of pit spoil piles. In contrast, fine coal reject (tailings) are proposed to report to an out-of-pit tailings storage facility (65 per cent) located adjacent to the Coal Processing Plant, and 35 per cent to a belt/filter press, with the paste reporting to coarse rejects system.

Initially, the overburden produced by mining the boxcut area will be stored at an out-of-pit overburden emplacement area adjacent to the low wall on the eastern side of the open pit. Some of the overburden has the potential to be saline and/or sodic and any out-of-pit overburden will be managed to ensure that saline and/or sodic materials do not report to final top and bench surfaces and batters., coarse reject material will be encapsulated in the out-of-pit emplacement area.

Saline and/or sodic materials will be placed within the core of the overburden emplacement area before covering with more benign materials, reshaping and adding topsoil and vegetation as part of the staged rehabilitation process. Some rock mulching may also be required on final

batters to limit potential erosion from surface runoff and any requirement for this approach this will be assessed during rehabilitation field trials.

Fine coal reject (tailings) will report to a purpose-built Tailings Dam in a slurry form. A two year placement and drying cycle will be undertaken, with final positioning in sealed cells within the overburden areas of Pits D and E. The tailings management strategy is detailed in Volume 4, Appendix O2.

Table 11-1 Potential Environmental Impacts – Mine Waste

Activity	Potential Environmental Impact
Excavation and disposal of potentially acid forming (PAF) materials	Acidification of water that comes into contact with the material, with associated impacts on surface water runoff and groundwater. Reduction in pH may increase solubility of metals, leading to metal concentrations in surface water and groundwater becoming elevated above background concentrations and degradation of environmental values of these waters. During mining, and potentially post mining, groundwater drawdown will prevent migration of acidified groundwater. Runoff from spoil disposal areas will be captured in sediment basins.
Excavation and disposal of dispersive materials	Dispersive materials will be susceptible to erosion when disposed of in above ground waste disposal areas. This in turn may lead to high levels of suspended solids in runoff water. If dispersive materials are placed at or near the final landform surface, the dispersivity may compromise the success of rehabilitation, particularly in relation to creation of a stable landform and restoration of vegetation cover. Runoff from spoil areas will be captured in sediment basins, which will remain in place until rehabilitation is complete.
Excavation and disposal of potentially saline materials	Salt from saline waste materials may become dissolved in surface runoff or groundwater that comes in contact with the saline or potentially saline wastes. This in turn may affect environmental values associated with surface water and groundwater resources. During mining, and potentially post mining, groundwater drawdown will prevent migration of acidified groundwater. Runoff from spoil disposal areas will be captured in sediment basins.
Excavation and disposal of all mine wastes	Placement of mine waste in above ground disposal areas will permanently alter surface topography and landform. Ex-pit mine waste disposal areas will be visible from the surrounding landscape, however there are limited sensitive receptors.
Generation of tailings	Tailings may be potentially acid forming and have similar impacts to PAF materials. In addition, tailings generally have low structural integrity and will be contained to prevent spread across the landscape.

11.4 Performance Outcome

Mine waste is managed to avoid impacts on environmental values of surface water and groundwater and to maximise rehabilitation success.

11.5 Proposed Controls

11.5.1 Design and Pre-construction

Table 11-2 Mine Waste – Design, Procurement and Preconstruction Controls

Control	Responsibility	Timing	Evidence
Conduct geochemical characterisation across the proposed mine area. Analyse results and use results to identify likely locations and volumes of PAF, potentially saline or dispersive waste materials.	Environmental Manager Mine Manager	Prior to commencement of mining	Test results and assessment report
Confirm preferred disposal and encapsulation strategies for PAF, potentially saline or dispersive waste. Incorporate into the mine plan and plan of operations.	Mine Manager	Prior to commencement of mining	Mine waste disposal strategy report
Update mine plan to ensure that PAF, potentially saline or dispersive waste can be placed directly into a suitable disposal location whereby adverse properties can be managed and impacts avoided.	Mine Manager	Prior to commencement of mining	Updated Mine Plan
Establish an ongoing testing program for mine waste characterisation to be carried out as mining progresses such that the characteristics of mine waste with respect to potential for acid formation, salinity and dispersivity are known prior to excavation. The testing program should include: • Required testing density, based on potential risk associated with different materials. • Field identification and classification of waste types for waste management operations. • Back up laboratory testing as required to validate field testing and better understand samples where field tests indicate potential problems. • Criteria against which monitoring results can be compared to identify the need for special management techniques.	Environmental Manager Mine Manager	Prior to commencement of mining	Program in place

Control	Responsibility	Timing	Evidence
Establish a mine waste tracking program that: • Identifies in advance the placement location for mine wastes based on characteristics and links to the geological model for the coal mine. • Records where particular mine wastes have been placed. • Correlates mine waste placement with surface water and groundwater monitoring.	Mine Manager	Prior to commencement of mining	Program in place

11.5.2 Construction

There are no management controls required during construction.

11.5.3 Operations

Table 11-3 Mine Waste - Operational Controls

Control	Responsibility	Timing	Evidence
Implement testing program ahead of each stage of mining activities.	Mine Manager	At least six months ahead of each new stage	Test results
Implement mine waste tracking program.	Mine Manager	Ongoing	Register of mine waste placement
Dispose of problem mine wastes in accordance with mine plan.	Mine Manager	Ongoing	Register of mine waste placement
Review groundwater and surface water monitoring programs to check that adequate monitoring is taking place in the vicinity of areas where problem wastes have been disposed to detect any acidification or increased salinity.	Environmental Manager	Every five years	Updated monitoring programs

11.6 Monitoring and Corrective Action

Table 11-4 Mine Waste - Monitoring and Corrective Action

Monitoring action	Responsibility	Frequency	Performance Requirement	Corrective Action
Conduct in situ testing of mine waste prior to excavation	Environmental Manager Mine Manager	Ahead of each stage	Problem wastes are identified	Ensure that problem wastes can be placed in waste disposal areas such that environmental harm is not caused.
Audit mine waste tracking program to check that correct placement is occurring	Environmental Manager	Every two years	All problem wastes are placed as per the mine plan	Raise an incident report and investigate potential for environmental impacts to arise. Potential responses might include: • Increased intensity of groundwater/surface water monitoring • In situ amelioration • Removal of wastes to another location.

Note also that monitoring activities in relation to surface water and groundwater are relevant to monitoring of the effectiveness of mine waste management.

12. General and Hazardous Waste Management

12.1 Legislative Framework

The key legislation in relation to waste management is the EP Act which identifies effective waste management strategies as part of an integrated management approach to environment protection and ecologically sustainable development and sets up requirements for minimisation, handling, transport, storage and disposal of wastes. Under the EP Act and EP Regulation, activities associated with waste management, including transport, treatment, storage and disposal of wastes are environmentally relevant activities and an authorisation is required to carry out these activities. Schedule 7 of the EP Regulation also defines regulated waste, being wastes that are particularly hazardous to the environment if not managed appropriately.

The *Environmental Protection (Waste Management) Regulation 2000* establishes procedures for tracking of certain regulated wastes. Trackable wastes are defined in Schedule 1 of this regulation and a docket system is in place to track these wastes from the point of origin to disposal.

Waste Reduction and Recycling Act 2011 (WRR Act) and *Waste Reduction and Recycling Regulation 2011* strengthens waste management and resource recovery practices in Queensland. The WRR Act provides a framework for statewide waste management strategy and establishment of levies and other mechanisms to promote waste minimisation. The strategy identifies waste tyres from commercial and industrial activities as a high priority for waste minimisation and management.

The following Adani System compliance guidelines also apply to waste management:

- CG-063 – Management of wastes
- CG-064 – Waste minimisation
- CG-065 – Waste recycling and reuse
- CG-066 – Waste treatment
- CG-121 – Waste disposal.

12.2 Environmental Values

Wastes represent lost or degraded material and energy resources.

Improper waste management can impact on a range of environmental values including land, air quality, surface water and groundwater. Improper waste management can also cause a range of public health hazards.

12.3 Potential Impacts

Types of wastes likely to be produced during construction and operation of the Carmichael Coal Mine are listed in Table 12-1, together with potential environmental or public health impacts that may arise if wastes are not properly managed. Mine wastes, including overburden, interburden, fines and rejects are discussed Section 11. Mine affected water is discussed in Section 9, emissions to air are discussed in Section 6 and greenhouse gas emissions (including vehicle exhausts) are discussed in Section 7.

Table 12-1 Potential Environmental Impacts – Waste Generation

Waste type	Potential Environmental Impact (with no management)
Vegetation waste	Fire hazard
	Emissions of greenhouse gases as vegetation rots
	Possible loss of nutrients in natural nutrient cycles
	Spread of weeds
	Visual impact
	May harbour vermin (may also harbour native animals)
Packaging waste	Lost resource
	Visual impact
	Source of litter
	Plastics may entrap native animals
Waste concrete and concrete wash out waste	Localised increases in pH
	Lost resource
	Visual impact
Scrap metal	Loss of resource
	Visual impact
	Localised soil contamination with potential to leach to surface and groundwater
	Human health risk (tetanus)
Other building and demolition wastes	Loss of resource
	Visual impact
Waste oil and oil contaminated wastes	Contamination of soils, surface water and groundwater
	Toxicity to plants and animals
	Degradation of water resources
	Loss of resource
Waste solvents and paints	Contamination of soils, surface water and groundwater
	Toxicity to plants and animals
	Degradation of water resources
	Loss of resource
Office wastes	Litter
	Loss of resource

Waste type	Potential Environmental Impact (with no management)
Food wastes	May attract vermin Odour Disease, particularly through bacterial infection
Other domestic wastes	Loss of resource Litter Plastics may entrap animals
Wastewater (toilets, showers, crib rooms) Sewage and water treatment plant sludge	Contamination of land, surface and groundwater Degradation of water resources Inhibition of native plant growth Increased nutrient levels in aquatic ecosystems, causing eutrophication and algal outbreaks Spread of disease Odour
Tyres	Fire hazard Toxic smoke if fire occurs Visual impact Loss of resource Collect water which may harbour mosquitoes and other biting insects
Batteries	Loss of resource Release of acidic and/or metallic contaminants to land, surface water and groundwater Toxicity to plants and animals Degradation of water resources Inhibition of native plant growth

12.4 Performance Outcome

Minimise generation of waste in accordance with the waste management hierarchy:

a. AVOID unnecessary resource consumption
b. REDUCE waste generation and disposal
c. RE-USE waste resources without further manufacturing
d. RECYCLE waste resources to make the same or different products
e. RECOVER waste resources, including the recovery of energy
f. TREAT waste before disposal, including reducing the hazardous nature of waste
g. DISPOSE of waste only if there is no viable alternative.

Avoid adverse impacts of waste on land contamination, surface and groundwater quality and visual amenity.

12.5 Proposed Controls

12.5.1 Design, Procurement and pre-construction

Table 12-2 General and Hazardous Waste Management – Design, Procurement and Preconstruction Controls

Control	Responsibility	Timing	Evidence
Identify opportunities for waste minimisation and recycling in design of all components.	Design Manager	During design phase	Design checklist
Include requirements for minimisation of packaging waste in contract specifications for equipment, plant, consumables and other items.	Procurement Manager	Prior to commencement of construction	Contracts and specifications
Ensure waste contracts are in place for all wastes that require removal from the mine for reuse, recycling, treatment and/or disposal. Utilise contractors that can offer reuse and recycling services in preference to those that cannot and ensure that all contractors hold appropriate authorisations to transport, receive, store, reprocess, treat and/or dispose of wastes expected to be generated.	Procurement Manager	Prior to commencement of construction	Requests for tenders, tenders received Contracts in place
Identify obligations for national pollutant inventory (NPI) reporting and ensure that mechanisms are in place to collect required data.	Environmental Manager	Prior to commencement of construction	Monitoring records
Select appropriate wastewater treatment system to achieve treatment levels that protect environmental values and allow maximum reuse of treated wastewater without creating health and safety issues.	Design Manager	Prior to commencement of construction	Design checklist
If treated wastewater is to be disposed of through irrigation, develop an effluent irrigation management plan based on soil testing and results of MEDLI modelling.	Design Manager	Prior to commencement of construction	Effluent irrigation management plan

Control	Responsibility	Timing	Evidence
Determine storage requirements for untreated and treated wastewater in the event of unforseen events such as malfunction of the wastewater treatment plant or wet weather.	Design Manager	Prior to commencement of construction	Design checklist

12.5.2 Waste Management Inventory

Table 12-3 General and Hazardous Waste Inventory and Management

Waste type	Waste storage and handling requirements	Indicative waste management methods
Vegetation waste	Store so as to minimise fire hazard Avoid mixing native vegetation with introduced vegetation where possible Store away from trafficked areas	Place logs and hollow trees in rehabilitated areas or areas of retained habitat. Mulch or otherwise treat native vegetation for reuse in revegetation areas (trials to be undertaken to determine best methods for reuse).
Packaging waste	Segregate plastic, wood and cardboard Flatten cardboard and store in low fire risk areas Contain plastics so that these do not blow away	Return packaging to source wherever possible. Mulch cardboard and wood for reuse in revegetation (subject to trials). Plastics and cardboard removed from site for recycling where viable.

Waste type	Waste storage and handling requirements	Indicative waste management methods
Waste concrete and concrete wash out waste	Concrete wash out in designated areas away from watercourses	Crush waste concrete for reuse in road building if required.
Scrap metal	Segregate from other wastes	Off-site recycling if feasible.
Other building and demolition wastes	Segregate from other wastes	Off-site recycling and / or disposal.
Waste oil and oil contaminated wastes	Store in sealed containers in a designated bunded area, away from sources of fire and watercourses	Consider use of biological methods to treat oily waste and waste oils. Combine with oily wastes from off-site infrastructure. Removal by authorised oil recovery contractor if viable.
Waste solvents and paints	Store in sealed containers in a designated bunded area, away from sources of fire and watercourses	Removal by authorised solvent recovery contractor if viable. Consider distillation of solvents to recover usable solvents. Harden waste paints. Removal for disposal in authorised landfill facility if other options are not feasible.

Waste type	Waste storage and handling requirements	Indicative waste management methods
Office wastes	Print paper on both sides Segregate paper, cartridges, computer wastes Store paper in a closed container to avoid litter	NA – will be managed with wastes from off-site infrastructure.
Food wastes	Store in sealed containers and remove to worker accommodation village for management	NA – will be managed with wastes from off-site infrastructure.
Other domestic wastes	Remove to worker accommodation village for management	NA – will be managed with wastes from off-site infrastructure.
Wastewater (toilets, showers, crib rooms)	Storage capacity for untreated wastewater for at least three days Treat in one or more package wastewater treatment plants to Class A or A+ Storage capacity for treated wastewater for up to 10 days	Mix with MAW for reuse.
Sewage and water treatment plant sludge	Store in fully contained receptacles in a designated area away from watercourses and flood plain areas	Use in revegetation areas – subject to trials.
Tyres	Puncture tyre walls so they cannot contain water Minimise duration of storage in stockpiles Stockpiles not to exceed 3 m in height and 200 m^2 in area and to be away from fire hazard areas	Reuse in engineering works, for example low level retaining walls if possible. Removal by tyre recycling or reconditioning service if feasible. Disposal in underground workings or spoil disposal areas following requirements of DEHP Operational Policy D*isposal and storage or scrap tyres at mine sites* (or current

Waste type	Waste storage and handling requirements	Indicative waste management methods
		relevant guidelines).
Batteries	Store in contained areas	Removal by authorised contractor for material recovery or disposal at an authorised disposal facility.

12.5.3 Other Controls

Table 12-4 General and Hazardous Waste Management - Controls

Control	Responsibility	Timing	Evidence
Maintain a waste register, including the following information: • Waste type and waste code • Waste source • Potential contaminants and other environmental hazards • Quantity generated • Storage locations and requirements • Whether the waste is regulated and trackable • Waste avoidance or reduction measures in place • Management method (reuse, recycling, on-site disposal, off-site disposal) • Quantities removed for reuse/recycling/disposal • Relevant waste contractor. A combined waste register may be maintained for the mine and off-site	Procurement Manager	Continual	Waste register

Control	Responsibility	Timing	Evidence
infrastructure			
For trackable wastes, waste register will include: • Consignment number for the load; • Transport provider's details (including licence number); • Date and time trackable waste removed from Adani Mining's premises; • Quantity removed; • Receiver's details (including licence number).	Procurement Manager	Continual	Waste register
If on-site tyre disposal is required, include placement of tyres in mine plan for backfilling of voids or underground stopes	Mine Manager	Continual	Mine plan

12.6 Monitoring and Corrective Action

Table 12-5 General and Hazardous Waste Management Monitoring and Corrective Action

Monitoring action	Responsibility	Frequency	Performance Requirement	Corrective Action
Review waste register for waste avoidance, reuse, recycling or other minimisation opportunities. Identify trends in waste generation and check that appropriate storage, handling and management measures are in place for each	Environmental Manager	Annually for first five years and then every second year	Waste avoidance and minimisation opportunities are maximised	Review on-site procedures and incorporate waste avoidance and minimisation measures. Amend waste contracts to maximise reuse and recycling in preference to disposal.

Monitoring action	Responsibility	Frequency	Performance Requirement	Corrective Action
waste type.				
Monitor wastes as required under the NPI scheme.	Environmental Manager	Annual	NPI report is submitted	NA
Implement monitoring requirements as set out in effluent irrigation management plan.	Environmental Manager	As per effluent irrigation management plan	As per effluent irrigation management plan	Adjust treatment methods. Adjust irrigation regime.
Review waste contracts.	Procurement Manager	Annual	Waste contractors are properly authorised to transport, treat and dispose of waste Waste contracts maximise reuse and recycling of waste over disposal where practical	Utilise only contractors with proper authorisations for waste management services. Amend waste contracts to maximise reuse and recycling in preference to disposal.
Track cost savings achieved by waste reduction and include in budget as a cost recovery	Procurement Manager	Annually	NA	NA

13. Terrestrial Ecology

13.1 Legislative Framework

Terrestrial ecosystem values are protected by Federal and State legislation.

The Commonwealth EPBC Act provides protection for matters of national environmental significance including listed threatened species, listed migratory species and threatened ecological communities. The mining activity must proceed in accordance with conditions of approval under this Act. Offsets are required where significant impacts on matters of national environmental significance are unavoidable.

In Queensland, the NC Act also provides a framework for protecting all native plants and animals including threatened species, breeding places and habitat.

Under the EP Act, mining projects are also subject to the Queensland Biodiversity Offsets Policy (DERM, October 2011) in relation to impacts on state significant biodiversity values.

Queensland *Land Protection (Pest and Stock Route Management) Act 2002* identifies declared pest plant and animal species, and provides for their control. The LP Act imposes a legal responsibility on all landowners to control declared species on their land (subject to certain conditions).

13.2 Environmental Values

The combined results of the EIS and SEIS studies indicate that most significant ecological values to occur within the Project (Mine) Area, or be subject to the potential indirect impacts of the Project (Mine), are as follows:

13.2.1 Commonwealth matters

- The Brigalow Threatened Ecological Community (TEC) that occurs within the Project (Mine) Area.
- The Great Artesian Basin (GAB) Discharge Springs Wetlands TEC that occurs at Doongmabulla Springs, 11 km west of the Project (Mine) Area.
- One Commonwealth-listed threatened flora species confirmed present within the Mine Area: waxy cabbage palm. A total of 831 palms (90 per cent of which were juveniles) were recorded from the Carmichael River corridor (within the Mine Area) and from Moses Springs, part of Doongmabulla Springs (10 km west of the Mine Area).
- Four Commonwealth-listed threatened fauna species confirmed present within the Project (Mine Area), namely squatter pigeon (southern), black-throated finch (southern), koala and ornamental snake. Squatter pigeon (southern) and black-throated finch (southern) were found to be locally-abundant within suitable habitat areas across the broader landscape, koala and ornamental snake were found as individuals within the Mine Area and the Mine (Offsite) Area respectively.
- One Commonwealth-listed threatened fauna species assessed as likely to occur, namely yakka skink.
- Four Commonwealth-listed migratory bird species confirmed present within the Project (Mine) Area, with a further 11 migratory bird species assessed as likely to occur. All are wide-ranging, locally common and abundant species that occur throughout the region.

- 25 Commonwealth-listed marine bird species confirmed present within the Project (Mine) Area, with a further 21 marine bird species assessed as likely to occur. All are wide-ranging, locally common and abundant species that occur throughout the region and are listed as Other (as opposed to Protected) Matters under the EPBC Act.

13.2.2 State matters

- State-listed Regional Ecosystems (classified as endangered or of concern) are scattered throughout the Project (Mine) Area.
- Bygana West Nature Refuge is a State-listed Category C Environmentally Sensitive Area (ESA) that occurs within the south of the Project (Mine) Area.
- Three State-listed threatened fauna species confirmed present within the Project (Mine) Area, namely black-necked stork, cotton pygmy-goose and little pied bat.
- Three State-listed threatened fauna species assessed as likely to occur within the Project (Mine) Area, namely black-chinned honeyeater, square-tailed kite and brigalow scaly-foot.
- Three State-listed WPAs occurring within the Mine Area.
- Three watercourses, as defined by the Water Act, within the Project (Mine) Area, the Carmichael River, North Creek and Cabbage Tree Creek.

Table 13-1 Potential Environmental Impacts - Terrestrial Ecology

Activity	Potential Environmental Impact
Vegetation clearing	Loss of native plants and vegetation communities. This includes loss of some threatened ecological communities (brigalow) and endangered and of concern regional ecosystems. Loss of habitat for native animals, including some threatened species. Injury or mortality to native animals. Clearing of the Bygana West Nature Refuge. Fragmentation of habitat, particularly in relation to east-west connectivity. Degradation of adjacent habitat due to dust deposition, changes in overland flow regimes, exposure of edges to sunlight and increased predation. Proliferation of weeds and pests, including class 2 declared weeds and pests under the LP Act. Proliferation of exotic pasture grasses including buffel grass (*Chenchrus cilaris*), which may impact the habitat quality for EPBC Act listed species including black-throated finch (southern).
Works in and adjacent to watercourses	Loss of or degradation of surface water resources utilised by native animals. Disturbance to riparian corridors utilised by native species.
Groundwater drawdown from mine	Reduced groundwater outflows at spring fed ecosystems (see also Section 10.3).

Activity	Potential Environmental Impact
dewatering	Drawdown impacts on Doongmabulla Springs are predicted to be minor. Preliminary drawdown predictions for Mellaluka Springs indicate drawdown of up to 8.0m Drawdown of one to four metres may occur in the vicinity of the Carmichael River.
General site activities	Introduction of new weeds and pests. Spread of weeds and pests across the site. Noise and light. Changed fire regime.
Underground mining and subsidence	See Section 22.3.

13.3 Performance Outcome

No unapproved loss in biodiversity values over and above those impacts permitted through project approvals and implementation of Offset requirements.

13.4 Proposed Controls

13.4.1 Design and Pre-construction

Table 13-2 Terrestrial Ecology – Design and Preconstruction Controls

Control	Responsibility	Timing	Evidence
Prepare offsets management plan.	Environmental Manager	Prior to any vegetation clearing	Offsets management plan
Prepare species specific management plans for: • Black throated finch • Brigalow reptiles • Squatter pigeon.	Environmental Manager	Prior to commencement of mining	Species management plans in place
Design lighting systems to minimise light spill into areas of native vegetation.	Design Manager	During detailed design	Design checklist
Review clearing requirements for MIA and other infrastructure and identify opportunities to reduce clearing of native vegetation and utilise existing cleared areas wherever possible.	Design Manager	During detailed design	Design checklist
Identify facilities and resources in the region for assistance in the event that native animals are injured and develop procedures for response to native animal injuries that avoid unnecessary suffering of animals.	Environmental Manager	Prior to any vegetation clearing	Injured animal procedures

13.4.2 Construction and Operations

Table 13-3 Terrestrial Ecology Construction and Operational Controls

Control	Responsibility	Timing	Evidence
Implement species specific management plans.	Environmental Manager	Ongoing	Survey and management records
Implement offset strategy and management plan.	Environmental Manager	Ongoing	Offset areas in place as per offset strategy
Conduct pre-clearing surveys. Surveys are to include: • Searches for breeding places or habitat • Searches of micro habitat for reptiles.	Environmental Manager	As specified in species specific management plans or otherwise, in wet season immediately prior to clearing	Survey results
Determine requirements to manually relocate species from areas to be cleared based on pre-clearing survey results and conduct relocations as required.	Environmental Manager	Prior to clearing	Records of translocations
Based on pre-clearing survey results, determine any particular requirements in relation to clearing and document in permit to disturb application. Requirements may include: • Presence of a spotter catcher • Clearing in a particular direction to allow animals to escape • Felling of habitat trees separately to general clearing • Salvage of habitat features • Mulching of vegetation.	Construction Manager/Area Manager	Prior to clearing	Permit to disturb specifies optimal clearing approach

Control	Responsibility	Timing	Evidence
Clearly delineate areas for vegetation clearing and ensure that all personnel involved are aware of the clearing limits.	Construction Manager/Area Manager	Prior to clearing	Clearing limits delineated
Conduct pest control program for feral cats, pigs and cane toads.	Environmental Manager	Annually	Records of control program.
Vehicles and equipment are to be cleaned before being brought to site and inspected on entry to site. *Queensland Government Checklist for Cleandown Procedures* (2000) to be followed for clean down and inspection (http://www.daff.qld.gov.au/documents/Biosecurity_EnvironmentalPests/IPA-Cleandown-Procedures.pdf).	Construction Manager/Area Manager	Whenever vehicles or equipment are brought to site	Weed hygiene declaration form
All soil and materials of plant origin to be certified as weed free by the supplier using the Queensland Government weed hygiene declaration form or similar (http://www.daff.qld.gov.au/4790_7075.htm).	Construction Manager/Area Manager	Whenever soil or plant materials are brought to site	Weed hygiene declaration form
Drag any road kill to the side of the road immediately and arrange for collection and disposal.	All personnel	Ongoing	Road kill removed from roads
Report injured animals to Environmental Manager/Officers.	All personnel	Ongoing	Incident records
Respond to injured animals as per procedures developed.	Environmental Manager	As required	Incident record

13.5 Monitoring and Corrective Action

Table 13-4 Terrestrial Ecology Monitoring and Corrective Action

Monitoring action	Responsibility	Frequency	Performance Requirement	Corrective Action
Conduct monitoring as per Species Management Plans.	Environmental Manager	As per species management plans	As per species management plans	As per species management plans.
Conduct monitoring of offset areas.	Environmental Manager	As per offset strategy and management plan	As per offset strategy and management plan	As per offset strategy and management plan.
Conduct inspections of disturbed areas for weed proliferation.	Environmental Manager	Annually	Weed levels in disturbed areas are similar to pre-clearing	Conduct a weed control program. Control programs will prioritise class 2 declared weed species listed under the LP Act that are known to occur within the Isaac Regional Council area including: • Bellyache bush • Chinee apple • Giant rat's tail grass • Harrisia cactus • Hymenachne (aquatic sp.) • Mother of millions • Parkinsonia • Prickly acacia • Prickly pear • Rubber vine • Salvinia

Monitoring action	Responsibility	Frequency	Performance Requirement	Corrective Action
				• Tobacco weed. Additional information and a copy of Isaac Regional Council's Pest Management Plan (27 June 2013) is located at http://www.isaac.qld.gov.au/c/document_library/get_file?uuid=00d7553f-4216-4a32-a00a-26043ccfcc8d&groupId=12238 Proliferation of exotic pasture species, including buffel grass (*Cenchrus ciliaris*) will also be monitored in disturbed areas due to potential impact on habitat quality for EPBC Act listed species.
Check for pest plants and fauna within subsided areas where ponding occurs.	Environmental Manager	Annually	Weed and pest animal levels are similar to pre-subsidence	Conduct a weed and pest control program.
Monitor pest animal numbers at key water resource locations.	Environmental Manager	Quarterly	No increase in pest animal occurrence	Conduct a pest animal control program. Control program will prioritise class 2 declared pest species listed under the LP Act that are known to occur within the Isaac Regional Council area including: • Dingo/ wild dog • European fox • European rabbit • Feral cat • Feral chital and rusa deers

Monitoring action	Responsibility	Frequency	Performance Requirement	Corrective Action
				• Feral pig • Migratory and spur-throated locusts.
Monitor road kill/injury statistics	Environmental Manager	Annually	No particularly high occurrences of animal death/injury	Provide fauna crossing or other control to protect animals from harm.

14. Aquatic Ecology

14.1 Legislative Framework

Legislative requirements in relation to aquatic ecosystems include:

- The EPBC Act protects a range of animals and plants that occur in aquatic environments
- The EP Act and associated EPP (Water) recognise aquatic ecosystem health as a water quality value and set objectives for protection of aquatic ecosystems
- The *Water Act 2000* includes requirements in relation to protection of watercourses, including a requirement for a riverine protection permit in relation to works in the bed and banks of watercourses and a water licence for diversion of water courses. On a mining lease, a riverine protection permit is not required but the Guideline - *activities in a watercourse, lake or spring associated with a resource activity or mining operations* (WAM/2008/3435) are relevant. The *Fisheries Act 1994* protects fish and fish habitat. Approval requirements in relation to disturbance of fish habitat are assessable development under the SP Act and as such; do not apply on a mining lease. However, it is noted that matters regulated by the Fisheries Act include maintaining fish passage and creating a waterway barrier.

14.2 Environmental Values

The main riverine feature of the Study Area is the Carmichael River, which flows through the mining lease and joins the Belyando River almost 20 km downstream of the mining lease. The river is located high in the Burdekin River catchment and seasonality in rainfall restricts flows to the wetter months, November to March. Flow of the Carmichael River varies with the intensity of wet season conditions annually however baseflow is maintained from groundwater and spring discharges.

Many streams and drainage channels within the catchment dry entirely during the winter months (June/July) when rainfall is typically lower than the summer months around December and January. Larger rivers sustain only pools or low flows during the drier, winter periods.

Field assessments within the Study Area detected a low diversity of aquatic flora and fauna species in the surveyed habitats.

No conservation significant species or communities were observed within the Study Area or are expected to occur based on habitat requirements.

14.3 Potential Impacts

Table 14-1 Potential Environmental Impacts – Aquatic Ecosystems

Activity	Potential Environmental Impact
Watercourse diversions and other works in watercourses	Loss of aquatic habitat
	Changes in downstream flows
	Scouring and degradation of bed and banks
	Changes in geomorphological form in downstream areas due to scouring or sediment deposition

Activity	Potential Environmental Impact
Change in topography	Changes in flows to downstream environments
Earthworks and spoil disposal	Release of sediment to watercourses (see also Section 17).
Groundwater drawdown	See Section 10
Underground mining	Ponding of ephemeral streams in subsidence troughs (see also Section 22)
Discharges of stormwater and mine affected water	See Section 9

14.4 Performance Outcome

Downstream habitats are not degraded by sediment deposition, scouring or water quality degradation.

Downstream flow changes remain within natural fluctuations.

14.5 Proposed Controls

14.5.1 Design and Pre-construction

Table 14-2 Aquatic Ecology – Design and Preconstruction Controls

Control	Responsibility	Timing	Evidence
Review clearing requirements for MIA and other infrastructure and identify opportunities to reduce disturbance to watercourses, avoid removal of mature trees if possible and utilise existing disturbed cleared areas wherever possible.	Design Manager	During detailed design	Design checklist
Design watercourse diversions using guidelines in place at the time (DEHP watercourse diversion guidelines, ACARP, Bowen Basin River Diversions, Design and Rehabilitation Criteria, Australian Coal Association Research Program (2002)). Ensure that geomorphologically stable channels are created and diversions will be stable in perpetuity.	Design Manager	During detailed design	Design checklist
Establish control and impact monitoring sites as follows: • Doongmabulla Springs • Upstream location on Carmichael River • Midway and downstream location on Carmichael River.	Environmental Manager	Prior to construction	Aquatic ecology monitoring program
Plan works in watercourses to minimise the period of disturbance to the watercourse.	Construction Manager	Prior to construction	Schedule
Schedule works in watercourses to occur outside the wet season wherever possible.	Construction Manager	Prior to construction	Schedule
As far as practicable, design pipeline crossings, culvert crossings and bed level crossings in accordance with:	Design Manager	During detailed design	Design checklist

Control	Responsibility	Timing	Evidence
• Code for self-assessable development Minor waterway barrier works – part 3 culverts (WWBW01) (DAFF, April 2013) • Code for self-assessable development Minor waterway barrier works – part 4 – bed level crossings (WWBW01) (DAFF, April 2013) • Guideline - activities in a watercourse, lake or spring associated with mining operations (WAM/2008/3435) (DERM (2010a)).			

14.5.2 Construction

Table 14-3 Aquatic Ecology – Construction Controls

Control	Responsibility	Timing	Evidence
Avoid undertaking works in streams in times of flow wherever possible.	Construction Manager	During construction	Schedule
Locate temporary lay down areas, parking areas and refuelling areas at least 100m from any defined watercourse.	Construction Manager	During construction	Inspections
For buried pipeline crossings ensure that design requirements are met during construction and: • Remove topsoil and vegetation and set aside for reinstatement • Place pipelines such that the bed level of the stream will be restored once backfilling is complete • Backfill trenches with material in a similar order to naturally occurring material • Replace topsoil • Stabilise with “soft” techniques such as jute matting or geotechnical	Construction Manager	During construction	Stable work areas

Control	Responsibility	Timing	Evidence
fabric.			
For culvert and low level crossings for access roads, ensure that design requirements are met during construction and: • Remove topsoil and vegetation and set aside for reinstatement • Place culverts or pipes such that the bed level remains even • Use topsoil and vegetation in rehabilitation • Stabilise completed surfaces with “soft” techniques such as jute matting or geotechnical fabric as far as practicable.	Construction Manager	During construction	Stable work areas
For diversions, ensure diversions are constructed as per design. Minimise construction activities during flow events where practical and stabilise works as quickly as possible after construction.	Construction Manager	During construction	Stable work areas
Ensure that all earthmoving equipment has undergone correct wash-down procedures to minimise the risk of introducing weeds (declared or otherwise) to aquatic environments within the Project (Mine).	Construction Manager/ Environment Manager	During Construction	Weed hygiene declaration

14.5.3 Operations

Note that operational controls in relation to erosion and sediment control, subsidence management, surface water management and groundwater management are relevant to protecting downstream aquatic ecosystem values.

Table 14-4 Aquatic Ecology - Operation Controls

Control	Responsibility	Timing	Evidence
For culvert and low level crossings for access roads, ensure that design requirements are met during construction and:	Environmental Manager	During operations	Stable work areas

Control	Responsibility	Timing	Evidence
• Remove topsoil and vegetation and set aside for reinstatement • Place culverts or pipes such that the bed level remains even • Use topsoil and vegetation in rehabilitation Stabilise completed surfaces with “soft” techniques such as jute matting or geotechnical fabric as far as practicable.			
Aquatic weed infestations will be identified and managed in accordance with the Isaac Regional Council Pest Management Plan and the weed and pest control strategies detailed within this EMP (Mine).	Environmental Manager	During operations	No increase in existing infestation or the occurrence of new infestations
Staff will be informed via a site specific induction of the aquatic species that are likely to be encountered within the Project Area	Environmental Manager	During operations	Induction training records
Wash-down of plant, machinery and vehicles will be undertaken in designated and controlled locations where waste water and weed seed material will be captured and prevented from discharging to watercourses.	Environmental Manager	During operations	Designated weed wash-down areas Weed hygiene declaration

14.6 Monitoring and Corrective Action

Table 14-5 Aquatic Ecosystems – Monitoring and Corrective Action

Monitoring action	Responsibility	Frequency	Performance Requirement	Corrective Action
Monitor aquatic ecology monitoring sites:	Environmental Manager	prior to commencement of mining.	No statistically significant changes between control and	If significant differences are observed, an incident should be logged and an incident investigation carried out to

Monitoring action	Responsibility	Frequency	Performance Requirement	Corrective Action
• In situ water quality (at time and location of each aquatic ecology monitoring event); • Presence of aquatic weeds; • Fish species and abundance; and • Macroinvertebrate taxa and abundance. Undertake statistical analysis of results including SIGNAL, PET and multivariate analysis.		Annually for first 10 years of mining. Biannually thereafter. Monitoring to take place towards the end of the wet season.	impact sites and between baseline and post impact results from each monitoring event.	determine cause of changes and develop corrective actions.

15. Biosecurity Management

15.1 Legislative Framework

Legislative requirements in relation to biosecurity include:

15.1.1 Commonwealth Legislation

***Environment Protection and Biodiversity Protection Act 1999* (EPBC Act)**

Under the EPBC Act, the Commonwealth can, among other things, list key threatening processes, develop and implement threat abatement plans (TAPs) and outline recovery plans to manage and reduce the impact of invasive species. As defined by SEWPaC, invasive species include diseases, fungi and parasites, feral animals, insects and other invertebrates, introduced marine pests and weeds.

Weeds

The Australian Weeds Strategy (DEWR, 2007) outlines a coordinated strategy for weed management across Australia. It provides consistent guidance on weed management and identifies Weeds of National Significance (WoNS), which are nationally agreed priority plants for control and management. Twenty WoNS are outlined in the Australian Weeds Strategy (DEWR, 2007); with an additional 12 included in April 2012. The strategy also addresses roles and responsibilities for weed management, outlining the various roles of government (national, state and local), industry and individuals in weed management. The following TAPs for weeds are of relevance to the Project (Mine):

- Threat abatement plant to reduce the impacts of northern Australia's biodiversity by the five listed grasses (SEWPaC, 2012)

Pest animals

The Australian Pest Animal Strategy (DEWR, 2007) outlines a national strategy for the management of vertebrate animals in Australia. This strategy outlines that it is the landholder's responsibility to detect and report new occurrences of pest animals and manage pest animals on their own land. Landholders also have a responsibility to management pest animal problems on their own land and where relevant, plan pest animal management activities jointly with neighbours. The following TAPs for pest species are of relevance to the Project (Mine):

- Threat abatement plan for competition and land degradation by unmanaged goats (DEWHA, 2008)
- Threat abatement plan for competition and land degradation by rabbits (DEWHA, 2008)
- Threat abatement plan for predation by European red fox (DEWHA, 2008)
- Threat abatement plan for predation by feral cats (DEWHA, 2008)
- Threat abatement plan for the habitat degradation, competition and disease transmission by feral pigs (DEWHA, 2005)
- Threat abatement plan for the biological effects, including lethal toxic ingestion, caused by cane toads (SEWPaC, 2011)

Diseases, fungi and parasites

Invasive diseases, fungi and parasites can have negative impacts on both biodiversity and agricultural crops. Due to the presence of threatened species within the Project (Mine) and the location of the Project within an agricultural landscape, it is vital that the Project does not introduce or spread diseases, fungi and parasites within the region. The following TAPs for diseases, fungi and parasites are of relevance to the Project (Mine):

- Beak and feather disease affecting endangered psittacine species (DEH, 2005)
- Threat abatement plan for infection of amphibians with chytrid fungus resulting in chytridiomycosis (DEH, 2006).

Quarantine Act 1908

The *Quarantine Act 1908* outlines a framework for the prevention or control of the introduction, establishment or spread of diseases or pests that will or could cause significant damage to human beings, animals, plants or other aspects of the environment or economic activities. Although a Commonwealth Act, the Queensland Department of Agriculture, Fisheries and Forestry administer the *Quarantine Act 1908* in Queensland.

15.1.2 State Legislation

***Land Protection (Pest and Stock Route Management) Act 2002* (LP Act)**

he LP Act is the primary piece of legislation for the management of weeds, pest animals and stock routes in Queensland. The Act provides for the management of particular pests in Queensland by declaring animals and plants to be declared pests, providing for pest management planning and establishing principles of pest management (on land). The LP Act also restricts the introduction, keeping or sale of declared pests and precents the spread of declared pests in the State.

Land Protection (Pest and Stock Route Management) Regulation 2003 (LP Regulation)

The LP Regulation supports the policy objectives outlined in the LP Act. The LP Regulation declares pest plant and animal species for control and management. The LP Regulation also provides current listings of all declared pest plant and animal species under the LP Act.

Land Act 1994

The *Land Act 1994* outlines a duty condition that it if a lease is issued for agricultural, grazing or pastoral purposes, the lessee must take reasonable steps to manage any declared pests.

Plant Protection Act 1989

The *Plant Protection Act 1989* aims to prevent, control and remove pest infestations of plants. The whole of Queensland is a declared pest quarantine area for the following species:

- Banana freckle
- Tropical race 4
- Fire ant
- Fire blight
- Grape phylloxera. As the Project is within a grape growing area, the Project occurs within the Special Control Zone for this pest.
- Mediterranean fruit fly
- Potato pest

- Asian sugarcane planthopper
- Branched broomrape
- Mango malformation disease.

The Project is also located within the southern buffer pest quarantine area for pests of banana plants other than tropical race 4 or banana freckle and within a quarantine area for the sugarcane pest plant.

Agricultural Chemicals Distribution Control Act 1966

May be relevant when using aerial control of spur-throated locust (*Austracris guttulosa*) and Migratory locust (*Locusta migratoria*) both Class 2 Declared Pest species under the LP Act- the check if this is relevant to aerial locust control

Pest Management Act 2001

The *Pest Management Act 2001* provides for the regulation of health risks associated with pest control activities and the adverse results of ineffective control of pests. Also establishes a licensing regime to regulate pest control activities and ensure that activities are carried out by pest management technicians in a safe and competent way. Contractors commissioned to undertake pest control within the Project (Mine) will be required to hold current a current licence under this Act.

***Land Protection (Pest and Stock Route Management) Act 2002* (LP Act)**

Land Protection (Pest and Stock Route Management) Regulation 2003

Provides legislative measures to manage pests and address the impacts they have on the economy, the environment and society.

Landowners, including state agencies, are required to control declared pest plants consistent with guidelines and local government area pest management plans and the Queensland Weeds Strategy 2002-06.

Under the Local Law provisions of the *Local Government Act 1993*, a local government can declare any plants not declared under the LP Act and enforce their control.

The *Land Act 1994* also has provisions requiring control of weeds declared under the LP Act on leasehold land.

15.2 Environmental Values

The Project Area contains a range of fauna habitat types that share broadly similar habitat values (based on habitat structure), but vary in their value for wildlife based on the specific forage and shelter resources they provide. Ironbark-box woodland was the most widespread fauna habitat type at the Project Area. In general, across the Project Area, disturbance to fauna habitats from cattle, weeds and feral animals was observed to be low. These disturbances were mainly observed in cleared areas, where ecological value is relatively low, between the Carmichael River and the Moray Carmichael Road, and in eastern parts of the Project Area.

Eight introduced fauna species comprising six mammals, one bird and one amphibian were also recorded during field studies including the following notable species:

- Feral cat
- Pig
- Cane toad

- Dingo
- House mouse
- European rabbit.

Native flora species were prevalent across much of the Project Area, in association with areas of remnant vegetation. Field studies identified 373 native flora taxa and 27 introduced taxa in the Project Area. Of the 27 introduced species, five are declared WONS and declared weeds under the Queensland LP Act.

Despite the agricultural land use within and surrounding the EPC 1690 Study Area, in general the prevalence of weeds, introduced animals and disturbances associated with cattle (i.e. loss of vegetative cover, compaction of ground, degradation of riparian areas and waterways) was observed to be relatively low. In localised areas, the level of disturbance observed was relatively higher – for example in the vicinity of cattle water points (farm dams, some stock troughs), and parts of the riparian zone of the Carmichael River. Habitats at the site characterised by remnant vegetation retained connectivity across much of the EPC 1690 Study Area (and beyond).

During the field surveys, 22 introduced species were recorded, of which two species are 'declared plants' under the LP Act, one of which, Parthenium weed (Parthenium hysterophorus), is a WONS. These species are outlined below:

- Parthenium weed (*Parthenium hysterophorus*)
  - EPC 1690 distribution consisted of non-remnant areas, brigalow, box woorland and within the Carmichael River, generally in very sparse clusters
- Prickley pear (*Opuntia stricta*)
  - Brigalow patches

Increased movement of people, vehicles, machinery, vegetation waste and soil may facilitate the spread of weeds at and near the Project Area. Five WONS that are also declared plants under the LP Act (parkinsonia (*Parkinsonia aculeata*), parthenium, prickly pear, velvety tree pear (*Opuntia tomentosa*) and rubber vine (*Cryptostegia grandiflora*)) are known to occur at the Project Area. Despite the fact that 27 introduced plant species were recorded, weeds were not found to be abundant across much of the Project Area.

15.3 Potential Impacts

Table 15.1 Potential Environmental Impacts

Activity	Potential Environmental Impact
Vehicle movements	Increased movement of people, vehicles, machinery, vegetation waste and soil may facilitate the spread of weeds at and near the Project Area. Five WONS that are also declared plants under the LP Act (parkinsonia (*Parkinsonia aculeata*), parthenium, prickly pear, velvety tree pear (*Opuntia tomentosa*) and rubber vine (*Cryptostegia grandiflora*)) are known to occur at the Project Area. Increasing the prevalence of weeds at the Project Area (and potentially beyond to the surrounding landscape), may reduce the quality of habitats for some flora and fauna species, particularly by replacing native plants.

Activity	Potential Environmental Impact
Construction activities	Vegetation clearing and soil disturbance allows seeds present in soil to germinate. Germination and plant growth for weeds is typically faster than for native species and this can lead to increased weed levels in disturbed areas and affect the ability for native vegetation to re-establish. There is also significant potential for weeds, either as seeds or other plant propagules, to be introduced to sites attached to dirty vehicles and equipment or to be contained in soil or seed mixes brought to the site. This can lead to increased levels of weeds already present on the site, or infestation by new weeds.
Ongoing operations	An increase in the prevalence of these animals may adversely impact native fauna in that it may lead to: • Increased competition for resources • Increased predation of native species by introduced animals • Habitat degradation including pig damage of riparian areas and erosion caused by rabbit burrowing.

15.4 Performance Outcome

No increase or spread of weeds beyond pre development conditions as a result of project activities.

No unapproved biosecurity management activities.

15.5 Proposed Controls

15.5.1 Design, Procurement and Pre-construction

Table 15-1 Biosecurity – Design, Procurement and Preconstruction Controls

Control	Responsibility	Timing	Evidence
Weed mapping will be undertaken prior to commencement of construction. Mapping will cover the whole site but be particularly focused at high risk locations, such as areas of black soil so that weed hotspots can be identified. Baseline field surveys of identified hotspots within and near construction areas will be undertaken prior to commencement of construction. Weed control will be undertaken in areas that are very heavily infested or where WONS or Class 1 or 2 weeds declared under the LP Act are present prior to disturbance.	Environmental Manager	Prior to Construction	Weed mapping report

15.5.2 Construction and Operation

Table 15-2 Biosecurity – Construction and Operational Controls

Control	Responsibility	Timing	Evidence
Waste management measures should include containment of food scraps in securely sealed containers.	Camp Manager	During Construction and Operations	Compliance
Vegetation and soil waste should not be moved to areas of lower weed infestation.	Construction Manager	During Construction and Operations	Site management plans No spread of infestations
Pest animal occurrence will be monitored during construction. If increased densities of pest animals are observed, or new pest animals are identified, humane pest controls will be implemented to manage numbers.	Environmental Manager	During Construction and Operations	Monitoring records and logs

Control	Responsibility	Timing	Evidence
Monitoring will be undertaken annually during construction, with results to be considered in terms of baseline information (collected prior to construction) and with reference to appropriate control (reference) sites. If significant infestations of any weeds occur, or if WONS or Class 1 or 2 weeds declared under the LP Act, weed control measures will be implemented. Weed control measures will be based on Queensland Department of Agriculture, Forestry and Fisheries and Isaac Regional Council advice. Declared pests listed under the *Plant Protection Act 1989* will also be monitored as part of the annual monitoring program during construction.	Environmental Manager	During Construction and Operations	Monitoring records and logs
All vehicles, equipment and materials brought onto site will be certified as free of weeds and weed seeds and carry a weed hygiene declaration. Records are to be kept of compliance with this requirement. Adani will install a weed wash down facility onsite.	Plant Manager / Contractors	During Construction and Operations	Records Wash down facility
Soil stripped and stockpiled from areas containing known declared pests listed under the *Plant Protection Act 1989* and weed infestations will be stored separately and are not to be moved to areas free of weeds and declared pests.	Site Manager	During Construction and Operations	Soil management plans and records
Construction staff will not bring domestic animals to the Project Area.	Site Manager	During Construction and Operations	No domestic animals
Monitoring of feral species populations in the Project Area and implementation of a control program if necessary.	Environmental Manager	During Construction and Operations	Monitoring records and logs Control Program

16. Scenic Amenity

16.1 Legislative Framework

While the EP Act includes aesthetic dimensions in its definition of environment, there are no specific provisions in relation to scenic amenity.

Scenic amenity is often a consideration under regional and local planning provisions.

16.2 Environmental Values

The landscape in the vicinity of the Carmichael Coal Mine is flat to undulating modified bushland, with slightly sharper rises to the west. The dominant land use is grazing which takes place on a mosaic of pasture and remnant vegetation.

Views from homesteads surrounding the Carmichael Coal Mine cannot see the mine area.

Viewers travelling along the Moray-Carmichael road will see the mine and associated infrastructure.

16.3 Potential Impacts

Table 16-1 Potential Environmental Impacts

Activity	Potential Environmental Impact
Vegetation clearing	Increased visual permeability Change in landscape from native vegetation to cleared land
Out of pit spoil dumps	Change in topography, creating up to 140m high permanent feature which will initially be exposed rock/soil and will ultimately be vegetated
Open cut pits	Change in topography creating permanent voids in the landscape
Mining infrastructure and facilities	Increase in presence of built infrastructure in the landscape.
Lighting	Appearance of a glow around mining activities and infrastructure at night

16.4 Performance Outcome

Minimal change to visual amenity from residential viewpoints.

16.5 Proposed Controls

16.5.1 Design, Procurement and Pre-construction

Table 16-2 Visual Amenity – Design, Procurement and Preconstruction Controls

Control	Responsibility	Timing	Evidence
Design lighting systems to minimise light spillage and upward “glow”.	Design Manager	During detailed design	Design checklist

16.5.2 Construction and Operation

Table 16-3 Visual Amenity – Construction and Operational Controls

Control	Responsibility	Timing	Evidence
Progressive rehabilitation of the mine as set out in SEIS Volume 4 Appendix Q1.	Mine Manager	Ongoing through operations	Successful rehabilitation as per EA requirements

16.6 Monitoring and Corrective Action

There are no monitoring requirements in relation to visual amenity.

16.7 Proposed Environmental Authority Conditions

There are no proposed environmental authority conditions in relation to visual amenity.

17. Erosion and Sediment Control

17.1 Legislative Framework

While there are no formal legislative requirements in relation to erosion and sediment control, the EP Act specifically makes it an offence to deposit contaminants into surface waters, and to place contaminants in such a way as the contaminant may be reasonably expected to enter surface waters.

For activities within the mining lease, the environmental authority contains general conditions regarding prevention of environmental harm.

17.2 Environmental Values

Environmental values relevant to erosion and sediment control include soil resources, particularly topsoil resources which are a scarce resource within the project area. Erosion and sediment mobilisation due to the lack of, or the inadequate design, implementation and management of approved erosion and sediment controls (ESC), has potential to impact on a surface water quality and aquatic ecosystem values as described in Section 17.4.

The majority of the soils defined within EPC 1690, have poorly structured topsoils which contain high proportions of fine sand, relative to silt and clay. These poorly structured surface soils have the potential to form bull dust when disturbed and are highly susceptible to both wind and water erosion if not adequately managed and protected. These sandy profiles are general acidic and infertile with a low water holding capacity, while areas of shallow rocky soils (Rudosols), occurring on crests and hill slopes have shallow effective rooting depths.

Many of the duplex soil types, have sodic subsoils, which will are dispersive if exposed and susceptible to tunnel and gully erosion. Areas of cracking red, brown or grey clays (Vertosols) also occur, (although less widespread) within the area, with a moderate fertility and varying levels of subsoil salinity and alkalinity. Poor drainage an inundation following high rainfall events will restrict vehicle movement on these soils. The high shrink swell capacity of these soils also has ramifications for the engineering design, placement of buildings, roads, pipelines and underground cables.

In total 19 soil types were identified within EPC 1690, based on geology, landform, native vegetation and soil profile features. Detailed descriptions of the soil types, together with their physical and chemical properties is provided in the EIS Volume 4 Appendix L Mine Soils Assessment. A summary of the soil types is presented in Table 17-1 below.

Table 17-1: Summary of soil types for EPC 1690

Soil Description	Australian soil classification	Area (Ha)
Gc1 – very shallow (0.25 m), gravelly, acid to neutral, brown loamy to clay loam	Leptic rudosol	849
Gc 2 Shallow to moderately deep (0.25–1.0 m), gravelly, acid to neutral, bleached loam to clay loam	Bleached-Leptic Tenosol	353
Lb 1 Moderately deep (0.5–1.0 m) acid to neutral soil with moderately thick loamy surface grading to red, massive fine sandy clay subsoil	Red Kandosol	423

Soil Description	Australian soil classification	Area (Ha)
Lb 2 Moderately deep (0.5–1.0 m) acid to neutral soil with medium to thick loamy surface grading to yellow-brown massive fine sandy clay subsoil	Yellow or brown Kandosol	7,521
Lb 4 Moderately deep (0.5 – 1.0 m), acid to neutral, yellow-brown, massive sand to loam.	Yellow-Orthic or brown-orthic Tenosol	482
Ln Shallow to moderately deep (< 0.75 m), slightly gravelly, acid to neutral, red well-structured clay.	Red Dermosol	214
Tm1 Deep (0.9 – 1.2 m) texture contrast soil with thick sandy surface over acid to neutral, massive, yellow-brown fine sandy clay subsoil	Yellow or brown Chromosol	3,037
Tm2 Deep (> 1.0 m) texture contrast soil with thick loamy surface over acid to neutral, well structured, yellow-brown fine sandy clay subsoil.	Yellow or brown Chromosol	188
Tm4 Deep (> 1.0 m) texture contrast soil with thick, bleached, sandy to loamy surface over alkaline, mottled, yellow-brown fine sandy clay subsoil.	Yellow or brown Sodosol or Chromosol	903
Mr2 Moderately deep, gravelly, acid to neutral bleached sand to loam	Bleached-Leptic Tenosol	695
Eb1 Texture contrast soil with thick, bleached sandy to loamy surface over alkaline, mottled, yellow-brown fine sandy clay subsoil.	Yellow or brown Sodosol	951

Soil Description	Australian soil classification	Area (Ha)
Eb2 Grey, brown or red cracking clay with hard-setting surface and moderate to strong gilgai or melon holes.	Red, brown or grey Vertosol	2,199
Eb3 Texture contrast soil with moderately thick, bleached loamy surface over alkaline, mottled, yellow-brown medium clay subsoil.	Yellow or brown Chromosol or Sodosol	639
Mb2 Yellow-brown, acid to neutral, massive, bleached sand to loam.	Bleached-Orthic Tenosol	1,347
Mb3 Red, acid, massive sand to loam.	Red-Orthic Tenosol	2,795
Mb4 Yellow to brown, acid, massive sand to loam.	Yellow-Orthic and Brown-Orthic Tenosol	1,653
Cr1 Acid to neutral, yellow-brown, massive and loose, sand to loam	Yellow-Orthic and Brown-Orthic Tenosol	949
Cr3 Texture contrast soil with moderately thick loamy surface over alkaline red, well-structured light medium clay subsoil.	Red Chromosol	531
Cr4 Texture contrast soil with moderately thick sandy to loamy surface over acid to neutral, brown, massive to weakly structured light medium clay subsoil.	Brown Chromosol	129
Eroded areas	NA	257

17.3 Estimated rates of soil loss

Estimates of the potential soil loss have important applications to both soil and water management. Estimates enable the planning of erosion and sediment control measures during disturbance, decommissioning and rehabilitation phases of the project.

An estimate of the long-term soil loss for all soil units (topsoil from sheet and rill erosion) was calculated using the Revised Universal Soil Loss Equation (RUSLE), (IECA *Best Practice*

Erosion and Sediment Control, International Erosion Control Association, Australasia, Appendix E, 2008).

The RUSLE uses five factors to calculate potential soil loss (t/ha/yr):

A=R*K*LS*P*C

Where:

A = Estimated soil loss (t/ha/yr)

R = Rainfall erosivity factor

K = Soil erodibility factor

LS = Slope length/gradient factor

P = Erosion control practice factor

C = Ground cover and management factor.

Calculated estimates for soil loss (topsoil) were found to be generally low across the Project area, and ranged from 9 to 263 t/ha/yr. These values reflect the relatively flat to gently sloping landscape found within the Project area, with slopes typically ranging from, 1% to 5%. The highest estimated of soil loss of 263 t/ha/yr, was calculated for the very shallow GC1 soil, occurring on side slopes of rock outcrops, with slopes reported to range from of 5 to 20% (an assumed value of 10% was used for the purposes of the calculation for this soil). Calculated values for soil loss are provided in the table below.

Limitations of the RUSLE

Limitations and assumptions on this method of soil loss estimation are outlined below:

- The calculated estimate of soil loss per soil mapping unit is an “indicator” only of potential soil loss
- The calculation addresses sheet and rill erosion only and excludes erosion caused by concentrated flow
- Estimate of the annual rate of soil loss
- A slope length of 80 m has been used for all soil mapping units
- The estimated does not take into consideration chemical dispersion, which potentially will increase following the disturbance of sodic soils
- Soil erodibility (K factor) is based on an estimate of the soil texture class (IECA, 2008)
- The rainfall intensity is based on an average for Emerald, Qld.

Table 17-3: Estimated rates of soil loss

SMU	Slope range (%)	Rainfall erosivity factor (R)	Soil erodibility factor (K)	Slope/length gradient factor (LS)	Erosion control practice factor (P)	Cover factor (C)	Annual soil loss (t/ha/YR)

17.4 Potential Impacts

Vegetation clearing, topsoil stripping, earthworks for mine infrastructure construction, together with the stockpiling of topsoil and overburden during both construction and operation will result in disturbance and exposure of soils to erosive forces from either overland flows of water or wind action.

An impact of erosion is loss of topsoil and potentially subsoils resources. Soil loss reduces the soil productivity, by decreasing rooting depth, removing soil nutrients and organic matter. Removal of vegetation will also increase the susceptibility of the predominantly sandy, low clay soils to raindrop impact, slaking, with the potential to set hard..

Sediment mobilised by overland flow will be carried to drainage lines and watercourses. Impacts include:

- Increased turbidity, affecting light penetration and photosynthesis processes in aquatic environments.
- Direct smothering of aquatic ecosystems by deposition of sediment.
- Where large quantities of sediment are transported to watercourses, geomorphological changes may occur. For example, sediment deposition may obstruct flow causing exacerbation of flooding and alteration of channel pathways.
- The quality of water available to downstream users may be degraded, particularly in relation to appearance and palatability. Pumps and pipes used to extract water from watercourses may become blocked by sediment build up.

All soils will be susceptible to erosion with the removal of vegetation. Soils susceptible to wind erosion include the soils with the sandy or loamy topsoils. Duplex soils with sodic subsoils will be susceptible to dispersion if exposed. Alkaline and sodic soils are generally dispersive, and have high erosion potential if exposed. Sodic, alkaline soils are also poor plant growth mediums due to low nutrient availability, and should not be used as such in rehabilitation of disturbed areas. Exposure of the soil surface to raindrop impact, resulting in surface capping, decreasing infiltration.

Note that impacts relating to wind erosion (dust generation) are covered in Section 6.

Works in watercourses will also result in erosion of the bed and banks if undertaken in flow conditions or if disturbed areas are not stabilised before flows occur. Management of the impacts of works in watercourses is covered in Section 14.

Poor topsoil management can lead to incorrect depths of stripping occurring, allowing for the mixing and stockpiling of topsoil and unsuitable subsoil material. Incorrectly stockpiled topsoil can lead to compaction and structural breakdown, together with poor aeration, which causes biological degradation, limiting the viability of the material for rehabilitation

Continued use of unsealed access tracks by heavy vehicles has the potential to pulverise the soil and produce bulldust, this is particularly relevant in soils with a moderate to high proportions of fine sand and silt.

17.5 Performance Outcome

Sediment releases from the mining activity will not cause degradation of aquatic ecosystem and water supply values downstream. Generally, this will be indicated by less than 10 per cent increase in turbidity levels from upstream to downstream of activity areas.

Topsoil resources will not be lost through erosion. This will be measured by visual observation of disturbed areas.

A number of complimentary management plans will be prepared prior to commencement of any construction activities which will also include performance outcomes in regards to erosion and sediment control. These include:

- Rehabilitation Management Plan

- Topsoil Management Plan
- Overburden Management Plan.

17.6 Proposed Controls

17.6.1 Design and Pre-construction

Table 17-1 Erosion and Sediment Control – Design and Preconstruction Controls

Control	Responsibility	Timing	Evidence
Erosion and Sediment Control Plan (ESCP) must be prepared in accordance with the *Best Practice Erosion and Sediment Control Manual* (IECA, 2008) and implemented for the Project area prior to the commencement of mining operations;	Design Manager	Prior to commencement of construction	Mine Erosion and Sediment Control Plan
Design stormwater systems for construction areas to include sediment retention basins capable of retaining a 1 in 20 year ARI event (or other event as determined through risk assessment in design phase).	Design Manager	Prior to commencement of construction	Design checklist Stormwater system designs
Locate infrastructure and facilities away from drainage lines and steep slopes wherever practicable.	Design Manager	Prior to commencement of construction	Design checklist
Schedule construction works as far as practical such that: • Works in streams do not need to take place in times of flow • Major earthworks activities do not take place in wet conditions • Permanent stormwater systems are installed as early as possible in the construction phase.	Construction Manager	Prior to commencement of construction	Construction Schedule
Design haul roads and other access tracks with drainage systems to minimise concentration of flow and erosion risk.	Design Manager	Prior to constructing haul roads	Design checklist
Design sediment ponds to capture runoff from overburden stockpiles. Runoff to be captured in up an approved event based design criteria.	Design Manager	Prior to creation of stockpiles	Design checklist

17.6.2 Construction

Table 17-2 Erosion and Sediment Control – Construction Controls

Control	Responsibility	Timing	Evidence
Develop and implement a customised erosion and sediment control plan for each work area, including linear infrastructure. General Principles and design standards for erosion and sediment control will be based on the International Erosion Control Association (Australasia) Best Practice Erosion and Sediment Control (IECA,2008)).	Construction Manager	Prior to any ground disturbance.	Erosion controls in place
Strip topsoil as per topsoil management plan (Section 19).	Construction Manager	When commencing construction	Topsoil register
For areas no longer required after construction, and for buried infrastructure alignments, reinstate areas by: • Reforming of surfaces to reinstate drainage patterns and prevent scouring or ponding • Replacement of topsoil and revegetation with selected native plant species. Trees and large shrubs are not to be placed over buried infrastructure. Erosion and sediment controls to remain in place until completion criteria are obtained.	Construction Manager	As soon as possible after completion of construction	Rehabilitation register
Dust Control Poorly structured topsoils which contain high proportions of fine sand, relative to silt and clay have potential to form bull dust when disturbed and are highly susceptible to both wind and water erosion if not adequately managed and protected. Mitigate for dust by: • Reduce exposure of disturbed areas to the minimum period required and install protective measures (placement of geo-fabric	Construction Manager and Environmental Manager	As required	Visual inspection

Control	Responsibility	Timing	Evidence
or similar) or undertake revegetation, rehabilitation as soon as practicable after the completion of construction • Upgrading the access track with gravel will help reduce the potential for bulldust to develop • Regular spraying of tracks using water trucks for dust suppression			
Compaction – decreasing infiltration, increasing surface runoff: • Restrict vehicle and plant movements to designated roads and active earthworks locations • Cleary define and mark no-go areas • Implement stripping of surface soils to mitigate impacts of compaction • Restrict vehicle movement on wet soil.	Environmental Manager	As required	Visual inspections
Sodic soils: • Surface stabilisation in areas of mapped sodic soils to achieve stable landform throughout the duration of disturbance • Minimise the amount of vegetation removal • Re-establish vegetation as soon as practically possible following disturbance • Ameliorate sodic soils with soil conditioners such as gypsum to improve soil structure if required	Environmental Manager	As required	Visual inspections
Additional ESC controls: • Design of all drainage around proposed structures and permanent landforms should consider the presence of erodible and dispersive soils and apply suitable erosion reduction methods;	Construction Manager	Prior to any ground disturbance , when commencing construction and as soon as possible after completion of	Erosion controls in place and rehabilitation register

Control	Responsibility	Timing	Evidence
• Minimise the area to be disturbed; • Minimising the period that the bare soil is left exposed to erosion by rapidly establishing complete grass covers or using other recommended protection measures e.g. geo-fabric linings or mulching (particularly important on sandy soils) • All disturbed areas should be revegetated, or protected from erosion using suitable erosion control measures; • Limiting the area disturbed, and clearing progressively, immediately prior to construction activities commencing if possible • Planning all activities with knowledge of soil types and soil characteristics • Safeguarding the surface layer by stripping and stockpiling topsoil prior to construction; • Controlling runoff and sediment loss from disturbed areas using appropriate short term erosion control measures such as silt fences, coir logs, diversion mounds, etc.; • Using temporary soil diversion mounds to control runoff within and to divert water away from construction sites where practicable; • Minimising the period that the bare soil is left exposed to erosion by rapidly establishing complete grass covers or using other recommended protection measures e.g. geo-fabric linings; and • Using sediment traps to minimise off-site effects of erosion		construction	
Refer Section 14.5 for controls in relation to watercourse crossings.			

17.6.3 Operations

During operations, controls for erosion in runoff from spoil dumps are through provision of sediment ponds and progressive rehabilitation. If ground disturbing activities are required, the controls for the construction phase should be followed.

17.7 Monitoring and Corrective Action

Table 17-3 Erosion and Sediment Control – Monitoring and Corrective Action

Monitoring action	Responsibility	Frequency	Performance Requirement	Corrective Action
Inspect erosion and sediment control devices	Environmental Manager	Weekly (Checklist)	See weekly checklist	Undertake repairs or replace devices. Modify or re-design if necessary Empty sediment from sediment traps. Repair scouring or other eroded areas.
Check capacity of sediment retention basins for overburden stockpiles and stormwater systems	Area Manager	At the end of each wet season	Design capacity is retained	Excavate deposited sediment and dispose of to in-pit disposal area.
Inspect stormwater systems, including diversion drains and outlets	Environmental Manager	Monthly during wet season	No visible signs of scouring, concentration of flow or bypass flows	Repair scouring. Modify or re-design if necessary Maintain, repair or upgrade stormwater system to prevent scouring, concentration of flows over high risk areas or bypass flows.

18. Contaminated Land

18.1 Legislative Framework

The legislative requirements covering contaminated land in Queensland are primarily contained in the EP Act and subordinate legislation. The EP Act is administered by DEHP.

Prior to commencement of mining, none of the affected land parcels were listed on the environmental management register (EMR) or contaminated land register (CLR). As the proposed mining activity includes notifiable activities, all land parcels on which the mining activity takes place will be listed on the EMR.

The EP Act contains a number of provisions in relation to the investigation, management and remediation of contaminated land. If notices are received from DEHP in regard to contaminated land, these notices must be complied with.

In Queensland, acceptable and unacceptable contaminant levels are set in:

- National Environment Protection (Assessment of Site Contamination) Measure 1999
- Draft Guidelines for the Assessment and Management of Contaminated Land in Queensland 1998.

It is an offence under the EP Act to remove soils from a site listed on the CLR or EMR without a permit.

18.2 Environmental Values

Contamination of soil affects the viability of the soil resource. Disturbance of contaminated soil, or contamination of soil also has potential to impact on a surface water quality, groundwater resources and aquatic ecosystem values as described in Section 18.3.

18.3 Potential Impacts

The potential impacts of land contamination may arise in two ways. First, construction and operation activities may increase human exposure to pre-existing contaminants, or mobilise contaminants to surface water or groundwater. Second, construction and operation activities may release contaminants into soils, causing soil contamination.

Soil contamination then has a number of flow on effects, including:

- Acute or chronic toxicity effects on humans and animals who come into contact with the soil, including where contaminated soil becomes windblown. Contaminated soil guidelines generally focus on whether or not levels of particular contaminants might be high enough to cause toxic effects.
- Inhibition of plant growth, and death of existing plants in contaminated areas.
- Mobilisation of contaminants by overland flows to surface watercourses. This in turn may lead to acute or chronic toxicity effects to aquatic organisms and to contamination of water supplies.
- Contaminants in watercourses may be deposited in sediment on the bed of the watercourse, resulting in sediment contamination. Subsequent flow events may re-mobilise sediments into the water columns, and contaminated sediments may also inhibit aquatic plant growth.

- Mobilisation of contaminants to groundwater, which in turn may lead to contamination of groundwater supplies. In high permeability aquifers, contaminant plumes may be conveyed over considerable distances. In alluvial aquifers such as that occurring along the Carmichael River, and where aquifers discharge as springs, contaminants may also be released into surface waterways.

18.4 Performance Outcome

Land contamination does not cause inhibition of plant growth, degradation of water resources or toxic effects to humans or other animals. Relevant contaminated land guidelines in place at the time will be used to indicate whether contaminant levels are acceptable (current guidelines are listed in Section 18.1.

18.5 Proposed Controls

18.5.1 Design, Procurement and Pre-construction

Table 18-1 Contaminated Land – Design and Preconstruction Controls

Control	Responsibility	Timing	Evidence
Notify DEHP of the location of all notifiable activities.	Environmental Manager	On issue of environmental authority	Correspondence
Design all fuel storages to meet the requirements of AS1940: storage and handling of flammable and combustible liquids.	Design Manager	Prior to construction	Design checklist
All fuel storage to be above ground.	Design Manager	Prior to construction	Design checklist
For all workshop areas, provide: • Secure storage for oils and waste oils with roof and containment bunding equal to 110 % of the largest container • An impervious floor (concrete or similar) in all areas where vehicle maintenance will routinely be carried out • Preferable roofed areas for vehicle maintenance • Containment bunding, including rollover bunds or drains such that spills and rainwater are contained within the designated area • Drainage of maintenance areas to sumps with oil/water separation • Return of treated stormwater and wastewater from maintenance areas to mine affected water storages.	Design Manager	Prior to construction	Design checklist
For refuelling areas, provide: • An impervious floor (concrete or similar) • Containment bunding, including rollover bunds such that spills and	Design Manager	Prior to construction	Design checklist

Control	Responsibility	Timing	Evidence
rainwater are contained within the designated area • Drainage of refuelling areas to sumps with oil/water separation • Return of treated stormwater and wastewater from refuelling areas to mine affected water storages.			
Design vehicle washdown areas so that all runoff water is captured and passed through oil water separators and sediment catchment devices.	Design Manager	Prior to construction	Design checklist
Include a provision in contracts that makes all contractors responsible for and liable for costs of clean-up of any contamination arising from activities undertaken by the contractor.	Procurement Manager	Prior to issuing any contract	Contract

18.5.2 Construction and Operation

Table 18-2 Contaminated Land – Construction and Operation Controls

Control	Responsibility	Timing	Evidence
Manage oily waste and hydrocarbon contaminated waste, including waste from sumps and bunds, in accordance with requirements in the waste management sub plan (Section 12).			
Water from vehicle wash areas to be recirculated for use.	Area Manager	Ongoing	Site checklist
Diesel storage tanks and bunds are regularly inspected and maintained.	Area Manager	As per AS 1940 and/or manufacturer's instructions	Maintenance records
Transport of diesel and other dangerous goods to be in accordance with Australian Code for Transport of Dangerous Goods by Road and Rail.	Warehouse Manager	Ongoing	Transport records
Mobile refuelling activities to be carried out as follows:	Area Managers	Ongoing	Observations of mobile refuelling activities

Control	Responsibility	Timing	Evidence
• Mobile tankers to have automatic shut off valves • At least one person present must have dangerous goods storage and handling and spill prevention and response training • Refuelling to be undertaken in a safe location, away from vehicle movement pathways • Refuelling not to take place within 100 m of a watercourse • Spill kit capable of cleaning up spills of at least 100 L to be available • Refuelling activity to be under visual observation at all times.			
Fixed refuelling activities to be supervised at all times.	Area Managers	Ongoing	Observations of mobile refuelling activities
Workshop, refuelling and other areas are not to be cleaned by hosing of water.	Area Managers	Ongoing	Weekly checklist
Spill kits to be in place at workshops, refuelling areas and other areas where fuels and oils are handled or stored.	Warehouse Manager	Ongoing	Weekly checklists
All spills to be addressed and reported as per onsite spill management procedures and reported as required.	All staff	Ongoing	Incident register and reports
Conduct risk assessment for incidents of contamination and determine appropriate mitigation and management strategies. Hierarchy of management approaches, from most to least preferred: • On-site treatment of the chemical substances to reduce risk to an acceptable level • Off-site treatment of excavated soil to reduce risk to an acceptable level, after which the treated soil is returned to the site • Containment of soil on site with a properly designed barrier	Environmental Manager	As required	Contaminated land register, incident reports

Control	Responsibility	Timing	Evidence
• Disposal of affected soil to an approved landfill. Document in contaminated land register and incident report.			
Undertake further testing as required to delineate extent of contamination and/or validate that adequate clean-up has occurred. Enter results in contaminated land register and incident report.	Environmental Manager	As required	Contaminated land register, incident reports
If it appears likely that groundwater contamination may have occurred, initiate groundwater testing.	Environmental Manager	As required	Contaminated land register, incident reports
If biosolids are to be used for soil conditioning, ensure relevant sampling, analyses and reporting is undertaken in accordance with the relevant guidelines with regards to potential contamination.	Environmental Manager	As required	Testing, Analysis and Reporting
Enter locations of all spills of diesel, oil or other hazardous substances into a contaminated land register. Include details of the type and quantity of contaminant, and testing and remediation actions undertaken. Provide a reference to the incident investigation report.	Environmental Manager	As required	Contaminated land register

18.6 Monitoring and Corrective Action

Table 18-3 Contaminated Land – Monitoring and Corrective Action

Monitoring action	Responsibility	Frequency	Performance Requirement	Corrective Action
Soil and groundwater testing as required to follow up a particular incident of contamination.	Environmental Manager	As required	Soil and groundwater contamination levels are within current guidelines	Further remediation as required until guideline levels are met.
See also weekly checklist.	Environmental Manager	Weekly After rain events	As per checklist	As required to achieve performance requirements in checklists.

19. Soil Resources

19.1 Legislative Framework

The requirement to manage topsoil arises from:

- Legislative requirements in relation to rehabilitation.
- State government policy SPP1/92 regarding maintenance of good quality agricultural land resources.

Note that there is no strategic cropping land within the mine area.

Under the *Forestry Act 1959*, the State must be given the opportunity to assess and harvest any timber or quarry resources on State land.

19.2 Environmental Values

Environmental values of soils relate to the soil types, the physical and chemical properties of soils, the ability of the soils to support native vegetation and pre-mining agricultural suitability and land use. Approximately 60 per cent of the mine site supported remnant native vegetation prior to mining, with condition of much of this area affected by the pre mining land use of grazing. Grazing occurred on a mixture of introduced and native pastures.

Soil types present within EPC 1690, are shown in EIS Volume 4 Appendix L Mine Soils Assessment. A key limitation for the majority of the soils is the variable depth to underlying hard sandstone or manganese pan. For Tm1, Tm4, Eb1 and Eb3 soils, depth to saline or sodic subsoil will also limit depth of stripping, while depth to strongly alkaline soil will limit the depth of useable material from soil Cr3. Further soil testing should be carried out prior to stripping to confirm stripping depths and other soil properties.

The majority of the soils also, have poorly structured topsoils which contain high proportions of fine sand, relative to silt and clay. These poorly structured surface soils have the potential to form bull dust when disturbed and are highly susceptible to both wind and water erosion if not adequately managed and protected. These sandy profiles are general acidic and infertile with a low water holding capacity, while areas of shallow rocky soils (Rudosols), occurring on the crests and hill slopes have shallow effective rooting depths.

A soil and land suitability assessment is to be conducted for the proposed mining area of EPC 1080 (eastern portion) and updates made to this EM plan when data is available.

Table 19-1 Soil types (EPC 1690)

Soil Description	Australian soil classification	Area (Ha)	Stripping depth	Limitations to stripping
Gc1 – very shallow (0.25 m), gravelly, acid to neutral, brown loamy to clay loam	Leptic rudosol	849	Not recommended for reuse	Shallow, rocky soil
Gc 2 Shallow to moderately deep (0.25–1.0 m), gravelly, acid to neutral, bleached loam to clay loam	Bleached-Leptic Tenosol	353	0.4 m	Variable underlying rock
Lb 1 Moderately deep (0.5–1.0 m) acid to neutral soil with moderately thick loamy surface grading to red, massive fine sandy clay subsoil	Red Kandosol	423	0.4 m	Variable underlying rock

Soil Description	Australian soil classification	Area (Ha)	Stripping depth	Limitations to stripping
Lb 2 Moderately deep (0.5–1.0 m) acid to neutral soil with medium to thick loamy surface grading to yellow-brown massive fine sandy clay subsoil	Yellow or brown Kandosol	7,521	0.4 m	Variable underlying rock
Lb 4 Moderately deep (0.5 – 1.0 m), acid to neutral, yellow-brown, massive sand to loam.	Yellow-Orthic or brown-orthic Tenosol	482	0.7 m	Variable underlying rock
Ln Shallow to moderately deep (< 0.75 m), slightly gravelly, acid to neutral, red well-structured clay.	Red Dermosol	214	0.4 m	Variable underlying rock
Tm1 Deep (0.9 – 1.2 m) texture contrast soil with thick sandy surface over acid to neutral, massive, yellow-brown fine sandy clay subsoil	Yellow or brown Chromosol	3,037	0.9 m	Sodic/dispersive subsoil and underlying rock
Tm2 Deep (> 1.0 m) texture contrast soil with thick loamy surface over acid to neutral, well structured, yellow-brown fine sandy clay subsoil.	Yellow or brown Chromosol	188	1.0 m	Variable underlying rock
Tm4 Deep (> 1.0 m) texture contrast soil with thick, bleached, sandy to loamy surface over alkaline, mottled, yellow-brown fine sandy clay subsoil.	Yellow or brown Sodosol or Chromosol	903	0.3 m	Sodic/saline subsoil
Mr2 Moderately deep, gravelly, acid to neutral bleached sand to loam	Bleached-Leptic Tenosol	695	0.6m	Variable underlying rock
Eb1 Texture contrast soil with thick, bleached sandy to loamy surface over alkaline, mottled, yellow-brown fine sandy clay subsoil.	Yellow or brown Sodosol	951	0.4m	Sodic/saline subsoil

Soil Description	Australian soil classification	Area (Ha)	Stripping depth	Limitations to stripping
Eb2 Grey, brown or red cracking clay with hard-setting surface and moderate to strong gilgai or melon holes.	Red, brown or grey Vertosol	2,199	Not recommended for reuse	shallow depth to saline/sodic subsoil, frequent melon holes
Eb3 Texture contrast soil with moderately thick, bleached loamy surface over alkaline, mottled, yellow-brown medium clay subsoil.	Yellow or brown Chromosol or Sodosol	639	0.3m	Sodic/saline subsoil
Mb2 Yellow-brown, acid to neutral, massive, bleached sand to loam.	Bleached-Orthic Tenosol	1,347	0.9 m	High fine sand content
Mb3 Red, acid, massive sand to loam.	Red-Orthic Tenosol	2,795	0.9 m	High fine sand content
Mb4 Yellow to brown, acid, massive sand to loam.	Yellow-Orthic and Brown-Orthic Tenosol	1,653	0.9 m	High fine sand content
Cr1 Acid to neutral, yellow-brown, massive and loose, sand to loam	Yellow-Orthic and Brown-Orthic Tenosol	949	0.9 m	High fine sand content
Cr3 Texture contrast soil with moderately thick loamy surface over alkaline red, well structured light medium clay subsoil.	Red Chromosol	531	0.7 m	Strongly alkaline subsoil
Cr4 Texture contrast soil with moderately thick sandy to loamy surface over acid to neutral, brown, massive to weakly structured light medium clay subsoil.	Brown Chromosol	129	0.9 m	High fine sand content
Eroded areas	NA	257	NA	NA

Land suitability

EPC 1690, falls outside of the reliable rainfall zone for reliable ‘rain fed’ cropping, and as such the agricultural suitability of the area was assessed for beef cattle grazing only, based on the DME 1995, guidelines. The results of the agricultural suitability analysis for each of the soil types, revealed that the majority of the soil types were classified as Class 4 (18,505 ha) or

Class 5 grazing land (6,549 ha), which is defined as marginal to unsuitable land for export quality cattle production. Typically shallow soil depths and sandy profiles, restricts the profile effective rooting depth (ERD) and the plant available water capacity (PAWC). The deep massive sandy red and yellow soils are also highly leached, with very low fertility. Soil Eb2 is Class 4 with limitations due to salinity and pH, while areas of Eb3 are either Class 3 or Class 4, depending on variable subsoil salinity levels.

A small area of Class 3 land (946 ha) was also identified. Areas of Class 3 land are suitable for cattle production in good seasons, and are restricted to the better soils of the Carmichael River levee.

19.3 Potential Impacts

Table 19-2 Potential Environmental Impacts – Construction and Operation

Activity	Potential Environmental Impact
Vegetation clearing	Exposure of soils to erosive forces, resulting in loss of soil due to increased surface runoff... All soils will be susceptible to erosion with the removal of vegetation. Soils susceptible to wind erosion include the soils with the sandy or loamy topsoils. Duplex soils with sodic subsoils will be susceptible to dispersion if exposed. Exposure of soils with fine sandy surface horizons to raindrop impact, resulting in surface capping, decreasing profile infiltration Reduced viability of topsoil/subsoil to support native plants and pasture due to possible degradation of topsoil structure and loss of organic matter. Sedimentation of adjacent water bodies Potential increased soil salinity through changes in hydrology Reduced agricultural productivity and associated economic impacts
Land suitability	During the construction and operation of the mine, it may be possible for existing land uses to continue within areas not directly affected by mining operations. However land impacted by mining will be excluded from its previous use, until rehabilitation following mining and the land is restored to its previous land suitability class or to a mutually agreed upon post mining land suitability.
Topsoil Stripping and stockpiling	Poor topsoil management can lead to incorrect depths of stripping occurring, potentially allowing for the mixing and stockpiling of topsoil and unsuitable subsoil material. Incorrectly stockpiled topsoil can lead to compaction and structural breakdown, together with poor aeration, which causes biological degradation, limiting the viability of the material for rehabilitation Exposure of soils to erosive forces, resulting in loss of soil due to increased surface runoff .resource
Earthworks	Soil compaction due to machinery impacts, decreases infiltration and increases the potential for surface runoff and sheet erosion, compaction also leads to an increase in the soil bulk density and affects seed germination and root establishment of vegetation

Activity	Potential Environmental Impact
	Continued use of unsealed access tracks by heavy vehicles has the potential to pulverise the soil and produce bulldust, this is particularly relevant in soils with a moderate to high proportions of fine sand and silt. Exposure of soils to erosive forces, resulting in loss of soil due to increased surface runoff .resource

19.4 Performance Outcome

Topsoil and subsoil resources are adequately recovered, stockpiled and biological and physical viability maintained to support the proposed post mining land use.

Minimise soil loss occurring due to mining operations, through implementation of appropriate erosion control practices

Minimise soil compaction

19.5 Proposed Controls

19.5.1 Design, Procurement and Pre-construction

Table 19-3 Soils – Design and Preconstruction Controls

Control	Responsibility	Timing	Evidence
Prepare a topsoil management plan for construction and the first five years of mining: • Clear delineation of area to be disturbed and soil types within this area • Proposed depth of stripping for each soil type and volume generated • Any pre-stripping treatment requirements (for example weed control) • Whether single or two phase stripping is required • Whether each soil type is to be immediately placed on an area prepared for rehabilitation or stockpiled • Location for rehabilitation placement or stockpiling of each soil type • Segregation of soils according to soil type, soil properties and potential for weed infestation • Management requirements while stockpiled • Intended use for each soil type in rehabilitation, having regard to: – Timing when area will become available for rehabilitation – Potential for soils to contain native plant seeds or introduced plant seeds – Surface cover requirements and required volume – Slope and drainage	Area Manager	Prior to any earthworks	Topsoil Management Plan

Control	Responsibility	Timing	Evidence
– Spoil characteristics – Intended revegetation scenario. • Topsoil must be stored in stockpiles no more than 1.5 m high to maintain biological and structural viability • Topsoil must be stockpiled for the shortest practicable and/or re-used as soon as possible to limit biological and structural degradation. • Placement of topsoil must consider the landscape position from where the topsoil was stripped. Light texture loamy sands and sandy loams are not to be placed on landforms with excessive slopes. • Depth of topsoil placement should be the same as the depth stripped. •			
Develop a topsoil register for recording: • Soil type • Source location • Date and depth of stripping • Location of stockpile placement • Volume in stockpile • Date of required management actions (turning, seeding, amelioration) • Date, depth and location of replacement.	Area Manager	Prior to any earthworks	Topsoil Register
Identify a suitable location or locations for topsoil stockpiling. The area should not be subject to significant overland flow, or flow should be diverted around the area. Risk of accidental disturbance should be minimised.	Area Manager	Ongoing	Site Operations Plan

Control	Responsibility	Timing	Evidence
Provide details to DNRM regarding proposed footprint relative to State land such that DNRM can determine whether there is a need to salvage quarry material or forest products.	Environmental Manager	6months prior to disturbance	Correspondence
Prepare an Erosion and Sediment Control Plan (ESCP) in accordance with the *Best Practice Erosion and Sediment Control Manual* (IECA, 2008) and implemented for the Project area prior to the commencement of mining operations; Design of all drainage around proposed structures and permanent landforms should consider the presence of erodible and dispersive soils and apply suitable erosion reduction methods; Minimise the area to be disturbed; All disturbed areas should be revegetated, or protected from erosion using suitable erosion control measures;	Area Manager	Prior to any earthworks	Erosion and Sediment Control Management Plan (ESCMP)
Prepare a Rehabilitation Management Plan	Environmental Manager	Prior to any earthworks	Rehabilitation Management Plan

19.5.2 Construction and Operations

Table 19-4 Soils – Operational Controls

Control	Responsibility	Timing	Evidence
Topsoil			
Update topsoil management plan.	Area Manager	Annually or as required to address revisions in the mine plan	Topsoil management plan
Survey soils types to confirm stripping depths and other limitations such as sodicity, slaking and alkalinity. Optimal characteristics for rehabilitation success include: • Particle size distribution that is dominated either by the coarse sand fraction; or alternatively the reactive clay fraction; preferably with limited fine sand and/or silt fractions • pH range appropriate for intended plant growth • Non-sodic/non-dispersive physical behaviour, particularly in the case of clay • Material • Very low levels of soluble salts • Fertility levels appropriate for the plant species to be grown. Avoid subsoils with elevated levels of soluble salts (soluble chloride contents >300-600 ppm or EC1:5 >0.6 dS/m).	Area Manager	Annually, or as required based on mine plan progress	Topsoil register
Document relevant details in topsoil register and determine topsoil storage requirements and optimal reuse in rehabilitation for each soil type.	Area Manager	Annually, or as required based on mine plan	Topsoil register

Control	Responsibility	Timing	Evidence
Determine treatment or amelioration requirements to maintain topsoil viability while stockpiled or placed in rehabilitation areas.		progress	
Strip topsoil prior to any earthworks or other surface disturbance. Topsoil stripping depths and other requirements will be set out in the topsoil management plan.	Area Manager	Prior to any earthworks or disturbance	Topsoil register
Place topsoil in stockpiles no more than 1.5 m in height and with side slope steepness depending on the nature of the topsoil such that stockpiles do not fail. Details for placement of and segregation of soil types in stockpiles will be set out in the topsoil management plan. Placement should occur immediately after stripping without any additional handling or intermediate stockpiling.	Area Manager	Immediately on stripping of topsoil	Topsoil register
Details of stripped topsoil volumes, placement location (stockpile or rehabilitation area) and any treatment such as seeding to be entered into the topsoil register.	Area Manager	On placement in stockpile or rehabilitation area	Topsoil register
If stockpiles are to remain in place for more than six months, rip and seed topsoils. Seeding may be with native grass species or a sterile introduced grass species. This should be recorded on the topsoil register.	Area Manager	Immediately after placement in stockpile	Topsoil register
Use water sprays to prevent wind erosion.	Area Manager	As required	Visual inspections
Design and conduct rehabilitation trials to test effectiveness of amelioration measures in relation to soil fertility and suitability for placement on slopes.	Environmental Manager	On commencement of mining	Rehabilitation trial records
Erodible light textured sandy soils: • Implement appropriate ESC measures; • Minimise the amount of vegetation removed; • Schedule construction activities where possible;	Environmental Manager, Area Manager	On commencement of construction and ongoing	Visual inspection and site operations plan

Control	Responsibility	Timing	Evidence
• Restrict vehicle movement to designated tracks; Protect exposed areas as soon as possible following disturbance by re-establishing vegetation, applying protective mulch to the surface on level to gently sloping areas, covering smaller areas and areas of steep slopes with geo-fabric or spray with an approved polymer to bind the soil;			
Soil Compaction • Use appropriate earthmoving machinery when working with these soils (i.e. using vehicles with large wheel/track size) • Implement controlled trafficking measures; • Minimise trafficking when the soils are wet; • Compacted areas that are to be rehabilitated should be remediated by ripping the compacted layer/s prior to the spreading of topsoil; • Depth of ripping is dependent on the degree of compaction, and should be assessed prior to rehabilitation works.	Environmental Manager	On commencement of mining and ongoing	Visual inspections
Placement of infrastructure • Ensure proper topsoil management procedures are implemented to ensure rehabilitation is successful • Implement appropriate ESC measures to avoid loss of high potential soil; • Undisturbed land will be returned, or retained as its pre-mining land suitability or as mutually agreed	Area Manager	Ongoing	Site Operations Plan
Dust creation • Minimise time of disturbance period required and install protective measures or undertake revegetation, rehabilitation as soon as practicably	Area Manager	Ongoing	Visual inspections

Control	Responsibility	Timing	Evidence
possible; • Schedule construction activities • Minimise and plan vehicle movement to only what is necessary • Seal tracks and roads if possible with, crushed stone and bitumen, or small problem areas with geo-fabric; • Cover gently sloping areas with mulch • Regular spraying of unsealed or temporary tracks using water trucks for dust suppression			
Dispersive soils			
• Surface stabilisation in areas of mapped sodic soils to achieve stable landform throughout the duration of disturbance • Minimise the amount of vegetation removal to what is absolutely necessary • Clearly define and mark out no-go areas • Re-establish vegetation as soon as practically possible following disturbance • Ameliorate sodic soils with soil conditioners such as gypsum to improve soil structure if required	Environmental Manager	As required	Visual inspections
Implement and manage erosion and sediment control practices	Area Manager	Prior to disturbance activities	ESCMP

19.6 Monitoring and Corrective Action

Table 19-5 Soils Monitoring and Corrective Action

Monitoring action	Responsibility	Frequency	Performance Requirement	Corrective Action
Rehabilitation	Environmental Manger and Area Manager		NA (documented in Rehabilitation Management Plan)	Identify constraints to rehabilitation and rectify and ameliorate conditions were required to maximise rehabilitation success
Test soils for pH, EC, chloride, exchangeable cations, particle size and dispersion.	Area Manager	Prior to stripping	NA (documented in topsoil register)	Identify constraints to stockpiling and rehabilitation and treatment or amelioration required to maximise rehabilitation success.
Visual inspection of topsoil stockpile areas	Environmental Manager	In high wind conditions	Minimal dust lift off	Apply water. Seed stockpiles if necessary.
Visual inspection of topsoil stockpile areas	Environmental Manager	Monthly and after rainfall (>10mm)	• Stockpiles are intact and not slumping • Management requirements in topsoil register have been implemented • Stockpiles greater than 6 months have been seeded • Vegetation cover is healthy (where required) • No sign of erosion • No infestation of weeds	Reshape stockpiles. Apply seed to stockpiles. Apply water.
Regularly monitor erosion	Environmental	Monthly	• Structures intact and functioning as	Repair and modify structures if required

Monitoring action	Responsibility	Frequency	Performance Requirement	Corrective Action
and sediment control structures, repair and modify as required	Manager	and after rainfall (>10mm)	required • No visible signs of structure failure	

20. Aboriginal Cultural Heritage

20.1 Legislative Framework

Protection of Aboriginal cultural heritage is largely achieved through the *Aboriginal Cultural Heritage Act 2003* which establishes a duty of care in relation to managing impacts on items and places of Aboriginal cultural heritage significance. For the Carmichael Coal mine, the duty of care will be discharged through the preparation and implementation of cultural heritage management plans, which are to be agreed by Adani and the relevant Aboriginal parties.

There are no Aboriginal cultural heritage places or items within the mining area that are listed under either Federal or Queensland heritage protection legislation (Commonwealth *Aboriginal and Torres Strait Island Heritage Protection Act 1984*, *Environment Protection and Biodiversity Conservation Act 1999*, *Queensland Heritage Act 1992*).

20.2 Environmental Values

The Project affects one native title/Aboriginal party area, being located within the external boundaries of the Wangan and Jagalingou People registered native title claim (QUD85/04, QC04/6)

Details of places and items of Aboriginal cultural heritage significance will not be disclosed in any public documentation. In general, the following Aboriginal cultural heritage values are associated with the mine site:

- Culturally significant sites within the Project Area should be viewed as connected to the broader landscape outside the Project Area boundary, particularly known ceremonial grounds, rock art, pathways, camp sites, scarred trees and scattered artefacts.
- The Carmichael River, Cabbage Tree Creek and a network of creeks and the northern creek system were generally identified as seasonal camping areas and pathways through the broader landscape. Artefact finds are more likely in these areas.
- Artefacts identified include a variety of stone artefacts, scarred trees, grinding grooves. Artefacts were present as discrete items or scatters, with denser scatters associated with potential camping places.

As a complete survey of the mining area has not been undertaken, there is potential for inadvertent discovery of other sites and artefacts.

20.3 Potential Impacts

20.3.1 Construction

Potential Aboriginal cultural heritage impacts during the construction phase are summarised in Table 20-1.

Table 20-1 Potential Cultural Heritage Impacts – Construction

Activity	Potential Cultural Heritage Impact
Vegetation clearing and ground disturbance	Vegetation clearing and ground disturbance will disturb and potentially destroy artefacts The contextual setting of artefacts will also be effectively destroyed by ground disturbance
Disturbance and erosion of streams and drainage lines	Erosion may expose artefacts on stream banks and drainage lines, with subsequent loss to downstream environments

20.3.2 Operations

Potential operational impacts on Aboriginal cultural heritage are summarised in Table 20-2. It should be noted that it is not intended to divert or otherwise alter the Carmichael River as part of the proposed mine.

Table 20-2 Potential Cultural Heritage Impacts – Operation

Activity	Potential Cultural Heritage Impacts
Vegetation clearing and ground disturbance	Vegetation clearing and ground disturbance will disturb and potentially destroy artefacts The contextual setting of artefacts will also be effectively destroyed by ground disturbance
Spoil placement	Spoil placement will permanently conceal any artefacts not already disturbed by vegetation clearing
Disturbance and erosion of streams and drainage lines	Erosion may expose artefacts on stream banks and drainage lines, with subsequent loss to downstream environments
Subsidence	Artefacts may be exposed due to ground movement and cracking Weathering processes may then destroy or degrade artefacts or alter the context in which the artefacts are located

20.4 Performance Outcome

Cultural heritage management plan requirements are met.

20.5 Proposed Controls

20.5.1 Design, Procurement and Pre-construction

During the design and pre-construction phase:

Table 20-3 Indigenous Heritage – Design, procurement and preconstruction controls

Control	Responsibility	Timing	Evidence
Cultural heritage management plans will be finalised and approved.	CEO	Pre-construction	Approved Plans
Any required pre-clearing surveys for construction areas will be undertaken in accordance with the cultural heritage management plan (CHMP).	Construction Manager	Pre-construction	Survey Reports
If significant finds are made, consideration will be given to whether infrastructure footprints can be altered to avoid disturbance.	Construction Manager	Pre-construction	Design Review
If keeping places are required, these will be established.	Construction Manager	Pre-construction	Established places as required

20.5.2 Construction

Table 20-4 Indigenous Heritage – Construction Controls

Control	Responsibility	Timing	Evidence
Monitoring of ground disturbing activities at certain locations. Protocols in relation to monitoring, including giving of notice to the relevant Aboriginal parties to provide monitors, the activities of these monitors during monitoring activities and requirements if a cultural heritage find is made are set out in the CHMPs.	Construction Manager	Ongoing	Compliance with CHMP
Collection and management of any artefact finds.	Construction Manager	Ongoing	Compliance with CHMP

20.5.3 Operation

Table 20-5 Indigenous Heritage – Operation Controls

Control	Responsibility	Timing	Evidence
Monitoring of ground disturbing activities at certain locations. Protocols in relation to monitoring, including giving of notice to the relevant Aboriginal parties to provide monitors, the activities of these monitors during monitoring activities and requirements if a cultural heritage find is made are set out in the CHMPs.	Mine General Manager	Ongoing	Compliance with CHMP
Collection and management of any artefact finds.	Mine General Manager	Ongoing	Compliance with CHMP

20.6 Monitoring and Corrective Action

Monitoring and corrective action requirements are set out in the CHMPs developed for the Carmichael Coal project.

21. Non-Indigenous Cultural Heritage

21.1 Legislative Framework

Legislation protecting non-Indigenous cultural heritage is as follows:

- The EPBC Act, administered by SEWPaC, protects listed national heritage places.
- The *Queensland Heritage Act 1992*, administered by the DEHP identifies and protects places of state heritage significance. It applies to discovery and protection of any previously unidentified archaeological artefacts or archaeological places.

The Charter for the Conservation of Places of Cultural Significance (The Burra Charter) 1977 is used to define cultural significance in Queensland and derives its philosophical principles from the International Council on Monuments and Sites (ICOMOS).

21.2 Environmental Values

There are no listed non-indigenous cultural heritage sites present within the mining area. Some items associated with pastoral activities may have limited, localised cultural heritage significance, however no particular values have been identified.

The potential for inadvertent discovery of significant non-indigenous cultural heritage items is considered low.

21.3 Potential Impacts

Potential impacts related to inadvertent discovery of non-indigenous cultural heritage items will arise from vegetation clearing and ground disturbance and hence, are similar during both the construction and operation phases. Potential impacts are shown in Table 21-1.

Table 21-1 Potential Cultural Heritage Impacts – Construction and Operation

Activity	Potential Cultural Heritage Impact
Vegetation clearing and ground disturbance	Inadvertent finds of items of actual or potential cultural heritage significance.

21.4 Performance Outcome

Previously unknown sites of non-indigenous cultural heritage significance are identified and contribution that these sites may make to understanding of pastoral activities and use of the area is recorded.

21.5 Proposed Controls

Table 21-2 Non-Indigenous Cultural Heritage – Construction and Operation Controls

Control	Responsibility	Timing	Evidence
In the event that an inadvertent find of potentially significant cultural heritage material is made cease work and notify the Environmental Officer or Environmental Manager.	All staff	Ongoing	Incident register
Determine whether further action is required and archaeological assessment and/or salvage if required.	Environmental Manager	If a find is made	Incident register

21.6 Monitoring and Corrective Action

In the event that a significant non-indigenous cultural heritage place or item is identified, monitoring requirements may need to be developed.

22. Subsidence Management

22.1 Legislative Framework

The requirement for subsidence management arises from:

- Requirements under the *Mineral Resources Act 1993* and environmental authority issued under the EP Act to restore mining sites such that a stable and sustainable landform is created.
- Obligations under the EP Act and environmental authority to prevent environmental harm.

22.2 Environmental Values

The Carmichael River is the regional drainage line in the area, which flows towards the east in the southern part of the mining lease area. It is not intended to cause subsidence within a 500m buffer either side of the Carmichael River.

A number of small drainage lines in the Carmichael Creek and Eight Mile creek catchments traverse the mining footprint, mostly running roughly perpendicular to the longwall orientation. These are ephemeral creeks with small catchments. For the northern mining area (north of Carmichael River), a ridgeline runs just west of the mining lease boundary and hence, watercourse catchments upstream of the underground mining area are small. Streams in this section drain largely towards Eight Mile Creek.

South of the Carmichael River, streams are somewhat discontinuous due to flatter topography and drain towards the Carmichael River and Belyando River.

22.3 Potential Impacts

Surface subsidence will occur in two stages as first the AB1 seam and then the D1 seam is mined with the panels offset. The maximum predicted total subsidence for the proposed longwalls after extraction in the AB1 seam is 2,625 mm and the maximum predicted total subsidence for the proposed longwalls after extraction in the AB1 and D1 seams is 5,550 mm (MSEC, 2013). As subsidence depends on a range of geological and geotechnical factors, there could be some variation from this estimate and subsidence may not be even across the footprint.

Table 22-1 Potential Subsidence Impacts – Construction and Operation

Activity	Potential Subsidence Impact
Altered topography	Maximum subsidence will be up to 5.5 metres, however as the mine layout for the two seams is offset, the final pattern of subsidence will be a series of parallel troughs 2-5 m deep and about 400 m wide. Length of the troughs will be variable. Alteration in drainage patterns due to altered topography. Bed profiles of streams will be affected by the subsidence profile. Tension cracks in the ground surface. The width and depth of tension cracks will depend on the underlying geology and also the

Activity	Potential Subsidence Impact
	speed at which subsidence occurs. As subsidence will be staged, this may reduce the formation of tension cracking. There will be a small reduction in downstream flows due to capture of water in the subsidence troughs. Root zones of vegetation may be affected either by the relatively rapid change in ground surface or by tension cracks. Altered hydrology may also result in wetter or dryer conditions for plants. Changes in hydrology of streams and overland flows may exacerbate erosion, however sediment mobilisation will be into the centre of the subsidence troughs and little if any sediment will be carried downstream. Depending on the size and depth of tension cracks, these may present a hazard to humans and cattle and possibly other ground dwelling native animals.

Note that there will be no infrastructure across the underground mining area. The existing Moray-Carmichael Road will be relocated prior to commencement of mining.

22.4 Performance Outcomes

A stable and sustainable landform is created over subsided areas which maximises opportunities for the subsided areas to support native vegetation and fauna.

22.5 Proposed Controls

22.5.1 Design and Pre-construction

Table 22-2 Subsidence – Design and Preconstruction Controls

Control	Responsibility	Timing	Evidence
Develop a Subsidence Management Plan prior to the commencement of underground mining activities, in accordance with the Mine Environmental Authority. The revised plan to be finalised and submitted for approval 6 months prior to the commencement of underground mining activities.	Underground Mining Manager	As per the Environmental Authority	Subsidence Management Plan
If mining infrastructure is to cross the underground mining footprint, design infrastructure to be resistant to the effects of subsidence.	Design Manager	During detailed design of infrastructure	Design checklist
Design creek diversions around the open cut areas to remain functional after subsidence.	Design Manager	Prior to development of diversions	Design checklist

22.5.2 Operations

Table 22-3 Subsidence – Operational Controls

Control	Responsibility	Timing	Evidence
Establish monitoring locations including: • One point immediately upstream, one mid-point and one point immediately downstream of underground footprint on waterway diversions • Vegetation characteristics and health monitoring transects and control points	Environmental	As per the Environmental Authority.	Subsidence Management Plan

Control	Responsibility	Timing	Evidence
• Habitat value transects • Topographical survey transects • Photo-monitoring points corresponding with each of the above monitoring locations.			

Control	Responsibility	Timing	Evidence
Determine detailed monitoring methodologies for vegetation health, habitat value and characteristics, stream condition and photo monitoring, drawing on established methodologies.	Environmental Manager	As per the Environmental Authority	Subsidence Monitoring Plan
Establish exclusion zones and remove cattle from underground mining footprint. Construct fences outside subsidence footprint to keep cattle from the subsided area.	Environmental Manager	Prior to underground mining	Visual inspection
Further develop the Draft Subsidence Management Plan (SEIS Volume 4 Appendix I2)	Environmental Manager	Prior to commencement of underground mining	Subsidence Management Plan

22.6 Monitoring and Management Responses

Table 22-4 Subsidence Monitoring and Management Responses

Monitoring action	Responsibility	Frequency and duration	Performance Requirement	Management Responses	Timing
Determine baseline conditions for: • Stream characteristics • Vegetation health and characteristics • Habitat features and values • Topography.	Environmental Manager	At least four stream and vegetation health surveys prior to commencement of underground mining over a minimum period of one year.	Baseline conditions are documented	None	As per the Environmental Authority
Inspect subsided areas for new and existing tension cracks. Document locations	Environmental Manager	As per the Environmental	As per the Environmental Authority	Grade and/or fill cracks with inert material, cover with	As per the Environmental

Monitoring action	Responsibility	Frequency and duration	Performance Requirement	Management Responses	Timing
and size of cracks and changes in crack size.		Authority		topsoil and revegetate. Use small scale equipment to minimise damage to intact vegetation and soils.	Authority
Monitor vegetation health and changes in vegetation characteristics in subsided areas using established transects. Monitor habitat characteristics and values. Establish reference and monitoring sites of equivalent size. Monitor for: • Foliar discolouration • Partial defoliation • Increased pathogenic attack • Tree death	Environmental Manager	As per the Environmental Authority	Regional ecosystem classifications have not changed Habitat suitability for native fauna species is retained Weed presence is not increasing	Management responses may include: • Weed control • Revegetate with suitable native species • Leave any fallen trees on site to provide habitat for fauna species.	As per the Environmental Authority
Monitor extent of ponding in subsidence troughs.	Environmental Manager	As per the Environmental Authority	Ponding is not causing a safety risk Ponding is not causing adverse environmental	Partially or fully drain ponds.	As per the Environmental Authority

Monitoring action	Responsibility	Frequency and duration	Performance Requirement	Management Responses	Timing
			impacts Water is not flowing into underground workings		
Monitor groundwater	Environmental Manager	As per the Environmental Authority	Groundwater not impacted indirectly by cracking		As per the Environmental Authority
Check stream diversions adjacent to subsided areas.	Environmental Manager	As per the Environmental Authority	Diversions remain stable and effective	Relocate or stabilise diversions.	As per the Environmental Authority

23. Emergency Management and Response

23.1 Emergency Response Plan

An emergency response plan will be developed for the mine as required by CG-015 Emergency Preparedness and Response and will include:

- An identification and risk assessment of potential emergencies and incidents, including those that might cause environmental harm.
- Roles and responsibilities in relation to emergency response, reporting and notification.
- Up-to-date site location and layout (Compliance Guideline CG-027 Technical Documentation).
- Emergency phone numbers (internal and external).
- Type, use and location of emergency response equipment, including PPE.
- Hazardous materials on site, including location, quantity, types, method of storage, handling, fire-fighting methods to be used and environmental hazards (refer Compliance Guideline CG-024 Hazardous Management and Dangerous Goods).
- Procedures for response to all reasonably foreseeable incidents and emergencies.
- The arrangements for alert or alarm situation (who should be notified, how, etc.).

Local emergency services will be consulted in preparation of the emergency response plan and the plan will be made available to local emergency services.

Likely emergencies or incidents which may have environmental impacts are shown in Table 23-1. In relation to environmental incidents and emergencies, requirements for prevention will be included in relevant sub-plans within this EMP.

Table 23-1 Emergencies with Potential Environmental Impacts

Incident	Potential Environmental Impact	Prevention	Emergency Response
Spills of environmentally hazardous materials	Contamination of soil Contamination of surface water and groundwater Toxicity to humans, animals and plants Water resources cannot be uses for identified beneficial uses	Design of storages Storage and handling procedures Training Spill containment and clean up equipment in place at risk areas for small, medium and large spills	Contain spill Remove all contaminated materials or remediate contamination in-situ.
Bushfire	Loss of native vegetation and habitat Death or injury of native animals Death or injury to humans Air pollution – particulates and greenhouse gas emissions	Management of combustible materials and ignition sources as per CG-045 and including vehicle movements across grassed areas and cigarettes. Fuel reduction where necessary and consistent with fire regimes for native vegetation Fire protection and fire fighting equipment Training	Fight fire using trained crews and equipment and with assistance from Queensland emergency services as required.
Accidental releases of mine affected water	Degradation of water quality such that beneficial uses are unable to continue	Design of mine water storages Mine water management system	Contain flows and discharge where possible.
Spontaneous combustion	Air pollution – particulates and greenhouse gas emissions Loss of coal resource	Minimise time in stockpiles	Spread stockpile and cool with water sprays. Reform stockpile and compact to prevent

Incident	Potential Environmental Impact	Prevention	Emergency Response
			oxygen ingress.
Landslide	Change in topography Degradation of water quality and habitat from erosion and sedimentation Loss of resources Death or injury to personnel or wildlife	Implementation of operation and construction safety plans Undertake a landslide hazard	Implement emergency response procedure for landslides and working within landslide prone areas

23.2 Incident Reporting and Notification

Incident reporting requirements will be set out in the Emergency Response Plan and will include those set out in Table 23-2.

Table 23-2 Incident Reporting and Notification

Type of Incident	Report to	Report by	Timing
All serious incidents	Mine Manager and/or Environmental Manager	First on scene	Immediately
Incidents involving actual or potential environmental harm	Mine Manager and/or Environmental Manager and/or officers	First on scene	Immediately
Incident involving non-compliance with environmental authority	DEHP – pollution hotline	Mine Manager and/or Environmental Manager	Within 24 hours (initial notification)
	DEHP – representative officer	Mine Manager and/or Environmental Manager	Within 14 business days (full report)
Incident involving non-compliance with another approval	Relevant agency	Mine Manager and/or Environmental Manager	On becoming aware of the non-compliance
Incidents causing actual or potential serious or material environmental harm (1)	DEHP Owner and occupier of affected land All persons at the affected land	Mine Manager or Environmental Manager (2)	Within 24 hours of becoming aware

(1) Note Environmental harm is defined in Sections 14-17 of the EP Act http://www.legislation.qld.gov.au/acts_sls/Acts_SL_E.htm

(2) Note that if the Mine Manager or Environmental manager is not available, the person who first became aware of the potential or actual environmental harm must themselves make a report to DEHP and the owners and occupiers of the affected land

23.3 Incident Investigation

Incident investigation requirements are set out in Section 4.4 of CG-006 Incident Investigation and Reporting.

In relation to environmental incidents, reports to the administering authority of the EP Act must include “the event, its nature and the circumstances in which it happened”.

Environmental incident investigations and reports will cover:

- A description of the incident, including witness accounts
- A description of any releases to land, air or water or other environmental harm that may have occurred, including loss of native plants or habitat for native animals
- A description of the environmental values affected or potentially affected
- Whether releases or other harm caused by the incident was in excess of prescribed standards or requirements (for example, whether particulate emissions exceeded compliance levels, or whether vegetation was cleared outside areas where clearing was authorised).
- Whether a formal non-compliance with legislative requirements or approval conditions occurred
- Whether the incident constituted serious or material environmental harm as defined under the EP Act
- Whether internal procedures or requirements were breached
- Formal and informal reports and notifications made internally and externally
- A review of the causes of the incident or near miss
- Recommendations in relation to actions required to rectify any environmental harm or damage that may have occurred
- Recommendations in relation to preventing a recurrence of the incident or near miss. These may include:
  - Disciplinary action against individual employees
  - Revisions to procedures and work methods
  - Maintenance, repairs or re-design of infrastructure, facilities or equipment.

All recommendations from incident investigations will be included in the Corrective Action Register.

24. Community

24.1 Legislative Framework

A key focus of the EP Act is to protect amenity and beneficial uses of the environment for humans, particularly in relation to noise, air quality, waste management, land contamination and surface and groundwater quality. Management measures to minimise impacts on these values are contained within this EMP. It is a condition of the environmental authority that if complaints are received in relation to any of these issues, these complaints are investigated and responded to.

Adani has developed a social impact management plan (SIMP) which contains a range of measures to mitigate and monitor social impacts of a project on members of the community. Hence, this EMP only addresses impacts on the community in relation to the environmental values protected under the EP Act.

24.2 Environmental Values and Potential Impacts

Environmental values and potential impacts in relation to the community are set out in this EMP as follows:

- Air quality
- Noise
- Water quality
- Scenic amenity.

24.3 Performance Outcome

Community amenity and beneficial uses of air, noise and water resources are not degraded when compared to requirements set out in the environmental authority.

24.4 Proposed Controls

If complaints or inquiries are received from a member of the community or other external party:

Table 24-1 Community – Pre Construction, Construction and Operation Controls

Control	Responsibility	Timing	Evidence
The complaint or inquiry will be recorded in the Consultation Manager database, including details of the complainant and the nature of the complaint.	Stakeholder Manager	Ongoing	Records and Actions
If an investigation of the complaint is required, this will be undertaken using the incident investigation procedure established under the EMS system.	Stakeholder Manager	Ongoing	Procedure followed as evidenced by incident reports
Any corrective actions identified will be entered into the corrective action register.	Stakeholder Manager	Ongoing	Records and Actions
Any community non-compliances with conditions of the environmental authority will be notified to the administering authority.	Stakeholder Manager	Ongoing	Records and Actions

25. References

Adani Compliance Guidelines

- CG-002 Legal Obligations
- CG-003 Training and Competency
- CG-004 Audits and Assessments
- CG-005 Corrective and Preventative Action
- CG-006 Incident Investigation and Reporting
- CG-008 Documentation and Document Control
- CG-009 Hazard Notification and HSE Improvement
- CG-011 Management Review
- CG-015 Emergency Preparedness and Response
- CD-019 Demolition and Decommissioning
- CG-021 Procurement
- CG-022 Contractor Management
- CG-024 Hazardous Management and Dangerous Goods
- CG-27 Technical Documentation
- CG-036 Work Permits
- CG-128 Management Commitment

Adani Management Standards

- ST-02 Planning Objectives and Legal Obligations
- ST-03 Training and Competency
- ST-04 Documentation, Document Control and Records
- ST-18 Reviews, Audits and Inspection

USEPA, Region 7 Environmental Management System, http://www.epa.gov/region7/ems/index.htm accessed 24/09/2012