Clarence Colliery

Centennial Coal

Mining Operations Plan

2014 - 2017

Table 1. MOP Title Block

Clarence Colliery **Mining Operations Plan**	
Name of Mine	Clarence Colliery
MOP Commencement Date	01 January 2014
MOP Completion Date	31 December 2017
Mining Authorisations (Lease / Licence No.)	ML 1353 ML 1354 ML 1583 CCL705
Name of Authorisation / Authorisation holder(s)	Centennial Coal Pty Ltd
Name of Mine Operator	Centennial Colliery Pty Ltd
Name and Contact Details of the Mine Manager	Gregory Shields 02 6353 8033
Name and Contact Details of Environmental Representative	Jesse Percival 02 6353 8039
Name of Representatives(s) of the Authorisation Holder(s)	Gregory Shields
Title of Representatives(s) of the Authorisation Holder(s)	Mine Manager
Signature of Representatives(s) of the Authorisation Holder(s)	
Date	30/09/2014
Version	FINAL

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1. Introduction

1.1 History of Operations

Clarence Colliery Pty Ltd (Clarence Colliery) is an underground coal mining operation located within the NSW Western Coalfields (**Plan 1A**). Clarence Colliery is a wholly owned subsidiary of Centennial Coal Company Limited (which is a wholly owned subsidiary of Banpu Public Company) and has been appointed as the management entity for the Clarence Joint Venture. Centennial Coal Company Limited has an 85% share in the Clarence Joint Venture comprised of a number of wholly owned subsidiaries including Coalex Pty Ltd (51% share), Clarence Coal Investments Pty Ltd (29% share) and Centennial Clarence Pty Ltd (5% share). The remaining 15% share in the Clarence Joint Venture is held by SK Networks Resources Australia Pty Ltd.

Operations at Clarence Colliery commenced in 1979. Coal is extracted from the Katoomba coal seam using bord and pillar partial extraction methods supplying coal to both domestic and export markets. Clarence Colliery is located approximately 15 kilometres east of Lithgow, to the north of Chifley Road (continuation of the Bells Line of Road) and the Main Western Rail Line. Newnes Junction village is located approximately 900 metres to the south-east of the site and contains a small number of residential dwellings. Clarence Village is also located approximately 1.5 kilometres to the south-west of the site.

A number of extractive industries are also located in close proximity to Clarence Colliery including the Hanson Quarry located immediately to the west and the disused Rocla Quarry located to the south-east of the site respectively. The Newnes Kaolin Project is an approved quarry, which is proposed to be established to the south-east of the site.

Land to the east of the site is protected under the Blue Mountains National Park, one of the eight protected areas making up the World Heritage Listed Greater Blue Mountains Area (UNESCO 2013). The Newnes State Forest is located to the north and west of Clarence Colliery. Clarence Colliery is located within the Hawkesbury-Nepean Catchment and discharges water to the Wollangambe River which eventually drains to the Colo River.

The principal components of the existing operations include:

- An underground coal mine with maximum production levels of three million tonnes per annum (Mtpa).
- Associated pit top area containing surface infrastructure including:

Mine administration and bath house building;

Store and workshop building;

Water treatment plant;

Rail loop and load out facilities;

Conveyor systems to transfer coal from the underground mine to the pit top facilities including the load out on the rail loop;

Run-of-Mine stockpile area;

Ventilation facility;

Washed coal stockpile area;

Coal Handling and Preparation Plant (CHPP);

Four partially rehabilitated existing Reject Emplacement Areas (REA);

Various water management structures include storage and leachate dams and irrigation area which forms part of the water management on site;

Sewage treatment plant; and

A downcast ventilation shaft located on the Newnes Plateau.

Clarence first Mining Operations Plan (MOP) covered the period 2001-2006. Clarence's current MOP 2007-2013 was approved in February 2007. In November 2010 Clarence requested an amendment of the MOP for the development of REA IV and V, update of mine contact details, proposed land preparation and construction and future water management, use of mining equipment and rehabilitation. This MOP will cover the period 2014-2017 following the expiry of the current MOP on December 31, 2013.

1.2 Current Consents, Authorisations and Licences

Clarence Colliery is situated in an environmentally sensitive area of State Significance and is therefore classified as State Significant Development. For the purposes of this MOP, such development is referred to as a Level 1 Mine. The Minister for Planning is the consent authority for State Significant Developments under Part 4 of the

Environmental Planning and Assessment Act 1979 (EP&A Act).

Clarence Colliery currently operates under three separate development consents. An Interim Development Approval was issued in 1976 by Blaxland Shire Council (now Lithgow City Council) for the construction of surface facilities. This consent was then modified in 1993 by Greater Lithgow County Council (now Lithgow City Council) to amend the REAs proposed in the original consent.

Development consent for an extension of underground coal mining and the consequent extension of surface reject disposal areas, water management and ancillary structures within the Clarence Colliery pit top was granted by Greater Lithgow County Council in 1994.

In 2005, Clarence received approval from the Department of Infrastructure, Planning and Natural Resources (now the Department of Planning and Infrastructure) to expand the operations into a new mining lease (ML1583) which consisted of the conversion of a number of tenements into the new mining lease. The development application number for this consent is 'DA 504-00'.

Centennial lodged a development application (DA) with Lithgow City Council in October 2000 for the proposed lease extension of Clarence Colliery. This DA was for the conversion of coal authorisations EL5072, ALA5, ALA8 and ALA307 to mining leases for the purpose of coal extraction using the existing mining system and pit top facilities. The development application (DA 504-00) was approved by the Minister for Planning on the 19th December 2005.

Mining operations at Clarence Colliery currently operate under a number of mining authorisations. The pit top area and underground mining operations occur within Consolidated Coal Lease 705 (CCL705) while underground mining also occurs within Mining Leases 1353, 1354 and 1583.

All licences, consents and approvals held by Clarence Colliery are listed in **Table 3**.

Table 3. Clarence Colliery Licences, Consents and Approvals

Licence/Approval/Consent	Approval/Number	Approval Authority	Date Granted-Expiry/Renewal Date
Development Consents			
Original Development Consent	IRM.GE.76	Blaxland Shire Council	Approved 15/06/1976
Development Consent Modification	IRM.GE.76	Lithgow City Council	Approved 21/07/1993
Development Consent	174/93	Lithgow City Council	Approved 15/02/1994
Development Consent	DA504-00	Department of Planning & Infrastructure	19/12/2005-31/12/2026
Licences			
Environmental Protection Licence	EPL726	Environment Protection Authority	02/07/2013-Renewed Annually 1st of January
Radiation (density gauge) Licence	RR739	Environment Protection Authority	2013-18/05/2015
	RR740	Environment Protection Authority	2013-18/05/2015
	RR1120	Environment Protection Authority	2013-18/05/2015
	RR1121	Environment Protection Authority	2013-18/05/2015

	RR1122	Environment Protection Authority	2013-18/05/2015
Radiation Licence	RL31190	Department of Environment and Heritage	2013-18/05/2014
Dangerous Goods Licence	NDG020999	WorkCover Authoirty NSW	03/04/2013-05/03/2014
Bore Licence	10BL156676	NSW Office of Water	12/05/1995-Perpetuity
Bore Licence	10BL161963	NSW Office of Water	13/08/2003-Perpetutiy
Bore Licence Leachate Transfer	10BL604765	NSW Office of Water	12/12/2012-11/12/2017
Bore Licence CLRP1	10BL161964	NSW Office of Water	13/08/2003-Perpetuity
Bore Licence CLRP2	10BL161965	NSW Office of Water	13/08/2003-Perpetuity
Bore Licence CLRP3	10BL602213	NSW Office of Water	10/12/2007-Perpetuity
Bore Licence CLRP4	10BL161962	NSW Office of Water	30/08/2003-Perpetuity
Bore Licence CLRP5, CLRP7, CLRP10	10BL602211	NSW Office of Water	10/12/2007-Perpetuity
Bore Licence CLRP6	10BL602212	NSW Office of Water	10/12/2007-Perpetuity
Bore Licence CLRP 12	10BL604063	NSW Office of Water	07/07/2010-Prepetuity
Bore Licence CLRP 11, 13, 14	10BL604099	NSW Office of Water	05/07/2010-Perpetuity
Bore Licence CLRP 15, 16	10BL604098	NSW Office of Water	05/07/2010-Perpetuity
Bore Licence CLRP 17, 20	10BL605316	NSW Office of Water	30/01/2013-Perpetuity
Bore Licence CC114	10BL602819	NSW Office of Water	09/03/2009-Perpetuity
Bore Licence CC115	10BL602820	NSW Office of Water	09/03/2009-Perpetuity
Bore Licence HV1, HV2, HVU1, HVU2	10BL603337	NSW Office of Water	07/09/2009-Perpetuity
Bore Licence 79 cut through mine dewatering	10BL165054	NSW Office of Water	22/09/2006-21/09/2011 (application in progress)
Bore Licence 82 cut through mine dewatering	10BL165053	NSW Office of Water	22/09/2006-21/09/2011 (application in progress)
Surface Licence Main Dam	10SL039344	NSW Office of Water	26/01/2008-25/01/2013
Surface Authority Town Water Supply	10SA001409	NSW Office of Water	30/09/2007-30/09/2017
Exploration Licence	EL5072	Department of Primary Industries	08/05/2006-11/11/2010
Authorisations			
Authorisation 307	A307	Department of Primary Industries	05/02/2010-24/08/2014
Authorisation A416	A416	Department of Primary Industries	29/03/2010-24/08/2014
Authorisation A451	A451	Department of Primary Industries	05/02/2010-24/08/2014
Project Approvals			
Reject Emplacement Area II	Section 126	Department of Primary Industries	Approved 19/06/1992

Reject Emplacement Area III	Section 126	Department of Primary Industries	Approved 07/10/1993
Reject Emplacement Area IV	Section 100	Department of Primary Industries	28/03/2011-01/07/2015
Reject Emplacement Area IVa extension	Section 100	Department of Primary Industries	18/09/2013-01/09/2017
Leases			
Consolidated Coal Lease	CCL705	Department of Trade and Investment, Regional Infrastructure and Services	20/12/2006-20/12/2027
Mining Lease	ML1353	Department of Trade and Investment, Regional Infrastructure and Services	21/07/1994-21/07/2015
Mining Lease	1354	Department of Trade and Investment, Regional Infrastructure and Services	21/07/1994-21/07/2015
Mining Lease	1583	Department of Trade and Investment, Regional Infrastructure and Services	09/07/2006-09/07/2027
Mining Operations Plan			
Mining Operations Plan	CCL705, ML1353, ML1354, ML1583	Department of Trade and Investment, Regional Infrastructure and Services	01/01/2007-31/12/2013
Subsidence Management Plans			
Subsidence Management Plan	700 Area	Department of Trade and Investment, Regional Infrastructure and Services	08/05/2009-01/05/2014
Subsidence Management Plan	700 West Area	Department of Trade and Investment, Regional Infrastructure and Services	18/06/12-01/06/2017 or to expiry/cancellation of ML1583
Subsidence Management Plan	Eastern Area	Department of Trade and Investment, Regional Infrastructure and Services	10/2005-01/06/2013 or to expiry of CCL705 or ML1353
Subsidence Management Plan	CCL705 Outbye Areas	Department of Trade and Investment, Regional Infrastructure and Services	08/05/2009-01/05/2014
Subsidence Management Plan	CCL705 Outbye Areas (Panels 302, 305, 306, 307, 400, 403 and 406)	Department of Trade and Investment, Regional Infrastructure and Services	08/05/2009-01/05/2014
Subsidence Management Plan	CCL705 Outbye Areas (Panels 314 & 316)	Department of Trade and Investment, Regional Infrastructure and Services	19/02/2010-01/02/2015 or to expiry/cancellation of CCL705
Subsidence Management Plan	CCL705 Outbye Areas (Panel 402 Only)	Department of Trade and Investment, Regional Infrastructure and Services	27/03/2009-01/01/2010 or to expiry/cancellation of CCL705
Subsidence Management Plan	CCL705 Outbye Areas (Panel 602 Only)	Department of Trade and Investment, Regional Infrastructure and Services	30/01/2009-01/01/2010 or to expiry/cancellation of CCL705
Access Agreement			
Access Agreement	Q648-100	State Rail Authority	10/07/1981-Life of Loop

Occupation Permit			
Occupation Permit	N/A	Forests NSW	Renewed Annually

A number of conditions relevant to the preparation of the MOP under Consolidated Coal Lease 705 (CCL705) and Mining Lease 1583 (ML1583) are presented in **Table 4**.

Table 4. CCL705 and ML1583 Conditions Relating to Preparation of MOP

CCL705 and ML1583 Conditions		Where addressed in this MOP
(4) The (Mining Operations) Plan must present a schedule of proposed mine development for a period of up to seven (7) years and contain diagrams and documentation which identify:	(a) area(s) proposed to be disturbed under the Plan;	**Section 2** Proposed Mining Activities
	(b) mining and rehabilitation method(s) to be used and their sequence;	**Section 5** Rehabilitation Planning and Management
	(c) areas to be used for disposal of tailings/waste;	**Section 2.3.5** Waste Management & **Section 2.3.4** Reject Emplacement
	(d) existing and proposed surface infrastructure;	**Section 2.2** Asset Register & **Section 2.3.2** Construction
	(e) existing flora and fauna on the site;	**Section 3.2.1.7** Flora & **Section 3.2.1.8** Fauna
	(f) progressive rehabilitation schedules;	**Section 7.2** Proposed Rehabilitation Activities during the MOP Term
	(g) areas of particular environmental, ecological and cultural sensitivity and measures to protect these areas;	**Section 3.2.1.7** Flora, **Section 3.2.1.8** Fauna & **Section 3.2.1.9** Other Risks – Heritage (Aboriginal and European)
	(h) water management systems (including erosion and sediment controls);	**Section 3.2.1.9** Other Risks – Surface Water & Ground Water & **Section 3.2.1.5** Erosion and Sediment Control
	(i) proposed resource recovery; and	**Section 2.3.9** Material Production Schedule during MOP Term
	(j) where the mine will cease extraction during the term of the Plan, a closure plan including final rehabilitation objectives/methods and post mining landuse/vegetation.	**Section 4** Post Mining Land Use

1.3 Land Ownership and Land Use

The majority of the surface area at Clarence falls within Newnes State Forest. Clarence Coal Pty Ltd owns a small amount of freehold land approximately 5.5 ha in area (Lot 1, D.P. 108485) (**Plan 1C**).

1.4 Stakeholder Consultation

Stakeholder consultation with government agencies, community groups and landholders in association to the development of the MOP has been consistent and open through consultation, public meetings, newsletters and Centennial Coal's website.

A Stakeholder Engagement Plan (SEP) has been developed for the MOP and incorporates where relevant, the identification and mitigation of stakeholder concerns regarding operations and the decommissioning and rehabilitation of areas disturbed as part of the MOP. Where practicable, progressive decommissioning and rehabilitation will be undertaken in consultation with the appropriate landholders impacted by the specific activities. Infrastructure and disturbance areas to be decommissioned and rehabilitated at the cessation of operations may require additional consultation. This consultation will be included in the detailed decommissioning and closure planning process. The consultation process may include:

- Identification of all stakeholders and preparation of a stakeholder engagement strategy;

- Discussion regarding the opportunities for the re-use of infrastructure constructed for the mine site;
- Detailed discussion on the final land-use for disturbance areas; and
- Identification of any other issues, key risks and information needs regarding decommissioning and rehabilitation of the mine site.

Centennial places the utmost importance on maintaining effective communication with the local communities and other stakeholders in which it operates. A stakeholder database has been developed for the site. Centennial will maintain this database throughout the mine life including during closure. A summary of key stakeholders are identified in **Table 5** and consultation between these groups and Centennial will be maintained through the website, Community Consultative Committee (CCC), public meetings and newsletters. Detailed closure planning will be integrated into the stakeholder engagement process as the mine approaches closure.

Consultation undertaken by Centennial for the development of this MOP is listed below.

Department of Trade and Investment, Regional Infrastructure and Services

Preparation of the MOP was discussed at 2011 and 2012 AEMR review meetings held on the 9/5/2102 and 28/08/2013.

After submission of the draft MOP in November 2013, a review meeting was held with representatives from DTIRIS in February 2014. Comments received during consultation are included in Appendix 7.

Forestry Corporation NSW

Clarence Colliery has formal arrangements with the Forestry Corporation NSW in the form of an Occupation Permit (OP). The OP sets out access arrangement to subsidence lines and groundwater monitoring locations on the Newnes Plateau. In addition the OP details rehabilitation and relinquishment requirements for infrastructure including exploration boreholes.

FNSW are also consulted during the Subsidence Management Plan (SMP) Application Process and provided with the Annual Environmental Management Report (AEMR).

Clarence Community Consultative Committee

The community consultation process has been formalised through the establishment of Clarence CCC in 2006. Committee meeting minutes are available online at the Centennial Coal website (www.centennialcoal.com.au).

The Clarence CCC met 4 times during 2013. Information presented in the meetings include operational, environmental and community performance updates.

Specific items discussed during committee meetings in 2013 include:

- The Subsidence Management Plan Development for 900 Area;
- The proposed modification to DA-504.00 for the construction of a new proposed Reject Emplacement Area;
- Rehabilitation Activities;
- Water Management Activities and Improvements;
- 800 Area Exploration Program;
- Community Activities; and
- Environmental incidents/complaints.

Table 5. Key Stakeholders

Government Agencies	Community Groups	Landholders
Lithgow City Council	Community Consultative Committee	Hanson Quarry (neighbouring)
Department of Trade and Investment, Regional Infrastructure and Services (DTIRIS)	Lithgow community	Kaolin Sands
NSW Department of Planning and Infrastructure	Local Aboriginal Groups	Clarence residents
Office Environment and Heritage	Blue Mountains Conservation Groups	Dargan residents
NSW Office of Water		Bell residents
Forestry Corporation NSW		Newnes Junction residents
Commonwealth Government (lessor)		Zig Zag Railway
Environment Protection Authority		Owner of the rail loop (Railcorp own corridor CEY the physical track, ballast, sleepers, etc.)
		Endeavour Energy

2. Proposed Mining Activities

2.1 Project Description

Operations at Clarence Colliery commenced in 1979 supplying coal to both domestic and export markets. Coal is extracted from the Katoomba seam using bord and pillar partial extraction methods with reserves for approximately 20-30 years of operations at existing extraction rates. As per Development Consent DA504-00, Clarence has approval to extract up to three Mpta of Run of Mine (ROM) coal currently producing approximately 2-2.5 Mtpa. The mining project has approval to operate for 21 years with the consent to lapse on 31 December 2026. The expected mine life of the project is anticipated to close in 20-25 years.

The principal components of existing pit top area surface structure includes:

- Mine administration and bath house building;
- Store and workshop building;
- Water treatment plant;
- Rail loop and load out facilities;
- Conveyor systems to transfer coal from the underground mine to the pit top facilities including the load out on the rail loop;
- Run-of-Mine stockpile area;
- Ventilation facility;
- Washed coal stockpile area;
- Coal Handling and Preparation Plant (CHPP);
- Four existing REAs;
- Various water management structures including storage and leachate dams and an irrigation area forming part of the water management on site;
- Sewage treatment plant; and
- A downcast ventilation shaft located on the Newnes Plateau.

Partial extraction mining activities are approved within the 800 Area (within ML1583 and CCL705) and 900 Area (within ML1583, ML1353 and CCL705). Two development consents exist over the 800 Area including DA504-00 and IRM.GE.76 and three over 900 Area including DA504-00, IRM.GE.76 and 174/93. Extraction within the 800 and 900 Area is scheduled to commence during the first quarter of 2014, **Table 6** presents the approximate year that each panel is scheduled to be extracted. This schedule is subject to change depending on equipment availability, conditions in other extraction panels and development rates within panels.
Activities over the MOP term are discussed in **Section 2.3**.

Table 6. Approximate Extraction Schedule

Year Extracted	Panel Number 800 Area	Panel Number 900 Area
2014	810	903a, 902, 904
2015	812	903, 903a
2016	814, 804	203, 910
2017	816, 804	902, 910
2018	818, 806	908
2019	818, 806	908
2017	820, 822, 808	906
2021	822, 808	906, 911, 982
2022		913, 915, 917
2023		917, 918, 921

2.2 Asset Register

In order to effectively address the complexity of various rehabilitation and closure treatments at Clarence Colliery, four management 'domains' have been identified (**Table 7**). This has enabled preliminary land use options to be assigned to appropriate areas of land which has enabled a greater focus on management of similar areas.
A combination of site location, type of land disturbance (if any) and specific environmental issues are typically addressed within each individual domain. This systematic approach has the added benefit of enabling Centennial to identify and implement effective mine closure on a progressive basis. This will result in the following key benefits both during and at the end of mining operations:

- Continually reducing liabilities by optimising rehabilitation works;
- Providing for a more accurate assessment of accrual for rehabilitation liability;
- Testing rehabilitation design and making adjustment to meet closure criteria;
- Enabling a tighter control on actual costs to undertake various rehabilitation treatments and enable improvement in budget allocation; and
- Identifying areas of high environmental risk.

Table 7. Domains Identified within this MOP

Domain	Size (m^2)
1: Coal Handling and Preparation Plant, Rail Loop and Overland Conveyors	396,418
2: Clarence Administration, Workshops and Pit Top Area	68,668
3: Reject Emplacement Area	123,335
4: Surrounding Areas	75,413

2.2.1 Domain 1: Coal Handling and Preparation Plant, Rail Loop and Overland Conveyors

Major assets:

- Site services;
- Buildings and fixed plant (including the CHPP, conveyors, drive station, transfer points, rejects bins, thickener tanks, dump hoppers and pit top storage);
- Mine entries (man and materials + coal conveyor);
- Refuelling Station;
- Water holdings – polishing lagoon, mine water treatment plant, main dam, primary arrestor and sewerage treatment;
- ROM and washed stockpile areas;
- Train loading facility and rail loop;
- Ventilation Facility and Downcast Shaft
- Switchyard; and
- High tension switch building.

The following sections outline the decommissioning, demolition and rehabilitation process for some of the key features within the Domain.

2.2.1.1 Site Services

All services including power, water and telephone for the entire domain will be disconnected and terminated to make them safe. The inspection pits and junction boxes for underground services will be sealed. Generally all underground services will be made safe and left buried in the ground where they are deeper the 1.5m. All services less than 1.5m will be recovered and removed. Overhead power lines will be removed and the materials (i.e. poles and wire) recovered for potential re-sale or recycling as applicable. Switch room buildings will be disconnected and demolished.

Where also practicable pipelines and cables with a diameter of approximately 200 mm or less will be capped and remain in-situ where they are located greater than 0.5 m below ground level. This is due to the risk of disturbing the re-established vegetation by excavation and removal. The cathodic protection systems (where fitted) will also be disconnected.

Pipelines with a diameter greater than 200 mm will be removed or filled with an inert material to avoid the potential for subsidence when the pipe deteriorates and collapses. When assessing the preferred decommissioning methodology, consideration will be given to the environmental significance of the area that the pipeline is to be removed from.

The location of pipelines that are to remain in-situ will be recorded in an abandoned services register and signs will be erected where appropriate.

Pipelines located in critical locations, for example infrastructure crossings of environmentally sensitive areas and/or riparian zones, will be filled with inert a material (such as concrete) to avoid additional disturbance of the environment.

All transformers will be tested for PCBs and verified as not contaminated prior to being removed from the site. All services relating to the Colliery will be removed back to the junction of Bells line of Road. Where services are shared with either the neighbouring quarry or the nearby residential houses they will be surveyed and left in situ.

2.2.1.2 Buildings and Fixed Plant

Prior to any demolition works an assets register will be completed. Any assets that can be transferred to another Centennial operation will be, or where appropriate sold, scrapped, recycled or disposed of.

Once completed all sumps will be de-watered and de-silted prior to the commencement of demolition. In addition, all items of equipment will be de-oiled, degassed, depressurised and isolated and all hazardous materials removed from the mine area. All recoverable scrap steel will be sold and/or recycled. Prior to disposal, all wastes will be assessed and classified in accordance with the relevant regulatory requirements.

All buildings within the Domain (including the CHPP) will be demolished and removed from the site. Overhead gantries and conveyors will be dismantled into manageable lengths and lower to the ground prior to being cut up as scrap steel. Prior to dismantling the conveyor will be rolled off and all gearboxes, etc containing oil will be drained. However, should the final land use option require any of the present infrastructures, specific buildings may remain at the site.

Any materials not recycled or re-sold will be disposed of in a suitable location either on-site or off-site at a licenced waste management facility. Opportunities, for the sale and/or re-use of assets and recycling of scrap steel will be maximised where possible. Material assessed as “not hazardous or contaminated” by a suitably qualified person will be crushed and disposed of in a suitable location, with preference given to on-site disposal in shafts or portals or taken off-site to an approved waste management facility.

Concrete footings and pads will be broken up to at least 0.5 m below the surface and

removed. Options for the re-use of this material (for example crushed and used as for road and track stabilisation) will be investigated as the mine approaches closure. If re-use or recycling opportunities are not available or viable, all "non-contaminated" waste material will be disposed of in a suitable location on-site or off-site at approved waste management facility.

Once the structure and the associated concrete slabs are removed, all areas would then be reshaped, deep ripped, topsoiled and seeded in accordance with requirements outlined below. The sewerage system will be removed from site, along with the potable water tanks.

The helipad will be removed by deep ripping the area to at least 400 mm in two directions. The area will be reshaped and contoured with the final landform. Where suitable quantities of topsoil material is not available at the site, the use of other organics such as bio-solids and/or compost will be assessed as an appropriate addition to enable the establishment of an appropriate vegetation cover.

2.2.1.3 Conveyors and Transfer Stations

All conveyors will be dismantled, removed from site and recycled at an appropriate facility). Opportunities for the sale and/or re-use of assets and recycling of materials will be maximised to the extent practicable. Over-head conveyors will be dismantled and lowered to the ground before being cut up. On ground conveyors will be cut up in situ. Underground conveyor systems will be left in the mine when it is sealed (where it is not required for another operation). All gearboxes and other vessels will be drained of oil and depressurised prior to sealing on the mine.

The carbonaceous material below and in the vicinity of the surface conveyors will be stripped to a depth of at least 0.5 m (or where it is totally recovered). Where possible the material will be considered for reprocessing, If this is not possible, it will be pushed up and stockpiled to be used to backfill the portal or shafts.

2.2.1.4 Clarence Mine Entries and Coal Delivery Systems

All services associated with the mine entries at the Clarence will be disconnected and made safe. As a minimum, the first 50 m of the conveyor and services from the surface will be dismantled, removed from site and recycled at an appropriate facility. Opportunities for the sale and/or re-use of assets and recycling of materials will be maximised to the extent practicable.

The decline tunnel will be backfilled for a minimum distance of 50 m (or to a depth of cover of no less than 15 m) from the surface against an engineered concrete bulk head. Construction of the engineered bulkhead will be undertaken by component personnel under the supervision of a suitably qualified engineer. Inert material such as concrete and carbonaceous material from around the site will be backfilled against the bulk head equal to the natural surface. Sealing of the decline tunnel will be undertaken in accordance with relevant regulator guidelines and approved by the Department. The location will be recorded on an abandoned services register, which will be retained on-site records and mine tracings.

Appropriate drainage infrastructure will be constructed to prevent erosion and to ensure runoff does not enter the mine or cause groundwater contamination. The final landform will be commensurate with the surrounding land and appropriate water management structures will be installed where required to ensure its integrity.

2.2.1.5 Water Management Infrastructure, Polishing Lagoon and the Water Treatment Plant

Water Management infrastructure will remain in situ operational until rehabilitation goals are achieved and discharge water achieves the appropriate standard dictated by Clarence's Environmental Protection Licence. Sediment traps and catchment dams will be maintained as required.

2.2.1.6 ROM and Washed Stockpile Areas

All reclaim tunnels under the stockpile areas will be dug out and recovered. The carbonaceous material on the base of the ROM and product stockpile areas will be stripped to a depth of 1m and disposed of in an available REA or placed against the cutting at the rear of the stockpile areas to create a gentle slope (at less than 10 degrees) that grades down from the rail load out bins across the current stockpile areas and joining the natural landform below the current Water Treatment Plant. This will effectively reinstate the pre-mining landform and also provide a reasonable amount of space to emplace rejects and the carbonaceous material from the bass of the stockpiles which will be compacted. The material used in this landform will be assessed for spontaneous combustion potential as well as the potential to generate leachate. A suitably designed cover will be used as required. Following this, the ROM batter will be reshaped to a slope of ten degrees. In addition, the area will be deep

ripped prior to being sown with native tree species in order to establish a native woodland ecosystem.

2.2.1.7 Train Loading Facility and Rail Loop

Options will be identified prior to mine closure for the potential ongoing use of the Clarence Colliery rail loop and rail loading facilities. Such potential uses include utilising the rail infrastructure for the surrounding sand mining operations.

If the rail loop and rail loading infrastructure is no longer required it will be removed. The track will be recycled and the ballast material preferentially stripped so that it can be reused for another application on site.

2.2.1.8 Bitumen Roads, Car Parks and Hardstand Areas

Access roads and tracks that are not required along with car parks and hardstand areas will be scalped to approximately 0.3 m below the surface to remove stabilised and compacted material. Material assessed as "not hazardous or contaminated" by a suitably qualified person will be crushed up and disposed of in a suitable location, with preference given to on-site disposal, for example in shafts or portal. During detailed closure planning consideration will be given to using a temporary crashing plant to crush concrete to produce a secondary product for re-sale.

Minor reshaping work will be undertaken to ensure surface level consistency with the surrounding areas. Any creek crossings, including culverts, etc., will be removed and the pre-existing drainage line re-instated.

2.2.1.9 High Tension Switch Building

The switch room building will be disconnected and demolished. The substations will be removed from the site and either used on another project or sold as a going concern.

2.2.1.10 General Rehabilitation Treatment

The entire CHPP area will be trimmed to facilitate the appropriate drainage of surface runoff from the site, rock raked to remove all surface rocks to a size of less than 500 mm and ripped on the contour to a depth of at least 1 m. Appropriate surface water management structures (contour banks, drains and settlement ponds) will also be appropriately designed and constructed. As indicated above, the site is generally a topsoil deficit site and where suitable quantities of topsoil material is not available at the site, the use of other organics such as bio-solids and/or compost will be assessed as an appropriate addition to enable the establishment of an appropriate vegetation cover.

The areas of established rehabilitation within Domain 1 at closure will require ongoing maintenance. In the context of this Conceptual Rehabilitation and Mine Closure Plan, maintenance constitutes two applications of fertiliser and weed management activities over a five year period, although this may vary depending on the extent of weed infestation.

2.2.2 Domain 2: Clarence Administration, Workshops and Pit Top Area

Major assets:

- Site services;
- Buildings and Infrastructure;
- Workshops and stores;
- General Sheds;
- Grit traps;
- Sewerage Treatment Plant and effluent irrigation area; and
- Access roads, car parks (x 2) and hard stand areas.

The following sections outline the decommissioning, demolition and rehabilitation process for some of the key features within the Domain.

2.2.2.1 Site Services

Similarly to Domain 1 above, all services including power, water and telephone for the entire domain will be disconnected and terminated to make them safe. The inspection pits and junction boxes for underground services will be sealed. Generally all underground services will be made safe and left buried in the ground where they are deeper the 1.5m. All services less than 1.5m will be recovered and removed. Overhead power lines will be removed and the materials (i.e. poles and wire) recovered for potential re-sale or recycling as applicable. Switch room building will be disconnected and demolished.

Where also practicable pipelines and cables with a diameter of approximately 200 mm or less will be capped and remain in-situ where they are located greater than 0.5 m below ground level. This is due to the risk of disturbing the re-established vegetation by excavation and removal. The cathodic protection systems (where fitted) will also be disconnected.

Pipelines with a diameter greater than 200 mm will be removed or filled with an inert material to avoid the potential for subsidence when the pipe deteriorates and collapses. When assessing the preferred decommissioning methodology, consideration will be given to the

environmental significance of the area that the pipeline is to be removed from.
The location of pipelines that are to remain in-situ will be recorded in an abandoned services register and signs will be erected where appropriate.
Pipelines located in critical locations, for example infrastructure crossings of environmentally sensitive areas and/or riparian zones, will be filled with inert a material (such as concrete) to avoid additional disturbance of the environment.
All transformers will be tested for PCBs and verified as not contaminated prior to being removed from the site. All services relating to the Colliery will be removed back to the junction of Bells line of Road. Where services are shared with either the neighbouring quarry or the nearby residential houses they will be surveyed and left in situ.

2.2.2.2 Buildings and Infrastructure

Prior to any demolition works an assets register will be completed. Once this is completed, all buildings, including the administration building, workshop, stores, bathhouses, training rooms and crib rooms will be demolished and they material from the structures removed from site. A hazardous materials assessment will be undertaken prior to the commencement of any demolition works and where appropriate additional controls will be put in place. During the demolition, any materials not recycled or re-sold will be disposed of in a suitable location either on-site or off-site at a licenced waste management facility. Opportunities, for the sale and/or re-use of assets and recycling of scrap steel will be maximised where possible. Material assessed as “not hazardous or contaminated” by a suitably qualified person will be crushed and disposed of in a suitable location, with preference given to on-site disposal in shafts or portals or taken off-site to an approved waste management facility.
Concrete footings and pads will be broken up to at least 0.5 m below the surface and removed. Options for the re-use of this material (for example crushed and used as for road and track stabilisation) will be investigated as the mine approaches closure. If re-use or recycling opportunities are not available or viable, all “non-contaminated” waste material will be disposed of in a suitable location on-site or off-site at approved waste management facility.
Once the structure and the associated concrete slabs are removed, all areas would then be reshaped, deep ripped, topsoiled and seeded in accordance with requirements outlined below.

2.2.2.3 Sheds and Grit Traps

All sumps will be de-watered and the excess coal removed prior to the commencement of demolition. In addition all items of equipment will be de-oiled, de-gassed, de-pressurised and isolated and all hazardous materials removed from the site.
At closure, a preliminary Hydrocarbon Contamination Assessment (Phase 1) will be implemented to determine whether an assessment (Phase 2 – detailed investigation of contamination involving drilling, etc) should be conducted. If any contaminated soil is identified at that time, it would be remediated and treated in accordance with NSW State Government requirements.

2.2.2.4 Land Assessment

All carbonaceous material in the domain will be stripped to a maximum depth of 1 m and buried as part of rehabilitation in Clarence REAs.
A Phase 1,2 and 3 contamination assessment approach will be carried out as required to identify hydrocarbon (and other) contamination in the areas surrounding the fuel storage and transfer facilities around both the Workshop and Station area. At closure, further sampling and analysis may be required to determine whether additional Phase assessments should be conducted and the fuel farm will be removed. Hydrocarbon impacted areas will be remediated and validated. Any contaminated material will be either removed from site or treated on site using appropriate technology which may include on-site bioremediation or some other technology.

2.2.2.5 Bitumen Roads, Car Parks and Hardstand Areas

Access roads and tracks that are not required post closure of the site, along with car parks and hardstand areas will be scalped to approximately 0.3 m below the surface to remove stabilised and compacted material. Material assessed as “not hazardous or contaminated” by a suitably qualified person will be crushed up and disposed of in a suitable location, with preference given to on-site disposal, for example in shafts or portals or taken off-site to an approved waste management facility. During detailed closure planning consideration will be given to using a temporary crashing plant to crush concrete to produce a secondary product for re-sale. Minor reshaping work will be undertaken to ensure surface level consistency with the surrounding

areas. Any creek crossings, including culverts, etc., will be removed and the pre-existing drainage line re-instated.

2.2.2.6 Sewerage Treatment Plant and Effluent Irrigation Area

The sheds and associated infrastructure associated with the Sewerage treatment ponds will be demolished and the structures removed from site. This will include all buried and overland pipelines. A hazardous materials assessment will be undertaken prior to the commencement of any demolition works and where appropriate additional controls will be put in place. During the demolition, any materials not recycled or re-sold will be disposed of in a suitable location either on-site or off-site at a licenced waste management facility. Opportunities, for the sale and/or reuse of assets and recycling of scrap steel will be maximised where possible. Material assessed as "not hazardous or contaminated" by a suitably qualified person will be crushed and disposed of in a suitable location, with preference given to on-site disposal in shafts or portals or taken off-site to an approved waste management facility.

The effluent from the ponds will be irrigated until such time as the ponds are dry. At this point the embankments around the ponds will be pushed back into the ponds to fill them to approximately the same level as the surrounding land. Should additional material be required it will be taken from areas on the site.

The sprinklers and pipes associated with the irrigation area will be removed and the irrigation seeded to allow it to return to natural bushland.

2.2.2.7 General Rehabilitation Treatment

The entire disturbed area of Domain 2 area will be trimmed to facilitate the appropriate drainage of surface runoff from the site, rock raked to remove all surface rocks to a size of less than 500 mm and ripped on the contour to a depth of at least 1 m. Appropriate surface water management structures (contour banks, drains and settlement ponds) will also be appropriately designed and constructed. As indicated above, the site is generally a topsoil deficit site and where suitable quantities of topsoil material is not available at the site, the use of other organics such as bio solids and/or compost will be assessed as an appropriate addition to enable the establishment of an appropriate vegetation cover.

The areas of established rehabilitation within Domain 2 at closure will require ongoing maintenance. In the context of this Conceptual Rehabilitation and Mine Closure Plan, maintenance constitutes two applications of fertiliser and weed management activities over a five year period, although this may vary depending on the extent of weed infestation.

2.2.3 Domain 3: Reject Emplacement Areas

Major assets:

- The Reject Emplacement Areas I, II, III and IV;
- Catch drains and pipelines;
- Leachate dams;
- Roads and tracks; and
- Areas previously rehabilitated.

The following sections outline the decommissioning, demolition and rehabilitation process for some of the key features within the Domain.

2.2.3.1 Reject Emplacement Areas (REA)

Reject Emplacement Areas I and II are currently rehabilitated and undergoing monitoring and maintenance. REA III requires reshaping and rehabilitation and REA IV is now actively being used. Progressive rehabilitation is occurring on REA IV at the completion on each 8m lift. The proposed REA VI will be located adjacent to the ROM stockpile and provide capacity for approximately 500,000 tonnes of reject emplacement. Further assessment is required for life of mine (LOM) disposal options beyond REA VI.

As additional areas are approved, these will be included into the rehabilitation and mine closure planning strategy for the site and updated in the MOP. REAs I and II will all require stabilisation treatment and ongoing maintenance which may include the removal of rills and pipes that may present long term stability issues around the walls of the emplacement.

All reject emplacement areas will be reshaped to a maximum of 18 degrees. Where available, the areas will be covered with a clay-based material to provide a basic cap (0.5-0.8m) and a substrate in which vegetation can be established The focus of the cap will be to minimise water ingress into the REA which currently expresses itself as a leachate at the toe of the REA. Water management structures such as banks and drains will most likely be required to facilitate the delivery of water safely off the landform to avoid any erosion which may comprise the cap. As indicated above, the site is generally a topsoil deficit site and where suitable quantities of topsoil material is not available at the site, the use of other organics such as bio-solids and/or

compost will be assessed as an appropriate addition to enable the establishment of an appropriate vegetation cover.

2.2.3.2 Leachate Capture and Sediment Dams

During detailed closure investigation into the long term impacts and management of that leachate will be completed. This may include the continued use of drains to divert the leachate or it may require the consideration or a more engineered solution to be employed. Notwithstanding the above, the existing catch drains at the toe of the REAs will remain in place to divert all water back into the underground until it is determined that either no leachate is expressing itself, or the quality of the leachate is suitable for discharge directly into the environment.

2.2.3.3 Roads and Tracks

Roadways and/or tracks may be required to remain to provide on-going access to monitor rehabilitation. Alternatively, roads and/or tracks may remain on-site if agreed in writing by the land-owner (Commonwealth).

Where they are required to be rehabilitated, minor reshaping work will be undertaken to ensure surface level consistency with the surrounding areas. Any creek crossings (i.e. culverts, etc.) will be removed and the pre-existing drainage line re-instated.

2.2.3.4 Existing Revegetated Areas

There are approximately 11 hectares of established rehabilitation within the REA area at closure the only activity required for the successful management of these areas is ongoing maintenance. In the context of this MOP, maintenance constitutes two applications of fertiliser and weed management requirements over a five year period, although this may vary depending on the extent of weed infestation. The cost of any minor remedial earthworks or soil conservation works that may be required are included as part of the contingency in the mine rehabilitation liability assessment.

2.2.4 Domain 4: Surrounding Areas

Major assets:

- Formed Roads and Access Tracks;
- Main dam;
- Ballast Boreholes and related water management infrastructure;
- Upcast shaft buildings;
- Old Water tanks; and
- Subsidence Management Areas (on the Newnes Plateau).

The following sections outline the decommissioning, demolition and rehabilitation process for some of the key features within the Domain.

2.2.4.1 Main Dam and Onsite Water Catchments

During the preparation of the detailed rehabilitation and Closure Plan a full engineering assessment of the dam wall and associated infrastructure will be undertaken. Any upgrades or remedial works will be completed prior to any ownership transfer to an appropriate agency to allow the dam to remain for community access.

Lithgow City Council (LCC) have a water transfer scheme which supplements the Lithgow water supply from the Clarence Colliery Main Dam. Further consultation will be undertaken closer to mine closure to determine the ongoing requirement for this scheme.

The current water storage ponds, settlement ponds and diversion banks in the pit-top area will be retained to provide erosion and sediment control during closure, and to maximise the availability of water for any future use of the site post closure. Miscellaneous dams around the site will be removed and reshaped to be consistent with the surrounding landform where they cannot be used in the final landform for the retention of clean water for use by native animals and stock. Minor earthworks upgrades and repairs will be conducted on these areas as required.

2.2.4.2 Main Ventilation Shafts and Service Bore Holes

Decommissioning and rehabilitating of up-cast fans shall be undertaken with general safely precautions and relevant approvals requiring final sign off/approval will be obtained from the regulator. The appropriate guidelines and standards will be followed to ensure that they meet that standard of the day.

Sealing of shafts associated with vent fans is required to ensure that surface runoff does not enter the mine and potentially contaminate groundwater. It is also to make safe the shaft and seal it from allowing fugitive gas emissions from the mine. For this task the key closure activities will include the removal of equipment (fans, pumps, housing, electrical services, etc.) as well as backfill the shaft, ensuring appropriate compaction to minimise subsidence. This may require the construction of a bulk head within the mine workings where it is accessible. All shaft openings will be sealed using an appropriately designed and engineered plug reinforcement that complies

with relevant construction standards. Finally a fence will be erected, including appropriate signage to prevent the access of loads such as heavy vehicular traffic bearing weight on the shaft plug/seal and potentially damaging the plug/seal or falling into the shaft.

2.2.4.3 Roads and Tracks

Roadways and/or tracks may be required to remain to provide on-going access to monitor rehabilitation. Alternatively, roads and/or tracks may remain on-site if agreed in writing by the land-owner (Commonwealth).

Where they are required to be rehabilitated, minor reshaping work will be undertaken to ensure surface level consistency with the surrounding areas. Any creek crossings (i.e. culverts, etc.) will be removed and the pre-existing drainage line re-instated.

2.2.4.4 Water Tanks

The three storage tanks are located adjacent to the rail loop. They potentially represent examples of early European heritage and it is understood that they have some heritage value that would need to be assessed during the detailed closure planning process These tanks also form part of the LCC water transfer scheme. Further consultation will be undertaken taken closer to mine closure to determine the ongoing requirements for the storage tanks. If they are assessed as not being significant they will be demolished and removed from the site. If they are considered heritage a plan of management will be prepared to ensure they are protected beyond mine closure.

2.2.4.5 Subsidence Management Areas

The primary objective pertaining to surface subsidence is to ensure that subsidence is limited to a value well within that considered to be characteristic of 'elastic' overburden behaviour (i.e. no caving to surface) which is defined as 100±25 mm. The partial extraction mining method adopted by Clarence Colliery results in a maximum predicted subsidence of 100 mm with low tilts and strains, virtually immeasurable valley closure, minimal (if any) subsidence and no surface cracking. Rehabilitation will be undertaken if any surface subsidence occurs.

A Trigger Action Response Plan (TARP) is developed for each Subsidence Management Plan (SMP) Application Area. An SMP must be prepared in accordance with Schedule 3 of DA504-00 for any mining activity which potentially may lead to subsidence. The TARP establishes trigger levels which are used to monitor against predictions made within the SMP. The TARP also provides strategic management responses to monitoring results with a focus on response to results that exceed predictions or cause actual or potential impacts and consequences.

2.2.4.6 Exploration and Groundwater Monitoring Wells

Exploration and groundwater monitoring wells and subsidence lines will be decommissioned in accordance with relevant regulatory requirements. The aim of well decommissioning is to prevent the leakage of gas and water. The outcomes for the decommissioning of the wells include:

- Isolation of zones of different pressure;
- Isolation of groundwater aquifers from each other;
- Plugging the top of the casing with a surface cement plug; and
- Removal of the well head.

Any disturbance associated with historical drill pads, sumps or access roads to drill sites will be reshaped as required and revegetated to be consistent with the surrounding vegetation.

2.3 Activities over the MOP Term

2.3.1 Exploration

Clarence Colliery intends to undertake an Exploration Program within the 900 Area during 2014. Planning for this program is still in the formative stages but it is envisaged the Program will consist of a minimum of three partly cored HQ sized boreholes. It is likely these holes will be located within ML1583, CCL705 and ML1353. This program will enable confirmation of future panel layout and confirm seam thickness, quality and structural trends. Groundwater monitoring equipment will also be installed in some of these boreholes. Planned exploration activities will be included in Annual Environmental Management Reports (AEMR) for each reporting period. Consultation will be undertaken prior to the commencement of specific exploration activities and all necessary approvals will be obtained.

Rehabilitation of exploration boreholes is undertaken in accordance with the Borehole Construction Environmental Management Plan (CEMP). This involves filling in drilling sumps, respreading topsoil and any cleared timber to stabilise the site. Sites are monitored until the landholder (Forest Corporation NSW) is satisfied and sites are removed from Clarence Occupation Permit (OP).

2.3.2 Construction

REA VI will be constructed during the MOP Period pending approval by the Department of Planning and Infrastructure (DoPI) and the Section 100 Approval by the Department of Trade, Industry, Regional Infrastructure and Services (DTIRIS).

Key infrastructure is described in **Section 2.2**.

2.3.3 Mining Operations (including mining purposes)

The mining system is the partial-pillar extraction system which has been in place for the last twelve years carried out within the following mining leases (ML) ML 1583 and ML 1353 and consolidated coal lease (CCL) CCL705. This system has been designed such that remnant pillars that remain within and between panels are long-term stable. Subsidence analysis results have proven this method of extraction results in extremely low levels of subsidence. Unlike full extraction mining, partial extraction minimises subsidence through leaving a proportion of the resource in situ. This provides support to the overlying strata, minimising the breakage and falling of the overburden and maintaining the integrity of the aquifers above. Within future mining areas maximum vertical long-term subsidence is predicted to not exceed 100 mm (but may typically range from 40 - 50 mm), and is considered to be negligible. Modelling based on these results provides great confidence that further mining in the Clarence Lease Areas using the partial pillar extraction method will have negligible impacts.

As shown in **Plan 3** mining activities at Clarence will take place during this MOP period in the eastern section of CCL705 and in both the east and western parts of ML1583 in 800 and 900 Area.

The mining system at Clarence is inherently flexible and progress within mining areas is largely driven by machinery availability. To this end, mine sequencing is subject to change. Panel layouts, dimensions and sequencing is managed through the SMP process and the Clause 88 (Coal Mine Health and Safety Regulation) process.

2.3.4 Reject Emplacement

Reject material not suitable for sale is stored in one of four REAs which cover an area of approximately 15 hectares as shown on **Plan 2** Mine Domains. REA I and REA II have reached capacity and are no longer in use and are currently in the rehabilitation phase. REA II also includes a stockpile area incorporating material stripped during the construction of REA IV, which will be subsequently used for rehabilitation following the completion of the REA.

REA III requires reshaping and rehabilitation. It currently receives fine material from sediment traps on site. It is anticipated REA II will be reshaped and rehabilitated during the MOP period.

REA IV commenced operation in July 2011 and is anticipated to reach capacity by mid 2014. REA IV is located adjacent to the access road and rail loop to the south-east of the stockpile areas. Material is transported to the REA with the use of dump trucks. Progressive rehabilitation is occurring on REA IV at the completion of each 8m lift.

The proposed REA VI located adjacent to the ROM stockpile will provide capacity for approximately 500,000 tonnes of material at a maximum production rate of 250,000 tonnes per annum (tpa).

Further life of mine (LOM) reject emplacement options are currently being pursued to provide reject emplacement capacity once the proposed REA VI reaches capacity.

2.3.5 Waste Management

Waste is managed in accordance with Clarence Waste Management Plan. Waste management practices are based on the Waste Management Hierarchy whereby waste is minimised in the first instance, reused/recycled in the second instance and disposed of as a last resort.

Waste is segregated into the following different streams for management and recycling and/or disposal:

- General Waste;
- Paper and Cardboard Recycling;
- Scrap metal;
- Packaged Oily Waste;
- Liquid Oily Waste;
- Diesel Particulate Filters; and
- Other special hazardous wastes

Clarence reviewed its Waste Management Plan in 2012 and updated the plan to include waste performance targets. Clarence has set the following targets to ensure continual improvement in site waste minimisation and management:

- 5% reduction in total waste volumes on a comparative year basis. Total waste volumes will be calculated on a kg of waste per ROM tonne produced.
- 10% improvement in recycling rates on a comparative year basis. Recycling rates will be calculated as a percentage of total waste material.

Waste targets will be reviewed and modified as required to assist in improving waste minimisation and management procedures.

2.3.6 Decommissioning and Demolition Activities

During the MOP period it is anticipated that REA III, REA IV and proposed REA VI will be progressively decommissioned and rehabilitated.

2.3.7 Progressive Rehabilitation and Completion

Rehabilitation will be progressively undertaken on areas that cease to be used for mining or mine-related activities as soon as reasonably practicable. This will reduce the amount of disturbed land at any one time and minimise the amount of contact water to be managed on site. REAs will be progressively rehabilitated during the MOP period. Where possible, topsoil and subsoil will be stripped for the development of REAs and directly applied to rehabilitation areas in accordance with best practices. Results of progressive rehabilitation will be used to refine rehabilitation methods for future application such as the selection of appropriate drainage measures and plant species for reestablishment.

2.3.8 Coal Handling and Processing

Coal from the underground operations is brought to the surface via the main ROM conveyor which is located to the south of the administration building. Coal is then run through a rotary breaker and crusher to reduce the size of the coal to 50 millimetres or less where it is conveyed to the ROM stockpile.

An understack coal reclaim system can either direct coal to the train loading bin or the CHPP for processing. The ROM stockpile is approximately 4 hectares in size and has the capacity to store 300,000 tonnes of coal.

Material from the ROM stockpiles is fed into the wash plant where it is washed and then either sent to the washed coal stockpile or the product stockpile. During the washing of the coal, fines (less than 0.05 mm) are collected and are run through a thickener and into belt filter presses which compress the slurry into cakes which are then sent to the product stockpile.

Coal entering the product stockpile is run through a screening plant which separates the coal into the following sizes: 25-50 millimetres, 15-25 millimetres and less than 15 millimetres loading onto trucks for domestic sale, along with the cakes of the fine material. The Domestic Product Stockpile has an area of approximately two hectares.

Coal which is sent to the Export coal stockpile is not sorted by size. The washed coal stockpile has an area of approximately four hectares and has a storage capacity of 300,000 tonnes of coal. Coal from the Export coal stockpile is collected via under stack coal reclaim system and transported to the train loading bin adjacent to the train loader which is located on the rail loop line which is accessed off the Main Western Rail Line. This coal is predominately then sent to Wollongong for export.

2.3.9 Material Production Schedule during MOP Term

During the MOP period approximately 9,200m^3 of topsoil will be stripped and 82,800m^3 of rock/overburden produced in 2014. This material is sourced from the development of REA VI.

Topsoil and overburden are preferably directly applied to rehabilitation areas when possible. If storage is required for later use, it is done so in accordance with the Construction Environmental Management Plan which outlines appropriate storage heights and sediment controls.

ROM coal production, reject material and product quantities will remain consist over the MOP term with roughly 2.5 Mt of ROM coal, 250,000 Mt of reject material and 2.25 of product produced yearly (**Table 8**).

Table 8. Material Production Schedule during the MOP Term

Material Production Schedule during the MOP Term								
Material	**Unit**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**
Stripped topsoil	m^3	9,200 (REA VI Development)	0	0	0	0	0	0
Rock/Overburden	m^3	82,800 (REA VI Development)	0	0	0	0	0	0
Ore or ROM Coal	Mt	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Reject material	Mt	250,000	250,000	250,000	250,000	250,000	250,000	250,000
Product	Mt	2.25	2.25	2.25	2.25	2.25	2.25	2.25

3. Environmental Issues Management

3.1 Environmental Risk Assessment

Environmental management at Clarence Colliery is undertaken through a risk driven methodology. A Mine Closure and Rehabilitation Risk Assessment was completed in May 2014. Specific aspects covered in the Risk Assessment include:

- exploration, spontaneous combustion,
- geochemical nature of material,
- land contamination,
- revegetation failure,
- acid metaliforous drainage,
- capping materials,
- seed supply,
- sequencing and timing of rehabilitation activities,
- leachate management,
- final landform design,
- visual amenity and failure to obtain stakeholder acceptance.

The 2014 Mine Closure and Rehabilitation Risk Assessment is included in **Appendix 1**. Additional controls identified to manage identified risks:

1. Complete a detailed rehabilitation plan to include soil suitability testing for capping material
2. Complete a detailed rehabilitation plan to include seed collection and planting schedule
3. Survey Capping material stockpile to estimate volumes available.
4. Discuss with the Clarence CCC appropriate consultation expectations regarding mine closure
5. Document a Memorandum of Understanding (MOU) with Lithgow City Council (LCC) regarding the water transfer scheme.
6. Develop a register of alternate landuse options post closure.

Further details on the existing controls in place as well as proposed environmental management controls are provided in **Section 3.2.**

3.2 Environmental Risk Management

3.2.1 Specific Risks relating to Rehabilitation

Site specific issues identified by risk assessments relating to the success of rehabilitation are outlined below in sections **3.2.1.1** to **3.2.1.9**.

3.2.1.1 Geology and Geochemistry

Regional Geology

Clarence Colliery lies within the Western Coalfield in the Sydney Basin.The overburden stratigraphy is of the late Permian and Triassic periods and largely consists of massive Triassic sandstones which are deeply dissected by numerous canyons and valleys. The strata associated with the coal seams were laid down during the Permian Period and comprise the Illawarra Coal Measures.

The Illawarra Coal Measures within the area can be divided into four sub-groups, namely the Wallerawang, Charbon, Cullen Bullen and Nile sub-groups. All of these, except the Nile sub-group contain commercially viable coal. Within these sub-groups, six major seams are found in the vicinity of Clarence. The Katoomba seam is the uppermost seam with the Lithgow seam recorded as the basal seam having up to 23m of Permian strata underlying it. These Permian sediments are typically characterised by thinner-bedded sandstone, siltstones, shales and claystones. The generalised stratigraphic column for the Western Coalfield is included in

Table 9.

Site Geology

The Katoomba seam ranges in thickness from 1.4m to in excess of 4.5m across Clarence Colliery's boundaries. The seam generally thickens to the east towards the National Park and dips 0.5 to 1.0 degree to the ENE, consistent with the regional trend. Depth of cover varies significantly across the site, ranging from approximately 100m to 320m. The Katoomba seam ash levels typically range from 10% to 24% with elevated values associated with the western portion of the mine. Sulphur content is very low throughout at less than 0.50%. Expected product yield is highest in the east and decreases to the west with an average modelled yield approaching 90%.

Structures (faults and shear zones) generally trend north-northwest to south-southeast across the mine holding. Mining conditions are typically good and minor faulting is easily accommodated in extraction areas. Some minor igneous dykes have previously been encountered at Clarence, but they did not have any significant impact on mining activity.

3.2.1.2 Material prone to Spontaneous Combustion

Spontaneous combustion can occur when coal oxidises and ignites as a result of internal heat which arises spontaneously due to reactions liberating heat faster than it can be lost to the environment. Spontaneous combustion risks include ROM coal stockpiles, product coal stockpiles and exploration holes. Clarence Colliery has not had any incidences of spontaneous combustion either underground or within surface emplacements.

The mine's telemetric monitoring system Clarence has the ability to continuously monitor and respond to any evidence of spontaneous combustion, in the unlikely event that the situation should arise. This system monitors both conveyor belt roadways as well as return roadways of working sections and outbye areas for ventilation flow, methane and carbon monoxide. The monitoring system has a readout and alarm at the surface as well as systems in place defining alarm levels and appropriate responses should they be triggered.

Table 9. Western Coalfield Stratigraphic Column

GROUP	FORMATION	COAL SEAMS / SIGNIFICANT UNITS
NARRABEEN GROUP		
ILLAWARRA COAL MEASURES	WALLERAWANG SUBGROUP	KATOOMBA SEAM WOODFORD/MIDDLE RIVER COAL MEMBER GAP SANDSTONE
	CHARBON SUBGROUP	STATE MINE CREEK FORMATION MOOLARBEN COAL MEMBER ANGUS PLACE SANDSTONE BAAL BONE FORMATION GLEN DAVIS FORMATION (upper Irondale seam) THE NEWNES FORMATION (middle Irondale seam) IRONDALE SEAM
	CULLEN BULLEN SUBGROUP	LIDSDALE SEAM BLACKMANS FLAT CONGLOMERATE LITHGOW SEAM MARANGAROO CONGLOMERATE
	NILE SUBGROUP	
SHOALHAVEN GROUP		

3.2.1.3 Material prone to Generating Acid Mine Drainage

Clarence conducts geochemical testing on coal reject which is produced. The material has a low acid neutralising potential (measured at 0.68 kg H2SO4 / tonne). Leachate water produced from the coal reject in captured in Clarence's leachate Management System. A clean water diversion drain has been constructed around the southern, eastern and western edges of the REA area in order to intercept and divert any clean catchment run-off prior to it entering the REA site. Leachate captured in this system is directed to the Clarence Water Treatment Plant to remove metals and adjust for pH before release off site via Clarence Licenced Discharge Point.

3.2.1.4 Mine Subsidence

The partial extraction mining method adopted by Clarence Colliery results in a maximum predicted subsidence of 100 mm with low tilts and strains, virtually immeasurable valley closure, minimal (if any) subsidence and no surface cracking. The primary objective pertaining to surface subsidence is to ensure that subsidence is limited to a value well within that considered to be characteristic of 'elastic' overburden behaviour (i.e. no caving to surface), which is defined as 100±25 mm. Monitoring to date has demonstrated that this target has been delivered.

A Trigger Action Response Plan (TARP) is developed for each Subsidence Management Plan (SMP) Application Area. An SMP must be prepared in accordance with Schedule 3, Condition 2 of DA504-00 for any mining activity which potentially may lead to

subsidence. The TARP establishes trigger levels which are used to monitor against predictions made within the SMP. The TARP also provides strategic management responses to monitoring results with a focus on response to results that exceed predictions or cause actual or potential impacts and consequences.

3.2.1.5 Erosion and Sediment Control

The soils at Clarence Colliery have a moderate to high erosion potential due to their sandy nature and occurrence on moderate to steep slopes. There are three areas of potential soil erosion and sediment transport within the Clarence Colliery lease area, as follows:

- Pit top surface facilities (eg: stockpile areas, conveyor belts, laydown areas and REAs);
- Underground Workings; and
- Surface areas potentially affected by subsidence (areas above mine workings).

Several types of erosion control measures have been implemented on the site with the aim of preventing soil erosion and the transport of sediment to downstream waters from these areas. These control measures are detailed in Clarence's Erosion and Sediment Control Plan (ESCP) which has been developed in accordance with Schedule 3, Condition 6 and 8 of DA 504-00.

A brief summary of these erosion control measures is given below.

Drainage Channels

Drains are constructed with either a parabolic or trapezoidal cross section to minimise erosion. Where possible, channels have been constructed with an adjacent earth bank or in some cases have been rock lined.

Flow channels in soil materials are limited to prevent erosion and where active erosion occurs, concrete weirs, gabion weirs, concrete pipes and run-off control channels are installed to control the water flow.

A clean water by-pass channel allows water from the upstream of the site to pass through without coming into contact with disturbed areas. This reduces the quantity of water that has potential to cause erosion and require treatment.

All water emanating from disturbed areas flows through collection pipes/channels/drains to a number of sediment control structures. These structures are detailed below.

Sediment Control Structures

The dirty water management system at Clarence consists of a number of major pollution control structures. These structures have been designed and located to contain dirty water from disturbed areas on site and to contain sediment mobilised by normal rainfall events, as well as to reduce flow velocity during high rainfall events. These include two Leachate Dams, the Polishing Lagoon, the Primary Separator, the "B" Thickener and the Main Dam.

In addition to these main pollution control structures, several small sediment traps have been constructed to collect sediment laden water from around the main ROM conveyor and one each at the drive station, rotary breaker and crusher. These small sediment traps report to the main pollution control structures.

Maintenance and Monitoring

The grit trap and primary separator are checked for sediment on a weekly basis or following rainfall. All other sediment control structures and drainage lines are checked monthly or after rainfall. Any area where erosion has occurred is repaired and the controlling structure upgraded. Sediment control structures are regularly maintained and cleaned out once capacity has been reduced by approximately 30%. Material is placed in the REA or where coal content is sufficiently high it is reprocessed.

Where additional disturbance is required the following mitigation measures to be implemented prior to the commencement of any activities to minimise erosion, and prevent sediment-laden drainage water from disturbed areas contaminating local waterways. The following general principles will continue to be used for erosion and sediment control on site throughout operation:

- Planning for erosion and sediment control during the design phase before any earthworks begin, including assessment of site constraints;
- Designing and operating drainage systems with scour protection of open drains, and energy dissipaters located at drain outlets for the life of the facility;
- Minimising the area of soil disturbed (staging of vegetation clearing), and therefore exposure to erosion;
- Conserving topsoil for later site rehabilitation (in a stabilised stockpiles);
- Diverting up-slope non-contact water away from disturbed areas so that concentrated flows are below erosive levels, and sediment is retained from disturbed areas;
- Rehabilitating disturbed lands quickly; and

- Maintaining erosion and sediment control measures appropriately.

3.2.1.6 Soil Type(s) and Suitability

Whilst it is acknowledged that the amount of disturbance is minimal given the site is an underground mine, there may be a need to strip topsoil for additional areas being disturbed. In these instances, where topsoil stripping is required, the following proposed topsoil handling conditions will be adopted to prevent excessive soil deterioration:

- Topsoil would be maintained in a slightly moist condition during stripping; material should not be stripped in either an excessively dry or wet condition;
- The surface of soil stockpiles would be left in a coarsely textured condition in order to promote infiltration and minimise erosion until vegetation is established;
- Topsoil stockpile heights would be designed to prevent biological and structural degradation. Where appropriate clayey soils will be stored in lower stockpiles for shorter periods of time compared to soils that have a coarser texture;
- Free-draining stockpiles would be created to minimise the formation of anaerobic zones; and
- Stockpiles would be formed in a "chevron" profile with batters graded to achieve slopes approaching 18 degrees.

Prior to use in rehabilitation soil would be characterised through testing to determine its suitability. If determined not suitable for rehabilitation, the soil will be improved by adding key nutrients, biological material and soil ameliorates such as lime to improves its structure.

3.2.1.7 Flora

Threatened Species

Extensive field surveys were conducted as part of due diligence in 2011 on Clarence Mine pit top area. In total, 87 plant species were detected growing during quadrat surveys within Clarence site. None of the plant species detected on the site are listed as threatened under the *Threatened Species Conservation Act (TSC Act) 1995* or *Environment Protection and Biodiversity Conservation Act (EPBC Act) 1999*. Native vegetation communities occurring within the site were delineated and mapped having reference to existing regional vegetation community mapping (DEC 2006), API and groundtruthing as required. Regional vegetation mapping identified eight vegetation communities occurring within the site. Two of the vegetation communities found on site, the Newnes Plateau Shrub Swamp and Newnes Plateau Hanging Swamp, are commensurate with the 'Temperate Highland Peat Swamps on Sandstone Endangered Ecological Community' listed under the Commonwealth *EPBC Act* 1999, while Newnes Plateau Shrub Swamp is also commensurate with the Endangered Ecological Community '*Newnes Plateau Shrub Swamp'* listed under the NSW *TSC Act* (1995).

Within the mining area, partial extraction technique employed at Clarence ensures minimal subsidence of approximately 30mm resulting in no surface disturbance. It is therefore extremely unlikely that mining at Clarence will have an impact on the local flora and ecological communities. A flora monitoring program was set up as part of the SMP process to verify that this is the case and to identify any natural variations. Risk and potential impacts to threatened flora over the mining area is managed through the SMP.

Seed Collection

Throughout the MOP period local native seed will be collected and stored for future rehabilitation throughout the MOP period.

Revegetation

Whilst there will be limited disturbance on the project site, the following section outlines the revegetation strategy for the site. This includes a strategy for during operation as well as the strategy for rehabilitation the disturbed areas following demolition and removal of the site infrastructure.

Engineering Treatments

Where necessary engineering treatments including felled timber and other available metrails will be applied to rehabilitation areas for stablistation after topsoil has been applied.

Species to be used for Revegetation

Species selection for areas to be rehabilitated to pre-existing conditions will focus on those species that will successfully establish on the available growth medium, bind the soil and will result in a variety of structure and food/habitat resources. Whilst every attempt will be made to use species that existed prior to the commencement of mining, some additional species may be required to ensure suitable initial groundcover for site stabilisation. This may include the use of short-lived annual exotic non-invasive grass species. Revegetation strategies will include a seed

collection program of local provenance as part of the rehabilitation program.
Prior to application, some of the tree seed will be pre-treated (i.e. inoculated and scarified) in order to break dormancy restrictions to promote earlier germination, develop more robust seedlings, wider and more uniform germination and increased germination rates.
A combination of native and introduced pasture species may be used on the disturbance areas to ensure the quick establishment of a continuous groundcover, thereby reducing the risk of erosion. Legumes may also be selected to assist in the supply of bio-available nitrogen to the soil. If the use of introduced grasses and/or legumes is deemed necessary for erosion control in the bushland areas, pasture seed and fertiliser will be applied at a lower rate than for pasture outcomes to reduce competition with tree seed and/or seedlings.
Where appropriate, native pasture species (warm season perennial, cool season perennial, yearlong green perennial and annual) will be sown. If steep slopes are present and it is not practicable to re-shape the area and/or there is a high risk if erosion introduced, stoloniferous grass species (e.g. Indian Couch) will be sown as their growth provides more extensive coverage in a shorter time.
The use of buffer zones will be site specific and should be considered prior to any revegetation activities. However, buffer zones should be established around any areas of remnant vegetation which are relatively undisturbed and where exotic species are not present.
Aerial sowing and/or ground broadcasting may be conducted for both tree and pasture seed as the preferred sowing methods and grazing may be restricted whilst the vegetation is establishing.
All revegetated areas will be monitored to ensure long-term groundcover establishment and success. Revegetation techniques will be continually developed and refined over the life of facility through an ongoing process of monitoring at the site and recognition of other industry experiences.

Special Treatment Areas

Additional erosion control measures such as the application of 'hydromulch' will be considered, particularly in drainage lines and steeper areas. Sugar cane (or other) mulch as slurry provides cover for the soil to improve pasture growth and/or modifying the soil surface to control erosion. Securely pressed against the surface of the soil, the mulch provides a high degree of erosion control and improves moisture availability to establishing pasture. The mulch also has the effect of protecting the soil surface against raindrop impact, improving the microenvironment for seed germination and establishment by reducing evaporation losses, and assisting in the control of surface erosion caused by overland water flow.
Opportunities for the use of potential soil ameliorants to accelerate the rehabilitation process will also be considered where appropriate.

Weed and Pest Management

Weed control operations are undertaken at Clarence in accordance with the *Noxious Weeds Act 1993* (NWA) which provides that occupiers of land have responsibility for controlling noxious weeds. Under Section 8 of the NWA, noxious weeds can be grouped into five classes, as follows:
Class 1 – State Prohibited Weeds;
Class 2 – Regionally Prohibited Weeds;
Class 3 – Regionally Controlled Weeds;
Class 4 – Locally Controlled Weeds;
Class 5 – Restricted Plants.
Pampas grass *(Cortaderia selloana)* (Class 3), Blackberry *(Rubus fructicosus)* (Class 4) and St Johns Wort (*Hypericum perforatum)* (Class 3) have been recorded at Clarence with weed control measures carried out as required to control the spread of these noxious weeds around the pit top including the CHPP, administration buildings, water storages, drainage lines, access roads and rehabilitation areas.
The presence of weed species has a potential major impact on revegetation and regeneration outcomes. In addition to this, the presence of weed species within the surrounding land has the potential to significantly impact on the biodiversity value of the rehabilitated areas. Weed management will be a critical component of the rehabilitation activities.
Weeds will be managed across the mine through a series of control measures, including:

- Designated light vehicle roads and track delineated around the site;
- Herbicide spraying or scalping weeds off topsoil stockpiles prior to re-spreading;
- Inspections of rehabilitated areas to identify potential weed infestations; and
- Identifying and spraying existing weed populations on-site together with on-going weed spraying over the life of the operation.

If weed control measures are required, this will be undertaken in a manner that minimises soil

disturbance. Any use of herbicides will be carried out in accordance with appropriate requirements to minimise the risk of impact on downstream water quality. Records will be maintained of weed infestations, and control programs would be implemented according to accepted management practice for the weed species concerned. The appropriate noxious weed control or eradication method and program will be undertaken in consultation with the Local Council and/or the local Noxious Weeds Inspector.

All weed management personnel would be trained in the use of herbicides. Herbicides listed under international conventions, such as the World Health Organisation and the Stockholm Convention, would only be used according to the requirements of those conventions.

3.2.1.8 Fauna

Habitat Management

Before surface disturbance occurs a due diligence survey will take place to identify any threatened species and any key habitat structures for birds and arboreal mammals including hollow bearing trees. Where possible these habitat structures will be left in situ, if it is not possible to retain these structures they will be relocated to rehabilitation areas on site.

Threatened Species

Extensive field surveys on Clarence Mine pit top area were conducted as part of due diligence in 2011. In total, 43 fauna species were detected on site, being 31 birds, eight mammals and four herpetofauna. Detected fauna species were mostly limited to diurnal bird species that are typical of the forest birds found along the east coast of NSW e.g. Eastern Yellow Robin (*Eopsaltria australis*), Grey Fantail (*Rhipidura albiscapa*), Grey Shrike-thrush (*Colluricincla harmonica*) and White-eared Honeyeater (*Lichenostomus leucotis*).

Two threatened bird species were detected on site which are listed as Vulnerable under the *TSC Act* 1995, namely Gang-gang Cockatoo (*Callocephalon fimbriatum*) and Scarlet Robin (*Petroica boodang*). These, and other threatened woodland birds are likely to utilise a majority of the forested habitat throughout the subject site and surrounding expansive State Forests and National Parks as part of their foraging, nesting and breeding habitat. Scarlet Robins are semi-migratory and are not likely to utilise the subject site exclusively due to the large areas of high quality habitat in the region.

Before any surface disturbance activities ecological due diligence surveys will be undertaken to identify any threatened species. Mitigation measures will also be identified prior to surface disturbance.

Pest Control

Feral cats, dogs and European Foxes have been previously identified on Clarence Colliery Leases. Environmental inspections have been included in the Clarence Colliery Work Order Management System to identify the presence of pest species and potential corrective actions which may include 1080 baiting and trapping.

3.2.1.9 Other Risks

Slopes and Slope Management

A Surface Slope Stability risk assessment (RA) was originally carried out in 2007. A review of this RA was carried out in April 2012. The Surface Slope Stability risk assessment covers all surface areas within the Clarence Colliery surface lease boundary, including:

- High walls – cut faces into natural rock/soil, road cuttings;
- Fill slopes and retaining walls;
- Low walls – not applicable (no low walls at Clarence, no open cut mining);
- Overburden dumps – not applicable;
- Coal handling stockpiles;
- REAs;
- Dam walls – Polishing Lagoon, Main Dam, Settling Dam, Leachate Dam #1 and #2; and
- Road Embankments

The RA identified three medium risks including:

- The risk from slope failure caused by erosion or failure of slope through lack of maintenance of fillslopes and retaining walls;
- The risk from slope failure caused by erosion or failure of slope through lack inappropriate design and construction or over topping of the tailings wall or piping; and
- The risk from slope failure caused by external erosion or failure through lack of maintenance, inappropriate vegetation, incorrect operation, over topping or piping erosion.

To ensure the residual risks associated with surface slopes remain at an acceptable level the RA will be reviewed as follows:

- Following any unplanned collapse or partial collapse of a surface slope;

- Prior to any change to the method of slope construction;
- Prior to any new high wall construction; or
- In accordance with the HSMS review timeframe.

Air Quality

Air quality in the locality surrounding Clarence Colliery is influenced by emissions generated by a range of sources including the existing operations, nearby extractive industries, vehicular traffic and regional emissions from more distant sources.

The primary components of the Clarence Colliery which contribute air emissions include surface infrastructure such as the bathhouse and administration buildings, Water Treatment Plant, store warehouse, diesel refuelling station and storage shed, machinery washdown bay and workshop, equipment and materials storage areas.

On-site dust monitoring is undertaken at three locations around the periphery of the mine and a weather station is located near the administration building.

Deposited matter is measured monthly at the three locations using standing dust deposition gauges and records average dust deposition rates. This includes the contribution from Clarence Colliery together with background dust levels from surrounding extractive industries and regional sources.

Clarence Colliery operates in accordance with an Air Quality Management Plan which includes the use of a number of emission controls to minimise the impact of the operations on nearby sensitive receivers. This includes the use of water sprays within the coal handling areas, product stockpiles, reject emplacements and haul roads.

Surface Water

A water management system operates across Clarence Colliery and is operated in accordance with an approved Water Management Plan (WMP) under DA 504-00.

The WMP has been developed to meet the requirements of Development Consent DA504-00, specifically Conditions 5 to 11 of Schedule 3. The WMP describes the systems in place to manage surface and underground water associated with the mining activities at Clarence Colliery.

The principle objectives of the WMP include:

- Separation of clean, dirty and leachate water
- Capture and treatment of dirty and leachate water to ensure compliance with Clarence's Environmental Protection Licence
- Appropriate sediment control are maintained

The WMP also describes the monitoring program to measure the performance of the water management system and applies to all operations at Clarence Colliery. A schematic of existing water management flows at Clarence Colliery is presented in **Figure 1**.

Ground Water

The partial extraction technique used at Clarence ensures that impacts on the surrounding groundwater resources are minimised in accordance with Schedule 3, Condition 6, 9, 10 and 11 of DA 504-00, Clarence has developed a Groundwater Monitoring Program and Response Plan. This Plan forms part of the Site Water Management Plan and was developed in consultation with regulatory bodies including Lithgow City Council, Sydney Catchment Authority, Office of Environment and Heritage and the Department of Planning and Infrastructure and has been approved by the Department of Planning.

The objectives of this monitoring program are to monitor and manage any potential impacts resulting from operations at Clarence on both groundwater baseflows and surface water flows in water bodies above the mine. These flows are critical to the protection of upland swamps and wetlands and supply a source of bore water to the residents of Clarence Village.

The program gathers baseline groundwater levels and quality data, develop groundwater impact assessment criteria, monitor the volume and quality of groundwater seeping into the underground mine workings and monitor regional groundwater levels in a number of geologic formations at the mine as follows:

I. Banks Wall Sandstone;
II. Burra-Moko Head Sandstone;
III. Caley Formation; and
IV. Katoomba Coal Seam.

Groundwater is also managed and monitored through the SMP process which includes risk assessment, performance monitoring and mitigation of residual risks.

Contaminated Land

Clarence completed a targeted Phase 2 Environmental Site Assessment (ESA) during 2012. The objective of the ESA was to assess the presence of soil and groundwater contamination in targeted areas identified as

areas of potential concern within the CHPP and Pit Top areas.

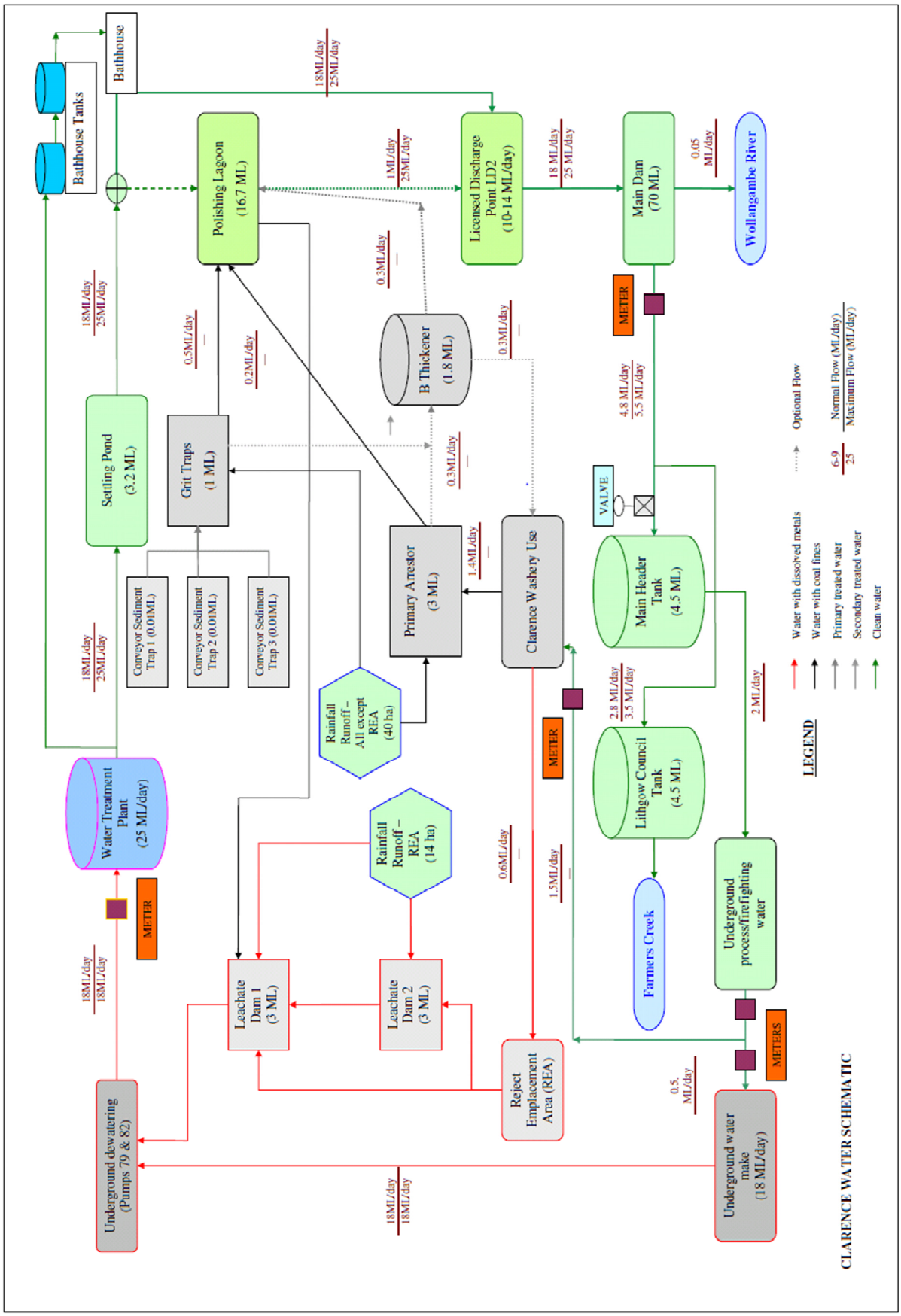

Figure 1. Clarence Water Schematic

The assessment included soil sampling, installation of seven groundwater monitoring wells, groundwater sampling and surface water sampling. Gathered information and analysis was used to create a conceptual site model which identifies impact media, contaminant transport pathways, exposure routes and exposed receptors to evaluate the risks associated with contamination.
An Action Plan was developed and the following monitoring commenced and completed during the 2013 reporting period:

- Bi-annual Groundwater Water Quality Analysis and measurement of Standing Water Levels (SWLs) at the nine installed bore holes. Samples are to be analysed for Heavy Metals (As, Cd, Cr, Cu, Pb, Hg, Ni and Zn), TPH, BTEX and PAH; and
- Bi-annual Surface Water Quality Assessment at the Clarence Main Dam (in addition to monthly compliance sampling). Samples are to be analysed for Heavy Metals (As, Cd, Cr, Cu, Pb, Hg, Ni and Zn), TPH, BTEX and PAH.

Nine bore holes (monitoring wells) and Clarence Main Dam were sampled in August, October and December 2013 including:

- MW01;
- MW02;
- MW03;
- MW04;
- MW05;
- MW06;
- MW07;
- MW08;
- MW09; and
- Dam01.

Monitoring results have recorded below 'trigger' levels for chemicals within water using the assessment criteria endorsed by NSW EPA to evaluate groundwater analytical results based on the ANZECC/ARMCANZ (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC [2000]) and Clarence's EPL 726 concentration limits.
Monitoring and sampling will continue until mine closure and results will be analysed and trended to identify any potential groundwater contamination.

Hazardous Materials

Clarence Colliery has implemented a Dangerous Goods and Hazardous Substances Management Plan. The primary objectives of this management plan include but are not limited to:

- Application of a suitable risk management process to identify hazards/risks and establish the appropriate controls;
- Establishing standards, procedures and the appropriate information and communication protocols;
- Ensuring as far as reasonably practicable that person(s) are sufficiently aware of their authority and responsibility;
- Providing means for induction and ongoing training for matters related to this management plan;
- Establishing a structured process for the identification, monitoring, assessment and control of changes associated to this management plan;
- Providing an effective measurement and monitoring process of the control measures including determination of compliance through audit and review; and
- Comply with the provisions of the operations Health and Safety Management System and relevant legislation, as a minimum.

This Hazardous Substances and Dangerous Goods Management Plan provides practical guidance for the purchase, storage, use, handling and disposal of Hazardous Substances at Clarence Colliery.

Greenhouse Gases, Methane Drainage/ Venting

Methane drainage is not required at Clarence.

Acid Mine Drainage

Reject material has the potential to produce acid and metalliferous drainage (AMD) and leachate . However the material has a low acid neutralising potential (measured at 0.68 kg H2SO4 / tonne) and geochemical testing occurs annual to characterise material.

Leachate is management is outlined in the WMP, and includes the following principle components:

- Leachate is captured within site Leachate Dams
- A transfer system is in place to ensure leachate water is treated before discharge offsite

Blasting

No blasting is conducted at Clarence Colliery.

Noise

Operational noise is managed in accordance with the approved Noise Management Plan (NMP). Key objectives of the NMP include

- Noise Impact Assessment Criteria for Day, Evening and Nigh Periods at nearby sensory receptors
- Monitoring to determine compliance with the impact assessment criteria
- 24 hours/7Days complaints hotline
- TARP to deal with complaints to ensure prompt response to concerns from nearby residents
- Mitigation to ensure the minimisation of operational noise

Visual and Lighting

Clarence Colliery's nearest neighbour is approximately 1.5 kilometres from the mine and is separated from the Colliery by a ridge. Consequently the risk of off-site visual or lighting impacts from the operation is extremely low. Nevertheless, in accordance with Condition 22 of DA 504-00, all external lighting associated with operations at Clarence complies with *Australian Standard AS4282 (INT) 1995 – Control of Obtrusive Effects of Outdoor Lighting*.

No community complaints have been recorded regarding light annoyance at Clarence.

Heritage (Aboriginal and European)

Aboriginal Heritage

Aboriginal sites in the area are generally situated in rock shelters although some open sites associated with hanging swamps have been found. No archaeological sites have been recorded within the Pit Top area. Seven aboriginal sites have been recorded in ML1353 of which six are located on or adjacent to Mt. Horne within ML 1354. The seventh site is located in CCL 705.

Two major site complexes have been identified within ML1353 & ML1354; one at Mt Horne (Site 1) and one south of Waratah Ridge Road (Site 2) approximately 300m west of Mt Horne. Site 1 comprises a large sandstone outcrop with two rock shelters both of which indicate evidence of occupation. Four separate and distinct clusters of grinding grooves exist on the outcrop above the shelters. On the talus slope between the rock outcrop and Waratah Ridge Road, chert and quartz flakes and cores have been found wherever the surface is exposed.

The second complex comprises several shelters and potential occupation sites. Stone artefacts and two quartz flakes were found under the shelters. A grey chert backed blade, possibly an elouera adze flake, was the only diagnostic form located. A charcoal drawing was located on the roof of a tunnel-like feature created by slabs of fallen sandstone. All archaeological sites in ML areas are management through the SMP.

An archaeological survey was conducted for the Clarence Colliery Lease Extension Environmental Impact Statement (EIS) (International Environmental Consultants 2000) and included a search of the DEC-NPWS database and the Native Title Register as well as a field survey of the lease extension areas. The desktop search identified 63 Aboriginal sites in the vicinity of the mine. Of these sites, 44 sites are within the lease areas. The 44 sites include:

- Twelve rock shelters with art;
- Eleven rock shelters with deposits;
- Six axe grinding groove sites;
- Fourteen open camp sites; and
- One scarred tree.

The archaeological field survey identified nine indigenous heritage sites and two isolated artefacts. The sites included six open campsites, two rock shelters with deposits and one group of three scarred trees which were recorded as one site. Six sites consisting of four open campsites and two rock shelters were located in the western section of ML1583. Three sites consisting of two open camp sites and 1 group of three scarred trees, as well as two isolated artefacts, were located in the eastern part of ML1583.

As described above, a number of aboriginal sites have been recorded in the Clarence Colliery lease areas. However, underground mining as proposed by Clarence will have no impact on Indigenous open scatter sites, scarred trees or isolated artefacts within the lease area because the mining method used does not result in any significant direct surface impacts (International Environmental Consultants 2000). No additional surface facilities are planned and all coal will be handled and processed within the boundaries of the existing Clarence Colliery surface facilities. Archaeological assessments for each SMP have been carried out in accordance with NSW Office of Environment and Heritage (OEH) Aboriginal Cultural Heritage Consultation requirements.

An agreement with the Gundungurra Tribal Council has been reached with regards to future mining and prospecting activities at Clarence. The Gundungurra Tribal Council is to be involved in all aboriginal heritage surveys for any exploration, surface development and subsidence planning activities.

European Heritage

A number of European heritage items have been identified in the Clarence Colliery lease areas include:

- A section of the Zig Zag Railway and associated buildings;
- The old Newnes railway route, which crosses the existing lease near the ventilation fan and the north western portion of ML1583. The Newnes rail link was constructed across the Newnes plateau between Newnes Junction in the south and Newnes in the north. The railway was completed in 1907, but was later abandoned with the cessation of mining at Newnes;
- The Old Bells Line of Road that passes across the western section of the Clarence Colliery lease areas; and
- A large disused corrugated iron and cement water storage tank located in the north-western section of the lease areas, above Bungleboori Creek. This tank was identified in the Clarence EIS in 2000, and may have been associated with the Newnes Railway activities in the area.

The literature review conducted as part of the archaeological investigations for the 2000 Clarence Colliery EIS also identified Happy Valley Springs as the site of a Drovers Camp from the 1820s. However, no physical evidence of this camp was identified during the field survey.

As is the case with all surface features, the major potential threat to heritage items from the underground mining operations is from potential subsidence related impacts. The partial extraction underground mining method used at Clarence and the resulting minimal surface disturbance means that there will be no direct impact on items of heritage significance in the vicinity of Clarence Colliery.

Clarence's lease area partially abuts the Blue Mountains National Park (BMNP), Wollemi Wilderness Area (WWA) and the Greater Blue Mountains World Heritage Area (GBMWHA) to the east and Newnes State Forest to the north. The BMNP, WWA and GNMWHA contain large pristine areas of great scenic and aesthetic value as well as providing primary habitat to a number of threatened and protected species (Clarence Colliery 2005, 2011 & 2013).

Partial extraction of coal is extremely unlikely to affect the BMNP, WWA and the GBMWHA. This is due to the fact that the level of subsidence will not exceed and that subsidence impacts will not occur outside the mining area (Clarence Colliery 2005, 2011 & 2013).

There is no overlap between the mining leases and the BMNP, WWA and the GBMWHA.

Newnes State Forest occupies the majority of the surface area at Clarence Colliery. The forest is currently managed by State Forests, who regularly carry out logging activities. In addition to logging, State Forests also maintain a number of tracks which attracts 4WD and trail bike enthusiasts. The area is also popular with campers and bushwalkers.

As part of the SMP application process, a legislative review of the environmental sensitivity of land occupied by Clarence Colliery is undertaken

Spontaneous Combustion

Clarence Colliery has not had any incidences of spontaneous combustion either underground or within surface emplacements, a therefore considered a low risk. However, through the mine's telemetric monitoring system Clarence has the ability to continuously monitor and respond to any evidence of spontaneous combustion, in the unlikely event that the situation should arise. This system monitors both conveyor belt roadways as well as return roadways of working sections and outbye areas for ventilation flow, methane and carbon monoxide. The monitoring system has a readout and alarm at the surface as well as systems in place defining alarm levels and appropriate responses should they be triggered.

Exploration

Exploration drilling provides critical information to further inform the geological model before mining occurs.

Exploration boreholes will be constructed and rehabilitated in accordance with a 'Borehole Construction -
Environmental Management Plan' (Borehole CEMP) established by Clarence Colliery that has been used fro previous successful exploration activities within Newnes Forest. The Borehole CEMP is a risk-based management plan addressing mitigation measures relating to:

- Vegetation clearing (including marking of approved clearing areas);
- Soil and water management / erosion and sediment control;
- Weed management;
- Site Completion and Rehabilitation and
- Staff and Contractor Inductions, Awareness and Training
- Inspections and Monitoring Program

Bushfire

Clarence will ensure that there is an adequate Asset Protection Zone (APZ) around all assets situated within the Clarence Mining Lease where possible. Asset Protection Zones act as a buffer between the development and the hazard and are the principal fire protection mechanism. For all assets with personnel working around them on a regular basis, the fuel load is to be reduced down to 10t/Ha (or less) within 30m of the building or as advised by the Rural Fire Service (RFS) where possible. For all other assets the fuel load is be reduced down to 10t/Ha (or less) within 20m of the asset or as advised by the RFS. The APZ will be maintained by one of the following methods or any combination of:

- Burning;
- Hand Clearing; and
- Machine Clearing

Most prescribed burns are planned from April through to September each year due to prevailing weather conditions such as high soil and fuel moisture content and low relative humidity and night time temperatures. Prescribed burns can take place outside this period if suitable conditions exist. Prescribed burns are also highly dependent on rainfall.

Fire prevention strategies employed on site include the following:

- Maintaining all mobile equipment in good working order with efficient exhaust systems and ensuring fire extinguishers are installed;
- Ensuring clearing operations are not undertaken during periods of extreme fire danger;
- Clarence Colliery's earthmoving equipment is available for fire fighting purposes in the event of a fire approaching the Pit Top; and
- Fire fighting water is reticulated around the Pit Top.

4. Post Mining Land Use

4.1 Regulatory Requirements

Regulatory requirements that specially affect the progress toward the post mining land use and rehabilitation include Mining Lease and Development Consent Conditions. These requirements are summarised in **Table 10** listing all the commitments and whether they relate to the entire site and/or to a domain or defined parcel of land.

In addition to the Mining Lease and Development Consent conditions there are further requirements under Section 100 of the *Coal Mines Health and Safety Regulation Act 2002* for Reject Emplacement Areas. Section 100 applications have to be approved y the Department before an additional REA is constructed. The application and provides details on:

- Emplacement design, engineering controls and life cycle;
- Approvals and environmental issues;
- Application of risk management principles;
- Reject emplacement and management;
- Construction and contractor management;
- Water controls and ecological management; and
- Final landform and rehabilitation.

Table 10. Regulatory and Approval Requirements

Approval Requirements	Commitments		Relation to entire site and/or domain/parcel of land
Development Consent DA504-00			
a) Define the objectives and criteria for mine closure	Addressed in **Section 2.2** of this document.		
b) Investigate options for the future use of the site, including the pit top and surface facilities area			
	Surface facilities - Mining Infrastructure Areas and CHPP	a) Centennial to explore potential sandmining opportunity within the current disturbance footprint. Active sand-mining is being undertaken on either side of the facilities. The existing infrastructure such as the rail loop could be used. b) Some other industrial use for other mines (existing or nearby leases (particularly if the site can be accessed by the underground. c) Some other non-mining industrial use that can make use of the existing rail loop and hard stand areas, etc. d) Recreational use of dams. e) Large allotment rural housing development on the flat areas. The site is adjacent to existing residential and has access and services. f) Synergies with Surrounding Extractive Industries. g) Revegetation on the site to utilised for Bio-banking or biodiversity offsets for other Centennial or non-Centennial projects. h) Some other conservation outcomes (threatened species). i) The existing water treatment plant to go to Lithgow City Council (LCC) to drought proof the Lithgow council area – Infrastructure is currently in place to transfer water to Farmers Creek dam. j) Other non-Centennial sand mines to access the rail loop and stockpile areas. k) Ecotourism (synergies with ZigZag Railway) – train trip on loop, Tourist mine (valued added experience). l) Hotel / resort complex- scenic outlook, proximity to National Parks, good access and existing facilities. m) Intensive agriculture (fish farms, etc) – utilising the large flat areas and the existing infrastructure – not	

		too far from markets in Sydney with rail access.	
	Mining Areas	a) Future mining – an expansion on the current mining footprint beyond what is approved at present if viable. b) Continue mining with thin seam machinery within current life of mine (LOM) areas.	
	Rejects Emplacement Area	a) Natural Bushland (current stated option).	
c) Investigate ways to minimise the adverse socio – economic effects associated with mine closure, including reduction in local employment levels	Addressed in **Section 1.4** of this document.		
d) Define a strategy for the ongoing management of water inflow to the mine	This requirement will be addressed closer to mine closure.		
e) Describe the measures that would be implemented to minimise or manage the ongoing environmental effects of the development	Addressed throughout **Entire Document**		
f) Describe how the performance of these measures would be monitored over time. Most of these conditions are covered in this plan.	Addressed in **Section** 8 of this Document		
g) Prepare a Mine Closure Strategy	Addressed in **Sections** 5, 7, 8 and 9 of this document		

4.2 Post Mining Land Use Goal

The key objective of site rehabilitation is to achieve an optimum post-mining land capability suitable for supporting the natural bushland environment which surrounds the site. All primary domains will be returned to a natural woodland environment, consistent with bushland surrounding the site which includes the vegetation communities as described in the Vegetation Communities of the Western Blue Mountains:
MU: 8 - Newnes Sheltered Peppermint – Brown Barrel Shrubby Forest;
MU: 29 - Sandstone Slopes Sydney Peppermint Shrubby Forest;
MU: 30 - Exposed Blue Mountains Sydney Peppermint – Silver-top Ash Shrubby Woodland;
MU: 43 - Pagoda Rock Sparse Shrubland;
MU: 44 - Sandstone Plateaux Tea Tree – Banksia – Mallee Heath;
MU: 50 – Newnes Plateau Shrub Swamp (EEC);
MU: 51 - Newnes Plateau Hanging Swamp (EEC);
MU: 62 - Cleared and Severely Disturbed Lands;

A conceptual final landform design and rehabilitation plan details land use on **Plan 4 (Appendix 5)**.

4.3 Rehabilitation Objectives

Specific Rehabilitation objectives for the primary Domains are specific measures which relate to:

1. Landscape Organisation
2. Vegetation Dynamics
3. Habitat complexity

These indices are derived from the principles of Ecosystem Function Analysis (EFA). EFA is used to determine when a post mined rehabilitated landscape reaches key targets of ecosystem function. These targets are quantitative and when targets are reached the site is capable of supporting a sustaining ecosystem. Permanent monitoring transects are established in areas of post-mined rehabilitated lands and correspondingly in adjacent undisturbed areas to provide analogue/reference sites. An analogue site is an ecosystem that serves as a model for restoring another ecosystem, and can be appropriately **used to set the benchmarks for rehabilitation and track rehabilitation progress and outcomes.**

Assessing the analogue sites is an integral part of the rehabilitation monitoring program, with the data collected and derived from these sites used to track target values for key biophysical parameters and indicators related to vegetation diversity/structure and habitat complexity, and providing data on the long-term goal for the rehabilitation areas. Locations of analogue and rehabilitation transects are displayed in **Figure 2.**

Overall, the data derived from the monitoring program provides a scientifically robust platform against which the effectiveness of post-mining rehabilitation techniques can be assessed and, where applicable, amended. This is done with the aim of achieving sustainable post-mining vegetation communities, which are aligned to the proposed post-mining land use for the Clarence mining lease area.

The monitoring program currently includes seven transects, comprising four transects in rehabilitated areas and three analogue transects. Six of these transects were established in 2012, while one new rehabilitation transect was established during this year's program of works.

Detailed performance indicators for rehabilitation progress and completion are outlined in **Section 2.2.**

Figure 2. Analogue and Rehabilitation Transects

5. Rehabilitation Planning and Management

5.1 Domain Selection

The following domains of the project area encompassed by the MOP are summarised in **Table 11**. There are four Primary domains (Operational Domains) including:

Domain 1: Coal Handling and Preparation Plant, Rail Loop and Overland Conveyors;
Domain 2: Clarence Administration, Workshops and Pit Top Area;
Domain 3: Reject Emplacement Area; and
Domain 4: Surrounding Areas.
The Secondary domains (Post Mining Land Use Domains) are defined as rehabilitation area – forest.

5.2 Domain Rehabilitation Objectives

The rehabilitation objectives for each of the Primary (Operational) and Secondary (Post Mining Land Use) domains is addressed in **Section 2.2**. This section provides information on key issues that pertain to their management.
Rehabilitation objectives for each domain and the relevant regulatory and approval requirements are listed in **Table 10.**

5.3 Rehabilitation Phases

The rehabilitation phase for each domain is outlined in **Table 12**. These rehabilitation phases depend on the post mining land use goal and rehabilitation objectives discussed in **Section 2.2**.

Table 11. Coding for Primary (Operational) and Secondary (Post Mining Land Use) Domains

Code	Primary Domains (Operational)	Code	Secondary Domains (Post Mining Land Use)
1	Coal Handling and Preparation Plant, Rail Loop and Overland Conveyors	A	Rehabilitation Area - Forest
2	Clarence Administration, Workshops and Pit Top Area	A	Rehabilitation Area - Forest
3	Reject Emplacement Area	A	Rehabilitation Area - Forest
4	Surrounding Areas	A	Rehabilitation Area - Forest
5	Water Management Structure	A	Sediment Control Structures

Table 12. Summary of Rehabilitation Phases proposed for Completion at the end of the MOP (by domain)

Domain / Rehabilitation Phase	Coal Handling and Preparation Plant, Rail Loop and Overland – Forest (1A)	Clarence Administration, Workshops and Pit Top Area - Forest (2A)	Reject Emplacement Area - Forest (3A)	Surrounding Areas – Forest (4A)
Active Mining Area	×	×	✓	✓
Decommissioning	×	×	✓	✓
Landform Establishment	×	×	✓	✓
Growth Medium Development	×	×	✓	✓
Ecosystem and Land use Establishment	×	×	✓	✓
Ecosystem and Land use Sustainability	×	×	✓	✓
Relinquished Lands	×	×	×	×

6. Performance Indicators and Completion/Relinquishment Criteria

This section outlines how the scores and observations recorded during the annual rehabilitation monitoring programme for each component of the monitoring program reflect the overall performance of each rehabilitation domain. When aligned to the analogue transects data, the data obtained for the rehabilitation transects allows an assessment as to whether the rehabilitated areas are on a trajectory to sustainability.

6.1 Landscape Function Analysis

The landscape function analysis (LFA) results describe the functionality of the landscape as a biophysical system by providing an assessment of the landscape organisation (though the landscape organisation index (LOI) and Patch Area Index (PAI) and of the soil surface condition (through the soil surface condition index (SSCIs)).

- The LOI is the proportion of the length of patch to the total length of the transect and reflects the heterogeneity of the

landscape in terms of the distribution of ground cover and other deposited materials
- The PAI is a measure of the area covered by the patches along the transect, and describes the ability of the landscape to capture and retain resources.
- The stability index indicates the ability of the soil to withstand erosive forces, and to reform following disturbance.
- The infiltration index defines how the soil partitions rainfall into soil-water (water available for plant use), and runoff water which is lost from the local system and may also transport materials (soil, nutrients and seeds) away.
- The nutrient cycling index indicates how efficiently organic matter is cycled back into the soil.

The soil surface indicators influencing on each soil surface condition index (SSCI) are represented in **Figure 3**.
Overall, a soil landscape that is on a trajectory to sustainability in context of a vegetative cover and soil stability would have high LOI and PAI values (i.e. close to 1 indicating good vegetation cover – while lower values indicate higher occurrence of bare ground) and high SSCI scores (out of a 100). The benchmarks for landscape function indices for rehabilitated mine sites are outlined in **Table 13** (benchmark values are derived from Tongway & Hindley (2003) and CSIRO (2008) and adapted from the index scores obtained for the analogue sites).

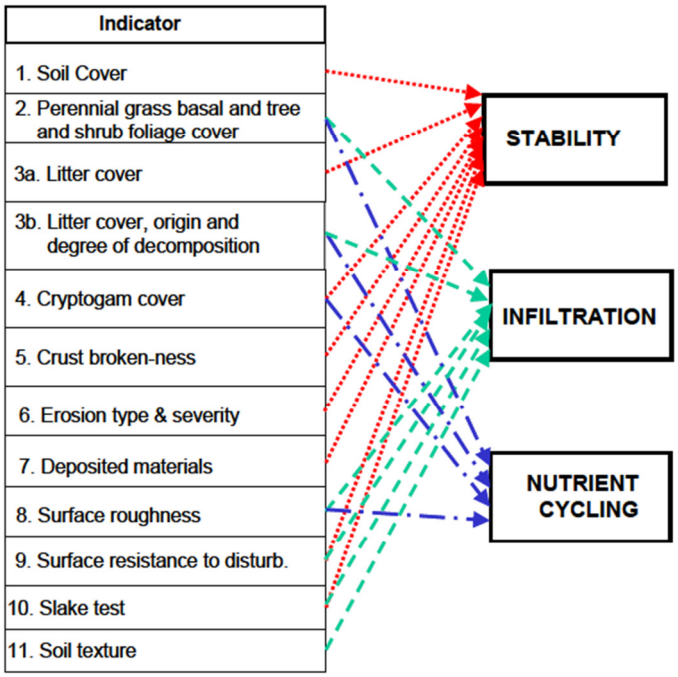

Figure 3. Allocation of the Indicators to the Soil Surface Assessment Indices

Table 13. Benchmarks for Landscape Function Indices

Rating	LOI	PAI	Stability Index	Infiltration Index	Nutrient Cycling Index
Excellent	>0.8	>0.7	55+	50+	40+
Good	0.6-0.8	0.5-0.7	45-55	40-50	30-40
Satisfactory	0.4-0.6	0.4-0.5	35-45	30-40	20-30
Poor	0.2-0.4	0.2-0.4	25-35	20-30	10-20
Very poor	<0.2	<0.2	<25	<20	<10

6.2 Vegetation Dynamics

In terms of vegetation dynamics, an area that is on a trajectory to self-sustainability would have:
- A low percentage of bare ground;

- High density of woody plants – or density similar to that of corresponding analogue sites;
- High average canopy cover – or similar to that of corresponding analogue sites; and
- High plant species richness – or similar to that of corresponding analogue sites.

The vegetation dynamics benchmarks for rehabilitated mine sites are derived directly from the observation gathered at the corresponding analogue sites, and in accordance with the ratings presented in **Table 14**.

Table 14. Vegetation Dynamics Benchmarks

Parameter	Excellent	Good	Satisfactory	Poor	Very poor
Bare ground percentage	<10%	10-20%	20-40%	40-70%	>70%
Total woody plant density	±10% of analogue sites average	Differs 10-20% from analogue sites average	Differs 20-40% from analogue sites average	Differs 40-70% from analogue sites average	Differs more than 70% from analogue sites average
Woody plants stratification	The percentage of plants in each stratum is within the standard deviations of the mean calculated for the analogue sites.	The percentage of plants in each stratum is within 1.5 standard deviations of the mean calculated for the analogue sites.	The percentage of plants in each stratum is within 2 standard deviations of the mean calculated for the analogue sites.	The percentage of plants in each stratum is within 3 standard deviations of the mean calculated for the analogue sites. **or** One stratum is missing/is not represented	The percentage of plants in each stratum deviates by more than 3 standard deviations of the mean calculated for the analogue sites. **or** Two strata are missing/are not represented
Total woody species richness	±10% of analogue sites average	Differs 10-20% of analogue sites average	Differs 20-40% of analogue sites average	Differs 40-70% of analogue sites average	Differs more than 70% of analogue sites average
Species assemblage / composition	Species assemblage is fully aligned to that of analogue sites, including relative abundance of specific species	Although some foreign species are present, the dominant / common species occurring in all stratums are those found in analogue areas **and/or** species are aligned to those found in analogue areas but the abundance and dominance patterns differ.	The dominant/common species establishing in one or two strata are generally aligned to those found in analogue areas **and/or** One stratum is missing / is not represented **and/or** No more than 50% of species establishing are foreign to analogue areas.	Although some species found in analogue areas may be represented, the rehabilitated area contains species mostly that are foreign to the corresponding analogue areas **and/or** Two strata are missing / not represented	Species establishing in rehabilitated areas are not found in analogue areas. A foreign / undesired ecosystem is re-establishing.
Canopy cover percentage	±10% of analogue sites average	±10-25% of analogue sites average	±25-40% of analogue sites average	±40-60% of analogue sites average	Differs more than 60% of analogue sites average

6.3 Habitat Complexity

Habitat structure and complexity and the availability of key ecological resources in forests strongly influence species richness and abundance, as well as ecological function (Lindenmayer et al., 2000). In terms of habitat complexity, an area that is on a trajectory to self-sustainability would have:

- Tree and shrub canopy present;
- Ground cover of vegetation present;
- Presence of logs, rocks and woody debris;
- Presence of free standing water and/or soil moisture; and
- Presence of tree hollows.

The higher the complexity score the more macro-habitats are available for flora and fauna in the area. Although theoretically the maximum score for habitat complexity is 18 for forested ecosystems, it is very unlikely that in any particular area all indicators of habitat complexity record the maximum score, and an ecosystem with a habitat complexity score >9 is generally considered complex and as

providing a range of micro-habitats as available to fauna. The benchmarks for habitat complexity are presented in **Table 15**.

Table 15. Habitat Complexity Benchmarks

Rating	Habitat complexity score
Excellent	≥9
Good	7-8
Satisfactory	5-6
Poor	3-4
Very poor	≤2

6.4 Disturbance Monitoring

Results of the disturbance monitoring reflect the level to which a site is affected by various disturbance factors. The ultimate objective of rehabilitation transects would be to have the lowest disturbance score (i.e. little or no disturbance factors impacting the site) or a degree of disturbance that is similar to that impacting the corresponding analogue sites (both in terms of the nature of the disturbance factors and their intensity).
The lower the overall disturbance score the less disturbed the site and therefore the more successful the rehabilitation.

7. Rehabilitation Implementation

7.1 Status at MOP Commencement

At the commencement of this MOP all domains (1-4) were active **(Plan 2 (Appendix 3))**. These active domains are subject to ongoing operations.

Progressive rehabilitation has commenced on Domain 3 (REAs). The rehabilitation status of Each REA at the commencement of the MOP is described below in **Table 16.**

Table 16. Rehabilitation Status of Domain 3 at MOP Commencement

REA	Approval Date	Approved Volume	Rehabilitation Status	Closure of REA	Description/Notes
I	1980's	Combined approved vol 3 Mt	Currently rehabilitated and undergoing monitoring and maintenance.	1980's	Domain 3 in MOP
II	19/06/1992	Combined approved vol 3 Mt	Currently rehabilitated and undergoing monitoring and maintenance.	Mid 1990's	Domain 3 in MOP To be used for topsoil/subsoil storage - material from REA VI in the established storage area.
III	7/10/1993	1.74Mt	Requires reshaping and rehabilitation. REA III is currently being investigated for future product marketing	Under Review in Strategic Management of Reject	Domain 3 in MOP. Strategically, market prospects for reject material are being pursued by Clarence as

			opportunities for finer reject materials, and final landform and timing of rehabilitation is directly influenced.	Emplacement	an opportunity to reduce reject volumes in the longer term.
IV	July 2011	0.54Mt	Progressive rehabilitation is occurring on REA IV at the completion on each 8m lift.	Expected capacity reached by Nov 2014.	REA IV is now actively being used. Reject Emplacement Management controls apply.
V	-	4.8Mt	N/A	Approx. 2yr capacity	Planning approval is in place to construct REA V within the Clarence Colliery Rail Loop. However this site is not a cost effective solution to reject emplacement and remains a contingency option only at this stage.
VI	-	Proposed 0.55Mt	Included within Domain 3 in MOP.		

7.2 Proposed Rehabilitation Activities during the MOP Term

Progressive rehabilitation of the surface emplacements has been undertaken over recent years and at present rehabilitation progress has kept up with emplacement development.

Table 17 summarises the forecast rehabilitation during the MOP period and is pictorially shown in **Plans 3A-3G (Appendix 4)**.

During the MOP term the following rehabilitation will occur:

- Further Progressive rehabilitation of REA IV (2 ha scheduled to be completed in 2014).
- REA VI is scheduled to be rehabilitated after the MOP period once additional capping material becomes available.

Table 17. Disturbance and Rehabilitation Progression during the term of the MOP

Year	Total Disturbance Area (ha) *	Total Rehabilitation Area (ha) (per MOP Year) **	Cumulative Rehabilitation Area	Comments/Explanation (provide a list of key changes)
At start of MOP	82	26	26	Includes pit top infrastructure areas Active REAs include REA III, REA IV and the proposed REA VI Rehabilitation Areas includes REA I, REA II and part of REA III, REA IV
1	82	2 (REA IVa Rehabilitation)	28	Includes pit top infrastructure areas Active REAs include REA III, REA IV and the proposed REA VI Rehabilitation Areas includes REA I, REA II and part of REA III, REA IV
2	82	0	28	Includes pit top infrastructure areas Active REAs include REA III, REA IV and the proposed REA VI Rehabilitation Areas includes REA I, REA II and part of REA III, REA IV
3	82	0	28	Includes pit top infrastructure areas Active REAs include REA III, REA IV and the proposed REA VI Rehabilitation Areas includes REA I, REA II and part of REA III, REA IV
4	82	0	28	Includes pit top infrastructure areas Active REAs include REA III, REA IV and the proposed REA VI Rehabilitation Areas includes REA I, REA II and part of REA III, REA IV LOM Reject Emplacement TBC

5	82	0	28	Includes pit top infrastructure areas Active REAs include REA III, REA IV and the proposed REA VI Rehabilitation Areas includes REA I, REA II and part of REA III, REA IV LOM Reject Emplacement TBC
6	82	0	28	Includes pit top infrastructure areas Active REAs include REA III, REA IV and the proposed REA VI Rehabilitation Areas includes REA I, REA II and part of REA III, REA IV LOM Reject Emplacement TBC
At End of MOP	82	0	28	Includes pit top infrastructure areas Active REAs include REA III, REA IV and the proposed REA VI Rehabilitation Areas includes REA I, REA II and part of REA III, REA IV LOM Reject Emplacement TBC

*Total disturbance area includes areas of land which are within the following phases: Active and Decommissioning. Temporary rehabilitation is to be considered as an active mining area for the purposes of this table.

** Total Rehabilitation Area includes areas of land which are within the following phases: Landform Establishment and Growth Medium Development, Ecosystem and Land Use Establishment, and Ecosystem and Land Use Sustainability.

7.3 Summary of Rehabilitation Areas during the MOP Term

Plans 3A – 3G display the annual sequence of mining and rehabilitation activities over the term of the MOP (**Appendix 4**).

7.4 Relinquishment Phase achieved during MOP period

It is not anticipated Clarence will relinquish any rehabilitated lands during the MOP period.

8. Rehabilitation Monitoring and Reporting

8.1 Rehabilitation Monitoring

Clarence undertakes an annual monitoring programme which involves the application of CSIRO's ecosystem function analysis (EFA) tool (Tongway & Hindley 2004), vegetation monitoring components, and the AECOM-developed Visual Monitoring tool.

The EFA methodology creates indices based on simple field indicators that reflect the measured variables of stability, water infiltration and nutrient cycling, in turn monitoring the functional status of the landscape. The methodology used does not replace the traditional methods of monitoring vegetation and fauna, but adds a functional interpretation to link vegetation structure and organisation more closely with soil function and the development of habitat for native fauna. Utilising the EFA method, scientifically robust data is provided on the rehabilitation sites, which when compared to the data collected from analogue sites, accurately reflects if the site is on a trajectory towards a sustainable ecosystem. The interpretation of this data enables the development of land management recommendations to address those sites having lower EFA rankings.

8.2 Research and Rehabilitation Trials and Use of Analogue Sites

Throughout the MOP period, knowledge gaps will be identified through a risk assessment process. This will drive specific rehabilitation trials which may consider (but not limited to):

- Capping Processes and Performance including the effectiveness of capping different materials
- Long term leachate management and treatment
- Vegetation selection to achieve rehabilitation goals

9. Intervention and Adaptive Management

Corrective actions are identified and carried out in accordance with the Rehabilitation Trigger Action Response Plan to ensure rehabilitation outcomes are maintained and enhanced for each rehabilitation domain .

During 2013 rehabilitation monitoring the following recommendations was made to improve and enhance rehabilitation outcomes. This will be an ongoing process throughout the MOP period.

Measures Applicable to All Domains

- Undertake maintenance direct seeding with a view to increase basal ground cover, thereby promoting soil stability and reducing the risk for further surface erosion, and also enhancing organic matter. Seeding mix should contain endemic fast germinating and winter growing species together with a combination of sterile cover crop species.
- Incorporation of organic matter on the ground to assist in the cycling of organic matter. This material could comprise of locally sourced limbs from trees (ideally carrying fruit and seed) similar to those used in REA IV – this approach is commonly used in bush regeneration programmes as it has the added advantages of:
  - Limiting site disturbance that can be associated with importing brush material to the site;
  - Targeting Eucalypt species at the time of seed set provides the opportunity for seed laden fruit to be placed in

immediate contact with the growing media, whilst also providing protection from the associated leaf/twig material to the seed from insect predation and climatic conditions; and
- Material can selectively be placed in patches throughout the centre of the rehabilitated areas where the impact of fringe colonisation is usually limited.

- Implement techniques to improve soil water infiltration and soil water holding capacity. The benefits of all potential amelioration techniques need to be considered in the context of the level of damage they may cause to existing vegetation, for example, by the use of earthmoving machinery in sensitive rehabilitation areas. Techniques may include:
  - In areas of slope greater than 10º, the amount of water available to plants can be maximised by simple practices such as deep ripping along the contour thus allowing more water to infiltrate and less to runoff;
  - Avoid smooth sculptured surfaces as they shed water and do not hold seed and fertiliser as readily as rough surfaces; and
  - Incorporation and/or addition of organic matter to the soil. This may be achieved via the addition of composted wood material or locally sourced hay to the soil surface immediately post the direct seeding of the site. This is recommended in all areas where material is available.
- Installation of habitat structures, such as rock or timber emplacements, as well as water features such as dams, shallow depressions and undulations across the rehabilitated areas to encourage fauna re-colonisation and provide microhabitats for plant regeneration. For example, stag trees could be erected as nesting and roosting sites in those areas where mature canopy tree species are lacking.
- Maintain vigilance and continue the implementation of the pro-active weed control program primarily targeting Pampas Grass. The weed control program should also include consideration of the management and utilisation of topsoil in context of weed infestation and dispersal.
- Undertake the next round of rehabilitation monitoring in late winter/spring 2014 to enable comparison with data recorded to date, and establish additional rehabilitation monitoring transects in larger rehabilitated areas (e.g. additional transect within REA III) and as rehabilitation progresses throughout the site.

REA I

- Maintenance direct seeding and/or tubestock plantings focusing on eucalypt canopy species, with species selection aligned to those found in analogue sites and local surrounding vegetation communities.

REA II

- Maintenance direct seeding and/or tubestock plantings focusing on ground shrubs and canopy species, ensuring that species are endemic and aligned local surrounding vegetation communities.

REA III

- Maintenance direct seeding and/or tubestock plantings focusing on ground shrubs and middle storey species, ensuring that species are endemic and aligned local surrounding vegetation communities.
- Assess large continuous areas of bare ground and areas where sheet and gully erosion is evident and implement localised remedial works including revegetation, as required and appropriate.

REA IV

- Undertake seeding and/or tubestock plantings of the rehabilitated batter. Review seeding mix in terms of diversity of species in all stratum aligned to the *Sandstone Slopes Sydney Peppermint Shrubby Forest/Woodland* community, and select a species mix that ensures:
  - Species are endemic to the local area;
  - The species mix provides for a diversity of genus and species in all stratum;
  - The mix includes ground cover and mid stratum species to improve the functionality of the landscape in terms of soil stability, nutrient cycling, water infiltration and habitat complexity;
  - The species mix is aligned to the habitat requirements of the key forest fauna species;
  - Rapid germination, soil stabilising species (cover crop) that don't have a propensity to become weeds; and
  - Application rates are adequate to ensure a stable and sustainable native vegetative cover.

- Three months following seeding, undertake a rapid walk over and visual assessment of the site to assess the establishment and survival of the revegetated areas with particular attention to:
  - Groundcover establishment;
  - The distribution and density of native species seedlings;
  - The need for supplementary fertiliser application; and
  - Emergence and establishment of undesirable species including weeds.
- Assess areas where rill and gully erosion is evident and implement localised remedial works, as required and appropriate.

9.1 Threats to Rehabilitation

Specific threats to rehabilitation are outlined in **Section 3.2** Environmental Risk Management.

9.2 Trigger Action Response Plan

The Trigger Action Response Plan (TARP) identifies short and long term threats to rehabilitation at Clarence and mitigation measures to ensure rehabilitation outcomes are achieved. The TARP is based on Landform Function Analysis monitoring techniques.

The overall site rating process is outlined in **Figure 4**.

Table 18. Rehabilitation TARP in Relation to Threats

Normal	Moderate	Poor
Condition		
Landscape Organisation, Soil Surface Condition, Vegetation Dynamics and Habitat Complexity classified as GOOD* during annual rehabilitation monitoring. The rehabilitation domain is on a trajectory to a self-sustaining ecosystem.	Landscape Organisation, Soil Surface Condition, Vegetation Dynamics and Habitat Complexity classified as MODERATE* during annual rehabilitation monitoring. The rehabilitation domain is on a trajectory to a self-sustaining ecosystem.	Landscape Organisation, Soil Surface Condition, Vegetation Dynamics and Habitat Complexity classified as POOR* during annual rehabilitation monitoring. The rehabilitation domain is losing nutrients from the system. Rehabilitation Domain is actively eroding.
Response		
Continue Annual Rehabilitation Monitoring.	Continue Annual Rehabilitation Monitoring. Consider remedial actions to improve performance, including but not limited to: - Seeding; - Planting tube stock; - Mulching; and - Improving soil condition through the addition of organic matter.	Continue Annual Rehabilitation Monitoring. Implement immediate engineering control measures to prevent ongoing active erosion. Consider remedial actions to improve performance, including but not limited to: - Seeding; - Planting tube stock; and - Mulching. Improving soil condition through the addition of organic matter.

*refer to **Figure 4** for Classification Descriptions

Monitoring component		Monitoring components individual scoring	Coefficient applied	Max score	Total 1	Disturbance	Overall site score	Overall site rating
Landscape function	Landscape organisation index	Each parameter is assigned a score ranging from 1 to 5 based on its performance against the corresponding benchmarks, as follows: - Excellent: score of **5**; - Good: score of **4**; - Satisfactory: score of **3**; - Poor: score of **2**; and - Very poor: score of **1**.	2	10	Scores for all parameters are added up to generate a site rating out of 100	The site's disturbance status score is subtracted from Total 1 to produce the overall site score and assign an overall site rating.	**≥80**	**Excellent**
	Patch area index		2	10			**60-79**	**Good**
	Stability index		2	10			**40-59**	**Satisfactory**
	Infiltration index		2	10			**30-39**	**Poor**
	Nutrient cycling index		2	10			**<30**	**Very poor**
Vegetation dynamics	Bare ground percentage		2	10				
	Total woody plant density		2	10				
	Woody plants stratification		1	5				
	Total species richness		2	10				
	Species assemblage		1	5				
	Canopy cover percentage		1	5				
Habitat complexity			1	5				

Figure 4. Overall Site Rating Process

10. Reporting

Clarence will report various reporting mechanisms required to verify compliance with the MOP and support progression towards the post mining land use goal and rehabilitation objectives in the AEMR. This will include:

- Results of monitoring against key performance indicators;
- Compliance against commitments;
- Results against Rehabilitation Tables in MOP;
- Key trends in monitoring results and progression towards achievement of
- Rehabilitation objectives and completion/relinquishment criteria;
- Reporting on discrepancies between the predicted and actual results;
- Reporting of where a Trigger Action Response Plan has been implemented to
- Counter poor/unpredicted rehabilitation results or environmental impacts;
- Results of trials;
- Non-compliances; and
- Incidents.

11. Plans

11.1 Plans 1A, 1B, 1C – Project Locality

Plans 1A – 1C display the mine in relation to its surrounds and potential sensitive receptors as pertain to the rehabilitation program and the associated land use and landscape (**Appendix 2**).

11.2 Plan 2 – Mine Domains at Commencement of MOP

Plan 2 displays the mine domains and the mining features at commencement of the MOP (**Appendix 3**).

11.3 Plan 3A – 3G – Mining and Rehabilitation

This is a series of plans which display the annual sequence of mining and rehabilitation activities over the term of the MOP (**Appendix 4**).

11.4 Plan 4 – Final Rehabilitation and Post Mining Land Use

Plan 4 displays the proposed post mining land use and landform at the completion of the project i.e. at the end of the mine life (**Appendix 5**).

11.5 Plan 5 – Rehabilitation and Post Mining Land Use Cross Sections

Plan 5 displays vertical and longitudinal sections to support and clarify plans and text (**Appendix 6**).

Table 19. Colour Coding for Plans

Feature	Description	Legend-Key
Project Approval boundaries	Maroon	
Major & Minor Roads	Black	
Rail Line	Black	
Rivers and major drainage lines	Cretean Blue	
Cliff Lines	Green	
Drains	Light Blue	
Powerline	Pink	
Telstra Aboveground Cable	Grey	
Telstra Underground Cable	Light Purple	
Telstra Optical Fibre Cable	Orange	
Archaeological Sites	Red	
Contours	Light Grey	
Mining Tenement		
Authority boundary	Dashed 1 long 1 short (Grey, width 1mm)	
Existing workings	Blue	
Expected mining area	Tuscan Red	
RCC Boundaries	Dark Grey	
Primary domains:		
Coal Handling Preparation Plant	Brown (transparent 30%)	
Administration and Pit Top	Brown (transparent 30%)	
Reject Emplacement Area	Brown (transparent 30%)	
Surrounding Roads and Facilities	Brown (transparent 30%)	
Secondary domains:		
Rehabilitation Area - Woodland	Tree 1 (Fir Green, size 8, transparent background)	

Rehabilitation phases		
Decommissioning	hatching (Grey, size 2, separation 5)	
Landform Establishment	hatching (Solar Yellow, size 2, separation 5)	
Growth Medium Development	hatching (Orange, size 2, separation 5)	
Ecosystem Establishment	hatching (Fir Green, size 2, separation 5)	
Ecosystem Sustainability	hatching (Blue, size 2, separation 5)	
Relinquished Lands	hatching (Purple, size 2, separation 5)	

12. Review and Implementation of the MOP

12.1 Review of the MOP

The MOP will be reviewed on an annual basis and documented in the AEMR. Rehabilitation provisions are reviewed on an annual basis and also included in the submission on the AEMR.

12.2 Implementation

The Clarence Environmental and Community Coordinator will be responsible for the monitoring, review and implementation of this MOP in consultation with the Clarence Technical Services Manager and Mine Manger.

References

Clarence Colliery 2005, *Eastern Area Partial Extraction, Subsidence Management Plan*.

Clarence Colliery 2011, *Partial Extraction of Areas 700 West and 800, Subsidence Management Plan.*

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Department of Environment and Conservation (DEC) 2006, *The Vegetation of the Western Blue Mountains*, Unpublished report funded by Hawkesbury – Nepean Catchment Management Authority, Department of Environment and Conservation, Hurstville.

International Environmental Consultants 2000, *Clarence Colliery Lease Extension - Environmental Impact Statement*, International Environmental Consultants.

Lindenmayer, D.B, Margules, C.R & Botkin, D.B 2000, 'Indicators of Biodiversity for Ecologically Sustainable Forest Management', *Conservation Biology*, vol. 14, no.4, pp. 941-950.

Tongway, D.J & Hindley, N.L 2003, *Indicators of Ecosystem Rehabilitation Success Stage Two – Verification of EFA Indicators Final Report*, CSIRO, Canberra.

Tongway, D. J & Hindley, N.L. (2004) Landscape Function Analysis: Procedures for monitoring and assessing landscapes, with special reference to minesites and rangelands, CSIRO, Canberra.

United Nations Educational, Scientific and Cultural Organization (UNESCO) 2013, *Greater Blue Mountains Area*, viewed 7 May 2013, <http://whc.unesco.org/en/list/917>

2014 Mine Closure and Rehabilitation Risk Assessment

Appendix 1

Contents

Executive Summary of Top 10 Severities

Study Approval

Scoping Documents Contents

1. Background

2. Objective

3. Potential Hazards

4a. Risk Assessment Boundary Definition

4b. Boundary Definition

5. Risk Assessment Methods

6. Previous Risk Assessment and other documents to be used and/or referenced

7. Information Required for Risk Assessment

8. Venue and Time

9. Risk Assessment Team Selection

10. Scope Confirmation

WRAC Analysis

WRAC Analysis Worksheet

WRAC Analysis Sorted by RR

WRAC Analysis Sorted by Consequence

Recommended Controls

CEY Risk Matrix

CEY Risk Matrix Page 1

CEY Risk Matrix Page 2

CEY Risk Matrix Page 3

BOWTIE (PRINT REPORT)

Executive Summary of Top 10 Risks

Executive Summary of Top 10 Severities

Study Approval

Scoping Documents Contents

1. Background

2. Objective

3. Potential Hazards

4a. Risk Assessment Boundary Definition

4b. Boundary Definition

5. Risk Assessment Methods

6. Previous Risk Assessment and other documents to be used and/or referenced

7. Information Required for Risk Assessment

8. Venue and Time

9. Risk Assessment Team Selection

10. Scope Confirmation

CEY Risk Matrix

CEY Risk Matrix Page 1

CEY Risk Matrix Page 2

CEY Risk Matrix Page 3

FMEA (PRINT REPORT)

Executive Summary of Top 10 Risks

Executive Summary of Top 10 Severities

Study Approval

Scoping Documents Contents

1. Background

2. Objective

3. Potential Hazards

4a. Risk Assessment Boundary Definition

4b. Boundary Definition

5. Risk Assessment Methods

6. Previous Risk Assessment and other documents to be used and/or referenced

7. Information Required for Risk Assessment

8. Venue and Time

9. Risk Assessment Team Selection

10. Scope Confirmation

FMEA

List of Components and Functions

Component Block Diagram

FMEA Worksheet

FMEA Sorted by RR

FMEA Sorted by Consequence

Effect Type - Safety: Issues Raised by FMEA

Recommended Controls

CEY Risk Matrix

CEY Risk Matrix Page 1

CEY Risk Matrix Page 2

CEY Risk Matrix Page 3

HAZOP (PRINT REPORT)

Executive Summary of Top 10 Risks

Executive Summary of Top 10 Severities

Study Approval

Scoping Documents Contents

1. Background

2. Objective

3. Potential Hazards

4a. Risk Assessment Boundary Definition

4b. Boundary Definition

5. Risk Assessment Methods

6. Previous Risk Assessment and other documents to be used and/or referenced

7. Information Required for Risk Assessment

8. Venue and Time

9. Risk Assessment Team Selection

10. Scope Confirmation

HAZOP

Nodes and Deviations

HAZOP Worksheet

HAZOP Sorted by RR

HAZOP Sorted by Consequence

Recommended Controls

CEY Risk Matrix

CEY Risk Matrix Page 1

CEY Risk Matrix Page 2

CEY Risk Matrix Page 3

Instructions:

Recommended Controls (hover for instructions):

Recommended Controls Do NOT enter additional Recommended Controls on this sheet.	Place(s) Used	Allocated To (Only one SITE person for each Recommended Control)	Required By Date	Pulse User No.	PULSE Ref. No.
1. Complete detailed rehabilitation plan to include soil suitability testing for capping material	Events: 2.1, 3.1, 3.2, 5.1, 6.1, 7.1, 8.1, 8.2	Jesse Percival	23-Jan-2015	20081	
2. Complete a detailed revegetation plan to include seed collection and planting schedule	Events: 2.1, 3.1, 3.2, 5.1, 6.1, 7.1, 8.1, 8.2, 8.3	Jesse Percival	28-Nov-2014	20081	
3. Survey capping material stockpile to estimate volumes available	Events: 7.1	Jesse Percival	23-Jan-2015	20081	
4. Discuss with CCC appropriate expectations regarding consultation for mine closure	Events: 12.1, 13.1, 13.2	Jesse Percival	23-Jan-2015	20081	
5. Document MoU with LCC regarding LCC water transfer scheme	Events: 13.1, 13.2	Greg Shields	15-Jan-2015	80021	
6. Develop a register of alternate landuse options post closure	Events: 13.1, 13.2	Jesse Percival	15-Oct-2014	20081	

Dyadem Stature for Risk Management:

Risk Assessment Title: Rehabilitation and Mine Closure Risk Assessment

Version: 1

Region: West

Site: Clarence

Department: ZZZZ Whole Site

Equipment / **Process:** HSMS

Stature Risk Assessment No.: 1000836000

Study Lifecycle State: Risk Assessment Approval Pending

Potential Hazard No.:

PULSE Actions Required URL:

Site Risk Assessment Ref. No. (Optional):

Dyadem Stature for Risk Management:

Risk Assessment Title: Rehabilitation and Mine Closure Risk Assessment

Version: 1

Region: West

Site: Clarence

Department: ZZZZ Whole Site

Equipment / **Process:** HSMS

Stature Risk Assessment No.: 1000836000

Study Lifecycle State: Risk Assessment Approval Pending

Potential Hazard No.:

PULSE Actions Required URL:

Site Risk Assessment Ref. No. (Optional):

Approver	Approved / Rejected	Date	Comments
1. Jesse Percival	Approved	May 19, 2014	

As a part of the 2014 - 2017 mining operations plan (MOP), Clarence is required to complete a risk assessment to determine risks associated with mine closure and rehabilitation. Areas covered in this risk assessment include exploration, spontaneous combustion, geochemical material, land contamination, revegetation failure, acid mine drainage, capping materials, seed supply, timing of rehabilitation activities, leachate management, final landform design, visual amenity and failure to obtain stakeholder acceptance of rehabilitation.

The following Hierarchy of Controls offers a framework for considering the effectiveness of controls. Note that the effectiveness of a control that is intended to reduce a risk decreases from top to bottom of the list. In other words, the closer the control type is to the top of the hierarchy, the more potentially effective the control.

·Eliminate the hazard or energy source (do not use the energy)

·Minimise or replace the hazard or energy source (reduce the amount of energy to a less damaging level or replace the energy with another that has less potential negative consequences)

·Control the hazard or energy using engineered devices (ex. Lock outs, chemical containers, mechanical roof support, gas monitors, etc.)

·Control the hazard or energy by using physical barriers (ex. machine guarding, warning signs, etc.)

·Control the hazard or energy with procedures (ex. Isolation procedures, standard operating procedures, etc.)

·Control the hazard or energy with personal protective equipment (ex. hard hats, boots with toe caps, gloves, safety glasses, welding gear, etc.)

·Control the hazard or energy with warnings and awareness (ex. posters, labels, stickers, verbal warnings, etc.)

To identify, assess and control the risks to people, plant and environment to ensure that rehabilitation complies with Government and stakeholder expectations or requirements for mine closure and rehabilitation.

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The boundary of this risk assessment includes the Clarence mining lease areas that require rehabilitation at the closure of the mine.

Yes/No	Method
Yes	Workplace Risk Assessment and Control (WRAC)
	Fault Tree Analysis (FTA)
	Safety Integrity Level Analysis to Australian Standard 61508 (SIL)
	Bow Tie Analysis (BTA)
	Failure Modes and Effects Analysis (FMEA)
	Hazard and Operability Analysis (HAZOP)

Document Name	Title	Version	Referenced Document Date
	Environment and community risk assessment		
	Mining Operations Plan 2014 - 2017		
	Clarence Mine Closure and Rehabilitation Plan		
	SEWPAC Approval (specific to exploration in 800 Area)		
	Independent audit for the Clarence Development Consent (DA 504-00)		
	Development consent DA 504-00		
	1976 Approval		
	1994 Approval		
	1993 Approval		
	EPL 726		

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Date	Description	Location	Start Time	End Time	Comment
1. 15-May-2014	Scoping	Clarence Conference Room	9:00 AM	12:00 PM	
2.	Assessment				
3.	Review				

Name	Title	Company	Industry Start Date	Yrs. of Exp.	Mobile Phone #	E-Mail Address	Pulse User No.	Role	Attendance		
									1. 15-May-2014	2.	3.
Edwina White	Technical Services Superintendent	Clarence Colliery	04-Dec-1995	18	0427 780 786	edwina.white@centennialcoal.com.au	20080	(none)	P		
Jesse Percival	Environment & Community Coordinator	Clarence Colliery	14-May-2010	4		jesse.percival@centennialcoal.com.au	20081	Risk Assessment Owner	P		
Barry Riley	HST Superintendent	Clarence Colliery	20-Nov-1989	25	0414 744 790	barry.riley@centennialcoal.com.au	20523	(none)	P		
Olivia Kay	Systems Administration Officer	Clarence Colliery	20-Nov-2007	7		olivia.kay@centennialcoal.com.au	20078	Administrative Assistant	P		
Bruce McKenzie	CHPP Superintendent	Clarence Colliery	03-Jan-1978	36	0417 331 187	bruce.mckenzie@centennialcoal.com.au	20087	(none)	A		

Approver	Scope Confirmation	Date	Comments
1. Olivia Kay	Yes	May 15, 2014	Jesse Percival unable to finalise approval but ok for approval of scoping to complete RA

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control	Bow Tie Extension
1. Exploration	There is a risk to Clarence from ::: Rehabilitation failure ::: Caused by: Bushfire or Erosion or Inadequate biological resources or Inadequate monitoring and maintenance or Inadequate planning or Vandalism Resulting in: Failure to meet rehabilitation requirements or Failure to meet stakeholder expectations or Inability to relinquish securities.	1.1.a. Review of Environmental Factors carried out 1.1.b. Inspection program of rehabilitated exploration 1.1.c. SEWPAC approval and annual performance reporting 1.1.d. Allocated budget for rehabilitation maintenance 1.1.e. Securities with the Department for all rehabilitated area 1.1.f. Annual reporting carried in AEMR 1.1.g. Borehole CEMP - sets out erosion and sediment controls	**D** (D)	5 (F)	24 (L)		
2. Spontaneous combustion	There is a risk to Clarence from ::: Heating of reject material ::: Caused by: bushfire or Inadequate biological resources or Inadequate capping or Inadequate compaction during emplacement or Inadequate	2.1.a. Annual rehabilitation monitoring carried out by experienced personnel 2.1.b. R70 tests show that Katoomba seam coal has a low-moderate propensity for spon com 2.1.c. Weekly and monthly environmental inspections 2.1.d. REA inspections RE appropriate compaction levels	**C** (Pb)	4 (F)	18 (M)	1. Complete detailed rehabilitation plan to include soil suitability testing for capping material 2. Complete a detailed revegetation plan to include seed collection and planting schedule	

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control	Bow Tie Extension
	monitoring and maintenance or Inadequate planning Resulting in: Failure to meet rehabilitation requirements or Failure to meet stakeholder expectations or Inability to relinquish securities or Injury to public traversing the area.	2.1.e. Capping material excavated during construction phase 2.1.f. Regular compaction testing carried out on REAs to monitor compaction performance 2.1.g. MOP sets out rehabilitation performance criteria					
3. Leachate management	There is a risk to Clarence from ::: Contaminated seepage ::: Caused by: Geochemistry of reject material or Inadequate capping or Inadequate revegetation Resulting in: Failure to meet rehabilitation requirements or Failure to meet stakeholder expectations or Inability to relinquish securities.	3.1.a. Annual rehabilitation monitoring carried out by experienced personnel 3.1.b. MOP sets out rehabilitation performance criteria 3.1.c. Capping material excavated during construction phase 3.1.d. Regular compaction testing carried out on REAs to monitor compaction performance 3.1.e. Site Water Management Plan 3.1.f. Securities with the Department for all rehabilitated area 3.1.g. REA VI will be clay line to form a low permeability barrier	C (Pb)	4 (F)	18 (M)	1. Complete detailed rehabilitation plan to include soil suitability testing for capping material 2. Complete a detailed revegetation plan to include seed collection and planting schedule	
	There is a risk to Clarence from	3.2.a. Securities with the Department	C	4	18	2. Complete a detailed revegetation plan to include seed	

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control	Bow Tie Extension
		for all rehabilitated area	(Pb)	(F)	(M)	collection and planting schedule	
	::: Contaminated surface water release offsite ::: Caused by: Geochemistry of reject material or Inadequate capping or Inadequate treatment of surface water or Poor surface water management Resulting in: Failure to meet rehabilitation requirements or Failure to meet stakeholder expectations or Inability to relinquish securities.	3.2.b. Site Water Management Plan				1. Complete detailed rehabilitation plan to include soil suitability testing for capping material	
		3.2.c. Regular compaction testing carried out on REAs to monitor compaction performance					
		3.2.d. Capping material excavated during construction phase					
		3.2.e. MOP sets out rehabilitation performance criteria					
		3.2.f. Annual rehabilitation monitoring carried out by experienced personnel					
4. Land contamination	There is a risk to Clarence from ::: Hydrocarbon in soil ::: Caused by: Inadequate decommissioning of surface and underground hydrocarbon storage facilities or Inadequate disposal of contaminated materials	4.1.a. Securities with the Department for all rehabilitated area	**E** (D)	4 (F)	23 (L)		
		4.1.b. Phase 1 and Phase 2 Environmental site assessment completed showing low contamination risk					
		4.1.c. Removal of pit top underground diesel tanks and validation report completed					
		4.1.d. Decommissioning of underground CHPP diesel tank					

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control	Bow Tie Extension
	Resulting in: Failure to meet rehabilitation requirements or Failure to meet stakeholder expectations or Inability to relinquish securities.	4.1.e. Shallow groundwater monitoring across the pit top					
	There is a risk to Clarence from ::: Excessive nutrients from Sewerage treatment plant ::: Caused by: Inadequate decommissioning of sewerage treatment plant or Inadequate disposal of contaminated pond material Resulting in: Failure to meet rehabilitation requirements or Failure to meet stakeholder expectations or Inability to relinquish securities.	4.2.a. Securities with the Department for all rehabilitated area 4.2.b. Annual review of rehabilitation liabilities	**C** (D)	5 (F)	22 (L)		
5. Revegetation	There is a risk to Clarence from	5.1.a. Annual rehabilitation monitoring carried out by experienced personnel	**C** (Pb)	4 (F)	18 (M)	2. Complete a detailed revegetation plan to include seed collection and planting schedule	

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control	Bow Tie Extension
	::: Failure to meet species requirements ::: Caused by: Bushfire or Erosion or Inadequate biological resources or Inadequate capping or Inadequate monitoring and maintenance or Inadequate planning or Inadequate revegetation or Pest attack or Weed invasions Resulting in: Failure to meet rehabilitation requirements or Failure to meet stakeholder expectations or Inability to relinquish securities.	5.1.b. Annual reporting carried in AEMR 5.1.c. Capping material excavated during construction phase 5.1.d. MOP sets out rehabilitation performance criteria 5.1.e. Site Water Management Plan 5.1.f. Quarterly maintenance of rehabilitation areas 5.1.g. Monthly weed management 5.1.h. Seed collection carried out 5.1.i. Commenced development of tube stock from local seed 5.1.j. Surrounded by extensive areas of natural vegetation				1. Complete detailed rehabilitation plan to include soil suitability testing for capping material	
6. Top soil	There is a risk to Clarence from ::: Inadequate management of topsoil ::: Caused by: Erosion or Inadequate biological	6.1.a. Annual rehabilitation monitoring carried out by experienced personnel 6.1.b. Annual reporting carried in AEMR 6.1.c. Topsoil management plan 6.1.d. progressive rehabilitation carried out as set out in the	**D** (D)	4 (F)	21 (L)	2. Complete a detailed revegetation plan to include seed collection and planting schedule 1. Complete detailed rehabilitation plan to include soil suitability testing for capping material	

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control	Bow Tie Extension
	resources or Inadequate capping or Inadequate monitoring and maintenance or Inadequate planning or Inadequate testing of material or Long-term storage of topsoil or Poor stockpiling management or Poor surface water management or Unviable topsoil material Resulting in: Failure to meet rehabilitation requirements or Failure to meet stakeholder expectations or Inability to relinquish securities.	MOP 6.1.e. MOP sets out rehabilitation performance criteria 6.1.f. Securities with the Department for all rehabilitated area 6.1.g. Site Water Management Plan 6.1.h. Only endemic vegetation species used on rehabilitation					
7. Capping material	There is a risk to Clarence from ::: Inadequate capping material ::: Caused by: Inadequate application of capping material or Inadequate testing of material or Lack of availability (i.e. volume) or Unsuitable capping material Resulting in: Failure to meet rehabilitation requirements or Failure to meet	7.1.a. Capping material excavated during construction phase 7.1.b. MOP sets out rehabilitation performance criteria 7.1.c. Securities with the Department for all rehabilitated area 7.1.d. Compaction testing of on site material demonstrates its suitability 7.1.e. Annual reporting carried in AEMR 7.1.f. Annual review of rehabilitation liabilities	**C** (Pb)	3 (F)	13 (S)	2. Complete a detailed revegetation plan to include seed collection and planting schedule 1. Complete detailed rehabilitation plan to include soil suitability testing for capping material 3. Survey capping material stockpile to estimate volumes available	

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control	Bow Tie Extension
	stakeholder expectations or Inability to relinquish securities.						
8. Reseeding and tube stock	There is a risk to Clarence from ::: Inadequate supply ::: Caused by: Inadequate biological resources or Inadequate development of tube stock or Inadequate planning or Inadequate storage of seed or Poor seed quality i.e. germination viability Resulting in: Failure to meet rehabilitation requirements or Failure to meet stakeholder expectations or Inability to relinquish securities.	8.1.a. Annual rehabilitation monitoring carried out by experienced personnel	**D** (D)	4 (F)	21 (L)	2. Complete a detailed revegetation plan to include seed collection and planting schedule	
		8.1.b. Annual reporting carried in AEMR				1. Complete detailed rehabilitation plan to include soil suitability testing for capping material	
		8.1.c. Annual review of rehabilitation liabilities					
		8.1.d. Commenced development of tube stock from local seed					
		8.1.e. Seed collection carried out					
		8.1.f. Budget allocation for ongoing seed collection					
		8.1.g. Surrounded by extensive areas of natural vegetation					
		8.1.h. Securities with the Department for all rehabilitated area					
	There is a risk to Clarence from ::: Inadequate diversity :::	8.2.a. Annual rehabilitation monitoring carried out by experienced personnel	**D** (D)	4 (F)	21 (L)	1. Complete detailed rehabilitation plan to include soil suitability testing for capping material	
		8.2.b. Annual reporting carried in AEMR				2. Complete a detailed revegetation plan to include seed collection and planting schedule	
		8.2.c. Annual review of rehabilitation					

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control	Bow Tie Extension
	Caused by: Inadequate biological resources or Inadequate development of tube stock or Inadequate planning or Inadequate storage of seed or Poor seed quality i.e. germination viability Resulting in: Failure to meet rehabilitation requirements or Failure to meet stakeholder expectations or Inability to relinquish securities.	liabilities 8.2.d. Commenced development of tube stock from local seed 8.2.e. Seed collection carried out 8.2.f. Budget allocation for ongoing seed collection 8.2.g. Surrounded by extensive areas of natural vegetation 8.2.h. MOP sets out rehabilitation performance criteria 8.2.i. Securities with the Department for all rehabilitated area					
	There is a risk to Clarence from ::: Poor timing of revegetation ::: Caused by: Inadequate knowledge or Inadequate (seasonal) planning or Poor climatic conditions	8.3.a. Annual rehabilitation monitoring carried out by experienced personnel 8.3.b. Annual reporting carried in AEMR 8.3.c. Surrounded by extensive areas of natural vegetation 8.3.d. Commenced development of tube stock from local seed 8.3.e. Seed collection carried out	**C** (D)	4 (F)	18 (M)	2. Complete a detailed revegetation plan to include seed collection and planting schedule	

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control	Bow Tie Extension
	Resulting in: Failure to meet rehabilitation requirements or Failure to meet stakeholder expectations or Inability to relinquish securities.	8.3.f. MOP sets out rehabilitation performance criteria					
		8.3.g. Securities with the Department for all rehabilitated area					
		8.3.h. Budget allocation for ongoing seed collection					
9. Timing of rehabilitation	There is a risk to Clarence from ::: Rehabilitation targets not achieved ::: Caused by: Inadequate biological resources or Inadequate budget available or Inadequate monitoring and maintenance or Inadequate planning or Inadequate revegetation or Inadequate (seasonal) planning or Poor climatic conditions or Unsuitable capping material or Unviable topsoil material Resulting in: Failure to meet rehabilitation requirements or Failure to meet stakeholder expectations or Inability to	9.1.a. Annual rehabilitation monitoring carried out by experienced personnel	**D** (D)	4 (F)	21 (L)		
		9.1.b. Annual reporting carried in AEMR					
		9.1.c. Surrounded by extensive areas of natural vegetation					
		9.1.d. Commenced development of tube stock from local seed					
		9.1.e. Seed collection carried out					
		9.1.f. MOP sets out rehabilitation performance criteria					
		9.1.g. Securities with the Department for all rehabilitated area					
		9.1.h. Budget allocation for ongoing seed collection					
		9.1.i. progressive rehabilitation carried out as set out in the					

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control	Bow Tie Extension
	relinquish securities.	MOP					
10. Final landform	There is a risk to Clarence from ::: Inadequate landform shaping ::: Caused by: Inadequate monitoring and maintenance or Inadequate operational control of reject emplacement area or Inadequate planning or Inadequate slope stability management Resulting in: Failure to meet rehabilitation requirements or Failure to meet stakeholder expectations or Inability to relinquish securities or Injury to public traversing the area.	10.1.a. Slope Stability Management Plan 10.1.b. Detailed designs of final landform for REAs 10.1.c. MOP sets out rehabilitation performance criteria 10.1.d. Annual rehabilitation monitoring carried out by experienced personnel 10.1.e. Securities with the Department for all rehabilitated area 10.1.f. Periodic surveys of REAs	**D** (D)	4 (F)	21 (L)		
	There is a risk to Clarence from ::: Landslip :::	10.2.a. Slope Stability Management Plan 10.2.b. Detailed designs of final landform for REAs 10.2.c. MOP sets out rehabilitation performance criteria	**D** (Pb)	4 (F)	21 (L)		

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control	Bow Tie Extension
	Caused by: Inadequate monitoring and maintenance or Inadequate operational control of reject emplacement area or Inadequate planning or Inadequate slope stability management Resulting in: Failure to meet rehabilitation requirements or Failure to meet stakeholder expectations or Inability to relinquish securities or Injury to public traversing the area.	10.2.d. Annual rehabilitation monitoring carried out by experienced personnel 10.2.e. Securities with the Department for all rehabilitated area 10.2.f. Periodic surveys of REAs					
11. Visual amenity	There is a risk to Clarence from ::: Community complaints ::: Caused by: Inadequate monitoring and maintenance or Inadequate planning or Inadequate revegetation or Inadequate (seasonal) planning or Poor climatic conditions or Weed invasions	11.1.a. Annual rehabilitation monitoring carried out by experienced personnel 11.1.b. Annual reporting carried in AEMR 11.1.c. Annual review of rehabilitation liabilities 11.1.d. progressive rehabilitation carried out as set out in the MOP 11.1.e. Surrounded by extensive areas of natural vegetation	**D** (Pb)	4 (R)	21 (L)		

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control	Bow Tie Extension
	Resulting in: Adverse company reputation or Failure to meet stakeholder expectations.						
12. Failure to obtain stakeholder acceptance	There is a risk to Clarence from ::: Community complaints ::: Caused by: Changing community expectations or Inadequate monitoring and maintenance or Inadequate planning or Inadequate revegetation or Inadequate (seasonal) planning or Poor climatic conditions or Weed invasions Resulting in: Adverse company reputation or Failure to meet stakeholder expectations.	12.1.a. Annual rehabilitation monitoring carried out by experienced personnel 12.1.b. Annual reporting carried in AEMR 12.1.c. Annual review of rehabilitation liabilities 12.1.d. progressive rehabilitation carried out as set out in the MOP 12.1.e. Clarence has CCC 12.1.f. MOP sets out rehabilitation performance criteria 12.1.g. MOP consultation with CCC 12.1.h. Rehabilitation Management Plan - available on the Centennial website	**C** (Pb)	4 (R)	18 (M)	4. Discuss with CCC appropriate expectations regarding consultation for mine closure	
13. Post closure landuse	There is a risk to Clarence from ::: Failure to meet post mining landuse	13.1.a. Clarence has CCC 13.1.b. Rehabilitation Management Plan - available on the	**D** (Pb)	3 (R)	17 (M)	4. Discuss with CCC appropriate expectations regarding consultation for mine closure 5. Document MoU with LCC regarding LCC water transfer scheme	

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control	Bow Tie Extension
	requirements ::: Caused by: Changing community expectations or Inadequate budget available or Inadequate monitoring and maintenance or Inadequate planning or Inadequate revegetation or Inadequate (seasonal) planning or Poor climatic conditions or Weed invasions Resulting in: Adverse company reputation or Failure to meet rehabilitation requirements or Failure to meet stakeholder expectations or Inability to relinquish securities or Injury to public traversing the area.	Centennial website					
		13.1.c. MOP consultation with CCC				6. Develop a register of alternate landuse options post closure	
		13.1.d. LCC Clarence Water Transfer Scheme in place					
		13.1.e. Rehabilitation Management Plan in place					
		13.1.f. MOP sets out rehabilitation performance criteria					
		13.1.g. MOP sets out final landuse domains					
		13.1.h. Annual rehabilitation monitoring carried out by experienced personnel					
		13.1.i. Annual review of rehabilitation liabilities					
		13.1.j. progressive rehabilitation carried out as set out in the MOP					
	There is a risk to Clarence from ::: Failure to plan for appropriate post closure stakeholder use :::	13.2.a. Clarence has CCC	**D** (Pb)	3 (R)	17 (M)	4. Discuss with CCC appropriate expectations regarding consultation for mine closure	
		13.2.b. MOP sets out final landuse domains				5. Document MoU with LCC regarding LCC water transfer scheme	
		13.2.c. MOP consultation with CCC				6. Develop a register of alternate landuse options post	

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control	Bow Tie Extension
	Caused by: Inadequate consultation or Inadequate planning Resulting in: Adverse company reputation or Failure to meet rehabilitation requirements or Failure to meet stakeholder expectations.	13.2.d. Securities with the Department for all rehabilitated areas 13.2.e. Rehabilitation Management Plan in place 13.2.f. LCC Clarence Water Transfer Scheme in place				closure	

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
7. Capping material	There is a risk to Clarence from ::: Inadequate capping material ::: Caused by: Inadequate application of capping material or Inadequate testing of material or Lack of availability (i.e. volume) or Unsuitable capping material Resulting in: Failure to meet rehabilitation requirements or Failure to meet stakeholder expectations or Inability to relinquish securities.	7.1.a. Capping material excavated during construction phase 7.1.b. MOP sets out rehabilitation performance criteria 7.1.c. Securities with the Department for all rehabilitated area 7.1.d. Compaction testing of on site material demonstrates its suitability 7.1.e. Annual reporting carried in AEMR 7.1.f. Annual review of rehabilitation liabilities	**C** (Pb)	3 (F)	13 (S)	2. Complete a detailed revegetation plan to include seed collection and planting schedule 1. Complete detailed rehabilitation plan to include soil suitability testing for capping material 3. Survey capping material stockpile to estimate volumes available
13. Post closure landuse	There is a risk to Clarence from ::: Failure to meet post mining landuse requirements ::: Caused by: Changing community expectations or Inadequate budget available or	13.1.a. Clarence has CCC 13.1.b. Rehabilitation Management Plan - available on the Centennial website 13.1.c. MOP consultation with CCC 13.1.d. LCC Clarence Water Transfer Scheme in place	**D** (Pb)	3 (R)	17 (M)	4. Discuss with CCC appropriate expectations regarding consultation for mine closure 5. Document MoU with LCC regarding LCC water transfer scheme 6. Develop a register of alternate landuse options post closure

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
	Inadequate monitoring and maintenance or Inadequate planning or Inadequate revegetation or Inadequate (seasonal) planning or Poor climatic conditions or Weed invasions Resulting in: Adverse company reputation or Failure to meet rehabilitation requirements or Failure to meet stakeholder expectations or Inability to relinquish securities or Injury to public traversing the area.	13.1.e. Rehabilitation Management Plan in place				
		13.1.f. MOP sets out rehabilitation performance criteria				
		13.1.g. MOP sets out final landuse domains				
		13.1.h. Annual rehabilitation monitoring carried out by experienced personnel				
		13.1.i. Annual review of rehabilitation liabilities				
		13.1.j. progressive rehabilitation carried out as set out in the MOP				
13. Post closure landuse	There is a risk to Clarence from ::: Failure to plan for appropriate post closure stakeholder use ::: Caused by: Inadequate consultation or Inadequate planning	13.2.a. Clarence has CCC				4. Discuss with CCC appropriate expectations regarding consultation for mine closure
		13.2.b. MOP sets out final landuse domains				5. Document MoU with LCC regarding LCC water transfer scheme
		13.2.c. MOP consultation with CCC	**D** (Pb)	3 (R)	17 (M)	6. Develop a register of alternate landuse options post closure
		13.2.d. Securities with the Department for all rehabilitated areas				
		13.2.e. Rehabilitation Management Plan in place				

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
	Resulting in: Adverse company reputation or Failure to meet rehabilitation requirements or Failure to meet stakeholder expectations.	13.2.f. LCC Clarence Water Transfer Scheme in place				
2. Spontaneous combustion	There is a risk to Clarence from ::: Heating of reject material ::: Caused by: bushfire or Inadequate biological resources or Inadequate capping or Inadequate compaction during emplacement or Inadequate monitoring and maintenance or Inadequate planning Resulting in: Failure to meet rehabilitation requirements or Failure to meet stakeholder expectations or Inability to relinquish securities or Injury to public traversing the area.	2.1.a. Annual rehabilitation monitoring carried out by experienced personnel 2.1.b. R70 tests show that Katoomba seam coal has a low-moderate propensity for spon com 2.1.c. Weekly and monthly environmental inspections 2.1.d. REA inspections RE appropriate compaction levels 2.1.e. Capping material excavated during construction phase 2.1.f. Regular compaction testing carried out on REAs to monitor compaction performance 2.1.g. MOP sets out rehabilitation performance criteria	**C** (Pb)	4 (F)	18 (M)	1. Complete detailed rehabilitation plan to include soil suitability testing for capping material 2. Complete a detailed revegetation plan to include seed collection and planting schedule
3. Leachate management	There is a risk to Clarence from	3.1.a. Annual rehabilitation monitoring carried out by experienced personnel	**C** (Pb)	4 (F)	18 (M)	1. Complete detailed rehabilitation plan to include soil suitability testing for capping material

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
	::: Contaminated seepage ::: Caused by: Geochemistry of reject material or Inadequate capping or Inadequate revegetation Resulting in: Failure to meet rehabilitation requirements or Failure to meet stakeholder expectations or Inability to relinquish securities.	3.1.b. MOP sets out rehabilitation performance criteria 3.1.c. Capping material excavated during construction phase 3.1.d. Regular compaction testing carried out on REAs to monitor compaction performance 3.1.e. Site Water Management Plan 3.1.f. Securities with the Department for all rehabilitated area 3.1.g. REA VI will be clay line to form a low permeability barrier				2. Complete a detailed revegetation plan to include seed collection and planting schedule
3. Leachate management	There is a risk to Clarence from ::: Contaminated surface water release offsite ::: Caused by: Geochemistry of reject material or Inadequate capping or Inadequate treatment of surface water or Poor surface water management	3.2.a. Securities with the Department for all rehabilitated area 3.2.b. Site Water Management Plan 3.2.c. Regular compaction testing carried out on REAs to monitor compaction performance 3.2.d. Capping material excavated during construction phase	C (Pb)	4 (F)	18 (M)	2. Complete a detailed revegetation plan to include seed collection and planting schedule 1. Complete detailed rehabilitation plan to include soil suitability testing for capping material

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
	Resulting in: Failure to meet rehabilitation requirements or Failure to meet stakeholder expectations or Inability to relinquish securities.	3.2.e. MOP sets out rehabilitation performance criteria 3.2.f. Annual rehabilitation monitoring carried out by experienced personnel				
5. Revegetation	There is a risk to Clarence from ::: Failure to meet species requirements ::: Caused by: Bushfire or Erosion or Inadequate biological resources or Inadequate capping or Inadequate monitoring and maintenance or Inadequate planning or Inadequate revegetation or Pest attack or Weed invasions Resulting in: Failure to meet rehabilitation requirements or Failure to meet stakeholder expectations or Inability to relinquish securities.	5.1.a. Annual rehabilitation monitoring carried out by experienced personnel 5.1.b. Annual reporting carried in AEMR 5.1.c. Capping material excavated during construction phase 5.1.d. MOP sets out rehabilitation performance criteria 5.1.e. Site Water Management Plan 5.1.f. Quarterly maintenance of rehabilitation areas 5.1.g. Monthly weed management 5.1.h. Seed collection carried out 5.1.i. Commenced development of tube stock from local seed 5.1.j. Surrounded by extensive	C (Pb)	4 (F)	18 (M)	2. Complete a detailed revegetation plan to include seed collection and planting schedule 1. Complete detailed rehabilitation plan to include soil suitability testing for capping material

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
		areas of natural vegetation				
8. Reseeding and tube stock	There is a risk to Clarence from ::: Poor timing of revegetation ::: Caused by: Inadequate knowledge or Inadequate (seasonal) planning or Poor climatic conditions Resulting in: Failure to meet rehabilitation requirements or Failure to meet stakeholder expectations or Inability to relinquish securities.	8.3.a. Annual rehabilitation monitoring carried out by experienced personnel 8.3.b. Annual reporting carried in AEMR 8.3.c. Surrounded by extensive areas of natural vegetation 8.3.d. Commenced development of tube stock from local seed 8.3.e. Seed collection carried out 8.3.f. MOP sets out rehabilitation performance criteria 8.3.g. Securities with the Department for all rehabilitated area 8.3.h. Budget allocation for ongoing seed collection	C (D)	4 (F)	18 (M)	2. Complete a detailed revegetation plan to include seed collection and planting schedule
12. Failure to obtain stakeholder acceptance	There is a risk to Clarence from ::: Community complaints ::: Caused by:	12.1.a. Annual rehabilitation monitoring carried out by experienced personnel 12.1.b. Annual reporting carried in AEMR 12.1.c. Annual review of rehabilitation liabilities	C (Pb)	4 (R)	18 (M)	4. Discuss with CCC appropriate expectations regarding consultation for mine closure

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
	Changing community expectations or Inadequate monitoring and maintenance or Inadequate planning or Inadequate revegetation or Inadequate (seasonal) planning or Poor climatic conditions or Weed invasions Resulting in: Adverse company reputation or Failure to meet stakeholder expectations.	12.1.d. progressive rehabilitation carried out as set out in the MOP				
		12.1.e. Clarence has CCC				
		12.1.f. MOP sets out rehabilitation performance criteria				
		12.1.g. MOP consultation with CCC				
		12.1.h. Rehabilitation Management Plan - available on the Centennial website				
6. Top soil	There is a risk to Clarence from ::: Inadequate management of topsoil ::: Caused by: Erosion or Inadequate biological resources or Inadequate capping or Inadequate monitoring and maintenance or Inadequate planning or Inadequate testing of material or Longterm storage of topsoil or Poor stockpiling management or Poor surface water management or Unviable topsoil material	6.1.a. Annual rehabilitation monitoring carried out by experienced personnel	**D** (D)	4 (F)	21 (L)	2. Complete a detailed revegetation plan to include seed collection and planting schedule
		6.1.b. Annual reporting carried in AEMR				1. Complete detailed rehabilitation plan to include soil suitability testing for capping material
		6.1.c. Topsoil management plan				
		6.1.d. progressive rehabilitation carried out as set out in the MOP				
		6.1.e. MOP sets out rehabilitation performance criteria				
		6.1.f. Securities with the Department for all rehabilitated area				

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
	Resulting in: Failure to meet rehabilitation requirements or Failure to meet stakeholder expectations or Inability to relinquish securities.	6.1.g. Site Water Management Plan				
		6.1.h. Only endemic vegetation species used on rehabilitation				
8. Reseeding and tube stock	There is a risk to Clarence from ::: Inadequate supply ::: Caused by: Inadequate biological resources or Inadequate development of tube stock or Inadequate planning or Inadequate storage of seed or Poor seed quality i.e.. germination viability Resulting in: Failure to meet rehabilitation requirements or Failure to meet stakeholder expectations or Inability to relinquish securities.	8.1.a. Annual rehabilitation monitoring carried out by experienced personnel	D (D)	4 (F)	21 (L)	2. Complete a detailed revegetation plan to include seed collection and planting schedule
		8.1.b. Annual reporting carried in AEMR				1. Complete detailed rehabilitation plan to include soil suitability testing for capping material
		8.1.c. Annual review of rehabilitation liabilities				
		8.1.d. Commenced development of tube stock from local seed				
		8.1.e. Seed collection carried out				
		8.1.f. Budget allocation for ongoing seed collection				
		8.1.g. Surrounded by extensive areas of natural vegetation				
		8.1.h. Securities with the Department for all rehabilitated area				
8. Reseeding and tube stock	There is a risk to Clarence from	8.2.a. Annual rehabilitation monitoring carried out by experienced personnel	D (D)	4 (F)	21 (L)	1. Complete detailed rehabilitation plan to include soil suitability testing for capping material

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
	::: Inadequate diversity ::: Caused by: Inadequate biological resources or Inadequate development of tube stock or Inadequate planning or Inadequate storage of seed or Poor seed quality i.e.. germination viability Resulting in: Failure to meet rehabilitation requirements or Failure to meet stakeholder expectations or Inability to relinquish securities.	8.2.b. Annual reporting carried in AEMR 8.2.c. Annual review of rehabilitation liabilities 8.2.d. Commenced development of tube stock from local seed 8.2.e. Seed collection carried out 8.2.f. Budget allocation for ongoing seed collection 8.2.g. Surrounded by extensive areas of natural vegetation 8.2.h. MOP sets out rehabilitation performance criteria 8.2.i. Securities with the Department for all rehabilitated area				2. Complete a detailed revegetation plan to include seed collection and planting schedule
9. Timing of rehabilitation	There is a risk to Clarence from ::: Rehabilitation targets not achieved ::: Caused by: Inadequate biological resources or Inadequate budget available or	9.1.a. Annual rehabilitation monitoring carried out by experienced personnel 9.1.b. Annual reporting carried in AEMR 9.1.c. Surrounded by extensive areas of natural vegetation 9.1.d. Commenced development of tube stock from local seed	**D** (D)	4 (F)	21 (L)	

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
	Inadequate monitoring and maintenance or Inadequate planning or Inadequate revegetation or Inadequate (seasonal) planning or Poor climatic conditions or Unsuitable capping material or Unviable topsoil material Resulting in: Failure to meet rehabilitation requirements or Failure to meet stakeholder expectations or Inability to relinquish securities.	9.1.e. Seed collection carried out 9.1.f. MOP sets out rehabilitation performance criteria 9.1.g. Securities with the Department for all rehabilitated area 9.1.h. Budget allocation for ongoing seed collection 9.1.i. progressive rehabilitation carried out as set out in the MOP				
10. Final landform	There is a risk to Clarence from ::: Inadequate landform shaping ::: Caused by: Inadequate monitoring and maintenance or Inadequate operational control of reject emplacement area or Inadequate planning or Inadequate slope stability management Resulting in: Failure to meet rehabilitation requirements or Failure to meet	10.1.a. Slope Stability Management Plan 10.1.b. Detailed designs of final landform for REAs 10.1.c. MOP sets out rehabilitation performance criteria 10.1.d. Annual rehabilitation monitoring carried out by experienced personnel 10.1.e. Securities with the Department for all rehabilitated area 10.1.f. Periodic surveys of REAs	**D** (D)	4 (F)	21 (L)	

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
	stakeholder expectations or Inability to relinquish securities or Injury to public traversing the area.					
10. Final landform	There is a risk to Clarence from ::: Landslip ::: Caused by: Inadequate monitoring and maintenance or Inadequate operational control of reject emplacement area or Inadequate planning or Inadequate slope stability management Resulting in: Failure to meet rehabilitation requirements or Failure to meet stakeholder expectations or Inability to relinquish securities or Injury to public traversing the area.	10.2.a. Slope Stability Management Plan 10.2.b. Detailed designs of final landform for REAs 10.2.c. MOP sets out rehabilitation performance criteria 10.2.d. Annual rehabilitation monitoring carried out by experienced personnel 10.2.e. Securities with the Department for all rehabilitated area 10.2.f. Periodic surveys of REAs	**D** (Pb)	4 (F)	21 (L)	
11. Visual amenity	There is a risk to Clarence from ::: Community complaints :::	11.1.a. Annual rehabilitation monitoring carried out by experienced personnel 11.1.b. Annual reporting carried in AEMR	**D** (Pb)	4 (R)	21 (L)	

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
	Caused by: Inadequate monitoring and maintenance or Inadequate planning or Inadequate revegetation or Inadequate (seasonal) planning or Poor climatic conditions or Weed invasions Resulting in: Adverse company reputation or Failure to meet stakeholder expectations.	11.1.c. Annual review of rehabilitation liabilities 11.1.d. progressive rehabilitation carried out as set out in the MOP 11.1.e. Surrounded by extensive areas of natural vegetation				
4. Land contamination	There is a risk to Clarence from ::: Excessive nutrients from Sewerage treatment plant ::: Caused by: Inadequate decommissioning of sewerage treatment plant or Inadequate disposal of contaminated pond material Resulting in: Failure to meet rehabilitation	4.2.a. Securities with the Department for all rehabilitated area 4.2.b. Annual review of rehabilitation liabilities	**C** (D)	5 (F)	22 (L)	

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
	requirements or Failure to meet stakeholder expectations or Inability to relinquish securities.					
4. Land contamination	There is a risk to Clarence from ::: Hydrocarbon in soil ::: Caused by: Inadequate decommissioning of surface and underground hydrocarbon storage facilities or Inadequate disposal of contaminated materials Resulting in: Failure to meet rehabilitation requirements or Failure to meet stakeholder expectations or Inability to relinquish securities.	4.1.a. Securities with the Department for all rehabilitated area 4.1.b. Phase 1 and Phase 2 Environmental site assessment completed showing low contamination risk 4.1.c. Removal of pit top underground diesel tanks and validation report completed 4.1.d. Decommissioning of underground CHPP diesel tank 4.1.e. Shallow groundwater monitoring across the pit top	**E** (D)	4 (F)	23 (L)	
1. Exploration	There is a risk to Clarence from ::: Rehabilitation failure ::: Caused by:	1.1.a. Review of Environmental Factors carried out 1.1.b. Inspection program of rehabilitated exploration 1.1.c. SEWPAC approval and annual performance reporting	**D** (D)	5 (F)	24 (L)	

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
	Bushfire or Erosion or Inadequate biological resources or Inadequate monitoring and maintenance or Inadequate planning or Vandalism Resulting in: Failure to meet rehabilitation requirements or Failure to meet stakeholder expectations or Inability to relinquish securities.	1.1.d. Allocated budget for rehabilitation maintenance 1.1.e. Securities with the Department for all rehabilitated area 1.1.f. Annual reporting carried in AEMR 1.1.g. Borehole CEMP - sets out erosion and sediment controls				

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
7. Capping material	There is a risk to Clarence from ::: Inadequate capping material ::: Caused by: Inadequate application of capping material or Inadequate testing of material or Lack of availability (i.e. volume) or Unsuitable capping material Resulting in: Failure to meet rehabilitation requirements or Failure to meet stakeholder expectations or Inability to relinquish securities.	7.1.a. Capping material excavated during construction phase 7.1.b. MOP sets out rehabilitation performance criteria 7.1.c. Securities with the Department for all rehabilitated area 7.1.d. Compaction testing of on site material demonstrates its suitability 7.1.e. Annual reporting carried in AEMR 7.1.f. Annual review of rehabilitation liabilities	**C** (Pb)	3 (F)	13 (S)	2. Complete a detailed revegetation plan to include seed collection and planting schedule 1. Complete detailed rehabilitation plan to include soil suitability testing for capping material 3. Survey capping material stockpile to estimate volumes available
13. Post closure landuse	There is a risk to Clarence from ::: Failure to meet post mining landuse requirements ::: Caused by: Changing community expectations or Inadequate budget available or Inadequate monitoring and maintenance or Inadequate planning	13.1.a. Clarence has CCC 13.1.b. Rehabilitation Management Plan - available on the Centennial website 13.1.c. MOP consultation with CCC 13.1.d. LCC Clarence Water Transfer Scheme in place 13.1.e. Rehabilitation Management	**D** (Pb)	3 (R)	17 (M)	4. Discuss with CCC appropriate expectations regarding consultation for mine closure 5. Document MoU with LCC regarding LCC water transfer scheme 6. Develop a register of alternate landuse options post closure

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
	or Inadequate revegetation or Inadequate (seasonal) planning or Poor climatic conditions or Weed invasions Resulting in: Adverse company reputation or Failure to meet rehabilitation requirements or Failure to meet stakeholder expectations or Inability to relinquish securities or Injury to public traversing the area.	Plan in place				
		13.1.f. MOP sets out rehabilitation performance criteria				
		13.1.g. MOP sets out final landuse domains				
		13.1.h. Annual rehabilitation monitoring carried out by experienced personnel				
		13.1.i. Annual review of rehabilitation liabilities				
		13.1.j. progressive rehabilitation carried out as set out in the MOP				
13. Post closure landuse	There is a risk to Clarence from ::: Failure to plan for appropriate post closure stakeholder use ::: Caused by: Inadequate consultation or Inadequate planning Resulting in: Adverse company reputation or Failure to meet rehabilitation	13.2.a. Clarence has CCC	**D** (Pb)	3 (R)	17 (M)	4. Discuss with CCC appropriate expectations regarding consultation for mine closure
		13.2.b. MOP sets out final landuse domains				5. Document MoU with LCC regarding LCC water transfer scheme
		13.2.c. MOP consultation with CCC				6. Develop a register of alternate landuse options post closure
		13.2.d. Securities with the Department for all rehabilitated areas				
		13.2.e. Rehabilitation Management Plan in place				
		13.2.f. LCC Clarence Water Transfer Scheme in place				

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
	requirements or Failure to meet stakeholder expectations.					
2. Spontaneous combustion	There is a risk to Clarence from ::: Heating of reject material ::: Caused by: bushfire or Inadequate biological resources or Inadequate capping or Inadequate compaction during emplacement or Inadequate monitoring and maintenance or Inadequate planning Resulting in: Failure to meet rehabilitation requirements or Failure to meet stakeholder expectations or Inability to relinquish securities or Injury to public traversing the area.	2.1.a. Annual rehabilitation monitoring carried out by experienced personnel 2.1.b. R70 tests show that Katoomba seam coal has a low-moderate propensity for spon com 2.1.c. Weekly and monthly environmental inspections 2.1.d. REA inspections RE appropriate compaction levels 2.1.e. Capping material excavated during construction phase 2.1.f. Regular compaction testing carried out on REAs to monitor compaction performance 2.1.g. MOP sets out rehabilitation performance criteria	**C** (Pb)	4 (F)	18 (M)	1. Complete detailed rehabilitation plan to include soil suitability testing for capping material 2. Complete a detailed revegetation plan to include seed collection and planting schedule
3. Leachate management	There is a risk to Clarence from ::: Contaminated seepage :::	3.1.a. Annual rehabilitation monitoring carried out by experienced personnel 3.1.b. MOP sets out rehabilitation performance criteria 3.1.c. Capping material excavated	**C** (Pb)	4 (F)	18 (M)	1. Complete detailed rehabilitation plan to include soil suitability testing for capping material 2. Complete a detailed revegetation plan to include seed collection and planting schedule

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
	Caused by: Geochemistry of reject material or Inadequate capping or Inadequate revegetation Resulting in: Failure to meet rehabilitation requirements or Failure to meet stakeholder expectations or Inability to relinquish securities.	during construction phase 3.1.d. Regular compaction testing carried out on REAs to monitor compaction performance 3.1.e. Site Water Management Plan 3.1.f. Securities with the Department for all rehabilitated area 3.1.g. REA VI will be clay line to form a low permeability barrier				
3. Leachate management	There is a risk to Clarence from ::: Contaminated surface water release offsite ::: Caused by: Geochemistry of reject material or Inadequate capping or Inadequate treatment of surface water or Poor surface water management Resulting in: Failure to meet rehabilitation requirements or Failure to meet stakeholder expectations or Inability to	3.2.a. Securities with the Department for all rehabilitated area 3.2.b. Site Water Management Plan 3.2.c. Regular compaction testing carried out on REAs to monitor compaction performance 3.2.d. Capping material excavated during construction phase 3.2.e. MOP sets out rehabilitation performance criteria 3.2.f. Annual rehabilitation monitoring carried out by experienced personnel	**C** (Pb)	4 (F)	18 (M)	2. Complete a detailed revegetation plan to include seed collection and planting schedule 1. Complete detailed rehabilitation plan to include soil suitability testing for capping material

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
	relinquish securities.					
4. Land contamination	There is a risk to Clarence from ::: Hydrocarbon in soil ::: Caused by: Inadequate decommissioning of surface and underground hydrocarbon storage facilities or Inadequate disposal of contaminated materials Resulting in: Failure to meet rehabilitation requirements or Failure to meet stakeholder expectations or Inability to relinquish securities.	4.1.a. Securities with the Department for all rehabilitated area 4.1.b. Phase 1 and Phase 2 Environmental site assessment completed showing low contamination risk 4.1.c. Removal of pit top underground diesel tanks and validation report completed 4.1.d. Decommissioning of underground CHPP diesel tank 4.1.e. Shallow groundwater monitoring across the pit top	**E** (D)	4 (F)	23 (L)	
5. Revegetation	There is a risk to Clarence from ::: Failure to meet species requirements ::: Caused by: Bushfire or Erosion or Inadequate biological resources or Inadequate	5.1.a. Annual rehabilitation monitoring carried out by experienced personnel 5.1.b. Annual reporting carried in AEMR 5.1.c. Capping material excavated during construction phase 5.1.d. MOP sets out rehabilitation performance criteria	**C** (Pb)	4 (F)	18 (M)	2. Complete a detailed revegetation plan to include seed collection and planting schedule 1. Complete detailed rehabilitation plan to include soil suitability testing for capping material

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
	capping or Inadequate monitoring and maintenance or Inadequate planning or Inadequate revegetation or Pest attack or Weed invasions Resulting in: Failure to meet rehabilitation requirements or Failure to meet stakeholder expectations or Inability to relinquish securities.	5.1.e. Site Water Management Plan				
		5.1.f. Quarterly maintenance of rehabilitation areas				
		5.1.g. Monthly weed management				
		5.1.h. Seed collection carried out				
		5.1.i. Commenced development of tube stock from local seed				
		5.1.j. Surrounded by extensive areas of natural vegetation				
6. Top soil	There is a risk to Clarence from ::: Inadequate management of topsoil ::: Caused by: Erosion or Inadequate biological resources or Inadequate capping or Inadequate monitoring and maintenance or Inadequate planning or Inadequate testing of material or Longterm storage of topsoil or Poor stockpiling management or Poor surface water management or Unviable topsoil material	6.1.a. Annual rehabilitation monitoring carried out by experienced personnel	**D** (D)	4 (F)	21 (L)	2. Complete a detailed revegetation plan to include seed collection and planting schedule
		6.1.b. Annual reporting carried in AEMR				1. Complete detailed rehabilitation plan to include soil suitability testing for capping material
		6.1.c. Topsoil management plan				
		6.1.d. progressive rehabilitation carried out as set out in the MOP				
		6.1.e. MOP sets out rehabilitation performance criteria				
		6.1.f. Securities with the Department for all rehabilitated area				
		6.1.g. Site Water Management Plan				

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
	Resulting in: Failure to meet rehabilitation requirements or Failure to meet stakeholder expectations or Inability to relinquish securities.	6.1.h. Only endemic vegetation species used on rehabilitation				
8. Reseeding and tube stock	There is a risk to Clarence from ::: Inadequate supply ::: Caused by: Inadequate biological resources or Inadequate development of tube stock or Inadequate planning or Inadequate storage of seed or Poor seed quality i.e.. germination viability Resulting in: Failure to meet rehabilitation requirements or Failure to meet stakeholder expectations or Inability to relinquish securities.	8.1.a. Annual rehabilitation monitoring carried out by experienced personnel	D (D)	4 (F)	21 (L)	2. Complete a detailed revegetation plan to include seed collection and planting schedule
		8.1.b. Annual reporting carried in AEMR				1. Complete detailed rehabilitation plan to include soil suitability testing for capping material
		8.1.c. Annual review of rehabilitation liabilities				
		8.1.d. Commenced development of tube stock from local seed				
		8.1.e. Seed collection carried out				
		8.1.f. Budget allocation for ongoing seed collection				
		8.1.g. Surrounded by extensive areas of natural vegetation				
		8.1.h. Securities with the Department for all rehabilitated area				
8. Reseeding and tube stock	There is a risk to Clarence from	8.2.a. Annual rehabilitation monitoring carried out by experienced personnel	D (D)	4 (F)	21 (L)	1. Complete detailed rehabilitation plan to include soil suitability testing for capping material

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
	::: Inadequate diversity ::: Caused by: Inadequate biological resources or Inadequate development of tube stock or Inadequate planning or Inadequate storage of seed or Poor seed quality i.e.. germination viability Resulting in: Failure to meet rehabilitation requirements or Failure to meet stakeholder expectations or Inability to relinquish securities.	8.2.b. Annual reporting carried in AEMR 8.2.c. Annual review of rehabilitation liabilities 8.2.d. Commenced development of tube stock from local seed 8.2.e. Seed collection carried out 8.2.f. Budget allocation for ongoing seed collection 8.2.g. Surrounded by extensive areas of natural vegetation 8.2.h. MOP sets out rehabilitation performance criteria 8.2.i. Securities with the Department for all rehabilitated area				2. Complete a detailed revegetation plan to include seed collection and planting schedule
8. Reseeding and tube stock	There is a risk to Clarence from ::: Poor timing of revegetation ::: Caused by: Inadequate knowledge or Inadequate (seasonal) planning or Poor climatic conditions	8.3.a. Annual rehabilitation monitoring carried out by experienced personnel 8.3.b. Annual reporting carried in AEMR 8.3.c. Surrounded by extensive areas of natural vegetation 8.3.d. Commenced development of tube stock from local seed	**C** (D)	4 (F)	18 (M)	2. Complete a detailed revegetation plan to include seed collection and planting schedule

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
	Resulting in: Failure to meet rehabilitation requirements or Failure to meet stakeholder expectations or Inability to relinquish securities.	8.3.e. Seed collection carried out 8.3.f. MOP sets out rehabilitation performance criteria 8.3.g. Securities with the Department for all rehabilitated area 8.3.h. Budget allocation for ongoing seed collection				
9. Timing of rehabilitation	There is a risk to Clarence from ::: Rehabilitation targets not achieved ::: Caused by: Inadequate biological resources or Inadequate budget available or Inadequate monitoring and maintenance or Inadequate planning or Inadequate revegetation or Inadequate (seasonal) planning or Poor climatic conditions or Unsuitable capping material or Unviable topsoil material Resulting in: Failure to meet rehabilitation requirements or Failure to meet	9.1.a. Annual rehabilitation monitoring carried out by experienced personnel 9.1.b. Annual reporting carried in AEMR 9.1.c. Surrounded by extensive areas of natural vegetation 9.1.d. Commenced development of tube stock from local seed 9.1.e. Seed collection carried out 9.1.f. MOP sets out rehabilitation performance criteria 9.1.g. Securities with the Department for all rehabilitated area 9.1.h. Budget allocation for ongoing seed collection	**D** (D)	4 (F)	21 (L)	

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
	stakeholder expectations or Inability to relinquish securities.	9.1.i. progressive rehabilitation carried out as set out in the MOP				
10. Final landform	There is a risk to Clarence from ::: Inadequate landform shaping ::: Caused by: Inadequate monitoring and maintenance or Inadequate operational control of reject emplacement area or Inadequate planning or Inadequate slope stability management Resulting in: Failure to meet rehabilitation requirements or Failure to meet stakeholder expectations or Inability to relinquish securities or Injury to public traversing the area.	10.1.a. Slope Stability Management Plan 10.1.b. Detailed designs of final landform for REAs 10.1.c. MOP sets out rehabilitation performance criteria 10.1.d. Annual rehabilitation monitoring carried out by experienced personnel 10.1.e. Securities with the Department for all rehabilitated area 10.1.f. Periodic surveys of REAs	**D** (D)	4 (F)	21 (L)	
10. Final landform	There is a risk to Clarence from ::: Landslip :::	10.2.a. Slope Stability Management Plan 10.2.b. Detailed designs of final landform for REAs 10.2.c. MOP sets out rehabilitation	**D** (Pb)	4 (F)	21 (L)	

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
	Caused by: Inadequate monitoring and maintenance or Inadequate operational control of reject emplacement area or Inadequate planning or Inadequate slope stability management Resulting in: Failure to meet rehabilitation requirements or Failure to meet stakeholder expectations or Inability to relinquish securities or Injury to public traversing the area.	performance criteria 10.2.d. Annual rehabilitation monitoring carried out by experienced personnel 10.2.e. Securities with the Department for all rehabilitated area 10.2.f. Periodic surveys of REAs				
11. Visual amenity	There is a risk to Clarence from ::: Community complaints ::: Caused by: Inadequate monitoring and maintenance or Inadequate planning or Inadequate revegetation or Inadequate (seasonal) planning or Poor climatic conditions or Weed invasions Resulting in:	11.1.a. Annual rehabilitation monitoring carried out by experienced personnel 11.1.b. Annual reporting carried in AEMR 11.1.c. Annual review of rehabilitation liabilities 11.1.d. progressive rehabilitation carried out as set out in the MOP 11.1.e. Surrounded by extensive areas of natural vegetation	**D** (Pb)	4 (R)	21 (L)	

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
	Adverse company reputation or Failure to meet stakeholder expectations.					
12. Failure to obtain stakeholder acceptance	There is a risk to Clarence from ::: Community complaints ::: Caused by: Changing community expectations or Inadequate monitoring and maintenance or Inadequate planning or Inadequate revegetation or Inadequate (seasonal) planning or Poor climatic conditions or Weed invasions Resulting in: Adverse company reputation or Failure to meet stakeholder expectations.	12.1.a. Annual rehabilitation monitoring carried out by experienced personnel 12.1.b. Annual reporting carried in AEMR 12.1.c. Annual review of rehabilitation liabilities 12.1.d. progressive rehabilitation carried out as set out in the MOP 12.1.e. Clarence has CCC 12.1.f. MOP sets out rehabilitation performance criteria 12.1.g. MOP consultation with CCC 12.1.h. Rehabilitation Management Plan - available on the Centennial website	**C** (Pb)	4 (R)	18 (M)	4. Discuss with CCC appropriate expectations regarding consultation for mine closure
1. Exploration	There is a risk to Clarence from ::: Rehabilitation failure :::	1.1.a. Review of Environmental Factors carried out 1.1.b. Inspection program of rehabilitated exploration 1.1.c. SEWPAC approval and	**D** (D)	5 (F)	24 (L)	

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
	Caused by: Bushfire or Erosion or Inadequate biological resources or Inadequate monitoring and maintenance or Inadequate planning or Vandalism Resulting in: Failure to meet rehabilitation requirements or Failure to meet stakeholder expectations or Inability to relinquish securities.	annual performance reporting 1.1.d. Allocated budget for rehabilitation maintenance 1.1.e. Securities with the Department for all rehabilitated area 1.1.f. Annual reporting carried in AEMR 1.1.g. Borehole CEMP - sets out erosion and sediment controls				
4. Land contamination	There is a risk to Clarence from ::: Excessive nutrients from Sewerage treatment plant ::: Caused by: Inadequate decommissioning of sewerage treatment plant or Inadequate disposal of contaminated pond material Resulting in: Failure to meet rehabilitation requirements or Failure to meet stakeholder expectations or Inability to	4.2.a. Securities with the Department for all rehabilitated area 4.2.b. Annual review of rehabilitation liabilities	**C** (D)	5 (F)	22 (L)	

Step	Potential Incident	Current Controls	L	MRC	RR	Recommended Control
	relinquish securities.					

Recommended Controls Do NOT enter additional Recommended Controls on this sheet.	Place(s) Used	Allocated To (Only one SITE person for each Recommended Control)	Required By Date	Pulse User No.	PULSE Ref. No.
1. Complete detailed rehabilitation plan to include soil suitability testing for capping material	Events: 2.1, 3.1, 3.2, 5.1, 6.1, 7.1, 8.1, 8.2	Jesse Percival	23-Jan-2015	20081	
2. Complete a detailed revegetation plan to include seed collection and planting schedule	Events: 2.1, 3.1, 3.2, 5.1, 6.1, 7.1, 8.1, 8.2, 8.3	Jesse Percival	28-Nov-2014	20081	
3. Survey capping material stockpile to estimate volumes available	Events: 7.1	Jesse Percival	23-Jan-2015	20081	
4. Discuss with CCC appropriate expectations regarding consultation for mine closure	Events: 12.1, 13.1, 13.2	Jesse Percival	23-Jan-2015	20081	
5. Document MoU with LCC regarding LCC water transfer scheme	Events: 13.1, 13.2	Greg Shields	15-Jan-2015	80021	
6. Develop a register of alternate landuse options post closure	Events: 13.1, 13.2	Jesse Percival	15-Oct-2014	20081	

RISK MANAGEMENT STANDARD **Management Standard-004**

CENTENNIAL RISK MATRIX							Likelihood					
							A Certain	B Probable	C Possible	D Remote	E Improbable	Description (D)
Rating	Consequence Note: Consequence may result from a single event or may represent a cumulative impact over a period of 12 months. Use the worst case reasonable consequence if there is more than one.						Common"	Has Happened within Centennial"	"Could Happen & has happened in non-CEY operations	Not Likely	"Practically impossible	Probability (Pb)
	Impact to Annual Business Plan (F)	Personal Injury (PI)	Business Interruption (BI)	Legal (L)	Reputation (R)	Environment (E)	Frequent incidents	Regular incidents	Infrequent incidents	Unlikely to occur. Very few recorded or known incidents	May occur in exceptional circumstances. Almost no recorded incidents.	Incident Frequency (IF)
							Operations – within 3 months	Operations – within 2 years	Operations – within 5 years	Operations – within 10 years	Operations – within 30 years	Operations (Op)
							Project – Every project	Project – Every 2 projects	Project – Every 5 projects	Project – Every 10 projects	Project – Every 30 projects	Project (Pr)
1. Catastrophic	>$50m	Multiple Fatalities	> 1month	Prolonged litigation, heavy fines, potential jail term	Prolonged International media attention	Long term impairment habitats/ ecosystem	1 (E)	2 (E)	5 (H)	7 (H)	11 (S)	
2. Major	$10m - $50m	Single Fatality	1 week to 1 month	Major breach/ major litigation	International media attention	Long term effects of ecosystem	3 (E)	4 (E)	8 (H)	12 (S)	16 (M)	
3. Moderate	$1m - $10m	Serious/ Disabling Injury	1 day to 1 week	Serious breach of regulation. prosecution/ fine	National media attention	Serious medium term environmental effects	6 (H)	9 (H)	13 (S)	17 (M)	20 (L)	
4. Minor	$100k - $1m	Lost Time Injury	12 hrs to 1 day	Non-compliance, breaches in regulation	Adverse local public attention	Minor effects to physical environment	10 (S)	14 (S)	18 (M)	21 (L)	23 (L)	
5. Insignificant	<$100k	First Aid Treatment Only	< 12 hrs	Low level compliance issue	Local complaints	Limited physical damage	15 (S)	19 (M)	22 (L)	24 (L)	25 (L)	

Risk Rating	Risk Category		Generic Management Actions
1 to 4	E	Extreme	Immediate intervention required from senior management to eliminate or reduce this risk
5 to 9	H	High	Imperative to eliminate or reduce risk to a lower level by the introduction of control measures. Management planning required at senior levels
10 to 15	S	Significant	Corrective action required, senior management attention needed to eliminate or reduce risk
16 to 19	M	Moderate	Corrective action to be determined, management responsibility must be specified
20 to 25	L	Low	Monitor and manage by corrective action where practicable

BOW TIE ANALYSIS - Control Effectiveness Matrix									
TYPE OF CONTROL	Examples	Description	Rank	Control Category	CONTROL – Impact / Status / Quality				
					A >= 80%	B 50 – 80%	C 50 / 50%	D 50 – 20%	E <= 20%
	Replace electric hand tools with compressed air alternatives in wet conditions	Eliminates a hazard by removal	1.	Elimination of hazard	100	45.0	40.0	14.0	10.0
	Replace large diameter, heavy cables with smaller ones that are easier to handle manually	Replace element with less risky alternative	2.	Substitution	85.0	40.0	35.0	13.0	8.5
	Automatic fire fighting sprinkler systems	An automatic device that operates without intervention by personnel	3.	Engineered without people	70.0	30.0	25.0	12.0	7.0
	Fire alarm that sounds & the operator then has to initiate an evacuation	A device that requires personnel to respond to a stimulus	4.	Engineered with people	50.0	20.0	14.0	10.0	5.0
	Inspection, maintenance and repair of machinery	A process carried out by personnel	5.	Procedural	20.0	15.0	10.0	6.5	2.0
	Employee made aware of dangers of large moving equipment where the operators have limited vision	Induction training programs	6.	Awareness	5.0	3.0	2.5	1.5	1.0

Dyadem Stature for Risk Management:

Risk Assessment Title: Rehabilitation and Mine Closure Risk Assessment

Version: 1

Region: West

Site: Clarence

Department: ZZZZ Whole Site

Equipment / **Process:** HSMS

Stature Risk Assessment No.: 1000836000

Study Lifecycle State: Risk Assessment Approval Pending

Potential Hazard No.:

PULSE Actions Required URL:

Site Risk Assessment Ref. No. (Optional):

Background	Potential Incident	RR

Background	Potential Incident	MRC

Approver	Approved / Rejected	Date	Comments
1. Jesse Percival	Approved	May 19, 2014	

As a part of the 2014 - 2017 mining operations plan (MOP), Clarence is required to complete a risk assessment to determine risks associated with mine closure and rehabilitation. Areas covered in this risk assessment include exploration, spontaneous combustion, geochemical material, land contamination, revegetation failure, acid mine drainage, capping materials, seed supply, timing of rehabilitation activities, leachate management, final landform design, visual amenity and failure to obtain stakeholder acceptance of rehabilitation.

The following Hierarchy of Controls offers a framework for considering the effectiveness of controls. Note that the effectiveness of a control that is intended to reduce a risk decreases from top to bottom of the list. In other words, the closer the control type is to the top of the hierarchy, the more potentially effective the control.

·Eliminate the hazard or energy source (do not use the energy)

·Minimise or replace the hazard or energy source (reduce the amount of energy to a less damaging level or replace the energy with another that has less potential negative consequences)

·Control the hazard or energy using engineered devices (ex. Lock outs, chemical containers, mechanical roof support, gas monitors, etc.)

·Control the hazard or energy by using physical barriers (ex. machine guarding, warning signs, etc.)

·Control the hazard or energy with procedures (ex. Isolation procedures, standard operating procedures, etc.)

·Control the hazard or energy with personal protective equipment (ex. hard hats, boots with toe caps, gloves, safety glasses, welding gear, etc.)

·Control the hazard or energy with warnings and awareness (ex. posters, labels, stickers, verbal warnings, etc.)

To identify, assess and control the risks to people, plant and environment to ensure that rehabilitation complies with Government and stakeholder expectations or requirements for mine closure and rehabilitation.

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The boundary of this risk assessment includes the Clarence mining lease areas that require rehabilitation at the closure of the mine.

Yes/No	Method
Yes	Workplace Risk Assessment and Control (WRAC)
	Fault Tree Analysis (FTA)
	Safety Integrity Level Analysis to Australian Standard 61508 (SIL)
	Bow Tie Analysis (BTA)
	Failure Modes and Effects Analysis (FMEA)
	Hazard and Operability Analysis (HAZOP)

Document Name	Title	Version	Referenced Document Date
	Environment and community risk assessment		
	Mining Operations Plan 2014 - 2017		
	Clarence Mine Closure and Rehabilitation Plan		
	SEWPAC Approval (specific to exploration in 800 Area)		
	Independent audit for the Clarence Development Consent (DA 504-00)		
	Development consent DA 504-00		
	1976 Approval		
	1994 Approval		
	1993 Approval		
	EPL 726		

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Date	Description	Location	Start Time	End Time	Comment
1. 15-May-2014	Scoping	Clarence Conference Room	9:00 AM	12:00 PM	
2.	Assessment				
3.	Review				

Name	Title	Company	Industry Start Date	Yrs. of Exp.	Mobile Phone #	E-Mail Address	Pulse User No.	Role	Attendance		
									1. 15-May-2014	2.	3.
Edwina White	Technical Services Superintendent	Clarence Colliery	04-Dec-1995	18	0427 780 786	edwina.white@centennialcoal.com.au	20080	(none)	P		
Jesse Percival	Environment & Community Coordinator	Clarence Colliery	14-May-2010	4		jesse.percival@centennialcoal.com.au	20081	Risk Assessment Owner	P		
Barry Riley	HST Superintendent	Clarence Colliery	20-Nov-1989	25	0414 744 790	barry.riley@centennialcoal.com.au	20523	(none)	P		
Olivia Kay	Systems Administration Officer	Clarence Colliery	20-Nov-2007	7		olivia.kay@centennialcoal.com.au	20078	Administrative Assistant	P		
Bruce McKenzie	CHPP Superintendent	Clarence Colliery	03-Jan-1978	36	0417 331 187	bruce.mckenzie@centennialcoal.com.au	20087	(none)	A		

Approver	Scope Confirmation	Date	Comments
1. Olivia Kay	Yes	May 15, 2014	Jesse Percival unable to finalise approval but ok for approval of scoping to complete RA

RISK MANAGEMENT STANDARD **Management Standard-004**

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	Fire alarm that sounds & the operator then has to initiate an evacuation	A device that requires personnel to respond to a stimulus	4.	Engineered with people	50.0	20.0	14.0	10.0	5.0
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Dyadem Stature for Risk Management:

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Version: 1

Region: West

Site: Clarence

Department: ZZZZ Whole Site

Equipment / **Process:** HSMS

Stature Risk Assessment No.: 1000836000

Study Lifecycle State: Risk Assessment Approval Pending

Potential Hazard No.:

PULSE Actions Required URL:

Site Risk Assessment Ref. No. (Optional):

Approver	Approved / Rejected	Date	Comments
1. Jesse Percival	Approved	May 19, 2014	

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Date	Description	Location	Start Time	End Time	Comment
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Name	Title	Company	Industry Start Date	Yrs. of Exp.	Mobile Phone #	E-Mail Address	Pulse User No.	Role	Attendance		
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Edwina White	Technical Services Superintendent	Clarence Colliery	04-Dec-1995	18	0427 780 786	edwina.white@centennialcoal.com.au	20080	(none)	P		
Jesse Percival	Environment & Community Coordinator	Clarence Colliery	14-May-2010	4		jesse.percival@centennialcoal.com.au	20081	Risk Assessment Owner	P		
Barry Riley	HST Superintendent	Clarence Colliery	20-Nov-1989	25	0414 744 790	barry.riley@centennialcoal.com.au	20523	(none)	P		
Olivia Kay	Systems Administration Officer	Clarence Colliery	20-Nov-2007	7		olivia.kay@centennialcoal.com.au	20078	Administrative Assistant	P		
Bruce McKenzie	CHPP Superintendent	Clarence Colliery	03-Jan-1978	36	0417 331 187	bruce.mckenzie@centennialcoal.com.au	20087	(none)	A		

Approver	Scope Confirmation	Date	Comments
1. Olivia Kay	Yes	May 15, 2014	Jesse Percival unable to finalise approval but ok for approval of scoping to complete RA

Recommended Controls Do NOT enter additional Recommended Controls on this sheet.	Place(s) Used	Allocated To (Only one SITE person for each Recommended Control)	Required By Date	Pulse User No.	PULSE Ref. No.
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2. Complete a detailed revegetation plan to include seed collection and planting schedule	Events: 2.1, 3.1, 3.2, 5.1, 6.1, 7.1, 8.1, 8.2, 8.3	Jesse Percival	28-Nov-2014	20081	
3. Survey capping material stockpile to estimate volumes available	Events: 7.1	Jesse Percival	23-Jan-2015	20081	
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RISK MANAGEMENT STANDARD **Management Standard-004**

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5. Insignificant	<$100k	First Aid Treatment Only	< 12 hrs	Low level compliance issue	Local complaints	Limited physical damage	15 (S)	19 (M)	22 (L)	24 (L)	25 (L)	

Risk Rating	Risk Category		Generic Management Actions
1 to 4	E	Extreme	Immediate intervention required from senior management to eliminate or reduce this risk
5 to 9	H	High	Imperative to eliminate or reduce risk to a lower level by the introduction of control measures. Management planning required at senior levels
10 to 15	S	Significant	Corrective action required, senior management attention needed to eliminate or reduce risk
16 to 19	M	Moderate	Corrective action to be determined, management responsibility must be specified
20 to 25	L	Low	Monitor and manage by corrective action where practicable

BOW TIE ANALYSIS - Control Effectiveness Matrix									
TYPE OF CONTROL	Examples	Description	Rank	Control Category	CONTROL – Impact / Status / Quality				
					A >= 80%	B 50 – 80%	C 50 / 50%	D 50 – 20%	E <= 20%
	Replace electric hand tools with compressed air alternatives in wet conditions	Eliminates a hazard by removal	1.	Elimination of hazard	100	45.0	40.0	14.0	10.0
	Replace large diameter, heavy cables with smaller ones that are easier to handle manually	Replace element with less risky alternative	2.	Substitution	85.0	40.0	35.0	13.0	8.5
	Automatic fire fighting sprinkler systems	An automatic device that operates without intervention by personnel	3.	Engineered without people	70.0	30.0	25.0	12.0	7.0
	Fire alarm that sounds & the operator then has to initiate an evacuation	A device that requires personnel to respond to a stimulus	4.	Engineered with people	50.0	20.0	14.0	10.0	5.0
	Inspection, maintenance and repair of machinery	A process carried out by personnel	5.	Procedural	20.0	15.0	10.0	6.5	2.0
	Employee made aware of dangers of large moving equipment where the operators have limited vision	Induction training programs	6.	Awareness	5.0	3.0	2.5	1.5	1.0

Dyadem Stature for Risk Management:

Risk Assessment Title: Rehabilitation and Mine Closure Risk Assessment

Version: 1

Region: West

Site: Clarence

Department: ZZZZ Whole Site

Equipment / **Process:** HSMS

Stature Risk Assessment No.: 1000836000

Study Lifecycle State: Risk Assessment Approval Pending

Potential Hazard No.:

PULSE Actions Required URL:

Site Risk Assessment Ref. No. (Optional):

Approver	Approved / Rejected	Date	Comments
1. Jesse Percival	Approved	May 19, 2014	

As a part of the 2014 - 2017 mining operations plan (MOP), Clarence is required to complete a risk assessment to determine risks associated with mine closure and rehabilitation. Areas covered in this risk assessment include exploration, spontaneous combustion, geochemical material, land contamination, revegetation failure, acid mine drainage, capping materials, seed supply, timing of rehabilitation activities, leachate management, final landform design, visual amenity and failure to obtain stakeholder acceptance of rehabilitation.

The following Hierarchy of Controls offers a framework for considering the effectiveness of controls. Note that the effectiveness of a control that is intended to reduce a risk decreases from top to bottom of the list. In other words, the closer the control type is to the top of the hierarchy, the more potentially effective the control.

·Eliminate the hazard or energy source (do not use the energy)

·Minimise or replace the hazard or energy source (reduce the amount of energy to a less damaging level or replace the energy with another that has less potential negative consequences)

·Control the hazard or energy using engineered devices (ex. Lock outs, chemical containers, mechanical roof support, gas monitors, etc.)

·Control the hazard or energy by using physical barriers (ex. machine guarding, warning signs, etc.)

·Control the hazard or energy with procedures (ex. Isolation procedures, standard operating procedures, etc.)

·Control the hazard or energy with personal protective equipment (ex. hard hats, boots with toe caps, gloves, safety glasses, welding gear, etc.)

·Control the hazard or energy with warnings and awareness (ex. posters, labels, stickers, verbal warnings, etc.)

To identify, assess and control the risks to people, plant and environment to ensure that rehabilitation complies with Government and stakeholder expectations or requirements for mine closure and rehabilitation.

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The boundary of this risk assessment includes the Clarence mining lease areas that require rehabilitation at the closure of the mine.

Yes/No	Method
Yes	Workplace Risk Assessment and Control (WRAC)
	Fault Tree Analysis (FTA)
	Safety Integrity Level Analysis to Australian Standard 61508 (SIL)
	Bow Tie Analysis (BTA)
	Failure Modes and Effects Analysis (FMEA)
	Hazard and Operability Analysis (HAZOP)

Document Name	Title	Version	Referenced Document Date
	Environment and community risk assessment		
	Mining Operations Plan 2014 - 2017		
	Clarence Mine Closure and Rehabilitation Plan		
	SEWPAC Approval (specific to exploration in 800 Area)		
	Independent audit for the Clarence Development Consent (DA 504-00)		
	Development consent DA 504-00		
	1976 Approval		
	1994 Approval		
	1993 Approval		
	EPL 726		

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Date	Description	Location	Start Time	End Time	Comment
1. 15-May-2014	Scoping	Clarence Conference Room	9:00 AM	12:00 PM	
2.	Assessment				
3.	Review				

Name	Title	Company	Industry Start Date	Yrs. of Exp.	Mobile Phone #	E-Mail Address	Pulse User No.	Role	Attendance		
									1. 15-May-2014	2.	3.
Edwina White	Technical Services Superintendent	Clarence Colliery	04-Dec-1995	18	0427 780 786	edwina.white@centennialcoal.com.au	20080	(none)	P		
Jesse Percival	Environment & Community Coordinator	Clarence Colliery	14-May-2010	4		jesse.percival@centennialcoal.com.au	20081	Risk Assessment Owner	P		
Barry Riley	HST Superintendent	Clarence Colliery	20-Nov-1989	25	0414 744 790	barry.riley@centennialcoal.com.au	20523	(none)	P		
Olivia Kay	Systems Administration Officer	Clarence Colliery	20-Nov-2007	7		olivia.kay@centennialcoal.com.au	20078	Administrative Assistant	P		
Bruce McKenzie	CHPP Superintendent	Clarence Colliery	03-Jan-1978	36	0417 331 187	bruce.mckenzie@centennialcoal.com.au	20087	(none)	A		

Approver	Scope Confirmation	Date	Comments
1. Olivia Kay	Yes	May 15, 2014	Jesse Percival unable to finalise approval but ok for approval of scoping to complete RA

Instructions:

Recommended Controls (hover for instructions):

Recommended Controls Do NOT enter additional Recommended Controls on this sheet.	Place(s) Used	Allocated To (Only one SITE person for each Recommended Control)	Required By Date	Pulse User No.	PULSE Ref. No.
1. Complete detailed rehabilitation plan to include soil suitability testing for capping material	Events: 2.1, 3.1, 3.2, 5.1, 6.1, 7.1, 8.1, 8.2	Jesse Percival	23-Jan-2015	20081	
2. Complete a detailed revegetation plan to include seed collection and planting schedule	Events: 2.1, 3.1, 3.2, 5.1, 6.1, 7.1, 8.1, 8.2, 8.3	Jesse Percival	28-Nov-2014	20081	
3. Survey capping material stockpile to estimate volumes available	Events: 7.1	Jesse Percival	23-Jan-2015	20081	
4. Discuss with CCC appropriate expectations regarding consultation for mine closure	Events: 12.1, 13.1, 13.2	Jesse Percival	23-Jan-2015	20081	
5. Document MoU with LCC regarding LCC water transfer scheme	Events: 13.1, 13.2	Greg Shields	15-Jan-2015	80021	
6. Develop a register of alternate landuse options post closure	Events: 13.1, 13.2	Jesse Percival	15-Oct-2014	20081	

RISK MANAGEMENT STANDARD **Management Standard-004**

CENTENNIAL RISK MATRIX							Likelihood					
							A Certain	B Probable	C Possible	D Remote	E Improbable	Description (D)
Rating	Consequence Note: Consequence may result from a single event or may represent a cumulative impact over a period of 12 months. Use the worst case reasonable consequence if there is more than one.						Common"	Has Happened within Centennial"	"Could Happen & has happened in non-CEY operations	Not Likely	"Practically impossible	Probability (Pb)
	Impact to Annual Business Plan (F)	Personal Injury (PI)	Business Interruption (BI)	Legal (L)	Reputation (R)	Environment (E)	Frequent incidents	Regular incidents	Infrequent incidents	Unlikely to occur. Very few recorded or known incidents	May occur in exceptional circumstances. Almost no recorded incidents.	Incident Frequency (IF)
							Operations – within 3 months	Operations – within 2 years	Operations – within 5 years	Operations – within 10 years	Operations – within 30 years	Operations (Op)
							Project – Every project	Project – Every 2 projects	Project – Every 5 projects	Project – Every 10 projects	Project – Every 30 projects	Project (Pr)
1. Catastrophic	>$50m	Multiple Fatalities	> 1month	Prolonged litigation, heavy fines, potential jail term	Prolonged International media attention	Long term impairment habitats/ ecosystem	1 (E)	2 (E)	5 (H)	7 (H)	11 (S)	
2. Major	$10m - $50m	Single Fatality	1 week to 1 month	Major breach/ major litigation	International media attention	Long term effects of ecosystem	3 (E)	4 (E)	8 (H)	12 (S)	16 (M)	
3. Moderate	$1m - $10m	Serious/ Disabling Injury	1 day to 1 week	Serious breach of regulation. prosecution/ fine	National media attention	Serious medium term environmental effects	6 (H)	9 (H)	13 (S)	17 (M)	20 (L)	
4. Minor	$100k - $1m	Lost Time Injury	12 hrs to 1 day	Non-compliance, breaches in regulation	Adverse local public attention	Minor effects to physical environment	10 (S)	14 (S)	18 (M)	21 (L)	23 (L)	
5. Insignificant	<$100k	First Aid Treatment Only	< 12 hrs	Low level compliance issue	Local complaints	Limited physical damage	15 (S)	19 (M)	22 (L)	24 (L)	25 (L)	

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	Inspection, maintenance and repair of machinery	A process carried out by personnel	5.	Procedural	20.0	15.0	10.0	6.5	2.0
	Employee made aware of dangers of large moving equipment where the operators have limited vision	Induction training programs	6.	Awareness	5.0	3.0	2.5	1.5	1.0

Plans 1A, 1B and 1C – Project Locality

Appendix 2

Plan 2 – Mine Domains at Commencement of MOP

Appendix 3

Plan 3A-3G – Mining and Rehabilitation

Appendix 4

Plan 4 – Final Rehabilitation and Post Mining Land Use

Appendix 5

Plan 5 – Rehabilitation and Post Mining Land Use Cross Sections

Appendix 6

DTIRIS Consultation Comments

Clarence Colliery 2014 – 2017 MOP

Comments

MOP Section	Comment/Queries	Recommendation	Clarence Comments
1 – Introduction			
1.1 – History of Operations	No specific comment regarding content with exception of labelling mentioned places and features on Plan 1A to 1C	• Improve labelling on Plans 1A to 1C to include surrounding features and places as mentioned in Section 1.1 (e.g. Newnes Kaolin Project, Hanson Quarry, Roca Quarry etc.)	• Noted
1.2 – Current Consents, Authorisations and Licences	No specific comment		
1.3 – Land Ownership and Land Use	No specific comment	• Refer to recommendations for Plan 1C	• Noted
1.4 – Stakeholder Consultation	Stakeholder consultation section is very high level and non-specific. As majority of surface lands are within Newnes State Forest, I would expected to see more detail on specific consultation strategy with Forest NSW, particularly in regards to management of subsidence impacts and access to land for exploration and subsidence management.	• Provide more detail in regards to agreements/commitments and consultation strategy required with Forest NSW • Based on consultation undertaken to date, outline a summary of stakeholder expectations regarding mine closure and final land use, rehabilitation objectives and completion criteria	• Noted: Clarence has formal arrangements with Forests in the form of a Occupation Permit, Forests are provided AEMR each year, Consulted in the SMP process, exploration process • Consultation regarding Mine Closure expectations occurred during the development of the Mine Closure and Rehabilitation Plan, More Detail can be added
2 – Proposed Mining Activities			
2.1 – Project Description	No specific comments		
2.2 – Asset Register	• There is no discussion regarding proposed post-mining land use for any of the domains. "General Rehabilitation Treatment" section for each current domain does not identify the proposed rehabilitation objective (e.g. native ecosystem, grazing land etc.). • Section 2.2.2.4 Land Assessment outlines that all carbonaceous material in the domain will be	• Refer to Domain Selection (Section 5.1) for recommendations. Add and discuss additional domains such as downcast ventilation shaft, deep pit tailings void and SMP areas. Is there a Section 100 in place for the deep pit tailings void? • The "General Rehabilitation Treatment" sections should include some discussion	• Noted: Post mining land use discussed in Section 4. • Deep Pit Tailings Void not a Primary Domain • Can add discussion regarding SMP Areas • Noted: Can add section of regarding post rehabilitation domains, Most however will

	stripped to a maximum depth of 1m and disposed of in the deep pit tailings void. There is no indication as to whether carbonaceous material will extend beyond a depth of 1m and if so, what measures will be implemented to cap this material to prevent exposure and minimise constraints to rehabilitation • The deep pit tailings void is mentioned in Section 2.2.2.4 but nowhere else in the document. This will be a key closure issue/risk which should be addressed by the MOP. • Section 2.2.3.1 outlines that all reject emplacement areas will be reshaped to a maximum of 18 degrees and where available, the areas will be covered with a clay based material to provide a basic cap (0.5-0.8m) and a substrate in which vegetation can be established.	in terms of the overall final land use and rehabilitation objective for each domain • The treatment of carbonaceous material as described in Section 2.2.2.4 should be focused on measures to prevent exposure and minimise constraints to rehabilitation • Further justification for the reshaping and revegetation approach for reject emplacement areas as outlined in Section 2.2.3.1 is required. This justification will need to include discussion on the risks and measures to be implemented to provide that the final landform and revegetation strategy can sustain the intended post-mining land use (e.g. Natural Bushland as outlined in Table 10 of MOP). Further discussion is also required on where the capping material will be sourced. • Section 2.2.4.2 should refer to DRE guidelines for mine sealing	be Natural Bushland • Noted: Ongoing performance monitoring is discussed in Section 5 • Noted
2.3 – Activities over the MOP Term	• Section 2.3.1 Exploration does not include any discussion on rehabilitation program • Labelling of various reject emplacement areas is required on Plan 2 (see recommendations under Plan 2 below) • Section 2.3.9 – does the reject material and product schedule outlined in Table 8 reflect the actual mining schedule as outlined in Plan 3? • Section 2.3.3 refers to Plan 4C, which does not exist. It is assumed that this should be Plan 3.	• Further detail on rehabilitation program for exploration borehole is required. Where boreholes are intended to be used for groundwater monitoring, Clarence Colliery will be required to obtain the necessary groundwater monitoring licences and landholder agreements will need to be in place prior to construction of borehole. • Further detail is required in regards to the tailings and reject emplacement methodology. This does not need to be a total repeat of what is in the S100, however, it should provide enough context to sufficiently provide an understanding of the types of	• Noted: Clarence has Construction Environmental Management Plans (CEMP) which outline the development, rehabilitation of boreholes. It is also outlined in REFs • Noted • Noted: Clarence has Topsoil Management Procedure, emphasis goes into direct re-use. • Noted

		risks/threats to rehabilitation of these facilities. • Section 2.3.9 requires more context in regards to where topsoil and rock/overburden material will be stripped from in the MOP term. How will this be managed and stored and what is the intended use? • Where construction and stripping activities are to occur in MOP Period, Section 2.3 should described measures for the salvage of biological resources for further use in rehabilitation. Measures may include topsoil/subsoil characterisation, topsoil management, salvage of habitat features (i.e. tree hollows, logs etc.).	
3 – Environmental Issues Management			
3.1 – Environmental Risk Assessment	The Environment and Community Risk Assessment as provided in Appendix 1 of the MOP is very broad brushed and partially relevant to the information on risks required by the MOP. Rehabilitation risks are only considered at a high level. In Section 3.1, DRE requires a more detailed risk assessment specific to mine rehabilitation, which should provide sufficient context to the discussion of environmental risk management in Section 3.2 of MOP.	As a minimum, risk assessment should address the following: • Exploration on Newnes Plateau – other than weeds, biodiversity impacts also need to be assessed in terms of aspects of clearing of land; ground disturbance and compaction; transport and access to site; vehicle movements; drilling and handling of drilling fluids; storage of materials/equipment/chemical etc.; and generation of wastes • Spontaneous combustion • Adverse geochemical material • Land contamination • Revegetation failure • Acid/neutral drainage • Topsoil handling and management, including a lack of topsoil	• Noted

		• Lack of capping material • Inadequate seed supply • Timing of rehabilitation activities (e.g. seasonal conditions) • Leachate from REAs • Inappropriate final landform design • Visual amenity of final landform design • Landform instability and geotechnical risks (e.g. filling and capping of deep pit tailings void) • Failure to obtain stakeholder acceptance of rehabilitation	
3.2 – Environmental Risk Management	• In general, the scope of environmental risk management pertaining to rehabilitation should be relative to the risk assessment provided in Section 3.1. • Section 3.2.1.2 outlines that no incidences of spon com have occurred in respect to coal stockpiles, product stockpiles and exploration holes. Should there be any changes to the geochemical nature of the seams, are there any systematic process in place to identify and manage spon com should it occur in surface emplacements such as coal stockpiles and REAs. Has the capping strategy for REAs been developed to address spon com risks as well as ignition of carbonaceous material from spon com? • Section 3.2.1.9 Other Risks (Land Contamination) – what were the results of the Phase 2 contamination sampling program? What are the likely risks to incurring a rehabilitation liability from contaminated land? • Section 3.2.1.9 Other Risks (Hazardous Materials) – for context, further details in regards to the type and typical quantities of hazardous materials stored/used on site?	• Section 3.2.1.6 Soil Type(s) and Suitability – recommend a process where topsoil is characterised prior to stripping or following extended periods of stockpiling, to determine its suitability and amelioration requirements for rehabilitation. • Section 3.2.1.7 should provide a more detailed overview of the seed collection and handling strategy, including the proposed timing for collection during the MOP period to ensure that there is sufficient and suitable seed stock available for the proposed rehab schedule. • Overall, the revegetation strategy outlined in Section 3.2.1.7 is very high level and needs to be more specific in relation to the intended final land use. Where native grass species is to be used for steep slope cover, recommend Clarence Colliery engage some specialist advice to determine most appropriate species. This may require some field trials to assess evaluate the success of	• Noted: does DRE have guidelines which should be referenced? • Noted • Noted

	• Section 3.2.1.9 Other Risks (Acid Mine Drainage) – outlines the potential for reject material to produce acid and metalliferous drainage. Whilst an overview of the active leachate system is provided, further detail should be provided as to how the design of the REAs will address the potential long term leachate post closure.	various species.	
4 – Post Mining Land Use			
4.1 – Regulatory Requirements	• Section 4.1 refers to regulatory requirements including mining lease and development consents. However, only development consent DA504-00 is listed in Table 10. • In Table 10, Condition (a) of DA504-00 requires objectives and criteria for mine closure to be defined. Table 10 outlines that this is addressed in Section 2.2 of the MOP, however, objectives and criteria are not addressed in Section 2.2 nor adequately in other sections of the MOP (refer to comments in Section 4.3 below). • In Table 10, Condition (c) of DA504-00 includes the requirement to investigate ways to minimise the adverse socio-economic effects associated with mine closure. Table 10 outlines that this is addressed in Section 1.4 of the MOP, however, Section 1.4 focuses on stakeholder engagement processes rather than the scope and timing requirements for a socio-economic assessment.	• Recommend Table 10 be expanded to include other relevant regulatory conditions/commitments pertaining to rehabilitation. Where a particular regulatory approval doesn't include relevant conditions for rehabilitation, this should be stated. Other commitments for rehabilitation as specified by mining lease related approvals such as S126/100s for the REAs should be included. • The deep pit tailings void is mentioned briefly in Section 2.2.2.4 Land Assessment in reference to the disposal of carbonaceous material. The list of approvals listed in Section Table 3 does not include any reference to the deep pit tailings void. It is recommended that Clarence Colliery provide further information in regards to the approval status of the deep pit tailings void (e.g. is there a Section 100 approval in place?).	• Table 10 only includes conditions relating to rehab from DA504.00 • Disposal of carbonaceous material will be consistent with section 100 approvals, this will be further clarified
4.2 – Post Mining Land Use Goal	• In Table 10, Condition (b) of DA504-00, the post-mining land use (Natural Bushland) is only listed for the REA. The proposed final land use for other areas on site is not stipulated in Section 4.2. • In Table 10, Condition (b) of DA504-00 requires Centennial to investigate options for the future	• Whilst DRE recognises that there are a number of options for post mining land uses given the location and attributes of the site, as listed by Centennial, there needs to be a base-case final land use(s) for all domains specified in the MOP that is consistent with current development	• Noted: Post mining land use was discussed during the development of the closure and rehabilitation plan • Noted

	use of the site, including the pit top and surface facilities. • Alternative post-mining land uses (e.g. industrial use etc.) will require further investigation by Clarence Colliery in consultation with the relevant stakeholders (e.g. Department of Planning & Infrastructure, Local Council, relevant landholders), which also may require an approval process. • Section 4.2 outlines that a final landform design and rehabilitation plan is detailed in Plan 4. The level of detail on this plan is not considered adequate to enable a proper assessment of the suitability of the final landform and land use plan. There is currently no indication of what is the proposed final land use(s) for the site.	consents and land use zonings. The land use goal as listed in Table 11 (Rehabilitation Area – Forest) needs to be included in this section. However, the goal needs to be more specific as discussed below. • Refer to Plan 4 for specific recommendations regarding this plan.	
4.3 – Rehabilitation Objectives	• The rehabilitation objectives listed in Section 4.3 are too broad and non-specific to the proposed final land use(s).	• It is recommended that objectives be further defined to enable the development of appropriate performance indicators as outlined in Section 6 below. Guidance material on typical closure objectives and closure criteria is outlined in Explanatory Note 1 – Example Rehabilitation Table of the MOP Guidelines. In addition to the objectives currently included in the MOP (e.g. landform & preservation of downstream water quality), further consideration should also be given to objectives relating to the following: ▪ management of site infrastructure water management infrastructure ▪ management of potential contamination ▪ revegetation and ecosystem establishment ▪ REA and tailings capping	• Noted

		▪ Weed management	
5 – Rehabilitation Planning and Management			
5.1 – Domain Selection		• In the case of Clarence Colliery, the primary domains should be determined based on the proposed post-mining land use that is consistent with the current development consents and current land zonings. In the case of Clarence Colliery with the all areas of the current pit top area proposed for Natural Bushland, there would only be one Primary Domain. As such, it is recommended that the current domains be listed as "Secondary – Operational Domains", which are defined as land management units within the mine site, usually with a unique operational and functional purpose as well as similar geophysical characteristics. As such, the discussion of activities for removal of assets from each of these domains and rehabilitation strategy should be reflective of what is required in order to meet the objectives of the primary land use domain. • Additional primary domains may be developed following the completion of the final land use studies, where different post-mining land uses are identified. In this event, the objectives and completion criteria for each of the secondary domains would need to be developed to be reflective of these final land use goals. • Due to different geographical locations as well as operational and rehabilitation schedules, it is recommended that each of the REA areas be listed as separate secondary domains. The advantage of	• Noted

		this approach is that it provides for better transparency in calculating rehabilitation cost estimates as well as progressively relinquishing securities following rehabilitation having met the objectives and completion criteria in each of these areas. • It is recommended that domains also be designated for SMP areas, deep pit tailings void and the ventilation facility on the Newnes Plateau. The latter should have specific final land use and associated closure objectives and criteria developed in consultation with Forest NSW	
5.2 – Domain Rehabilitation Objectives		• Refer to Section 4.3 above. This information should be presented in table format as per Explanatory Note 1 – Example Rehabilitation Table of the MOP Guidelines.	• Noted
5.3 – Rehabilitation Phases	• As approved mining operations is expected to continue beyond the MOP period, both the CHPP and Admin domains should remain as Active Mining Areas during the MOP Term. • In regards to the REA domain, please note that reaching the "Ecosystem and Land Use Sustainability" phase of rehabilitation during the MOP term means that monitoring can demonstrate that rehabilitation is tracking towards meeting the objectives and completion criteria for this area	• Refer to Section 5.1 above. Table 12 should be expanded to include the additional domains.	• Noted
6 – Performance Indicators and Completion/Relinquishment Criteria	• Section 6 has not been developed in accordance with Explanatory Note 1 – Example Rehabilitation Table of the MOP Guidelines. • Clarence Colliery is proposing to only use LFA as a performance indicator and has not provided any target levels for completion criteria.	• It is recommended that completion criteria be developed in consideration of Explanatory Note 1 – Example Rehabilitation Table of the MOP Guidelines for the objectives of each domain as listed above. In the case of the objectives for Clarence Colliery, the	• Include rehab table from explanatory note 1 • Current completion criteria is based on LFA benchmarks • It is outcome based: This was chosen to provide a degree of flexibility whilst achieving the same outcome

	• Whilst LFA is a valuable tool in describing the functionality of a landscape as a biophysical system, it should not be relied on as the soul performance indicator for completion criteria. • Specific, Measurable, Achievable, Realistic and Time-Bound criteria should be developed to assess and verify whether rehabilitation has attained the specific objectives for each domain. • SMART criteria should also be developed in consideration of reference/analogue sites	completion criteria should address the following aspects as a minimum: ▪ Landform – slope/profile, geotechnical stability, capping design, erosion, drainage design, presence of hazardous materials, mine entry sealing design etc. ▪ Infrastructure - decommissioning, removal of hazardous materials, management of pipelines/powerlines etc. ▪ Land suitability – contamination levels, soil profile development, soil compaction/crusting etc. ▪ Revegetation – target vegetation species/community, habitat structures, evidence of natural secondary regeneration, vegetation cover, weed infestation ▪ Water quality ▪ Bushfire – implementation of specific controls based on advice from NSW Rural Fire Service	• Provides quantifiable performance indicators
7 – Rehabilitation Implementation			
7.1 – Status at MOP Commencement	• This section appears to be incomplete. Please refer to recommendations for Plan 2 below.		
7.2 – Proposed Rehabilitation Activities during the MOP Term	• The areas presented in Table 16 appear to be in-correct. It appears that the Cumulative Rehabilitation Area has been calculated based on Total Disturbance Area + Total Rehabilitation Area per MOP Year. • It also appears that the figures reported in Total Rehabilitation Area per MOP Year are cumulative rather than ha per year.	• More discussion is required to describe the scope of rehabilitation activities per domain during the MOP term. This type of information is currently provided in Section 9 and as such it is suggested that this information be re-located to this section. • Rectify issues in Table 16	• Repetition of other sections? • Please detail issues of table 16 • Timing based on availability of decommission infrastructure/REA • High level of detail to go into each season of each year

		• What is the timing and schedule of rehabilitation activities? Scheduling of rehabilitation should take into consideration revegetating in optimal seasonal conditions.	
7.3 – Summary of Rehabilitation Areas during the MOP Term	• It appears that there has been a misinterpretation of the use of rehab phases reported in each domain within Table 17. For example, Table 17 is currently showing the following: ▪ 4.3ha of Domain 1 (CHPP) has been decommissioned at the start of the MOP period ▪ 2.9ha of Domain 2 (Admin) has had landform establishment at the commencement of the MOP Period and a further 5ha of landform establishment will be completed by the end of the MOP term • Based on a review of information covered in existing MOP, it is expected that Domain 1 and 2 should be presented as Active Mining for the MOP term. • For Domain 3 (REAs), there is no transparency in how the areas for each rehabilitation phase have been derived. These should be reflected in Plans 3.	• Rectify issues in Table 17 to ensure that correct rehabilitation phases are presented • As per Section 5.1 above, recommend to split and report the REAs as separate domains in order to provide more transparency of how figures are calculated for the various rehabilitation phases • See Plan 3 for recommendations	• Will fix table 17 • REAs are same form, same rehab methodology, will it add complexity separating domains • Will included literature on rehabilitation methodologies
7.4 – Relinquishment Phase achieved during MOP period	• No specific comment		
8 – Rehabilitation Monitoring and Research			
8.1 – Rehabilitation Monitoring	• The rehabilitation monitoring section is very high level and non-specific	• It is recommended that further detail be provided in this section with a monitoring program to be developed to assess performance against the rehabilitation objectives and completion criteria outlined in Sections 5.2 and 6. • This does not need to be complex, but	• What other methods does DRE suggest for Rehabilitation? • LFA is adaptable, quantifiable and allows ecosystem development to be tracked • AEMR includes rehabilitation

		for the current rehabilitation areas (REAs), the program should include at least the following: ▪ A description of the methods for monitoring against the criteria other than just EFA/LFA (e.g. methodology designed with more focus on relative abundance of species which is more repeatable between surveys with less observer bias) ▪ The proposed program and timing of monitoring ▪ The location of rehabilitation monitoring and analogue/reference sites • It is expected that the results of the monitoring program will be detailed in the Annual Environmental Management Report. This information is expected to be utilised to verify at what phase the rehabilitation can be classified as for each area (e.g. Ecosystem Establishment to Ecosystem Development).	
8.2 – Relinquishment Phase achieved during MOP period	• Section 8.2 appears to be in-complete.	• It is recommended research and rehabilitation trials for Clarence Colliery be developed to address potential knowledge gaps associated with implementing rehabilitation for the site. Knowledge gaps should be identified through risk assessments, rehabilitation monitoring and observations. Specific to Clarence Colliery, opportunities for research and trials should be considered in relation to the following: ▪ Capping processes for the REAs ▪ Establishment of native	• Results risk assessment for mine closure to be included for potential rehabilitation trials

		groundcovers; ▪ Long term REA leachate control etc.	
9 – Intervention and Adaptive Management			
9.1 – Threats to Rehabilitation	• As outlined in Section 7.2 above, the initial information contained in Section 9 is describing rehabilitation methodology and as such it would be appropriate to relocate this information to Section 7.2	• As discussed in Section 3.1 outlined above, it is recommended that a more specific risk assessment for rehabilitation be undertaken to adequately determine the Threats to Rehabilitation for Clarence Colliery.	• Noted
9.2 – Trigger Action Response Plan	• Existing TARP is limited to outcomes of EFA/LFA monitoring	• Recommend to expand TARP to cover specific risks/threats identified in the rehabilitation risk assessment. This should include threats to the establishment of rehabilitation such as the following: ▪ Occurrence of erosion ▪ Storm events ▪ Germination failure ▪ Predation of revegetation by animals ▪ Spon com ▪ Drought ▪ Bushfire ▪ Weed infestation	• Noted. Specific Mine Closure and Rehabilitation Risk Assessment Compeletd
10 – Reporting	• No specific comments		
Plans			
1A – Pre-Mining Environment – Project Locality		• Recommend to include an insert to show location of the project in State wide context	• Noted
1B – Pre-Mining Environment – Natural Environment	• No specific comments		
Plan 1C – Pre-Mining Environment – Built Environment	• No specific comments		
Plan 2 – Mine Domains		• Label location of ventilation facility and	• Noted

		include as a separate domain – this should have specific final land use and associated closure objectives and criteria developed in consultation with Forest NSW	
Plan 2 – Mine Domains (Surface Detail)		• Current scale does not provide sufficient resolution of surface facilities. Suggest zooming in on area of surface facilities from base of rail loop to immediately north of water storage area • Improve labelling of surface facilities (e.g. label the various REAs, mine entries, water management infrastructure, ventilation, stockpiles, hydrocarbon storage facilities, workshops, deep pit tailings void etc.) • Label the quarries to differentiate ownership from Clarence Colliery	• Noted
Plan 3 – Mining & Rehabilitation	• Plan does not show the limit of subsidence to 20mm	• Recommend zooming in to each of the mining areas (i.e. 2 plans) to provide more clarity and context of the environmental surface features where underground mining is occurring (creeks, roads, transmission lines etc.) • Suggest to add domains as per Section 5.1	• Noted
Plan 3A to 3G – Mining & Rehabilitation (Surface Detail)		• Current scale does not provide sufficient resolution of surface facilities. Suggest zooming in on area of surface facilities from base of rail loop to immediately north of water storage area • Improve labelling of surface facilities (e.g. label the various REAs, mine entries, water management infrastructure, ventilation, stockpiles, hydrocarbon storage facilities, workshops, deep pit tailings void etc.) • Suggest to add domains as per Section	• Noted

		5.1 • Label the specific year on each plan e.g. 2014, 2015 etc.	
Plan 4 – Final Rehabilitation & Post Mining Land Use	Suggest that Plan 4 relating to underground mining area is not relevant and as such not required for the MOP.		
Plan 4 – Final Rehabilitation & Post Mining Land Use (Surface Detail)		• Current scale does not provide sufficient resolution of surface facilities. Suggest zooming in on area of surface facilities from base of rail loop to immediately north of water storage area • Improve labelling of surface facilities (e.g. label the various REAs, mine entries, water management infrastructure, ventilation, stockpiles, hydrocarbon storage facilities, workshops, deep pit tailings void etc.) • Suggest to add domains as per Section 5.1 • Show final landform contours and proposed final land use	• Noted


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