DONALDSONCOAL

Part of the Yancoal Australia Group

ABN: 87 073 088 945

YANCOAL

兖煤澳大利亚有限公司

Rehabilitation Management Plan

Donaldson Coal Mine

October 2023

Prepared by

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DONALDSON COAL
PTY LTD

ABN: 87 073 088 945

Rehabilitation Management Plan

for the

Donaldson Coal Mine

Prepared for:

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DONALDSONCOAL
Part of the Yancoal Australia Group

Summary Table

Name of Mine		Donaldson Coal Mine - Rehabilitation Management Plan		
RMP Commencement Date		2 July 2022		
Mineral Authorities		ML1461	**Expiry Date**	20 December 2020 (renewal sought)
Name of Leaseholder		Donaldson Coal Pty Ltd		
Version	**Author**	**Purpose**	**Approved by**	**Date of Submission**
1	RWC / Donaldson Coal	New Document	Phillip Brown	1 August 2022
2	RWC / Donaldson Coal	Approval of ROBJ and FLRP	James Benson	6 October 2023

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LIST OF ACRONYMS

AHD	Australian Height Datum
ARI	Annual Recurrence Interval
BTEX	benzene, toluene, ethylbenzene and xylene
DA	Development Application
DRE	Department of Resources and Energy
EIS	Environmental Impact Assessment
EPA	Environment Protection Authority
EPL	Environment Protection Licence
FMCD	Four Mile Creek Downstream
FMCU	Four Mile Creek Upstream
FPC	foliage projective cover
GSS	Global Soil Systems Pty Limited
GSSE	GSS Environmental Pty Limited
HEC	Hydro Engineering & Consulting
LTI	Lost Time Injury
ML	Mining Lease
MLALC	Mindaribba Local Aboriginal Land Council
MOP	Mining Operations Plan
MTI	Medical Treatment Injury
NRAR	Natural Resources Access Regulator
NSW	New South Wales
PKK	PKK Environment & Infrastructure Pty Ltd
RACI Matrix	responsible, accountable, consulted and informed matrix
RCE	Rehabilitation Cost Estimate
RFS	Rural Fire Service
RMP	Rehabilitation Management Plan
RO	Report Only
ROM	Run of mine
RWC	R.W. Corkery & Co. Pty Limited
RWI	Restricted Work Injury
SDCD	Scotch Dairy Creek Downstream
SDCU	Scotch Dairy Creek Upstream
SLR	SLR Consulting Australia Pty Ltd
SMP	Subsidence Management Plan
t/ha	tonnes per hectare
V:H	Horizontal Velocity
WFCD	Weakleys Flat Creek Downstream
WFCU	Weakleys Flat Creek Upstream

1. INTRODUCTION TO MINING PROJECT

This Rehabilitation Management Plan (the "Plan") has been prepared by R.W. Corkery & Co. Pty Limited (RWC) in conjunction with Donaldson Coal Pty Limited (Donaldson Coal) for the Donaldson Open Cut Coal Mine (the "Donaldson Mine"). The Donaldson Mine is located approximately 23km northwest of Newcastle, NSW (the "Donaldson Mine Site") (**Figure 1**).

This Plan has been prepared in accordance with the following documents and guidelines.

- *Form and Way: Rehabilitation Management Plan for Large Mines* (July 2021).
- *Form and Way: Rehabilitation Objectives, Rehabilitation Completion Criteria and Final Landform and Rehabilitation Plan for Large Mines* (October 2022).
- *Guideline: Rehabilitation Risk Assessment* (July 2021)
- *Guideline: Rehabilitation Records* (July 2021).
- *Guideline: Rehabilitation Controls* (July 2021)
- *Guideline: Rehabilitation Objectives and Rehabilitation Completion Criteria* (January 2023)

1.1 HISTORY OF OPERATIONS

1.1.1 Development

The Donaldson Mine is owned and operated by Donaldson Coal, a wholly owned subsidiary of Yancoal Australia Limited. Donaldson Coal also owns and operates the Abel Underground Coal Mine, with surface facilities partly integrated within the Donaldson Mine Site and underground mining operations occurring immediately south of the Donaldson Mine Site.

Development consents for the Donaldson mine were granted in December 1999. Development commenced January 2001 and the first coal was dispatched during March 2001. Consent for mining operations lapsed on 31 December 2013, however, certain conditions, including rehabilitation requirements, continue to apply without a specified approval lapse date.

1.1.2 Operation

The Donaldson Mine consisted of three open cut pits; namely the Donaldson Open Cut Pit, the West Pit, and the Square Pit. Mining operations within the Donaldson Mine Site ceased April 2013. Run-of-Mine (ROM) Coal from surface (Donaldson) and underground (Abel) mining operations (including coarse reject material) was transported via internal sealed haul roads to the Bloomfield Coal Handling and Preparation Plant, located approximately 2.5km to the northwest of the Donaldson Mine Site.

Handling, processing, and rail load-out of coal was entirely contained at the Bloomfield Coal Handling and Preparation Plant. Subsequently, no tailings or coarse reject material (other than low-grade waste rock retained within the Open Cut Pits for direct disposal) were disposed of within the Abel or Donaldson Mine Sites.

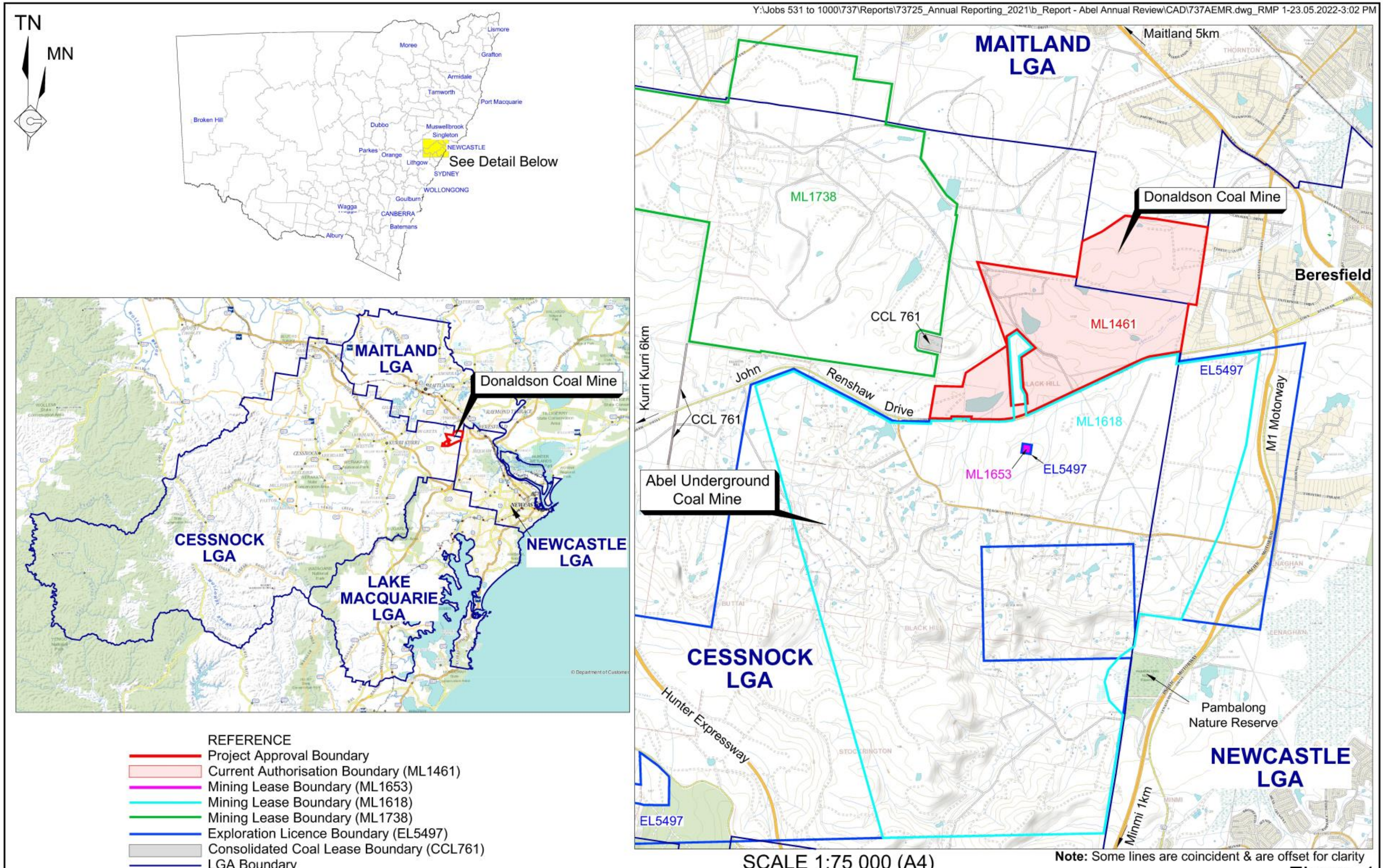

Figure 1
LOCALITY PLAN

1.1.3 Rehabilitation

Progressive backfilling of the Donaldson Open Cut began as soon as adequate progression and capacity within the pit had occurred, with the majority of overburden material being placed in-pit since March 2002. Reshaping of backfilled material to a landform commensurate to the existing topography commenced September 2002.

The cessation of open cut mining operations allowed for significant rehabilitation operations within the Donaldson Open Cut Pit with backfilling and revegetation of the disturbed area completed in March 2014.

Other progressive rehabilitation activities at the Donaldson Mine have included reshaping of sections of the pit walls of the West and Square Pits and removal of various infrastructure including fuel storage tanks, traffic control boom gates, and a number of bitumen and dirt roads.

Mine-related infrastructure currently remaining within ML 1461 included the following.

- Administration office.
- Workshop.
- Core shed.
- Selected access roads.

The Abel and Donaldson Mines are currently under Care and Maintenance

1.2 CURRENT DEVELOPMENT CONSENTS, LEASES AND LICENCES

Table 1 presents the current development consents, approvals, leases and licences for the Donaldson Mine.

Table 1
Current Consents, Authorisations and Licenses

Approval/Lease/Licence	Issue Date	Expiry Date	Details / Comments
Development Consent*			
Development Consent (combined DA 98/01173 and 118/698/22)	14/10/1999	-	Modified on 26 September 2005 and 24 June 2011. Consent for mining operations lapsed on 31 December 2013. Certain conditions of the consent will continue to operate after the consent for mining operations has lapsed.
Mining Authorisations*			
ML 1461	22/12/1999	22/21/2020 (renewal sought)	Incorporates an area of 515.5ha with depth restrictions and surface exceptions.
Other Approvals & Licences			
Environment Protection Licence No. 12856	9 July 2008 (licence version 1 October 2021)	Not applicable	Issued by the Environment Protection Authority (EPA).
Water Supply Works Approval 20WA211590	01/08/09	31/07/22	Issued for the works associated with the open cut mining pits as located within the *Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources 2009.*
* Boundary presented on **Figure 1**			

It should be noted that ML 1618 associated with the Abel Mine partially overlaps with ML 1461 for the Donaldson Mine (see **Figure 1**), with surface and or depth restrictions applicable to the respective leases. For the purpose of this Plan, the responsibility of the rehabilitation of the section of overlap has been attributed to the Abel Mine given that this area is utilised principally for the Abel Mine operations.

1.3 LAND OWNERSHIP AND LAND USE

1.3.1 Land Ownership

Details of land ownership on and in the vicinity of the Donaldson Mine and the boundaries of ML 1482 are shown in **Table 2** and **Figure 2**.

Table 2
Land Tenure

ID	Lot Number	DP Number	Type
1	53	755237	Freehold
2	41	755237	Freehold
3	46	755237	Freehold
4	81	627799	Freehold
5	121	567150	Freehold
6	109	1100314	Freehold
7	110	1100314	Freehold
8	131	1098413	Freehold
9	13	1097621	Freehold
10	1392	1126633	Freehold
11	111	1128130	Freehold
12	119	1154904	Freehold
13	1	838310	Freehold
14	12	1007491	Freehold
15	202	1203914	Freehold
16	127	1173519	Freehold
17	311	1237460	Freehold
18	302	1237460	Freehold
19	303	1237460	Freehold
20	310	1237460	Freehold
21	619	1267996	Freehold
22	620	1267996	Freehold
23	621	1267996	Freehold
24	301	1237460	Freehold
25	931	816814	Freehold

1.3.2 Current Land Uses and Key Environmental Features

Figures 2, **3** and **4** also show the key environmental features of the lands within and in the vicinity of the Donaldson Mine Site. In summary, the land in the immediate vicinity of the Donaldson Mine Site primarily consists of:

- mixed remnant and regrowth native vegetation;
- agricultural production and rural property;
- manufacturing and industry;
- transport and communication; and
- coal mining and production.

1.3.3 Historical Land Use

Previous mining activities by non-Donaldson Coal related ventures have also been undertaken within or near the Abel and Donaldson Mine Sites. The primary mining activities relate to the Stockrington No. 2 Colliery which mined the uppermost coal seam, the West Borehole Seam, in the southern section of the underground mine area until closure of the mine in the early 1980s. A number of smaller mines including the Black Hill Borehole, Blackhill Borehole No. 3, Buttai Borehole, Duckenfield, Duckenfield Old, Great Borehole, Hilltop Borehole, Linton Borehole, Mimi Open Cut, Mountain Borehole Underground, Mountain Borehole Open Cut, Rosewood Borehole, RW Miller, Stockrington, Stockrington Borehole, Taylors Borehole, Taylors Borehole No. 2 and Valley Borehole have also been undertaken within and surrounding the Abel and Donaldson Mine Sites.

1.3.4 Easements and Infrastructure

Service-related infrastructure that is owned, operated, and maintained by third parties, including associated easements are located within the Mine Site, as shown on **Figure 2**. This includes:

- Transmission Powerlines (Transgrid)
- Hunter Water Pipeline (Hunter Water Corporation)
- Snowy Hydro Gas Pipeline (Snowy Hydro Limited)

The following presents an overview of each of the above and a summary of rehabilitation-related accountabilities and responsibilities attributed to Donaldson Coal.

Transgrid Powerlines

The main Transgrid transmission powerline traverses the Donaldson Mine Site generally east to west for approximately 2.8km. The easement is approximately 40m wide, and covers approximately 8.7ha within the Donaldson Mine Site. Certain Mine-related infrastructure is located within the easement, such as sealed and unsealed roads and Rumbles Dam. Maintenance of vegetation within the easement is the responsibility of Transgrid.

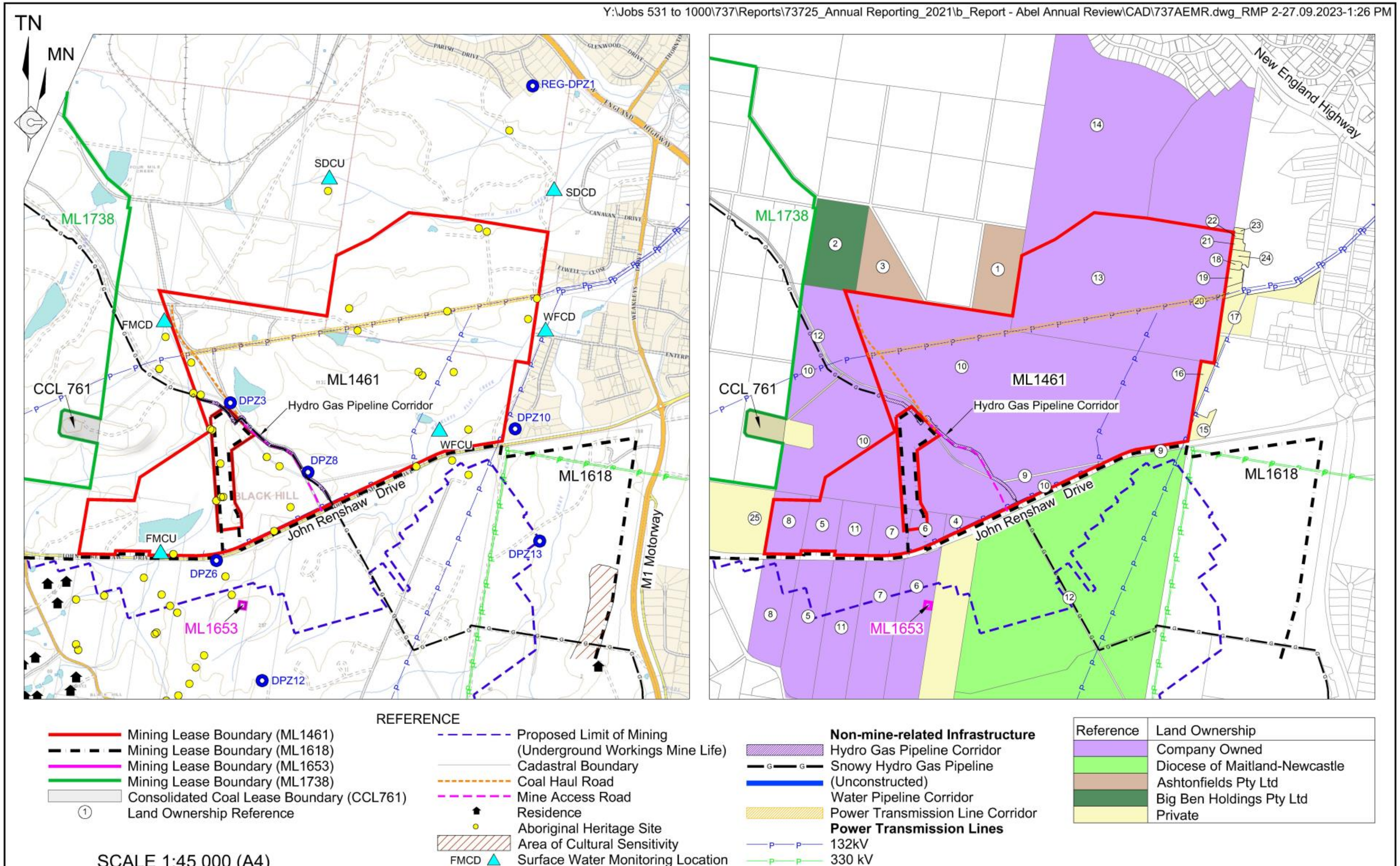

Figure 2
BUILT ENVIRONMENT

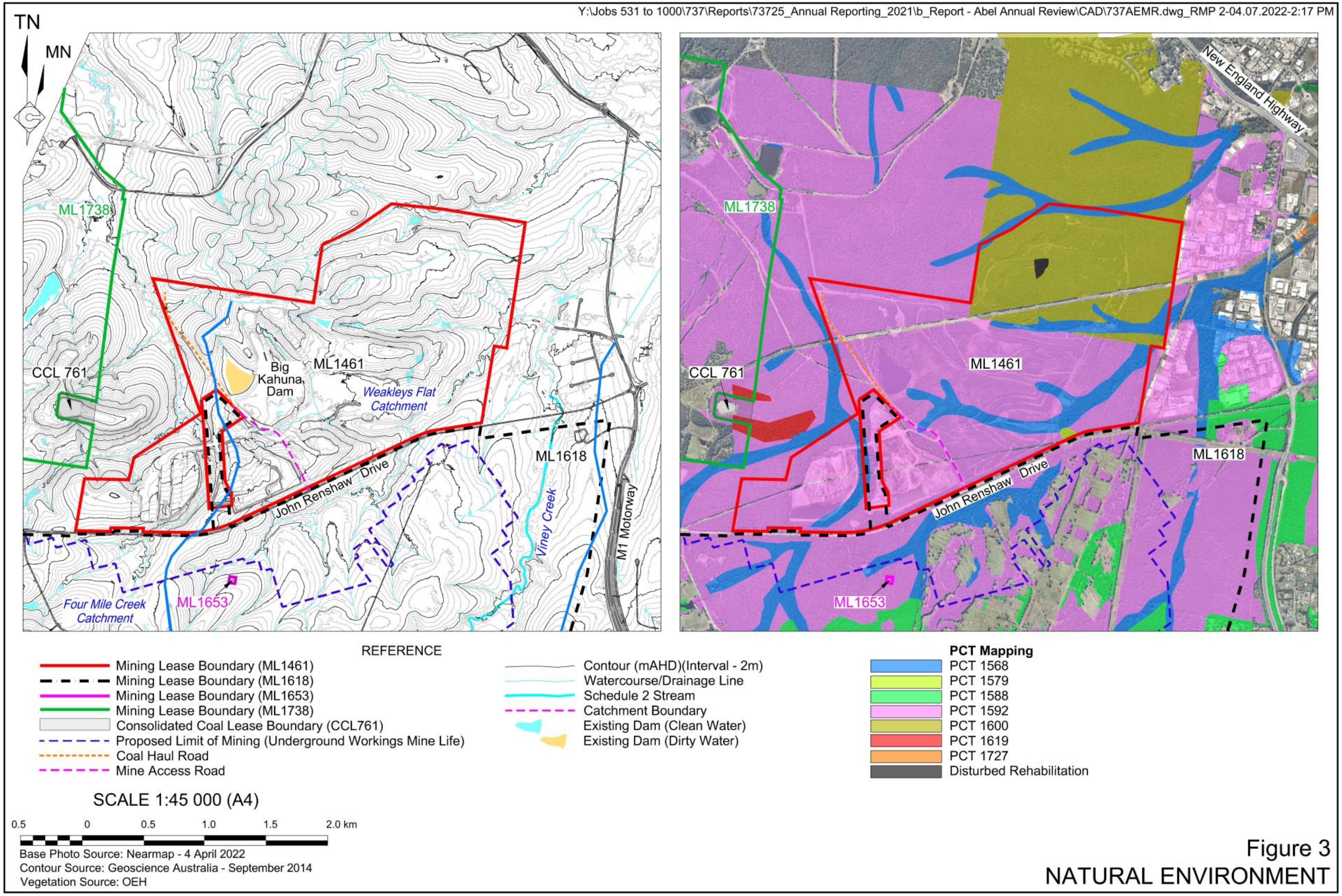

Figure 3
NATURAL ENVIRONMENT

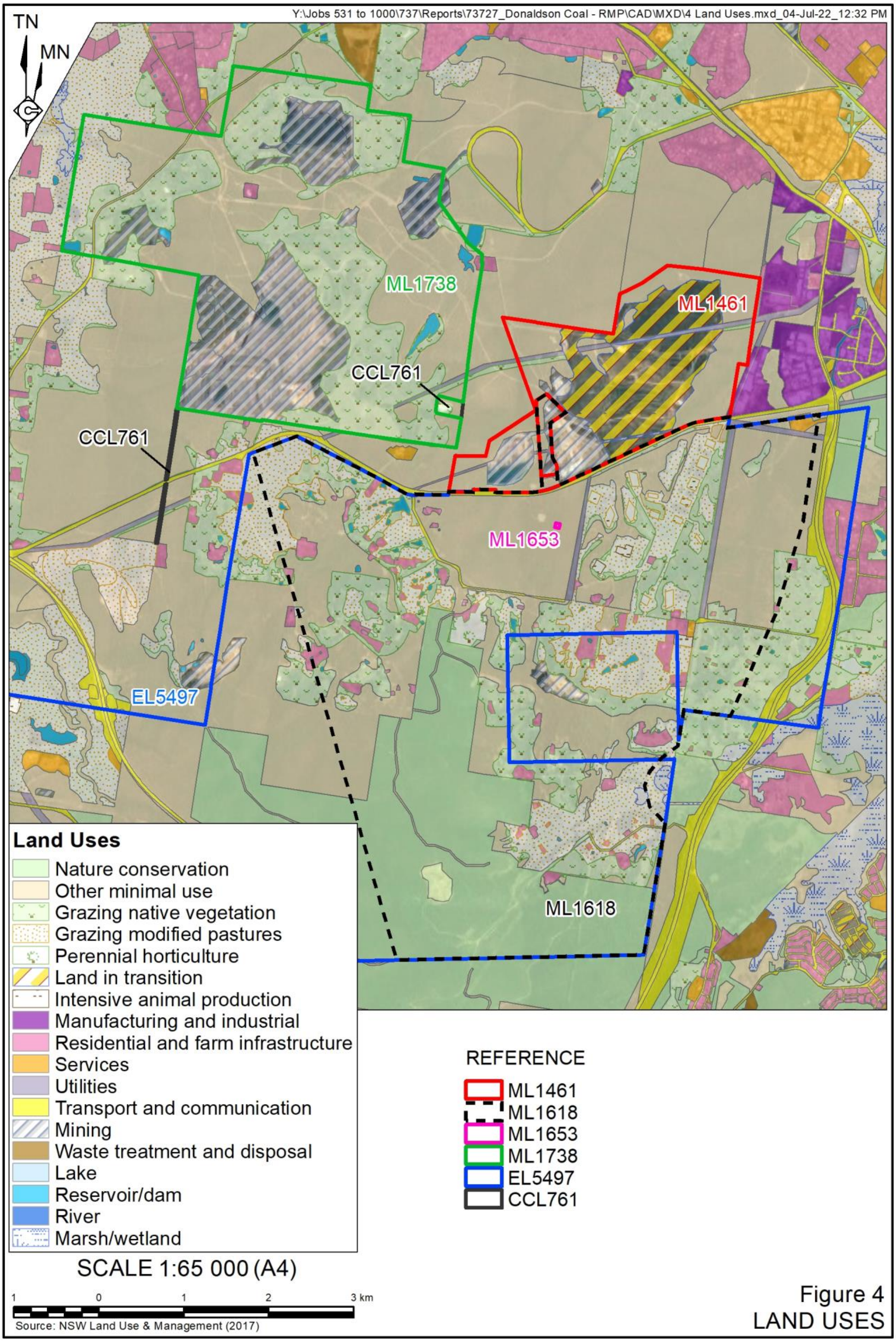

Figure 4
LAND USES

Power to the Donaldson and Abel Mine Sites is via a section of overhead line between the main transmission line and John Renshaw Drive, where it connects to site in the vicinity of the West and Square Pits.

The main Transgrid transmission powerline will not be impacted by rehabilitation of the Donaldson and Abel Mine Sites and is to be retained post-closure. During rehabilitation, Mine-related infrastructure not required for post-mining land use will be removed and associated disturbance will be rehabilitated in accordance with the surrounding easement land use. Maintenance of residual infrastructure will continue to be the remit of Transgrid.

Hunter Water Corporation Pipeline

A section of water pipeline owned by Hunter Water Corporation transects the Abel and Donaldson Mine Sites in the vicinity of the main access and haul road. Within the Abel and Donaldson Mine Sites and north of John Renshaw Drive, the pipeline is approximately 1.4km long, of which approximately 1.1km is above ground. The easement for the pipeline is approximately 10m wide and covers approximately 1ha within the Abel and Donaldson Mine Sites. Certain Mine-related infrastructure is located within the easement, such as sealed and unsealed roads. Maintenance of vegetation within the easement is the responsibility of Hunter Water Corporation, except for in the vicinity of Mine-related infrastructure.

The Hunter Water Corporation Pipeline will not be impacted by rehabilitation of the Abel and Donaldson Mine Sites, and is to be retained post-closure. During rehabilitation, Mine-related infrastructure not required for post-mining land use will be removed and associated disturbance will be rehabilitated generally in accordance with the surrounding easement land use. Maintenance of residual infrastructure will continue to be the remit of Hunter Water Corporation.

Snowy Hydro Gas Pipeline

A section of the Snowy Hydro Gas Pipeline transects the Abel and Donaldson Mine Sites in the vicinity of the Hunter Water Corporation Pipeline and main access and haul road[1]. Within in the Abel and Donaldson Mine Sites north of John Renshaw Drive, the pipeline is approximately 1.4km long. The easement varies in width but is generally approximately 25m wide. Maintenance of vegetation within the easement is the responsibility of Snowy Hydro, except for in the vicinity of Mine-related infrastructure. South of John Renshaw Drive, the Snowy Hydro Gas Pipeline is located within lands not disturbed by Mine-related activities (excluding rehabilitation within subsidence management zones) and is therefore not relevant to this RMP.

The Snowy Hydro Gas Pipeline will not be impacted by rehabilitation of the Abel and Donaldson Mine Sites, and is to be retained post-closure. During rehabilitation, Mine-related infrastructure not required for post-mining land use will be removed and associated disturbance will be rehabilitated generally in accordance with the surrounding easement land use. Maintenance of residual infrastructure will continue to be the remit of Snowy Hydro.

[1] Note: To be constructed

2. FINAL LAND USE

2.1 REGULATORY REQUIREMENTS FOR REHABILITATION

Regulatory requirements specifically affecting the progress towards the post mining land use are detailed in **Table 3**.

2.2 FINAL LAND USE OPTIONS ASSESSMENT

The final land use for the Abel and Donaldson Mine Sites is interconnected and has previously been assessed over the life of the Abel and Donaldson Mines. **Table 4** presents a summary of the final land use options that have been considered and/or proposed for the Abel and Donaldson Mine Sites. A summary of the consultation undertaken at the time of the options assessments or proposed final land use or landform is also provided.

In summary, the approved final land use comprises a mix of environmental conservation, final voids, water storage and retained infrastructure and is presented as the Final Landform and Rehabilitation Plan (see Section 5 and **Plans 1** and **2**). It is noted that the approved 2020 *Mining Operations Plan (Amendment B)* and attached *Closure Strategy for the West and Square Pits* report present a range of final land use and landform options for the West and Square Pits of the Donaldson Mine Site (see **Table 4**). For the purposes of this Plan, Donaldson Coal presents the previously approved Closure Option C as the Final Landform and Rehabilitation Plan. Notwithstanding, Donaldson Coal contends that any of the existing approved final land use options remain valid. Any material changes to the indicative preferred final land use and landform plan would be addressed in future revisions to this Plan and/or other rehabilitation planning documents.

2.3 FINAL LAND USE STATEMENT

The final land use for the Donaldson Coal Mine is as follows.

- Nature Conservation:
  - Rehabilitated mixed species native plant communities commensurate with surrounding natural areas.
  - Retained water storages providing seasonable habitat for wildlife.
- Infrastructure:
  - Retained hardstand and road networks to support future land use and to provide safe access for long term maintenance.
  - Retained water management infrastructure to support long term final land use.
- Final Voids:
  - Variable water storage within West and Square Pits suitable for industrial use.

The Final Landform and Rehabilitation Plan is presented as **Plans 1** and **2**.

Table 3
Regulatory Requirements for Rehabilitation

Consent	Condition No.	Requirement	Domain Area	Timing	RMP Section
Approvals and Licences					
Donaldson Open Cut Coal Mine Consolidated Consent (DA 98/00173 and 118/698/22) (expired)	**Environmental Management Strategy**				
	11(iii, iv, v)	The (Environmental Management) Strategy shall cover the area of mining, the haul road and rail loading facility, and the Conservation Areas. The Strategy shall include: (iii) overall environmental management objectives and performance outcomes, during construction, mining and decommissioning of the mine, for each of the key environmental elements for which management plans are required under this Consent; (iv) overall ecological and community objectives and a strategy for restoration and management, including habitat areas, creek lines and drainage channels, within the context of those objectives; (v) identification of cumulative environmental impacts and procedures for dealing with these at each stage of the development;	All domains	During operation and rehabilitation.	4.1, 6.2
	Air Quality Management				
	40	The Applicant shall ensure the prompt and effective rehabilitation of all disturbed areas as soon as practicable to minimise the generation of dust.	All domains	During operation and rehabilitation.	6.2.1.10
	Water Quality Management				
	61(x)	(The Water Management Plan shall include but not be limited to:) (x) Development of a strategy for the decommissioning of water management structures, including dirty water dams and clean water diversion dams, and long term management of the final void.	All domains	During operation and rehabilitation.	6.2.1.10, 6.2.2.2, 6.2.3.1, 6.2.3.4

Table 3 (Cont'd)
Regulatory Requirements for Rehabilitation

Consent	Condition No.	Requirement	Domain Area	Timing	RMP Section
Approvals and Licences (Cont'd)					
Donaldson Open Cut Coal Mine Consolidated Consent (DA 98/00173 and 118/698/22) (expired) (Cont'd)	**Flora and Fauna Management**				
	78	The Flora and Fauna Management Plan shall also include a Rehabilitation Plan that details the measures to be undertaken to progressively rehabilitate disturbed areas of the mine to replicate the original vegetation cover that existed before mining occurred. The Applicant shall be responsible for the management and monitoring of the rehabilitated mine site until such time as the Director- General agrees that restoration has been successful.	All domains	During operation and rehabilitation.	6.2.1.2, 6.2.1.3, 6.2.6.3, 8
	78A	By 31 October 2011, the Applicant shall revise the Rehabilitation Plan to the satisfaction of the Director-General. The revised plan must: (i) be prepared in consultation with DRE; (ii) include: • the rehabilitation objectives for the site; • a strategic description of how the rehabilitation of the site would be integrated with surrounding land uses; • a general description of the short and long term measures that would be implemented to rehabilitate the site, including; – managing remnant vegetation and habitat on site; – minimising impacts on fauna; – minimising visual impacts; – conserving and reusing topsoil; – controlling weeds, feral pests, and access; and – managing bushfires; • detailed performance and completion criteria for the rehabilitation of the site; • a detailed description of how the performance of the rehabilitation works would be monitored over time to achieve the stated objectives and against the relevant performance and completion criteria; and • details of who is responsible for monitoring, reviewing and implementing the plan.	All domains	During operation and rehabilitation.	4, 2, 7, 8, 10

Table 3 (Cont'd)
Regulatory Requirements for Rehabilitation

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Consent	Condition No.	Requirement	Domain Area	Timing	RMP Section
Approvals and Licences (Cont'd)					
Mining Leases (Standard Conditions of Mining Leases - Rehabilitation)					
ML 1461	4	**Must prevent or minimise harm to the environment** (1) The holder of a mining lease must take all reasonable measures to prevent, or if that is not reasonably practicable, to minimise, harm to the environment caused by activities under the mining lease. (2) In this clause – ***harm*** to the environment has the same meaning as in the *Protection of the Environment Operations Act 1997**.***	All domains	During operation and rehabilitation.	6.2
	5	**Rehabilitation to occur as soon as reasonably practicable after disturbance** The holder of a mining lease must rehabilitate land and water in the mining area that is disturbed by mining activities under the mining lease as soon as reasonably practicable after the disturbance occurs.			6.2
	6	**Rehabilitation must achieve final land use** (1) The holder of a mining lease must ensure that rehabilitation of the mining area achieves the final land use for the mining area. (2) The holder of a mining lease must ensure any planning approval has been obtained that is necessary to enable the holder to comply with subclause (1). (3) The holder of the mining lease must identify and record any reasonably foreseeable hazard that presents a risk to the holder's ability to comply with subclause (1) **Note –** clause 7 requires a rehabilitation risk assessment to be conducted whenever a hazard is identified under this subclause.		During rehabilitation	2, 3, 4.1

Table 3 (Cont'd)
Regulatory Requirements for Rehabilitation

Consent	Condition No.	Requirement	Domain Area	Timing	RMP Section
Approvals and Licences (Cont'd)					
ML 1461 (Cont'd)	6 (Cont'd)	(4) In this clause – ***final land use*** for the mining area means the final landform and final land uses to be achieved for the mining area – (a) as set out in the rehabilitation objectives statement and rehabilitation completion criteria statement, and (b) for a large mine – as spatially depicted in the final landform and rehabilitation plan, and (c) if the final land use for the mining area is required by a condition of development consent for activities under the mining lease – as stated in the condition. ***planning approval*** means – (a) a development consent within the meaning of the *Environmental Planning and Assessment Act 1979*, or (b) an approval under that Act, Division 5.1.		During rehabilitation.	2.3, 4, 5
	7	**Rehabilitation risk assessment** (1) The holder of a mining lease must conduct a risk assessment (a ***rehabilitation risk assessment***) that – (a) identifies, assesses and evaluates the risks that need to be addressed to achieve the following in relation to the mining lease – (i) the rehabilitation objectives, (ii) the rehabilitation completion criteria, (iii) for large mines – the final land use as spatially depicted in the final landform and rehabilitation plan, and (b) identifies the measures that need to be implemented to eliminate, minimise or mitigate the risks. (2) The holder of the mining lease must implement the measures identified.		During construction, operation and rehabilitation.	3

Table 3 (Cont'd)
Regulatory Requirements for Rehabilitation

Consent	Condition No.	Requirement	Domain Area	Timing	RMP Section
Approvals and Licences (Cont'd)					
ML 1461 (Cont'd)	7 (Cont'd)	(3) The holder of a mining lease must conduct a rehabilitation risk assessment – (a) for a large mine – before preparing a rehabilitation management plan, and (b) for a small mine – before preparing the rehabilitation outcome documents for the mine, and (c) whenever a hazard is identified under clause 6(3) – as soon as reasonably practicable after it is identified, and (d) whenever given a written direction to do so by the Secretary.		During construction, operation, and rehabilitation.	3, 11
	8	**Application of Division** This Division does not apply to a mining lease unless— (a) the security deposit required under the mining lease is greater than the minimum deposit prescribed under the Act, section 261BF in relation to that type of mining lease, or (b) the Secretary gives a written direction to the holder of the mining lease that this Division, or a provision of this Division, applies to the mining lease.			11
	9	**General requirements for documents** A document required to be prepared under this Division must— (a) be in a form approved by the Secretary, and **Note—** The approved forms are available on the Department's website. (b) include any matter required to be included by the form, and (c) if required to be given to the Secretary—be given in a way approved by the Secretary.			All sections

Table 3 (Cont'd)
Regulatory Requirements for Rehabilitation

Consent	Condition No.	Requirement	Domain Area	Timing	RMP Section
Approvals and Licences (Cont'd)					
ML 1461 (Cont'd)	10	**Rehabilitation management plans for large mines** (1) The holder of a mining lease relating to a large mine must prepare a plan (a rehabilitation management plan) for the mining lease that includes the following— (a) a description of how the holder proposes to manage all aspects of the rehabilitation of the mining area, (b) a description of the steps and actions the holder proposes to take to comply with the conditions of the mining lease that relate to rehabilitation, (c) a summary of rehabilitation risk assessments conducted by the holder, (d) the risk control measures identified in the rehabilitation risk assessments, (e) the rehabilitation outcome documents for the mining lease, (f) a statement of the performance outcomes for the matters addressed by the rehabilitation outcome documents and the ways in which those outcomes are to be measured and monitored. (2) If a rehabilitation outcome document has not been approved by the Secretary, the holder of the mining lease must include a proposed version of the document. (3) A rehabilitation management plan is not required to be given to the Secretary for approval. (4) The holder of the mining lease— (a) must implement the matters set out in the rehabilitation management plan, and (b) if the forward program specifies timeframes for the implementation of the matters—must implement the matters within those timeframes.			This Plan

Table 3 (Cont'd)
Regulatory Requirements for Rehabilitation

Consent	Condition No.	Requirement	Domain Area	Timing	RMP Section
Approvals and Licences (Cont'd)					
ML 1461 (Cont'd)	11	**Amendment of rehabilitation management plans** The holder of a mining lease must amend the rehabilitation management plan for the mining lease as follows— (a) to substitute the proposed version of a rehabilitation outcome document with the version approved by the Secretary—within 30 days after the document is approved, (b) as a consequence of an amendment made under clause 14 to a rehabilitation outcome document—within 30 days after the amendment is made, (c) to reflect any changes to the risk control measures in the prepared plan that are identified in a rehabilitation risk assessment—as soon as practicable after the rehabilitation risk assessment is conducted, (d) whenever given a written direction to do so by the Secretary—in accordance with the direction.			This Plan
	12	**Rehabilitation outcome documents** (1) The holder of a mining lease must prepare the following documents (***the rehabilitation outcome documents***) for the mining lease and give them to the Secretary for approval— (a) the ***rehabilitation objectives statement***, which sets out the rehabilitation objectives required to achieve the final land use for the mining area, (b) the ***rehabilitation completion criteria statement***, which sets out criteria, the completion of which will demonstrate the achievement of the rehabilitation objectives, (c) for a large mine, the ***final landform and rehabilitation plan***, showing a spatial depiction of the final land use.			4, 5

Table 3 (Cont'd)
Regulatory Requirements for Rehabilitation

Consent	Condition No.	Requirement	Domain Area	Timing	RMP Section
Approvals and Licences (Cont'd)					
ML 1461 (Cont'd)	12 (Cont'd)	(2) If the final land use for the mining area is required by a condition of development consent for activities under the mining lease, the holder of the mining lease must ensure the rehabilitation outcome documents are consistent with that condition.			
	13	**Forward program and annual rehabilitation report** (1) The holder of a mining lease must prepare a program (a ***forward program***) for the mining lease that includes the following— (a) a schedule of mining activities for the mining area for the next 3 years, (b) a summary of the spatial progression of rehabilitation through its various phases for the next 3 years, (c) a requirement that the rehabilitation of land and water disturbed by mining activities under the mining lease must occur as soon as reasonably practicable after the disturbance occurs. (2) The holder of a mining lease must prepare a report (an ***annual rehabilitation report***) for the mining lease that includes— (a) a description of the rehabilitation undertaken over the annual reporting period, (b) a report demonstrating the progress made through the phases of rehabilitation provided for in the forward program applying to the reporting period, (c) a report demonstrating progress made towards the achievement of the following— (i) the objectives set out in the rehabilitation objectives statement, (ii) the criteria set out in the rehabilitation completion criteria statement, (iii) for large mines—the final land use as spatially depicted in the final landform and rehabilitation plan.			10, 11

Table 3 (Cont'd)
Regulatory Requirements for Rehabilitation

Consent	Condition No.	Requirement	Domain Area	Timing	RMP Section
Approvals and Licences (Cont'd)					
ML 1461 (Cont'd)	13 (Cont'd)	(3) If a rehabilitation outcome document has not been approved by the Secretary, the holder of the mining lease must rely on a proposed version of the document. (4) The holder of the mining lease must give the forward program and annual rehabilitation report to the Secretary. (5) In this clause— ***annual reporting period*** means each period of 12 months commencing on— (a) the date on which the mining lease is granted, or (b) if the Secretary approves another date in relation to the mining lease— the other date			
	14	**Amendment of rehabilitation outcome documents and forward program** (1) This clause applies to— (a) a rehabilitation outcome document if it has been approved by the Secretary, and (b) a forward program if it has been given to the Secretary. (2) The holder of a mining lease must not amend a document to which this clause applies that relates to the mining lease unless— (a) the Secretary gives the holder a written direction to do so, or (b) the Secretary, on written application by the holder, gives a written approval of the amendment. (3) The holder of the mining lease must amend the document in accordance with the Secretary's direction or approval. (4) Nothing in this clause prevents the holder of a mining lease preparing a draft amendment for submission to the Secretary for approval.			10, 11

Table 3 (Cont'd)
Regulatory Requirements for Rehabilitation

Consent	Condition No.	Requirement	Domain Area	Timing	RMP Section
Approvals and Licences (Cont'd)					
ML 1461 (Cont'd)	15	**Times at which documents must be prepared and given** (1) The holder of a mining lease must do the following before the end of the initial period— (a) prepare a rehabilitation management plan, and (b) prepare rehabilitation outcome documents and give them, other than the rehabilitation completion criteria statement, to the Secretary for approval, and (c) prepare a forward program and give it to the Secretary. (2) The holder of the mining lease must prepare a forward program and annual rehabilitation report and give them to the Secretary before— (a) 60 days after the last day of each annual reporting period, commencing with the annual reporting period in which the forward program was given to Secretary under subclause (1)(c), or (b) a later date approved by the Secretary. (3) A rehabilitation completion criteria statement relating to completion of rehabilitation during a period covered by a forward program must be given to the Secretary for approval when the forward program is required to be given to the Secretary. (4) The holder of the mining lease must prepare updated rehabilitation outcome documents for the mining lease and give them to the Secretary for approval before— (a) 60 days after a development consent is modified following an application referred to in clause 20(1)(b), or (b) a later date approved by the Secretary. (5) A rehabilitation completion criteria statement is not required to be given to the Secretary under subclause (4) unless a rehabilitation completion criteria statement has already been given to the Secretary under subclause (3).			This Plan

Table 3 (Cont'd)
Regulatory Requirements for Rehabilitation

Consent	Condition No.	Requirement	Domain Area	Timing	RMP Section
Approvals and Licences (Cont'd)					
ML 1461 (Cont'd)	15 (Cont'd)	(6) The Secretary may, by written notice, direct the holder of a mining lease to prepare, or give to the Secretary, a document required to be prepared under this Division at a time other than that specified in this clause. (7) The holder of the mining lease must comply with the direction. (8) In this clause— initial period means the period commencing when the mining lease is granted and ending— (a) 30 days, or other period approved by the Secretary, after this Division first applies to the mining lease, or (b) if this Division applies to the mining lease because of an increase in the required security deposit— **(i)** when the surface of the mining area is disturbed by activities under the mining lease, or **(ii)** at a later date approved by the Secretary.			
	16	**Certain documents to be publicly available** (1) This clause applies to the following documents— (a) a rehabilitation management plan, (b) a forward program, (c) an annual rehabilitation report. (2) The holder of a mining lease must make a document to which this clause applies publicly available by— (a) publishing it on its website in a prominent position, or (b) if the holder does not have a website— providing a copy of it to a person— (i) on the written request of a person, and (ii) without charge, and (iii) within 14 days after the request is received.			Noted

Table 3 (Cont'd)
Regulatory Requirements for Rehabilitation

Consent	Condition No.	Requirement	Domain Area	Timing	RMP Section
Approvals and Licences (Cont'd)					
ML 1461 (Cont'd)	16 (Cont'd)	(3) If a document is published on the website of the holder of the mining lease, the holder must ensure that it is published— (a) for a rehabilitation management plan—within 14 days after it is prepared or amended, or (b) for a forward program or an annual rehabilitation report—within 14 days after it is given to the Secretary or amended, (4) Personal information within the meaning of the *Privacy and Personal Information Protection Act 1998* is not required to be included in a document made available to a person under this clause.			
	17	**Records demonstrating compliance** The holder of a mining lease must create and maintain records of all actions taken that demonstrate compliance with each of the conditions set out in this Part. **Note—** The Act, sections 163D and 163E provide for the form in which records must be kept and the period for which they must be retained.			7
	18	**Report on non-compliance** (1) The holder of a mining lease must provide the Minister with a written report detailing any non-compliance with— (a) a condition of the mining lease, or Note— The Act, section 364A contains provisions relating to the use and disclosure of information provided under this condition. (b) a requirement of the Act or this Regulation relating to activities under the mining lease. (2) The holder of the mining lease must provide the report within 7 days after becoming aware of the non-compliance.			7, 10, 11

Table 3 (Cont'd)
Regulatory Requirements for Rehabilitation

Consent	Condition No.	Requirement	Domain Area	Timing	RMP Section
Other Commitments to Rehabilitation					
Environmental Impact Statement (PKK Environment & Infrastructure, 1998)	General mining plan, including staging and rehabilitation.	• Section 6.3.2 Staging – General commitments for the progressive rehabilitation of the Donaldson Mine Site. – End of Mine (Figure 6.7 of the EIS) – retention of West Pit as final void and internal haulage road as potential fire trail	All domains	Life of Mine	6.2
		• Section 6.3.5 Rehabilitation and End Use – Restoration of disturbed areas post-mining to a stable landform and a landscape which is compatible with the surrounding environment. – Establish a nil or low maintenance vegetation cover comprising native species and suitable introduced species for disturbed areas – Final land use compatible with local planning requirements. – Areas affected by mining which are not intended to be rehabilitated include the internal mine access roads (of value for bush fire control) and retained sediment control dams. – Rehabilitation of final void. – Soil used to create noise bunds would be used for covering of overburden. – General requirements for species selection. – Specifies lack of defined final land use.	All domains	Life of Mine	5 6.2.5.3 4.2 6.2.2.2 6.2.3.4 6.2.1.1 6.2.5.3 2
State of Environmental Effects (Donaldson Coal, 2004)	General Rehabilitation	• General commitment for progressive rehabilitation based on existing methodologies.			6.2

Table 3 (Cont'd)
Regulatory Requirements for Rehabilitation

Consent	Condition No.	Requirement	Domain Area	Timing	RMP Section
Other Commitments to Rehabilitation					
Environmental Assessment (Resource Strategies, 2012)	General Decommissioning and Rehabilitation	• Sealing of mine portals and ventilation shafts. • Removal of surface infrastructure (excepting roads and water management structures required for future land uses). • Reshaping of the ground surface to form a stable surface with embankments at a maximum of 10 degrees. • Construction of permanent surface water management structures such as contour banks, drains and settlement ponds. • Rock raking and ripping of roads and hardstand areas. • Spreading of soil and seed. (*EA Section 2.12*)			6.2.2, 6.2.3.2, 6.2.3.1, 6.2.5.2
	Square Pit	The Square Pit will be maintained as a void for water storage and / or tailings storage. The mine closure plan will be revised prior to the emplacement of any coarse rejects or tailings. (*EA Section 3.4*)			6.2.3.1, 6.2.2.3
		Should the Square Pit have been used for storage of groundwater inflows from the mine, it will be dewatered, with the water returned to the underground workings. (*EA Section 3.4*)			6.2.3.4

Table 4
Summary of Final Land Use Options Assessments

Document or Plans Where Proposed / Considered	Final Land Use Option	Area[1]	Comments	Consultation
Integrated Mine Closure Plan (GSSE, 2008) – Appendix 5 of the *Landscape Management Plan* (GSSE, 2008)	Intermodal Freight Facility	General vicinity of Donaldson Open Cut Mine	Identified as part of the *Draft Lower Hunter Regional Strategy 2005*. Not considered further as would require re-disturbance of rehabilitated lands. In addition, backfilling operations did not include engineered compaction or other activities that would be required to support significant industrial development.	*Landscape Management Plan* (incorporating the Integrated Mine Closure Plan and Final Void Management Plan) prepared in consultation with Department of Water and Energy, Department of Environment and Climate Change, Maitland Council and Cessnock Council.
	Conservation	Bushland Conservation Area	The Bushland Conservation Area was established in 2001 and is required to be maintained until January 2037. As such, no other land use is permitted until at least 2037.	
	Water Storage	West and Square Pits[2]	Included uses such as wildlife habitat, recreational use, aquaculture, and other commercial uses.	
	Tailings Storage Facility	Square Pit	Identified as part of "Other Mining Uses".	
	Domestic/ Commercial Waste Disposal	West and Square Pits[2]	Considered further in *Final Void Management Plan* (see below).	
Final Void Management Plan (GSSE, 2008) – Appendix 4 of the *Landscape Management Plan* (GSSE, 2008)	Backfilling	West and Square Pits[2]	Identifies that insufficient overburden is available to completely backfill pits, however, backfilling is to be undertaken to reduce the size of the pits as mining progresses.	
	Water Storage Area		Identifies that water quality likely to be unsuitable for human consumption due to salinity levels but may be suitable for recreational, aquaculture and industrial water use options. This use is identified as the preferred use.	
	Conservation		Identifies potential use for wetland or wildlife habitat, however, deep and steep-sided voids are generally not suited for this use without provision of safe ingress and egress points for wildlife.	
	Domestic/Commercial Waste Disposal		Identifies potential use for waste disposal, however, the likely physical and chemical properties of waste and the volumes that would be disposed would present a potential leachate risk to local groundwater. The proximity to sensitive areas, such as Hexham Swamp would also need to be managed.	

Table 4 (Cont'd)
Summary of Final Land Use Options Assessments

Document or Plans Where Proposed / Considered	Final Land Use Option	Area[1]	Comments	Consultation
Rehabilitation Management Plan (v2, 2019)	Water Storage	Abel Box Cut (part of West Pit)	Identifies use as water storage with batters stabilised with local native plant species.	Department of Planning and Environment (30 April 2019) Cessnock Council (30 April 2019) Maitland Council (30 April 2019) Natural Resource Access Regulator (30 April 2019) Office of Environment and Heritage (30 April 2019) Resources Regulator (30 April 2019)
	Conservation	Remaining surface disturbance areas.	Identified as general rehabilitation objective for rehabilitated woodland areas.	
	Existing Land Use	Any areas impacted by subsidence (relevant to Abel Mine only).	Areas impacted by subsidence are returned to the existing land use within a timeframe agreed upon with the landholder.	
Mining Operations Plan (Amendment B) (2020) Appendix 1 - *Closure Strategy for the West and Square Pit (2020)*	Tailings Storage Facility (Variable fill level)	Square Pit	Part of the three approved final land use and landform options for the Square Pit. Final landform would be a void of variable depth based on amount of tailings and respective capping depths, with the remainder of the void left as water storage.	Resources Regulator (30 September 2020)
	Water Storage	West and Square Pit	Stabilised final voids for permanent water storage. General landform shaping methodologies outlined.	

Note 1: See Figure 5

Note 2: Previously referred to as Donaldson and Abel Open Cut Pits in earlier documents

2.4 FINAL LAND USE AND MINING DOMAINS

2.4.1 Final Land Use Domains

The final land use domains for the Donaldson Mine Site are defined in **Table 5** and displayed on **Plan 1**.

Table 5
Final Land Use Domains

Final Land Use Domain	Domain ID[1]	Domain Description
Native Ecosystem Area	A	Includes the majority of the Donaldson Mine Site and consists of mixed native species plant communities comparable to analogue sites.
Water Storage	G	Includes the Big Kahuna Dam and all other water management infrastructure to be retained to support final land use.
Infrastructure	I	Includes structures, hardstand areas, and internal roadways to be retained to support final land use.
Final Void	J	Includes the areas of the West and Square Pits to be used as water storage.
Note 1: See **Plan 1**		

2.4.2 Mining Domains

Table 6 defines the final land use domains for the Donaldson Mine and **Plan 1** and **Figure 5** display the mining domains for the Donaldson Mine Site.

Table 6
Mining Domains

Mining Domain		Domain ID[1]	Domain Description
Infrastructure		1	Includes the buildings, structures, hardstand areas, and internal roadways.
Water Management Area		3	Includes the Big Kahuna Dam and all other water management infrastructure.
Active Mining Area (Open Cut Void)		5	Includes West and Square Pits.
Other	Rehabilitation Area –Woodland	8a	Includes the backfilled and rehabilitated historic extraction area of the Donaldson Open Cut and other rehabilitated areas of surface disturbance associated with the Donaldson Mine.
Note 1: See **Figure 5**			

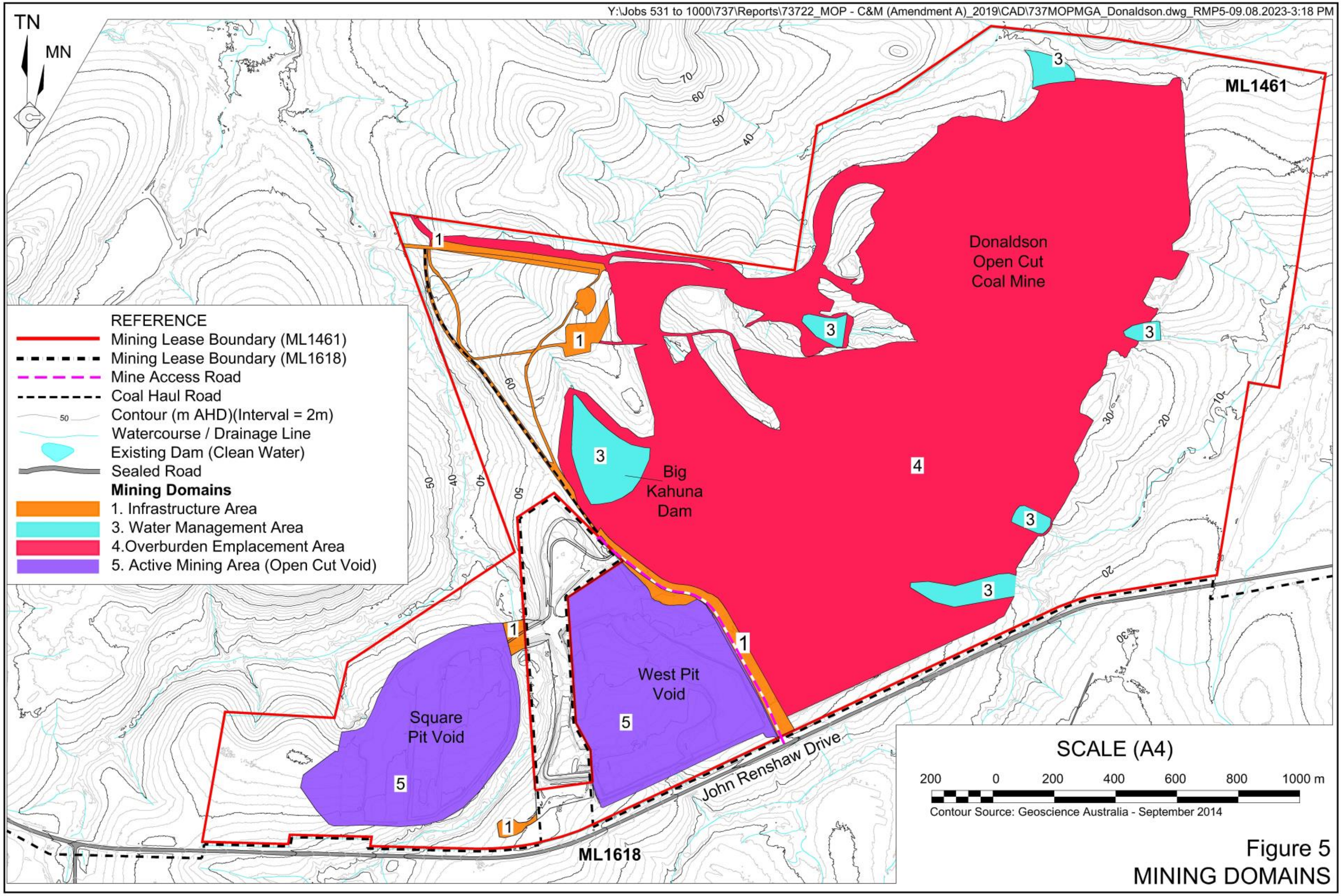

Figure 5
MINING DOMAINS

3. REHABILITATION RISK ASSESSMENT

The following presents an overview of the most recent rehabilitation risk assessment undertaken in accordance with Clause 7 of Schedule 8A of the *Mining Regulation 2016*.

The risk assessment was undertaken generally in accordance with *Australian Standards HB 203:2006, AS/NZS 4360:2004* and *AS/NZS ISO 31000:2018 Risk Management – Principles & Guidelines*. The risk assessment comprised of a review of the rehabilitation risk assessment undertaken in August 2020 as a part of the West and Square Pit Closure Strategy for Closure Option 2 (closure of Abel Mine with no resumption of mining). The review consisted of:

- revision of previously identified risks and risk controls in consideration of the proposed rehabilitation objectives and completion criteria;
- identification of previously identified risk controls that could be reasonably applied to the full Abel and Donaldson Mine Sites, where practicable; and
- identification of residual risks to rehabilitation for the remainder of the Abel and Donaldson Mine Sites (i.e. not the West and Square Pits) that would be required to be addressed as part of a comprehensive assessment.

Risks to achieving the rehabilitation objectives and rehabilitation completion criteria outlined in Section 4, as well as the final landform outlined in Section 5, were identified and assessed jointly by Donaldson Coal and R.W. Corkery & Co. Pty Limited during the preparation of this Plan. Site-specific threats to rehabilitation were assessed based on both the results of previous rehabilitation efforts, as well as observations of site-specific conditions and threats to rehabilitation observed during site inspections. This risk assessment was completed with consideration of existing controls as well as those risk controls outlined in this plan.

It should be noted that the following presents a summary of the most recent rehabilitation risk assessment undertaken for the combined Abel and Donaldson Mine Sites in accordance with the *Form and Way: Rehabilitation Management Plan for Large Mines* (July 2021).

For each identified risk to rehabilitation, potential adverse outcomes were identified and allocated a risk rating based on the potential consequences and likelihood of occurrence. **Table 7** presents the Donaldson Coal Risk Matrix for the consequence, likelihood and risk rating used during this analysis. Where risks were determined to be unacceptable, namely those risks classified as “Moderate” or above, a Trigger Action Response Plan has been developed and is presented in Section 10.

Table 8 presents the results of the risk analysis assuming the implementation of standard mitigation measures and those outlined within this Plan.

Table 7
Donaldson Coal Risk Matrix

Loss Type		Effect / Consequence				
		1 Insignificant	2 Minor	3 Moderate	4 Major	5 Catastrophic
(P) Harm to People		Slight injury or health effects report only (RO) or first aid injury (FAI)	Minor injury or health effects – medical treatment injury (MTI) or restricted work injury (RWI)	Serious bodily injury or health effects – lost time injury (LTI)	Single Fatality	Multiple fatalities
(E) Environmental Impact		Environmental nuisance – trivial or negligible, short term impact to area of low significance, minimal or no physical remediation required. No regulation. Cost < $1,000	Minor environmental harm – short term impact to area of limited local significance, limited physical remediation. Reportable Breach /Minor Non Compliance, potential warning notice, other notices (infringement / prosecution) unlikely. Costs $1K - $10K	Serious environmental harm – medium term impact to area of local conservation value, medium term physical remediation, actual community health impacts or significance or pollution or contamination Infringement Notice but Prosecution unlikely Costs $10k - $100k	Major environmental harm – long term reversible impacts to area of regional conservation significance, health statistics in community alter as a result of this incident or pollution or contamination Prosecution Costs $100k - $1M	Extreme environmental harm – irreversible impacts on environmental values of extreme & widespread areas, or those of national conservation significance, community fatalities or pollution or contamination Prosecution, License revoked Costs > $1M
(O) Asset Damage and Other Consequential Losses		Slight damage < $1M or < 1 day disruption to operation	Minor damage $1M - $5M or <1 week disruption to operation	Local damage $5M - $20M or <1 month disruption to operation	Major damage $20M -$100M or <6 months partial loss of operation	Extreme damage > $100M or 6 months Substantial or total loss of operation
(R) Impact on Reputation		Slight impact – Public awareness may exist but no public concern Isolated compliance failure – no brand damage	Limited impact – Some local public concern Intervention of regulating authority – minimal brand damage	Considerable impact - Regional public concern Major compliance failure involving fines – medium brand damage	National impact – National public concern Temporary withdrawal of license to operate – significant brand damage	International impact - International public attention Loss of shareholder confidence – irreparable brand damage
Likelihood	**Likelihood Examples (Guide)**	**Level of Risk**				
A (Almost Certain)	Likely that the unwanted event could occur several times per year at this location	11 (M)	16 (H)	20 (H)	23 (E)	25 (E)
B (Likely)	Likely that the unwanted event could occur several times per year in the Australian mining industry; or could happen annually	7 (M)	12 (M)	17 (H)	21 (E)	24 (E)
C (Possible)	The unwanted event could well have occurred in the Australian mining industry at some time in the past 10 years	4 (L)	8 (M)	13 (H)	18 (H)	22 (E)
D (Unlikely)	The unwanted event has happened in the Australian mining industry at some time; or could happen in 50 years	2 (L)	5 (L)	9 (M)	14 (H)	19 (H)
E (Rare)	The unwanted event has never been known to occur in the Australian mining industry; or is highly unlikely that it could ever occur	1 (L)	3 (L)	6 (M)	10 (M)	15 (H)

Table 8
Donaldson Rehabilitation Risk Assessment

Risk Identification & Analysis								Risk Reduction Strategy		Residual Risk				
#	Location	Mining Domain	Final Land Use Domain	Spatial Reference	Risk Source	Potential Impact/Consequence	Loss Type	Existing Control	Additional Control / Action	Consequence	Likelihood	Target Risk	Risk Level	RMP Section
General														
1	All	All	All	-	Insufficient resourcing: • skills and experience of rehabilitation personnel. • funding for or prioritisation of rehabilitation activities. • ongoing maintenance of rehabilitation requirements.	Rehabilitation signoff not given by Regulator	(O) Asset Damage and Other	Existing rehabilitation success. Experienced environmental team. Yancoal corporate oversight and experience. Existing Environmental Management Strategy and associated Plans. Rehabilitation Cost Estimate.	Review budget provisions for rehabilitation of Abel and Donaldson Mine Sites Review RCE based on Closure Option 2 for West and Square Pits.	3	D	9	(M)	Section 7 and RCE/Forward Program
							(R) Impact on Reputation			2	D	5	(L)	
2	All	All	All	-	Lack of clearly defined responsibilities	Rehabilitation signoff not given by Regulator	(O) Asset Damage and Other	Mining Engineering Manager responsible for seeking approval for funding for closure, provision of resources for rehabilitation and managing rehabilitation activities. Environment and Community Superintendent responsible for design of technical closure plans. Yancoal Corporate Standard - Rehabilitation (Includes RACI matrix). Mining Operations Plans.	Responsibilities to be defined in Section 7 of the Rehabilitation Management Plans.	1	D	2	(L)	Section 7
Decommissioning														
3	All	All	All	-	Impacts on European heritage items	N/A - no European heritage items located within Abel and Donaldson Mine Sites.								
4	All	All	All	-	Impacts on Aboriginal heritage items: • Four Mile Creeks (Aboriginal Conservation Area) • Individual Aboriginal sites located surrounding active areas and above underground mining area	Inadvertent damage during rehabilitation activities. Prosecution	(E) Environmental Impact	Survey of area completed by Archaeologists and Mindaribba Local Aboriginal Land Council (MLALC) previously. Aboriginal Heritage Management Plan. Ground Disturbance Permit.	1. Survey of areas not previously surveyed by local Aboriginal group (MLALC). 2. Survey of areas not previously surveyed by Archaeologists. 3. Obtain Section 90 Permit if required to relocate any found Aboriginal artefacts.	2	D	5	(L)	Section 6.2.1.13
5	All	Infrastructure Area Active Mining Area (Open Cut Void) Water Management Area (Big Kahuna)	Native Ecosystem Water Storage Area Infrastructure Final Void	A1 A5 G3 J5 I1	Contamination resulting from storage and handling of hydrocarbons, resins, cement.	Contamination of waterways or land resulting in infringement notice	(E) Environmental Impact	Storage and handling of hydrocarbons in accordance with Australian Standards and Industry best practice. Pollution Incident Response Management Plan. Ongoing surface water monitoring program.	1. Phase 1 Contamination Study of high-risk infrastructure and storage areas. 2. Consider disposal options as a result of the Phase 1 Contamination Study in budget for Mine Closure and Rehabilitation.	3	D	9	(M)	Section 6.2.2.4
6	All	Infrastructure Areas Active Mining Area (Open Cut Void)	Native Ecosystem Infrastructure Final Void	A1 A5 J5 I1	Generation of waste products from demolition process.	Wastes not disposed of correctly (either at licensed disposal facility or in accordance with EPL and RMP) - infringement notice	(E) Environmental Impact	Reputable waste contract company engaged (licensed). Donaldson and Abel Waste Management Plan.	1. Determine disposal methods of waste products (either at licensed disposal facility or in accordance with EPL and Mine Closure Plan) and include in a Decommissioning Plan for Mine Closure.	2	D	5	(L)	Sections 6.2.1.5, 6.2.2.2, and 6.2.2.5

Table 8 (Cont'd)
Donaldson Rehabilitation Risk Assessment

Risk Identification & Analysis								Risk Reduction Strategy		Residual Risk				
#	Location	Mining Domain	Final Land Use Domain	Spatial Reference	Risk Source	Potential Impact/Consequence	Loss Type	Existing Control	Additional Control / Action	Consequence	Likelihood	Target Risk	Risk Level	RMP Section
Decommissioning (Cont'd)														
7	Donaldson	Active Mining Area (Open Cut Void)	Native Ecosystem Final Void	A5 J5	Groundwater accumulation in West Pit final void. Note: Seam is down-dip to South from West Pit (West Pit floor is below Lower Donaldson - water will migrate back to underground)	Unknown until water model review is completed	(E) Environmental Impact	Groundwater model undertaken for Abel EA includes Bloomfield and Abel groundwater results.	1. Review the existing water model to confirm final standing water level and potential for discharges. 2. Implement control requirements from water model review if potential for West Pit to discharge.	2	D	5	(L)	Section 6.2.3.4
8	Donaldson	Active Mining Area (Open Cut Void)	Native Ecosystem Final Void	A5 J5	Groundwater accumulation in Square Pit final void. Note: Potential for spill halfway along Eastern Wall in Square Pit (low point) and discharge in Four Mile Creek.	Unknown until water model review is completed	(E) Environmental Impact	Groundwater model undertaken for Abel EA includes Bloomfield and Abel groundwater results.	1. Review the existing water model to confirm final standing water level and potential for discharges. 2. Implement control requirements from water model review if potential for Square Pit to discharge.	2	D	5	(L)	Section 6.2.3.4
9	All	Active Mining Area (Open Cut Void)	Native Ecosystem Final Void	A5 J5	Adverse geotechnical and/or geochemical issues associated with process waste storage facilities (e.g. tailings, reject emplacements), overburden and waste rock dumps, etc.	N/A - No placement of tailings in either Square Pit or West Pit Voids under currently proposed Option 2.								
10	Abel	Infrastructure Area Active Mining Area (Open Cut Void)	Native Ecosystem	A1 A5	Unauthorised access to underground workings.	Unauthorised access to underground by public following cessation of mining (no ventilation to underground workings)	(P) Harm to People	Current access is restricted via use of gates being locked on Portal Entrances.	1. Decommissioning Plan to include prevention of access to underground following cessation of mining (including sealing of portals). Current mining status until final sealing of 3 x Portals and 2 x Shafts.	4	E	10	(M)	Section 6.2.2.6
Landform Establishment														
11	Abel	Underground Mining Area	Variable	K6	Failure of service boreholes or gas well seals.	No gas wells currently in place for the underground workings. Failure of water service borehole could result in loss of potable water to underground workings.	(E) Environmental Impact	Inspection of active service boreholes to ensure water service remains function / does not leak.	1. Decommissioning Plan to include disconnection of any remaining water services to the underground workings.	1	D	2	(L)	Section 6.2.2.6
12	Abel	Infrastructure Area Active Mining Area (Open Cut Void)	Native Ecosystem	A1 A5	Failure of mine seals: • 3 x Portals • 2 x Shafts	Unauthorised access to underground by public following cessation of mining (no ventilation to underground workings)	(P) Harm to People		1. Sealing of 3 portals and 2 shafts in accordance with applicable guidelines. 2. High Risk Activity Notification for Final Sealing.	4	E	10	(M)	Section 6.2.2.6
						Integrity of seals compromised by rehabilitation blasting activities - authorised access underground	(P) Harm to People		1. Decommissioning Plan to include prevention of access to underground following cessation of mining (including sealing of portals).	4	E	10	(M)	Section 6.2.2.6

Table 8 (Cont'd)
Donaldson Rehabilitation Risk Assessment

Risk Identification & Analysis								Risk Reduction Strategy		Residual Risk				
#	**Location**	**Mining Domain**	**Final Land Use Domain**	**Spatial Reference**	**Risk Source**	**Potential Impact/Consequence**	**Loss Type**	**Existing Control**	**Additional Control / Action**	**Consequence**	**Likelihood**	**Target Risk**	**Risk Level**	**RMP Section**
Landform Establishment (Cont'd)														
13	Donaldson	Active Mining Area (Open Cut Void)	Native Ecosystem Final Void	A5 J5	Instability of highwalls and low walls.	Landform failure - public safety	(P) Harm to People	Fencing and signage at property boundary and around the perimeter of the final voids. Bunding at top of highwalls. Design of rehabilitation blasting to minimise risk. Currently approved final slopes range from 10 degrees and 18 degrees.	1. Geotechnical/Final Landform Study to determine slope requirements for highwall to be long-term geotechnically stable (West Pit and Square Pit) based on final standing water level for Square Pit. 2. If outcomes of Geotechnical/Final Landform Study determine different slope requirements, update relevant Management Plans and RMP.	2	C	8	(M)	Section 6.2.3.4
						Rehabilitation signoff not given by Regulator	**(R) Impact on Reputation**	Fencing and signage at property boundary and around the perimeter of the final voids. Bunding at top of highwalls. Design of rehabilitation blasting to minimise risk.	1. Geotechnical/Final Landform Study to determine slope requirements for highwall to be long-term geotechnically stable (West Pit and Square Pit) based on final standing water level for Square Pit. 2. If outcomes of Geotechnical/Final Landform Study determine different slope requirements, update relevant Management Plans and RMP.	**2**	**D**	**5**	**(L)**	Section 6.2.3.4
14	All	Active Mining Area (Open Cut Void)	Native Ecosystem Final Void	A5 J5	Availability of suitable materials for capping of hazardous materials and impounded tailings/coarse reject materials	N/A - No placement of tailings in either Square Pit or West Pit Voids under currently proposed Option 2.								
15	All	Active Mining Area (Open Cut Void)	Native Ecosystem Final Void	A5 J5	Availability of suitable materials for capping of carbonaceous material and other unsuitable materials on final landform batters.	Exposed carbonaceous or other unsuitable material impact upon growth medium and ability to establish vegetative cover.	(E) Environmental Impact		1. A Rehabilitation Materials Balance Report to be prepared prior to commencement of final landform shaping.	4	E	10	(M)	Section 6.2.2.4
						Rehabilitation signoff not given by Regulator	(O) Asset Damage and Other			2	E	3	(L)	
16	All	All	All	-	Final landform instability (e.g. Steep slopes, erosion, etc.) affecting final land use capability.	Water quality impacts. Impact on ability to establish vegetative cover.	(E) Environmental Impact	Existing erosion and sediment control structures on completed rehabilitation areas.	1. Conduct Final Landform Study to determine appropriate slope and water/erosion control design and structures for areas yet to be rehabilitated.	2	D	5	(L)	Section 6.2.3.4
17	Abel	Underground Mining Area	Variable	K6	Final landform unsuitable for existing land use (e.g. Large rocks present affecting cultivation, settlement and surface subsidence leading to extended ponding etc.)	Subsidence impacts prevent or reduce existing land uses.	(E) Environmental Impact	Rehabilitation Management Plan. Subsidence Management Plan. Rehabilitation Monitoring. Mining operations ceased 2015.	1. Continued implementation of existing subsidence rehabilitation procedures.	1	C	4	(L)	Section 6.3
						Rehabilitation signoff not given by Regulator	(R) Impact on Reputation			1	C	4	(L)	

Table 8 (Cont'd)
Donaldson Rehabilitation Risk Assessment

Risk Identification & Analysis								Risk Reduction Strategy		Residual Risk				
#	**Location**	**Mining Domain**	**Final Land Use Domain**	**Spatial Reference**	**Risk Source**	**Potential Impact/Consequence**	**Loss Type**	**Existing Control**	**Additional Control / Action**	**Consequence**	**Likelihood**	**Target Risk**	**Risk Level**	**RMP Section**
Landform Establishment (Cont'd)														
18	All	Active Mining Area (Open Cut Void)	Native Ecosystem Final Void	A5 J5	Diversion of surface water runoff away from catchment areas.	Final voids (Square Pit and West Pit) fill and discharge - unknown consequence until water model review is completed.	(E) Environmental Impact	Donaldson and Abel Water Management Plan.	1. Review the existing water model to confirm final standing water level and potential for discharges. 2. Implement control requirements from model review if potential for West Pit or Square Pit to discharge.	2	D	5	(L)	Section 6.2.3.4
						Loss of water flow downstream due to capture of water in West Pit Void and Square Pit Void.	(E) Environmental Impact	Donaldson and Abel Water Management Plan.	1. Final Landform Design to include water management requirements (e.g. diversions, etc.) considering potential impacts on water flow downstream.	3	D	9	(M)	Section 6.2.3.4
19	All	Active Mining Area (Open Cut Void)	Native Ecosystem Final Void	A5 J5	Groundwater accumulation in voids.	Final void fills and discharges - unknown consequence until water model review is completed.	(E) Environmental Impact	Donaldson and Abel Water Management Plan.	1. Review the existing water model to confirm final standing water level and potential for discharges. 2. Implement control requirements from model review if potential for West Pit or Square Pit to discharge. 3. Maintain Groundwater Licence for Final Void/s.	2	D	5	(L)	Section 6.2.3.4
20	All	-	-	-	Watercourse diversion instability affecting riparian health.	N/A - no watercourse diversions in place or proposed.								
21	All	-	-	-	Water availability for dust suppression.	Inadequate water supply resulting in excess dust generation or requirement to stand down rehabilitation equipment.	(E) Environmental Impact	West Pit, Square Pit and Big Kahuna water available as required. Lack of water availability extremely unlikely. Chichester Hunter Water Main traverse property with existing connections for Abel and Donaldson operations.		2	E	3	(L)	Section 6.2.5.4

Table 8 (Cont'd)
Donaldson Rehabilitation Risk Assessment

Risk Identification & Analysis								Risk Reduction Strategy		Residual Risk				
#	Location	Mining Domain	Final Land Use Domain	Spatial Reference	Risk Source	Potential Impact/Consequence	Loss Type	Existing Control	Additional Control / Action	Consequence	Likelihood	Target Risk	Risk Level	RMP Section
Growth Medium Development														
22	All	Infrastructure Area Active Mining Area (Open Cut Void)	Native Ecosystem	A1 A5	Adoption of inappropriate or inadequate rehabilitation techniques, including equipment fleet.	Impacts of establishing vegetation due to soil compaction.	(E) Environmental Impact	Current high standard of Rehabilitation on site (past experience of managing similar voids) - accepted as industry best practice. Site Environmental Team experienced in rehabilitation. Use of experienced rehabilitation contractors (external) - previously conducted rehabilitation on site. Use of experienced rehabilitation consultants (external) - industry recognised content/technical experts. Yancoal Corporate environmental team provide expertise. Yancoal Corporate Standards - Rehabilitation (in progress). Existing Environmental Management Strategy and associated Plans (available on Internet/Intelex). Fit for Purpose Equipment used for rehabilitation activities (consideration of weight, compaction, etc.)	1. Preparation of this Rehabilitation Management Plan. 2. Review equipment prior to and at commencement of rehabilitation works to ensure fit for purpose.	2	D	5	(L)	Section 6.2.4.4
23	All	Infrastructure Area Active Mining Area (Open Cut Void)	Native Ecosystem	A1 A5	Subsoil and topsoil deficit for rehabilitation activities.	Suitable subsoil and topsoil material volume unavailable on site leading to inadequate depth of growth material.	(E) Environmental Impact		1. A Rehabilitation Materials Balance Report to be prepared prior to commencement of final landform shaping. 2. Source and budget any topsoil materials required.	2	D	5	(L)	Sections 6.2.1.1, 6.2.4.4
24	All	Infrastructure Area Active Mining Area (Open Cut Void)	Native Ecosystem	A1 A5	Chemical properties of growth medium inadequate to support revegetation (e.g. Lack of organic matter, nutrient deficiency, lack of soil biota, adverse soil chemical properties).	Impacts of establishing vegetation due to soil chemical properties.	(E) Environmental Impact	Growth medium used successfully for existing Donaldson Coal Mine rehabilitation areas.	1. Undertake testing of growth medium to ensure suitable chemical properties / to calculate required rate of ameliorants (gypsum, fertiliser etc).	2	D	5	(L)	Section 6.2.4.1
Ecosystem and Land Use Establishment														
25	All	Infrastructure Area Active Mining Area (Open Cut Void)	Native Ecosystem	A1 A5	Lack of availability and quality of seed resources, including genetic integrity.	Inability to establish preferred species	(E) Environmental Impact		1. Source seed resources sufficiently in advance of rehabilitation works to ensure supply.	2	E	3	(L)	Section 6.2.5.4

Table 8 (Cont'd)
Donaldson Rehabilitation Risk Assessment

Risk Identification & Analysis								Risk Reduction Strategy		Residual Risk				
#	Location	Mining Domain	Final Land Use Domain	Spatial Reference	Risk Source	Potential Impact/Consequence	Loss Type	Existing Control	Additional Control / Action	Consequence	Likelihood	Target Risk	Risk Level	RMP Section
Ecosystem and Land Use Establishment (Cont'd)														
26	All	Infrastructure Area Active Mining Area (Open Cut Void)	Native Ecosystem	A1 A5	Weed and pest control: • weed introduction and control (or lack thereof) • Damage from fauna (e.g. kangaroos, feral goats, etc.) • Insects and plant disease.	Impacts on vegetation (establishing and ongoing) - completion criteria not met.	(E) Environmental Impact	Flora and Fauna Management Plan includes weed management. Annual Weed Management Program. Environmental Inspections. Rehabilitation Monitoring. Current high standard of Rehabilitation on site (past experience of managing similar voids) - accepted as industry best practice.		2	D	5	(L)	Section 6.2.5.6
27	All	Infrastructure Area	Infrastructure	I1	Lack of structural integrity of infrastructure to be retained in final landform.	Retained infrastructure not suitable for final land use.	(P) Harm to People	Ongoing use and maintenance of infrastructure.	1. Decommissioning Plan to include assessment for retained infrastructure (safety/access control bunding, fencing, access roads) to be retained. 2. Based on results of assessment, undertake any recommended repairs or revise retention options.	1	C	4	(L)	Section 6.2.2.3
						Rehabilitation signoff not given by Regulator.	(R) Impact on Reputation			1	C	4	(L)	
28	All	Infrastructure Area Active Mining Area (Open Cut Void)	Native Ecosystem	A1 A5	Adoption of inappropriate or inadequate revegetation techniques.	Application of inappropriate species mix for respective domain area. Unnecessary compaction of growth medium. Inability to establish adequate vegetative cover.	(E) Environmental Impact	Current high standard of Rehabilitation on site (past experience of managing similar voids) - accepted as industry best practice. Site Environmental Team (experience in rehabilitation). Use of experienced rehabilitation contractors (external) - previously conducted rehabilitation on site. Use of experienced rehabilitation consultants (external) - industry recognised content/technical experts. Yancoal Corporate environmental team provide expertise. Yancoal Corporate Standards - Rehabilitation (in progress). Existing Environmental Management Strategy and associated Plans (available on Internet/Intelex). Fit for Purpose Equipment used for rehabilitation activities (consideration of weight, compaction, etc.) Direct seeding.		2	D	5	(L)	Sections 6.2.5.3, 6.2.4.4 and 6.2.5.5

Table 8 (Cont'd)
Donaldson Rehabilitation Risk Assessment

Risk Identification & Analysis								Risk Reduction Strategy		Residual Risk				
#	Location	Mining Domain	Final Land Use Domain	Spatial Reference	Risk Source	Potential Impact/Consequence	Loss Type	Existing Control	Additional Control / Action	Consequence	Likelihood	Target Risk	Risk Level	RMP Section
Ecosystem and Land Use Establishment (Cont'd)														
29	All	Infrastructure Area Active Mining Area (Open Cut Void)	Native Ecosystem	A1 A5	Weather and climatic influences (e.g. Drought; intense rainfall events; bushfire; etc.)	Damage to vegetation due to fire, flood or drought.	(E) Environmental Impact	Bushfire Management Plan. Water Management Plan. Ability to obtain water from West Pit and Big Kahuna Dam. Rehabilitation Management Plan. Access to Hunter Water Pipeline. Local Rural Fire Service (established relationship with local RFS).	1. Review the existing water model to confirm final standing water level and potential for discharges.	2	C	8	(M)	Section 6.2.5.1
30	All	Infrastructure Area Active Mining Area (Open Cut Void)	Native Ecosystem	A1 A5	Insufficient establishment of vegetative cover / projected foliage cover.	Impacts on vegetation (establishing and ongoing) - completion criteria not met. Inappropriate levels of erosion / soil loss.	(E) Environmental Impact	Flora and Fauna Management Plan includes weed management. Annual Weed Management Program. Environmental Inspections. Rehabilitation Monitoring. Current high standard of Rehabilitation on site (past experience of managing similar voids) - accepted as industry best practice. Rehabilitation Management Plan. Water available on site - Big Kahuna Dam.		2	D	5	(L)	Sections 6.2.5.5 and 8.2
31	All	Infrastructure Area Water Management Areas Active Mining Area (Open Cut Void)	Native Ecosystem Water Storage Area Final Void	A1 G3 A5 J5	Erosion and failure of drainage and water management/storage structures.	Impacts on water quality and potential discharge.	(E) Environmental Impact	Final Landform Design to include water management requirements (e.g. diversions, etc.). Rehabilitation Management Plan - includes erosion and sediment control. Environmental Inspections. Rehabilitation Monitoring. Donaldson and Abel Water Management Plan.	1. Ongoing inspection and maintenance of any Water Management structures required as part of final landform design. 2. Sediment Dam Investigation Report.	4	D	14	(H)	Sections 6.2.1.10 and 6.2.6.2
32	Abel	Underground Mining Area (SMP)	Other	K6	Overgrazing of pasture rehabilitation areas above underground workings (if impacted by subsidence).	Pasture cover establishment delayed.	(R) Impact on Reputation	Rehabilitation Management Plan. Subsidence Management Plan. Rehabilitation Monitoring.		1	C	4	(L)	Abel RMP
Ecosystem and Land Use Development														
33	All	Infrastructure Area Active Mining Area (Open Cut Void)	Native Ecosystem	A1 A5	Weather and climatic influences (e.g. Drought; intense rainfall events; bushfire; etc.)	Damage to vegetation due to fire, flood or drought.	(E) Environmental Impact	Bushfire Management Plan. Water Management Plan. Ability to obtain water from West Pit and Big Kahuna Dam. Rehabilitation Management Plan - includes erosion and sediment controls. Access to Hunter Water Pipeline. Local Rural Fire Service (established relationship with local RFS).	1. Review the existing water model to confirm final standing water level and potential for discharges.	2	C	8	(M)	Sections 6.2.5.1 and 6.2.6.4

Table 8 (Cont'd)
Donaldson Rehabilitation Risk Assessment

Risk Identification & Analysis								Risk Reduction Strategy		Residual Risk				
#	Location	Mining Domain	Final Land Use Domain	Spatial Reference	Risk Source	Potential Impact/Consequence	Loss Type	Existing Control	Additional Control / Action	Consequence	Likelihood	Target Risk	Risk Level	RMP Section
Ecosystem and Land Use Development (Cont'd)														
34	All	Infrastructure Area Active Mining Area (Open Cut Void)	Native Ecosystem	A1 A5	Vandalism to revegetation areas.	Damage to vegetation due to vandalism.	(E) Environmental Impact	Fencing and signage at property boundary. Environmental Inspections. Rehabilitation Monitoring.		2	C	8	(M)	Sections 6.2.6.4 and 6.2.6.5
35	All	Infrastructure Area Active Mining Area (Open Cut Void)	Native Ecosystem	A1 A5	Inadvertent or unauthorised access.	Damage to vegetation due to inappropriate access.	(E) Environmental Impact	Fencing and signage at property boundary. Definition of retained access tracks. Weekly boundary inspections undertaken.		2	D	5	(L)	Sections 6.2.6.4 and 6.2.6.5
36					Post-closure water quality issues (e.g. high salinity, etc.)	Refer to #31 Erosion and Failure of Drainage and Water Management / Storage Structures, #18, #19 water Accumulation in Voids.								
37	All	Infrastructure Area Active Mining Area (Open Cut Void)	Native Ecosystem	A1 A5	Insects and plant disease.	Refer to #26 Weed & Pest Control								
38	Abel	Underground Mining Area (SMP)	Variable	K6	Overgrazing of pasture rehabilitation areas above underground workings (if impacted by subsidence).	Pasture cover establishment delayed.	(R) Impact on Reputation	Rehabilitation Management Plan. Subsidence Management Plan. Rehabilitation Monitoring.		1	C	4	(L)	Abel RMP
39	All	All	-	-	Lack of resources for rehabilitation maintenance.	Refer to #1 General (Resourcing)								
40	All	Infrastructure Area Active Mining Area (Open Cut Void)	Native Ecosystem	A1 A5	Inadvertent or unauthorised access.	Refer to #35 Inadvertent or unauthorised access.								
41	All	Infrastructure Area Active Mining Area (Open Cut Void)	Native Ecosystem	A1 A5	Insufficient establishment of vegetative cover / projected foliage cover.	Completion criteria not met. Inappropriate levels of erosion / soil loss.	(E) Environmental Impact	Flora and Fauna Management Plan includes weed management. Annual Weed Management Program. Environmental Inspections. Rehabilitation Monitoring against completion criteria Current high standard of Rehabilitation on site (past experience of managing similar voids) - accepted as industry best practice. Rehabilitation Management Plan. Water available on site - Big Kahuna Dam. Completion criteria submitted to Resources Regulator.	1. If required, seek assessment and review by rehabilitation expert / ecologist and implement recommendations.	2	D	5	(L)	Section 6.2.6.4
						Rehabilitation signoff not given by Regulator	(R) Impact on Reputation			2	D	5	(L)	

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Table 8 (Cont'd)
Donaldson Rehabilitation Risk Assessment

Risk Identification & Analysis								Risk Reduction Strategy		Residual Risk				
#	Location	Mining Domain	Final Land Use Domain	Spatial Reference	Risk Source	Potential Impact/Consequence	Loss Type	Existing Control	Additional Control / Action	Consequence	Likelihood	Target Risk	Risk Level	RMP Section
Ecosystem and Land Use Development (Cont'd)														
42	All	Infrastructure Area Active Mining Area (Open Cut Void)	Native Ecosystem	A1 A5	Ecosystem established is not self-sustaining / contains inappropriate species.	Completion criteria not met.	(E) Environmental Impact	Flora and Fauna Management Plan includes weed management. Annual Weed Management Program. Environmental Inspections. Rehabilitation Monitoring. Current high standard of Rehabilitation on site (past experience of managing similar voids) - accepted as industry best practice. Rehabilitation Management Plan. Completion Criteria submitted to Resources Regulator. Rehab inspections against Completion Criteria	1. If required, seek assessment and review by rehabilitation expert / ecologist and implement recommendations.	2	D	5	(L)	Section 6.2.6.4
						Rehabilitation signoff not given by Regulator	(R) Impact on Reputation			2	D	5	(L)	

4. REHABILITATION OBJECTIVES AND REHABILITATION COMPLETION CRITERIA

4.1 REHABILITATION OBJECTIVES AND REHABILITATION COMPLETION CRITERIA

Table 9 presents the approved rehabilitation objectives and proposed rehabilitation completion criteria for individual final land use domains at the Donaldson Mine. Final land use domains are shown on **Plan 1** and current Mining Domains are shown on **Figure 5**.

Table 9
Rehabilitation Objectives and Rehabilitation Completion Criteria

Final Land Use Domain	Mining Domain	Spatial Reference[1]	Rehabilitation Objective Category	Proposed Rehabilitation Objective	Indicator(s)	Proposed Rehabilitation Completion Criteria	Validation Method
Native Ecosystem	Infrastructure	A1	Bushfire	The risk of bushfire impacts to the community, environment and infrastructure has been addressed to the extent required as part of rehabilitation.	Appropriate bushfire hazard controls (where required) have been implemented on the advice from the NSW Rural Fire Service.	Bushfire controls implemented.	Statement provided and before/after photos.
Native Ecosystem	Overburden Emplacement Area	A4					
Water Storage Area	Water Management Area	G3					
Infrastructure	Infrastructure	I1					
Final Void	Active Mining Area (open cut void)	J5					
Native Ecosystem	Infrastructure	A1	Ecological rehabilitation	Levels of ecosystem function have been established that demonstrate the rehabilitation is self-sustainable	Indicators of nutrient cycling are suitable for sustaining the target vegetation community (e.g. PCT(s))	Litter cover is within 10th-90th percentile variation range of reference sites/data.	Rehabilitation monitoring reports, independent soil reports (where required) that demonstrate long-term function of rehabilitated landform.
Native Ecosystem	Overburden Emplacement Area	A4			Evidence of plant regeneration from 0.04 hectare fixed monitoring plots or a walk over of the ecological rehabilitation area	Second generation individuals of trees are within the 10th-90th percentile variation range of reference sites/data.	Before and after photos, rehabilitation monitoring reports, independent ecological reports (where required) that validate rehabilitation completion criteria have been met.
Final Void	Active Mining Area (open cut void)	J5			Cover of exotic species within 0.04 hectare fixed monitoring plots is low	Foliage cover of 'high threat exotic' (HTE) weeds is within 10th-90th percentile variation range of reference sites/data or at a level that does not cause significant risk to rehabilitation.	Before and after photos, rehabilitation monitoring reports, independent ecological reports (where required) that demonstrate long-term stability of rehabilitated landform.
					Resilience demonstrated by the effects of drought and fire on composition, structure and other function attributes.	Resilience to drought and fire.	Rehabilitation monitoring reports, environmental monitoring records.
					Threats to rehabilitation.	Vertebrate pest species – presence and damage is recorded at a level that does not cause significant risk to rehabilitation.	Rehabilitation monitoring reports.
						Domesticated stock - presence and damage is recorded at a level that does not cause significant risk to rehabilitation.	
Native Ecosystem	Infrastructure	A1	Ecological rehabilitation	Vegetation composition of rehabilitated areas contains species that are commensurate with one or more of the modified native vegetation and plant communities of the analogue sites within the Bushland Conservation Area (Including Riparian Moist Forest, Smooth-barked Apple Forest, Spotted Gum - Ironbark Forest, Tall Moist Forest, Hunter Lowland Redgum Forest, and their derivatives)	Native plant species recorded from 0.04 hectare fixed monitoring plots are characteristic of the target vegetation community (e.g. target PCT)	Native plant species are characteristic of the target vegetation community(s) when compared to analogue sites.	Before and after photos, rehabilitation monitoring reports, independent ecological reports (where required) that validate rehabilitation completion criteria have been met.
Native Ecosystem	Overburden Emplacement Area	A4				At least 80% of species established are consistent with or complementary to surrounding local plant communities and represent >80% of the total projected foliage cover	
Final Void	Active Mining Area (open cut void)	J5				Weed abundance within rehabilitated areas is <20% projected foliage cover or equivalent to or less than that observed at analogue sites.	

Table 9 (Cont'd)
Rehabilitation Objectives and Rehabilitation Completion Criteria

Final Land Use Domain	Mining Domain	Spatial Reference[1]	Rehabilitation Objective Category	Proposed Rehabilitation Objective	Indicator(s)	Proposed Rehabilitation Completion Criteria	Validation Method
Native Ecosystem	Infrastructure	A1	Ecological rehabilitation	Vegetation structure of rehabilitated areas is recognisable as, or is trending towards, one or more of the modified native vegetation and plant communities of the analogue sites within the Bushland Conservation Area (Including Riparian Moist Forest, Smooth-barked Apple Forest, Spotted Gum - Ironbark Forest, Tall Moist Forest, Hunter Lowland Redgum Forest, and their derivatives)	Biomass metrics of plant growth forms recorded from 0.04 hectare fixed monitoring plots are characteristic of the target vegetation community (e.g. PCT), or an ongoing trend toward becoming characteristic is evident from the monitoring data	Foliage Projective Cover, Basal Area, and Total Stand Volume of native plant growth forms are characteristic of, or trending towards, the target vegetation community type(s).	Before and after photos, rehabilitation monitoring reports, independent ecological reports (where required) that validate rehabilitation completion criteria have been met.
Native Ecosystem	Overburden Emplacement Area	A4				For areas returned to native grassland, projected foliage cover is greater than or equal to 70%.	
Final Void	Active Mining Area (open cut void)	J5				For areas returned to woodland the Total Foliage Projection Cover (including groundcover, shrubs and overstory) exceeds 150%.	
						For areas returned to woodland the total stand volume is within 20% of existing matured rehabilitation areas and/or analogue sites.	
						Relative abundance of native species is within 20% of existing matured rehabilitation areas and/or analogue sites.	
Native Ecosystem	Infrastructure	A1	Groundwater	Groundwater levels are within the range predicted in pre-mining environmental assessment (or otherwise approved)	Groundwater quality both on and off a mining lease represent an acceptable level of change from a defined reference condition.	Groundwater levels, groundwater flow.	Water quality monitoring reports.
Water Storage Area	Water Management Area	G3					Environment Protection Licence relinquished by Environment Protection Authority.
Final Void	Active Mining Area (open cut void)	J5					Independent hydrological assessment report.
Water Storage Area	Water Management Area	G3	Groundwater	Groundwater quality is similar to, or better than the pre-disturbance groundwater quality or the range as predicted in pre-mining environmental assessment (or otherwise approved)	Water quality parameters selected from Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000 and or Environment Protection Licence.	Water quality discharged from rehabilitated mining operation meet specifications in Environment Protection Licence and or ANZECC guidelines for specific environment.	Independent hydrological assessment report.
Final Void	Active Mining Area (open cut void)	J5					
Water Storage Area	Water Management Area	G3	Land contamination	Areas are free from contaminants and hazardous materials.	Waste material and/or visible contamination areas on site surface.	There are no visible signs of contamination following the removal of plant, equipment and materials.	Statement provided and before/after photos.
Native Ecosystem	Infrastructure	A1				All rubbish/ waste materials removed from site.	
Native Ecosystem	Overburden Emplacement Area	A4			Soil testing for contaminants of concern as listed by Health Investigation Level of the National Environment Protection (Assessment of Site Contamination) Measure (1999) applicable to land use type.	Contamination will be appropriately remediated so that appropriate guidelines for land use are met, e.g. Health Investigation Level of the National Environment Protection (Assessment of Site Contamination) Measure (1999).	Contamination Remediation Report prepared by Land Contamination Consultant
Infrastructure	Infrastructure	I1				Excess sludge/material has been removed from surface water dams.	Site Contamination Audit Report and Site Audit Statement prepared by EPA Accredited Auditor (where required).
Final Void	Active Mining Area (open cut void)	J5					
Final Void	Active Mining Area (open cut void)	J5	Land contamination	Final void design does not represent a potential source of pollution.	Measured – contamination levels in surface and groundwater surrounding emplacement for contaminants of concern associated with waste material emplaced.		

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Table 9 (Cont'd)
Rehabilitation Objectives and Rehabilitation Completion Criteria

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Final Land Use Domain	Mining Domain	Spatial Reference[1]	Rehabilitation Objective Category	Proposed Rehabilitation Objective	Indicator(s)	Proposed Rehabilitation Completion Criteria	Validation Method
Native Ecosystem	Infrastructure	A1	Landform stability	Final landforms are safe, stable and non-polluting.	Highwall and low wall design	Final shaping of pit walls undertaken in accordance with approved design.	Single occurrence inspection and report, including photographs and final landform survey plan, prior to growth medium establishment.
Native Ecosystem	Overburden Emplacement Area	A4			Visual evidence of erosion or landform instability	No evidence of active erosion or other landform instability (e.g. mass movement) that would require moderate or significant maintenance is observed.	Visual inspections undertaken on a regular basis until site relinquishment.
Infrastructure	Infrastructure	I1					Final inspection report , with photographs, prepared as part of completion report.
Final Void	Active Mining Area (open cut void)	J5			Access controls	Barriers are placed adjacent retained access road to prevent public access to potentially hazardous landforms or sensitive rehabilitation areas, if required.	Single occurrence relinquishment inspection and report, including photographs, following decommissioning.
Final Void	Active Mining Area (open cut void)	J5	Landform stability	Final void is not utilised for unauthorised purposes.	Access controls	Barriers are placed adjacent retained access road to prevent public access to potentially hazardous landforms or sensitive rehabilitation areas, if required.	Single occurrence relinquishment inspection and report, including photographs, following decommissioning.
Native Ecosystem	Infrastructure	A1	Removal of infrastructure	All infrastructure and services not required for the final land use are removed.	Removal of all services (power, water, communications) that have been connected on the site as part of the operation.	All utility infrastructure removed.	Statement provided, utility service disconnection record / notification.
Native Ecosystem	Overburden Emplacement Area	A4			Heritage obligations (e.g. development consent under the Environmental Planning and Assessment Act 1979, approvals under the Heritage Act 1977, etc.) have been met (e.g. archival recording, building retention or building demolition with footings preserved).	Permits and approval documents issued.	Copy of any relevant approval documentation and archival reports/records.
Infrastructure	Infrastructure	I1				All archival reports required are complete and submitted.	As-constructed final landform plan, photos, decommissioning reports etc.
Final Void	Active Mining Area (open cut void)	J5			Removal of all plant, equipment and associated infrastructure including processing facilities, stockpile areas, rail infrastructure and loading facilities, underground hydrocarbon storage tanks, office complex, portable offices, exploration core samples, camp facilities, storage racks, samples.	Infrastructure removed.	
Water Storage Area	Water Management Area	G3	All water management infrastructure not required for the final land use are removed.		Removal of all footings or removal to a certain depth (e.g. 0.5 metres).	Footings removed and or removed to specified depths to avoid exposure pathways to subsequent final land use.	Surveyed and marked on the as-constructed final landform plan.
					Removal of all water management infrastructure (including pumps, pipes and power).	Infrastructure removed.	Statement provided and before/after photos.
					All drill cores have been removed and taken either to an authorised storage or a disposal location.	Cores removed and relocated.	Statement provided, receipt records from storage or disposal location.
					Surveying and sealing of all drill holes, boreholes and gas wells in accordance with departmental guidelines and relevant standards.	Sealing completed and verified.	Engineering report/statement, plug and abandonment log, photos, as-constructed drawings, records of fill materials and concrete plugs, filling methods etc.
					Surveying and sealing of all underground mine entries in accordance with departmental guidelines and relevant standards.	Sealing completed and verified by suitably qualified engineer.	Engineering report/statement, plug and abandonment log, photos, as-constructed drawings, records of fill materials and concrete plugs, filling methods etc.

Table 9 (Cont'd)
Rehabilitation Objectives and Rehabilitation Completion Criteria

Page 4 of 5

Final Land Use Domain	Mining Domain	Spatial Reference[1]	Rehabilitation Objective Category	Proposed Rehabilitation Objective	Indicator(s)	Proposed Rehabilitation Completion Criteria	Validation Method
Native Ecosystem	Infrastructure	A1	Retention of infrastructure	All infrastructure that is to remain as part of the final land use is safe and does not pose any hazard to the community.	Potential hazards (e.g. electrical, mechanical) have been effectively isolated and secured.	Hazards isolated and secured.	Statement provided by suitably qualified engineer.
Native Ecosystem	Overburden Emplacement Area	A4		Retained infrastructure benefits from relevant development consent approvals and/or licences and/or binding agreements (as relevant).	Damage to access tracks has been repaired and stabilised.	Repairs complete.	As-constructed final landform plan, photos etc.
Water Storage Area	Water Management Area	G3			Where applicable, necessary approvals are in place (e.g. development consent under the Environmental Planning and Assessment Act 1979) where buildings and infrastructure are to be retained as part of final land use.	Permits and approval documents issued.	Copy of any relevant approvals.
Infrastructure	Infrastructure	I1			Heritage obligations as required under the Environmental Planning and Assessment Act 1979, Heritage Act 1977, etc. have been met (e.g. archival recording, building retention and restoration).	Permits and approval documents issued; archival reports (where required) complete and submitted.	Copy of any relevant approvals.
Final Void	Active Mining Area (open cut void)	J5			The structural integrity of the infrastructure is suitable and safe for use as part of the intended final land use.	The structural integrity of the infrastructure has been inspected by a suitably qualified engineer and determined to be suitable and safe as part of the intended final land use.	Engineering report/statement, photos, risk assessment verifying modes of failure are adequately addressed to minimise risks to public safety or the environment.
					Infrastructure is in a condition (e.g. structural, electrical, other hazards) that is suitable for the intended final land use.	Formal acceptance from the subsequent landowner that infrastructure is in a condition that is suitable for the intended final land use in accordance with formal agreement.	Formal acceptance from landowner.
					If any underground pipelines or other infrastructure are to remain in situ, they do not pose a hazard for the intended final land use.	The location of the infrastructure has been marked on a plan and registered with the relevant local authority (e.g. local Council) and Dial Before You Dig.	Surveyed and marked on the as-constructed final landform plan.
						Formal acceptance from the subsequent landowner that underground infrastructure has been left in a condition that is suitable for the intended final land use in accordance with formal agreement.	Copy of notification to local Council and Dial Before You Dig
							Formal acceptance from landowner.
							Identified on an appropriate legal instrument associated with the land title.
Water Storage Area	Water Management Area	G3	Retention of infrastructure	Retained water management structures are safe, stable and provide for long-term water management.	Where applicable, necessary approvals are in place (e.g. development consent under the Environmental Planning and Assessment Act 1979) where buildings and infrastructure are to be retained as part of final land use.	Permits and approval documents issued.	Copy of any relevant approvals.
					The structural integrity of the infrastructure is suitable and safe for use as part of the intended final land use.	The structural integrity of the infrastructure has been inspected by a suitably qualified engineer and determined to be suitable and safe as part of the intended final land use.	Engineering report/statement, photos, risk assessment verifying modes of failure are adequately addressed to minimise risks to public safety or the environment.
					Infrastructure is in a condition (e.g. structural, electrical, other hazards) that is suitable for the intended final land use.	Formal acceptance from the subsequent landowner that infrastructure is in a condition that is suitable for the intended final land use in accordance with formal agreement.	Formal acceptance from landowner.
					If any underground pipelines or other infrastructure are to remain in situ, they do not pose a hazard for the intended final land use.	The location of the infrastructure has been marked on a plan and registered with the relevant local authority (e.g. local Council) and Dial Before You Dig.	Surveyed and marked on the as-constructed final landform plan.
						Formal acceptance from the subsequent landowner that underground infrastructure has been left in a condition that is suitable for the intended final land use in accordance with formal agreement.	Copy of notification to local Council and Dial Before You Dig
							Formal acceptance from landowner.
							Identified on an appropriate legal instrument associated with the land title.

Table 9 (Cont'd)
Rehabilitation Objectives and Rehabilitation Completion Criteria

Final Land Use Domain	Mining Domain	Spatial Reference[1]	Rehabilitation Objective Category	Proposed Rehabilitation Objective	Indicator(s)	Proposed Rehabilitation Completion Criteria	Validation Method
Final Void	Active Mining Area (open cut void)	J5	Surface water	Minimisation of final void catchments.	Presence of water management infrastructure	Final void perimeter diversion bund(s) and other water management structures constructed to minimised catchment in accordance with Blue Book or other appropriate design criteria.	Single occurrence relinquishment inspection and report including photographs following decommissioning.
Native Ecosystem	Infrastructure	A1	Surface water	Runoff water quality from mine site is similar to, or better than the pre-disturbance runoff water quality.	Water quality parameters selected from Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000 and or Environment Protection Licence.	Water quality discharged from rehabilitated mining operation meet specifications in Environment Protection Licence and or ANZECC guidelines for specific environment.	Water quality monitoring reports.
Native Ecosystem	Overburden Emplacement Area	A4					Environment Protection Licence relinquished by Environment Protection Authority.
Water Storage Area	Water Management Area	G3					Independent hydrological assessment report.
Infrastructure	Infrastructure	I1					Depending on the nature, scale and risks associated with a specific site, achievement of criteria may need to be evaluated over a number of years (e.g. 5 years to 15+ years).
Final Void	Active Mining Area (open cut void)	J5					
Water Storage Area	Water Management Area	G3	Surface water	Surface water quality within retained Water Management Infrastructure is capable of supporting final land use.	Water quality parameters selected from Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000 and or Environment Protection Licence.	Water quality discharged from rehabilitated mining operation meet specifications in Environment Protection Licence and or ANZECC guidelines for specific environment.	Water quality monitoring reports.
							Environment Protection Licence relinquished by Environment Protection Authority.
							Independent hydrological assessment report.
Native Ecosystem	Infrastructure	A1	Water approvals	Structures that take or divert water such as final voids, dams, levees etc. are appropriately licensed (e.g. under the Water Management Act 2000) and, where required, ensure sufficient licence shares are held in the water source(s) to account for water take.	Final landform considers advice from relevant Government Agency whether sufficient licence shares are available in the water source to account for water stored in voids and dams in the proposed final landform.	Water approvals / licences are granted by relevant NSW Government Agency.	Confirmation from relevant Government Agency that relevant water approvals / licences are able to be granted.
Native Ecosystem	Overburden Emplacement Area	A4					
Water Storage Area	Water Management Area	G3					
Infrastructure	Infrastructure	I1					
Final Void	Active Mining Area (open cut void)	J5					

4.2 REHABILITATION Objectives and Rehabilitation Completion Criteria – Stakeholder Consultation

Table 10 presents a summary of the consultation undertaken with relevant stakeholders with regards to the proposed rehabilitation objectives and completion criteria presented in this Plan. This table will be updated with each revision of this Plan to include details of further consultation with relevant and interested stakeholders.

Table 10
Community Consultation Activities

Page 1 of 3

Department of Planning and Environment
Form of Consultation: Letter (email transmission) dated 2 June 2022 Matters Subject to Consultation: Rehabilitation Objectives and Completion Criteria Outcomes: No response received
Resources Regulator
Form of Consultation: Letter (email transmission) dated 2 June 2022 Matters Subject to Consultation: Rehabilitation Objectives and Completion Criteria Outcomes: No response received
Mining, Exploration, and Geoscience
Form of Consultation: Letter (email transmission) dated 2 June 2022 Matters Subject to Consultation: Rehabilitation Objectives and Completion Criteria Outcomes: No response received
Department of Planning and Environment - Water
Form of Consultation: Letter (email transmission) dated 2 June 2022 Matters Subject to Consultation: Rehabilitation Objectives and Completion Criteria Outcomes: No response received
Water NSW
Form of Consultation: Letter (email transmission) dated 2 June 2022 Matters Subject to Consultation: Rehabilitation Objectives and Completion Criteria Outcomes: No response received
Environment Protection Authority
Form of Consultation: Letter (email transmission) dated 2 June 2022 Matters Subject to Consultation: Rehabilitation Objectives and Completion Criteria Outcomes: No response received
Maitland City Council
Form of Consultation: Letter (email transmission) dated 2 June 2022 Matters Subject to Consultation: Rehabilitation Objectives and Completion Criteria Outcomes: No response received
Cessnock City Council
Form of Consultation: Letter (email transmission) dated 2 June 2022 Matters Subject to Consultation: Rehabilitation Objectives and Completion Criteria Outcomes: No response received

Table 10 (Cont'd)
Community Consultation Activities

City of Newcastle Council
Form of Consultation: Letter (email transmission) dated 2 June 2022
Matters Subject to Consultation: Rehabilitation Objectives and Completion Criteria
Outcomes: The following ten items were recommended to be addressed within the RMP
1. Consider surrounding changing land uses and minimise any impact on the delivery of the Emerging Black Hill Precinct Catalyst Area as identified in the Greater Newcastle Metropolitan Plan 2036 and the Black Hill Employment Lands Concept Approval. *The Beresfield-Black Hill Catalyst Area consists of the Beresfield Precinct and the Emerging Black Hill Precinct. These areas are located outside or adjacent of the boundary of ML1461 but within and in the vicinity of ML1618. It is noted that the Emerging Black Hill Precinct is as of yet undeveloped; however, the development of the Beresfield Precinct, as identified by the Greater Newcastle Metropolitan Plan 2036, has significantly progressed while directly adjoining the Donaldson Mine Site. Based on the above, Donaldson Coal considers that further development of these areas would not be inhibited by the presence of the rehabilitated Abel and Donaldson Mine Sites.* *In addition to the above, it is noted that underground mining operations as part of the Abel Mine have previously occurred within and in the vicinity of the Emerging Black Hill Precinct. Any subsidence impacts will continue to be managed in accordance with the existing approved subsidence management plans.*
2. Consider Objective 1 '*Diversify the Hunter's mining, energy and industrial capacity*' of the Draft Hunter Regional Plan 2041, particularly the post-mining land use principles outlined under Strategy 1.1, Strategy 1.2 and Action 1. *The Draft Hunter Regional Plan 2041 defines the Abel and Donaldson Mine Sites as being located within the National Pinch Point Regionally Significant Growth Area of the Greater Newcastle District Planning and Growth Area. Within the National Pinch Point District Planning and Growth Area, the Abel and Donaldson Mines are located within or in the vicinity of the Beresfield, Black Hill, Four Mile Creek and Stockrington Precincts. It is noted that the land uses within these areas are largely undefined or do not accurately reflect current land use (namely conservation and mining). The objectives for these precincts are provided on Page 75 of the Draft Hunter Regional Plan 2041.* *It should be noted that the design of the final voids would permit their use as industrial water supply. Furthermore, though not proposed as part of this Plan, where existing infrastructure areas are located, these areas will be rehabilitated in a manner in which future industrial developments would not be prevented. Notwithstanding, for the backfilled open cut mining areas, the approved backfilling was not designed to support industrial development, and therefore these areas are not considered to be suitable for such use. The establishment of native ecosystem areas however is consistent with the listed objectives regarding the conservation of high environmental value lands.* *Objective 1 relates to opportunities for developing mining-affected areas and in general discusses the potential for rehabilitation outcomes greater than returning lands to pre-mining land uses. It is noted that Objective 1 states: "there may be times and circumstances when land should be kept as agricultural or biodiversity lands to maintain the character of the local area". Furthermore, the establishment of biodiversity corridors in areas of existing vegetation is also discussed as part of Objective 1. The rehabilitated areas of the Donaldson Mine Site are almost wholly surrounded by significant areas of remnant and/or regrowth vegetation that have been protected and maintained since the opening of the Donaldson Mine. Donaldson Coal contends that the rehabilitation of disturbed areas to native ecosystems would meet those criteria. Apart from limited hardstand areas, no other significant infrastructure is located within the Abel and Donaldson Mine Site which would provide unique opportunities for re-development of industrial areas.* *In light of the above, the rehabilitation of the Abel and Donaldson Mine Sites as biodiversity areas is generally in accordance with the land use principals outlined in Strategy 1.1, namely avoiding land use conflicts and maintaining/enhancing biodiversity corridors. Strategy 1.2 outlines stages at which consultation should be undertaken in regard to alternative land uses. This is addressed in this table and in* ***Table 4****. Action 1 relates to development applications involving non-permissible land uses and is therefore not considered to be relevant to this Plan.*

Table 10 (Cont'd)
Community Consultation Activities

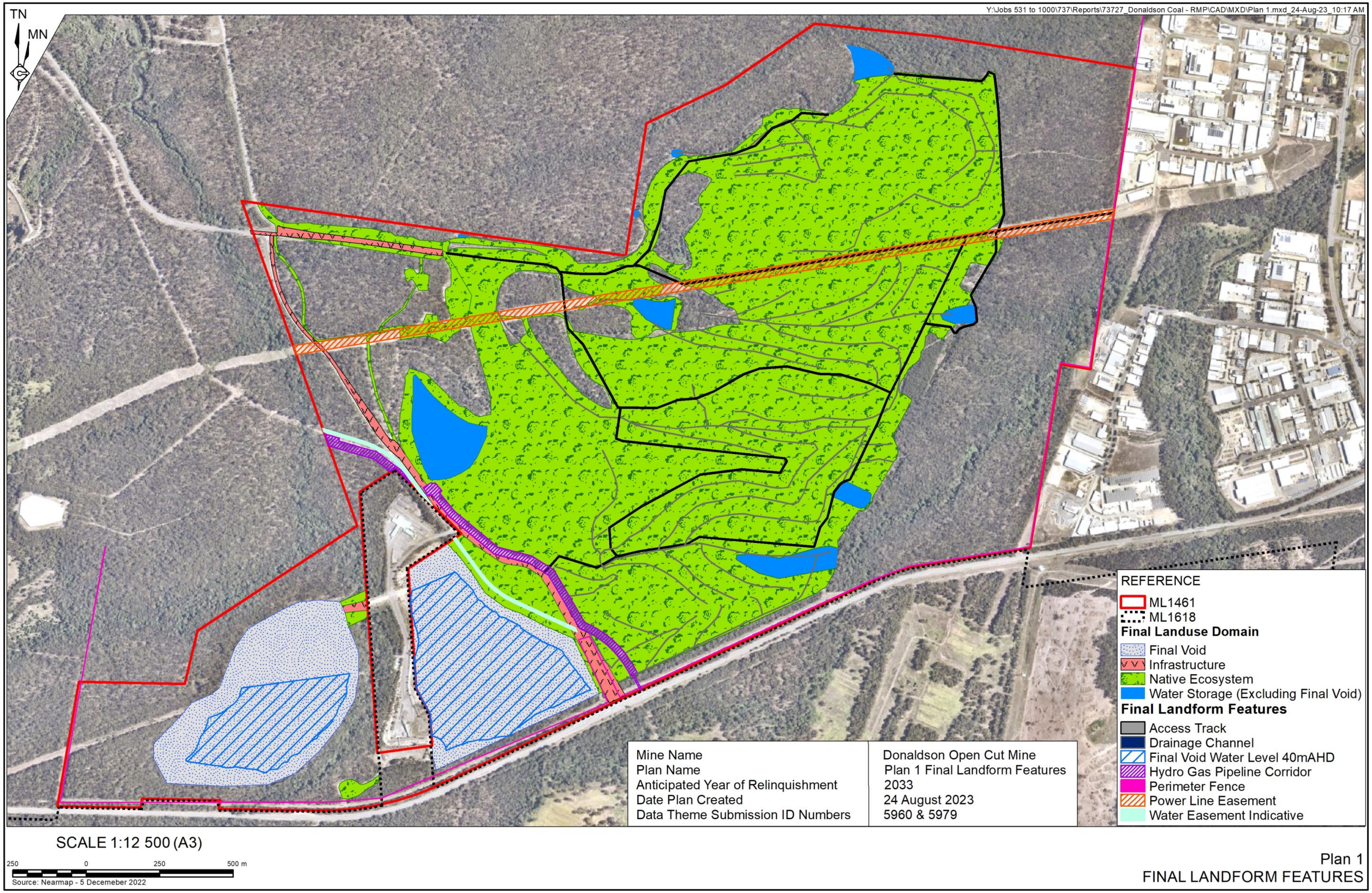
Page 3 of 3

City of Newcastle Council (Cont'd)
3. Identify all risks and mitigation measures to the Newcastle LGA regarding the rehabilitation of these mines. *Donaldson Coal contends that risks to the area within and in the vicinity of the Abel and Donaldson Mine sites has been considered at all times over the progressive development of the Abel and Donaldson Mines. The environmental management measures detailed in this Plan, other management plans, the development consents, and other licences and approvals are considered to be appropriate for the scale of impacts that have been predicted or experienced over the life of the mines. Based on the above, the risks to all surrounding areas are considered to have been adequately addressed.* 4. Address the potential for leaching contaminants into Beresfield through surface runoff and groundwater. *Potential impacts to water quality are actively monitored and managed in accordance with existing and approved management plans* 5. Identify whether these mines for part of a water catchment that runs into the Newcastle LGA. Consider water quality monitoring of downstream creeks during rehabilitation works to monitor environmental impacts. *The Weakleys Flat Creek Catchment (see **Figure** 3) runs into the Newcastle LGA. Surface water monitoring will continue to be undertaken during rehabilitation works (see Section 6.2.6.3).* 6. Ensure any road or road infrastructure retained is gated and locked to prevent public vehicle access. *Existing security measures will be retained to prevent public access (see Section 6.2.2.1)* 7. Ensure any roads remain as maintenance access only and rest with the landowners. Any future road dedications to the public or others to be part of planning or subdivision approvals. *Noted.* 8. Consider the Newcastle Bush Fire Risk Management Plan and any required bushfire management plans. Retain access for Rural Fire Service vehicles. *The Newcastle Bush Fire Management Plan will be considered as part of ongoing bush fire management. Existing emergency access will be retained.* 9. Use a nearby undisturbed reference ecosystem/location for the validation of the 'ecosystem and land use establishment and development phase'. Any fauna or flora data near the boundary of the Newcastle LGA should be reported to CN (preferably with shp. files). *The use of analogue sites is discussed in Section 8.1. All flora and fauna reporting will continue to be undertaken in accordance with the development consent.* 10. Investigate potential of linking rehabilitated lands to Stockton-Watagans biodiversity corridor. *The establishment and protection of biodiversity areas within the Abel and Donaldson Mine Sites would be consistent with any biodiversity and conservation related developments outside of the control of Donaldson Coal.*
Community Consultation Committee
Form of Consultation: Letter (email transmission) dated 2 June 2022 Matters Subject to Consultation: Rehabilitation Objectives and Completion Criteria Outcomes: No response received
Mindaribba Local Aboriginal Land Council
Form of Consultation: Letter (email transmission) dated 2 June 2022 Matters Subject to Consultation: Rehabilitation Objectives and Completion Criteria Outcomes: No response received
Awabakal Local Aboriginal Land Council
Form of Consultation: Letter (email transmission) dated 2 June 2022 Matters Subject to Consultation: Rehabilitation Objectives and Completion Criteria Outcomes: No response received

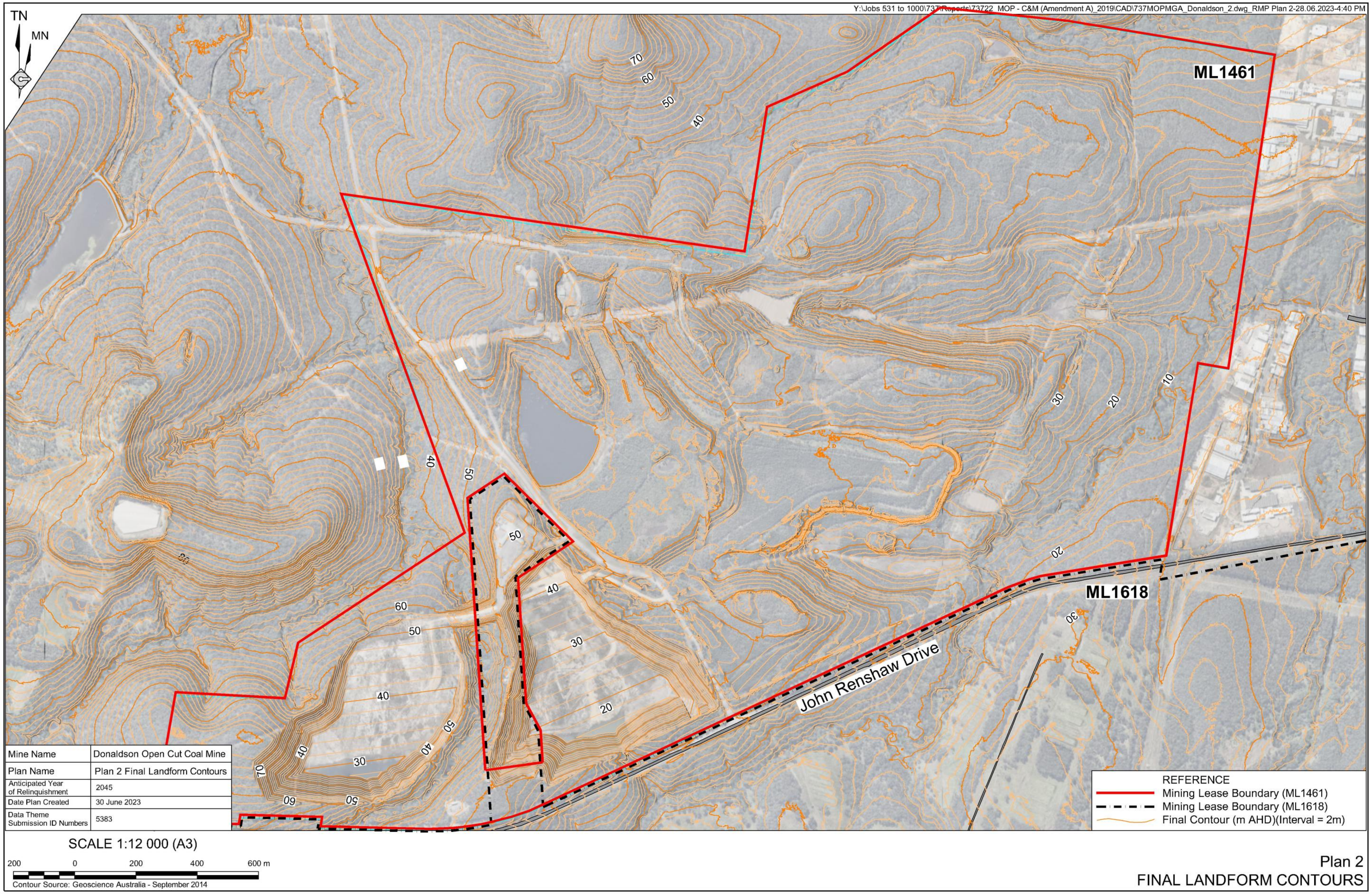
5. FINAL LANDFORM AND REHABILITATION PLAN

5.1 FINAL LANDFORM AND REHABILITATION PLAN

Plan 1 presents the final landform features for the Donaldson Mine Site and **Plan 2** presents the final landform contours for the Donaldson Mine Site.



DONALDSONCOAL
Part of the Yancoal Australia Group


Y:\Jobs 531 to 1000\737\Reports\73722_MOP - C&M (Amendment A)_2019\CAD\737MOPMGA_Donaldson_2.dwg_RMP Plan 2-28.06.2023-4:40 PM
TN
MN
ML1461
ML1618
John Renshaw Drive
Mine Name
Donaldson Open Cut Coal Mine
Plan Name
Plan 2 Final Landform Contours
Anticipated Year of Relinquishment
2045
Date Plan Created
30 June 2023
Data Theme Submission ID Numbers
5383
REFERENCE
Mining Lease Boundary (ML1461)
Mining Lease Boundary (ML1618)
Final Contour (m AHD)(Interval = 2m)
SCALE 1:12 000 (A3)
200 0 200 400 600 m
Contour Source: Geoscience Australia - September 2014
Plan 2
FINAL LANDFORM CONTOURS

6. REHABILITATION IMPLEMENTATION

6.1 LIFE OF MINE REHABILITATION SCHEDULE

As discussed in Section 2.2, the approved final landforms for the Abel and Donaldson Mine Sites include scenarios for the resumption of underground mining operations within the Abel Mine which would potentially include the deposition of tailings within the Square Pit.

For the purpose of this Plan, Donaldson Coal has assumed that no further mining operations will occur. Notwithstanding the Abel and Donaldson Mines remain on Care and Maintenance until a final decision has been made on whether or not economic mining can recommence at the Abel Mine. At this stage mining operations at the Abel Mine are approved up to end December 2030. It is currently anticipated that, if mining operations have not recommenced, mine closure activities will be progressed for both the Donaldson and Abel Mines. Mine closure activities are expected to be completed within a 5-year period with these areas of the site remaining within the Ecosystem Establishment Phase for a further 5 to 10 years prior to reaching the Ecosystem Development and Relinquishment phases (i.e. estimated site relinquishment is December 2045).

During Care and Maintenance, the remaining ‘operational’ areas of the Abel and Donaldson Mines will not be available for rehabilitation and as such, opportunities for further progressive rehabilitation prior to closure of the Abel and Donaldson Mines are limited. However, during this time continued monitoring and completion of additional closure planning, including completion of a rehabilitation materials balance report (for capping material and growth medium) and updated water modelling, will be undertaken.

Figure 5 depicts the current extent of disturbance at the Donaldson Mine Site (i.e. the Mining Domains). Where practicable, disturbance activities associated with the Abel Mine are included in the RMP for the Abel Mine. **Plans 3** to **7** present the indicative rehabilitation schedule for the Donaldson Mine Site by depicting the status of disturbance / rehabilitated during each 4 to 5-yearly increment between the commencement of this Plan, Mine closure, and achievement of relinquishment.

6.2 PHASES OF REHABILITATION AND GENERAL METHODOLOGIES

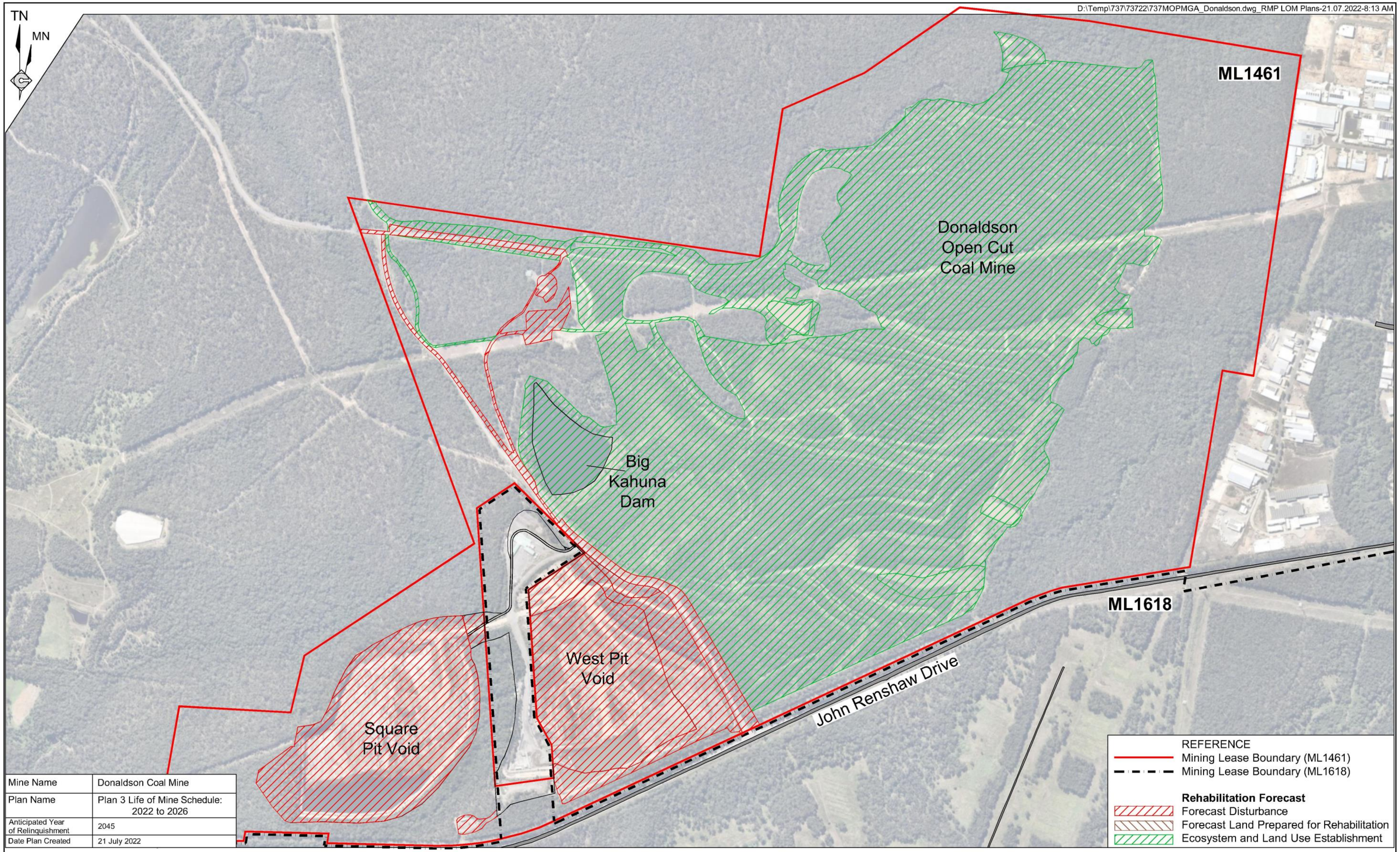
6.2.1 Active Mining Phase

6.2.1.1 Soils and Materials

Existing Environment

The soils within the Donaldson Mine Site were assessed by Global Soil Systems Pty Limited (GSS, 1998) and described in the original *Environmental Impact Assessment* (EIS) for the Donaldson Mine (PKK, 1998) as consisting of four distinct horizons:

- brownish-black friable loam (topsoil);
- bleached, hardsetting sandy clay loam (topsoil);
- pedal bright reddish-brown mottled clay (subsoil); and
- mottled grey puggy clay (subsoil).



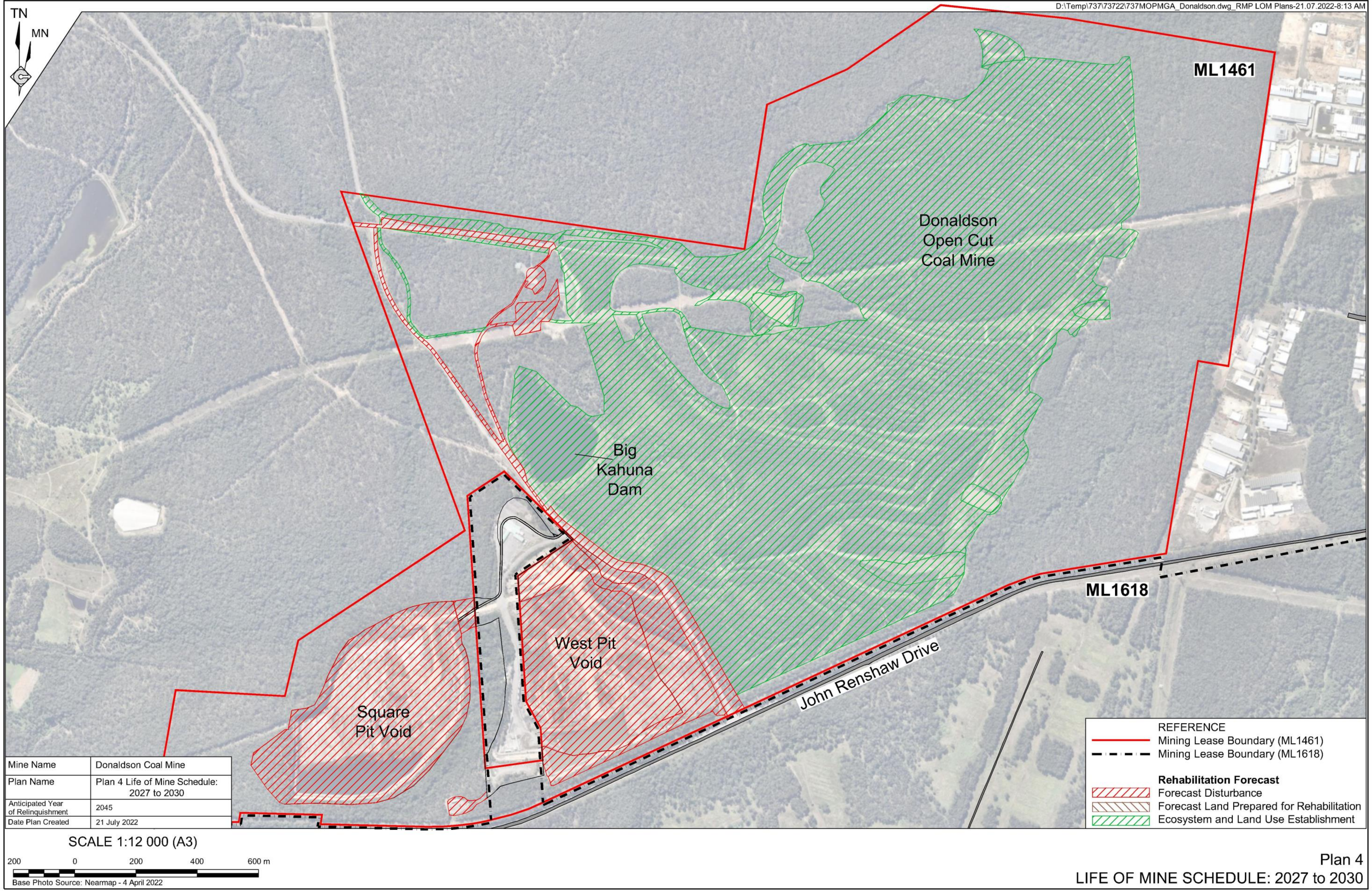
Mine Name	Donaldson Coal Mine
Plan Name	Plan 3 Life of Mine Schedule: 2022 to 2026
Anticipated Year of Relinquishment	2045
Date Plan Created	21 July 2022

SCALE 1:12 000 (A3)

200 0 200 400 600 m

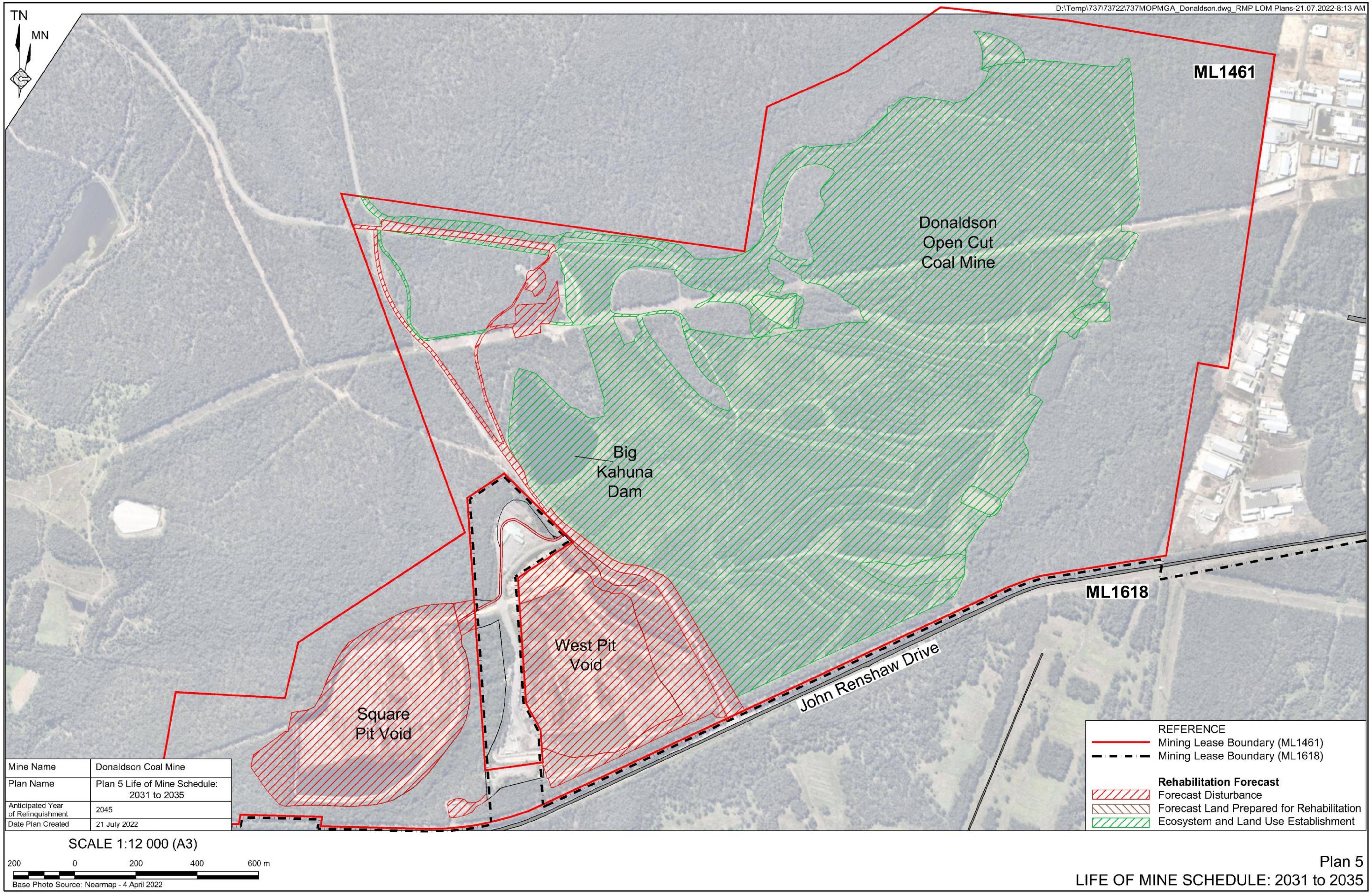
Base Photo Source: Nearmap - 4 April 2022

Plan 3
LIFE OF MINE SCHEDULE: 2022 to 2026



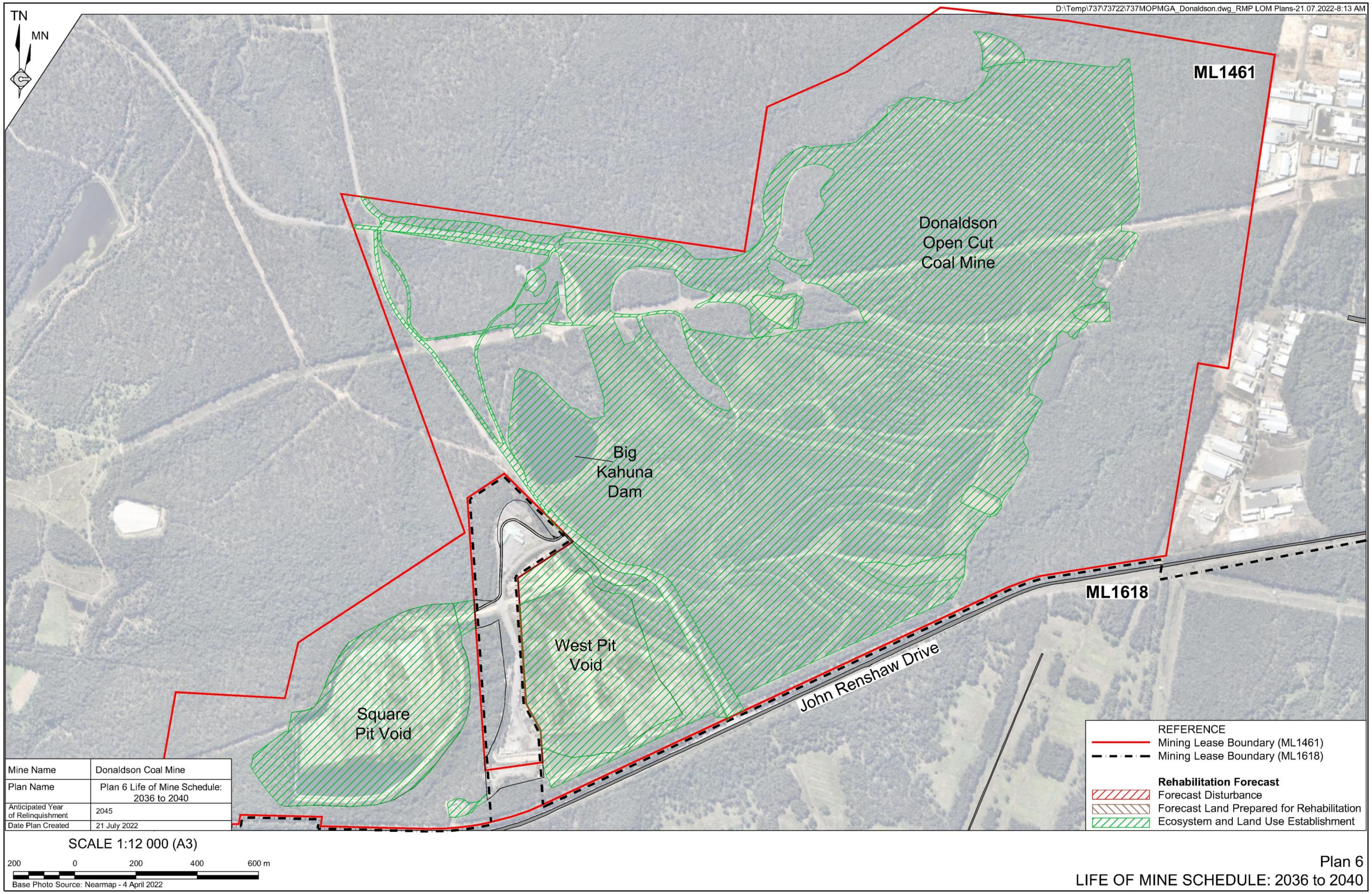
Mine Name	Donaldson Coal Mine
Plan Name	Plan 4 Life of Mine Schedule: 2027 to 2030
Anticipated Year of Relinquishment	2045
Date Plan Created	21 July 2022

Plan 4
LIFE OF MINE SCHEDULE: 2027 to 2030



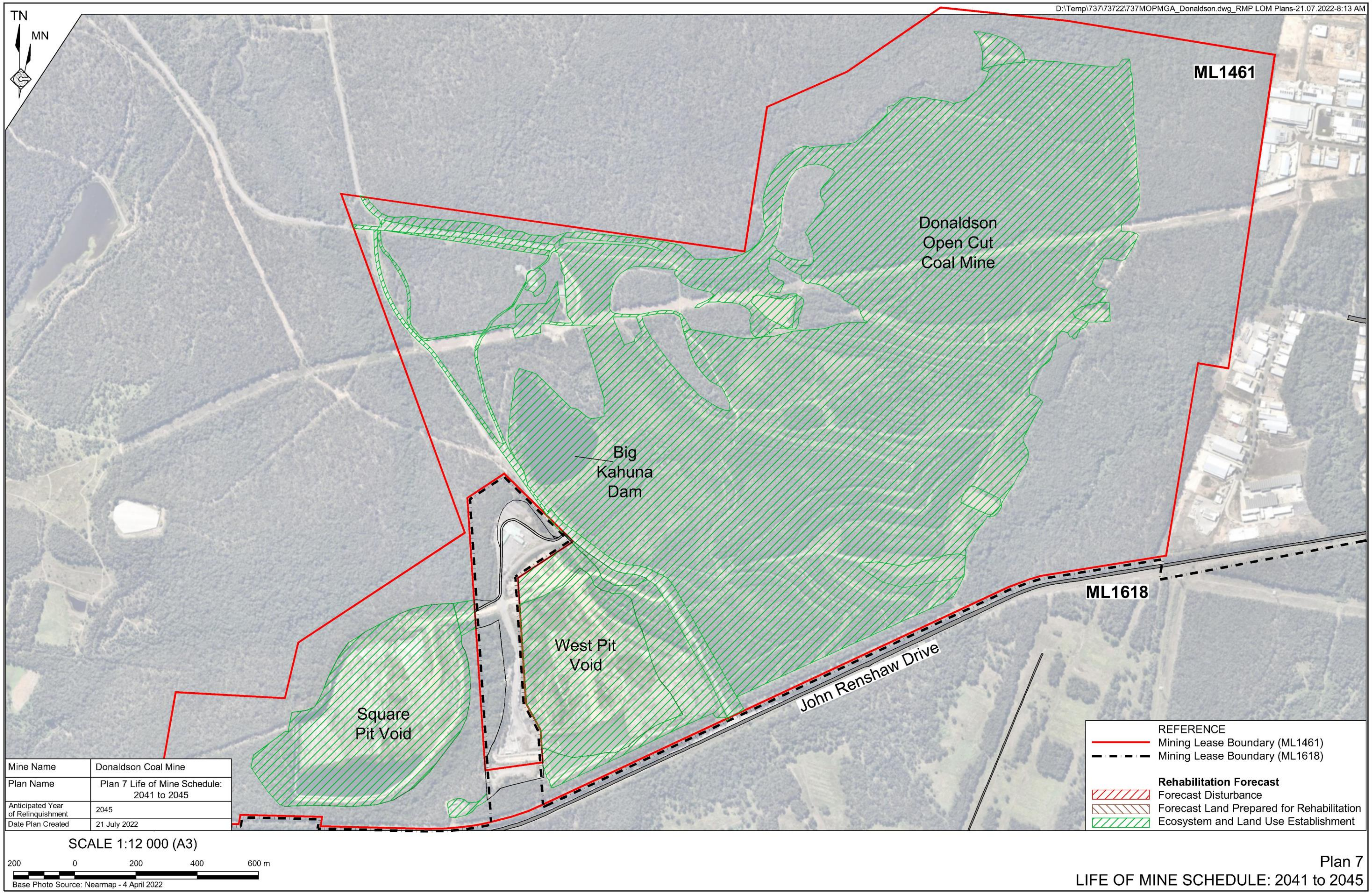
Mine Name	Donaldson Coal Mine
Plan Name	Plan 5 Life of Mine Schedule: 2031 to 2035
Anticipated Year of Relinquishment	2045
Date Plan Created	21 July 2022

Plan 5
LIFE OF MINE SCHEDULE: 2031 to 2035



Mine Name	Donaldson Coal Mine
Plan Name	Plan 6 Life of Mine Schedule: 2036 to 2040
Anticipated Year of Relinquishment	2045
Date Plan Created	21 July 2022

Plan 6
LIFE OF MINE SCHEDULE: 2036 to 2040


D:\Temp\737\73722\737MOPMGA_Donaldson.dwg_RMP LOM Plans-21.07.2022-8:13 AM
TN
MN
ML1461
Donaldson
Open Cut
Coal Mine
Big
Kahuna
Dam
West Pit
Void
Square
Pit Void
ML1618
John Renshaw Drive
REFERENCE
Mining Lease Boundary (ML1461)
Mining Lease Boundary (ML1618)
Rehabilitation Forecast
Forecast Disturbance
Forecast Land Prepared for Rehabilitation
Ecosystem and Land Use Establishment
Mine Name
Donaldson Coal Mine
Plan Name
Plan 7 Life of Mine Schedule: 2041 to 2045
Anticipated Year of Relinquishment
2045
Date Plan Created
21 July 2022
SCALE 1:12 000 (A3)
200
0
200
400
600 m
Base Photo Source: Nearmap - 4 April 2022
Plan 7
LIFE OF MINE SCHEDULE: 2041 to 2045

In addition to the above, the fertility of the soil was recorded as 'moderate' for the uppermost topsoil horizon and as 'low' for the remaining soils. The land within and in the general vicinity of the Donaldson Mine Site was classified as 'Class 4' and suitable for grazing in accordance with the (then) Department of Land and Water Conservation land capability classification system. The land within the Donaldson Mine Site was classified as having a 'low' to 'moderate' erosion hazard, and soil acidity was reported to be 'strongly' to 'very strongly' acidic with potential implications for fertility identified.

A further assessment was undertaken by GSS Environmental Pty Limited (GSS Environmental, 2004) as part of the *Statement of Environmental Effects: Modification to the Approved Mining Area at the Donaldson Open Cut Coal Mine, Beresfield* (Donaldson Coal, 2004) for the expansion of Donaldson Open Cut Pit. The results of that assessment identified that the soils within the (then) proposed expansion areas consisted of Yellow Duplex Soils of four distinct horizons:

- brown loam (topsoil);
- light yellowish brown sandy loam (topsoil);
- yellowish red light clay(subsoil); and
- yellowish red light clay with up to 40% mottling (subsoil).

Furthermore, GSS Environmental (2004) stated that the sub-soils were not considered suitable for stripping, stockpiling and re-spreading for use as a topdressing material for reshaped overburden. A maximum stripping depth of 0.5m was recommended in all areas where both topsoils were present, and 0.3m where only the uppermost layer was present. GSS Environmental (2004) classified the soils within the expansion area as Class 4 and suitable for grazing. Notwithstanding, as the original vegetation cover was native woodland, GSS Environmental did not identify any significant issues that would prevent the restoration of the existing soil capability.

Ongoing Management

In general, stripped and salvaged topsoil from the advancing development of the open cuts were directly relocated to areas undergoing progressing rehabilitation.

Minimal additional stripping of undisturbed soils is anticipated to be required as part of the remaining rehabilitation operations and would be limited to the perimeters of the West and Square Pits during landform shaping. In the event topsoil stripping occurs, topsoil management will be consistent with that during active mining.

The main aim of the management of the stockpiling or redistribution of topsoil is to ensure that topsoil from different topographical areas is stockpiled separately (where possible) or is redistributed immediately to areas of similar topography in the already mined, and regraded, areas. The immediate redistribution of topsoil is preferable for several reasons:

- to avoid double-handling;
- to avoid the need for additional disturbed land for stockpiling;
- to limit the reduction in the quality (in terms of resilience) of the native seed bank present in the soil, which arises when topsoil is stockpiled; and
- to limit the impact on soil quality.

If required, topsoil will be removed and stockpiled, or redistributed, according to different topographical areas (including riparian, ridgetop, slope and highly weed infested), where practicable. It is noted that topsoil will not be stripped when soil is too wet or too dry and where possible the stripping of topsoil will take place after the setting of seed.

Topsoil management will consider whether the topsoil has a large amount of weed seed in the soils seed bank. If the topsoil is deemed to carry a high proportion of weed seed, it will be preferable to manage this topsoil in an effort to reduce its weed propagule content and redistribute later. The main approach to the management of topsoil within the Donaldson Mine Site is to maximise its re-use in the rehabilitation works. For the majority of the Donaldson Mine Site, the re-use of topsoil will simply involve moving topsoil from one location to another. However, the management of weed-infested topsoil will be considered on a 'case-by-case' basis. Depending on the level of need for contaminated soils, treatment options may include targeted and regular application of herbicides or the partial/complete sterilisation of weed contaminated soils.

Requirements for Rehabilitation

Anticipated Remaining Requirements

To achieve the required depth of 150mm of topsoil for the remaining areas to be rehabilitated, approximately 47 700m^3 of growth medium is anticipated to be required.

In addition to the above, due to the presence of carbonaceous material within the West and Square Pits, in order to achieve the relevant rehabilitation completion criteria inert capping material will be required. The volume of capping material required is yet to be calculated and will require further final void planning to be completed.

Existing Soil and Capping Material

Donaldson Coal anticipates that there is likely to be insufficient resources for use as growth medium and capping material available within the Abel and Donaldson Mine Sites. Prior to the landform establishment phase of rehabilitation, Donaldson Coal will undertake a formal survey of all known material stockpiles and develop a Rehabilitation Materials Balance. The Rehabilitation Materials Balance will be used to identify the volume and type of materials required for landform establishment and growth medium establishment, which may be sourced from off-site locations. Information on all material sourced from off-site will be recorded in the *Rehabilitation Quality Assurance Register*, including provenance, volume, and any known characteristics.

It should be noted that as part of the original *Environmental Assessment* the various amenity and acoustic bunds within the Donaldson Mine Site, to be largely constructed with suitable growth medium, were identified as potential sources of soil resource for rehabilitation. Notwithstanding the above, significant vegetation communities have subsequently developed on the remaining bunding within the Donaldson Mine Site. Hence, Donaldson Coal considers that disturbance of these areas would likely result in avoidable impacts to on-site biodiversity. In addition, the mature vegetation enhances the effectiveness of the visibility barriers from the viewpoint of vehicles on James Renshaw Drive.

6.2.1.2 Flora

Existing Environment

The following presents a summary of the existing vegetation within and in the vicinity of the Donaldson Mine Site as presented in the original EIS for the Donaldson Mine.

The pre-mining environment of the Donaldson Mine Site was typical of a highly disturbed area of mixed remnant and regrowth forests. The dominant vegetation type was described as 'open forest' with Spotted Gum (*Corymbia maculata*) dominating the canopy, with a diverse group of co-associate canopy species. The species mix was associated with the highly artificial nature of the disturbance regime, notably the fire regime, rather than any clear ecological pattern. Species assemblages of the mid-story and understory were also associated with significantly altered disturbance regimes. Exotic species were more associated with localised areas of illegal rubbish dumping and within heavily degraded areas.

There are two species of threatened flora located on the Donaldson Coal Mine Site; *Tetratheca juncea* (Black-eyed Susan) and *Grevillea parviflora ssp parviflora* (Small-flower Grevillea). *Tetratheca juncea* was identified in the initial EIS for the Donaldson Coal Mine and *Grevillea parviflora ssp parviflora* was identified during additional flora searches of the Donaldson Mine Site. A *Tetratheca juncea Management Plan* was developed by Gunninah Environmental Consultants Pty Ltd (Gunninah Environmental Consultants Pty Ltd, 2000a). The aim of the *Tetratheca juncea Management Plan* was to provide a comprehensive program for the *Tetratheca juncea* population in the southwestern portion of the Donaldson Mine Site. A survey and identification report (Gunninah Environmental Consultants Pty Ltd, 2000b) was completed, which located the boundaries of the *Tetratheca juncea* population and defined the limit of the conservation precinct. Subsequent work during 2001 and 2002 has extended the boundary after up to an additional 200 plants have been found during routine monitoring and vegetation characterisation. In addition, approximately four hundred plants have been discovered during routine pre-clearing surveys and monitoring episodes. A large proportion of these plants fall outside of the active disturbance area of the Donaldson Mine Site, adding further conservation significance to the area(s) identified and managed by Donaldson Coal as the *Tetratheca juncea* Conservation Area. The following control measures are employed at the Donaldson Mine Site in order to ensure a high level of conservation for the threatened plant species *Tetratheca juncea* and *Grevillea parviflora ssp parviflora*.

- Establishment of the Bushland Conservation Area to conserve habitat.
- The reduction of the (then) proposed mining footprint and the establishment of the *Tetratheca juncea* Conservation Area protecting a known population of *Tetratheca juncea*.
- Ongoing monitoring and management protocols.
- Pre-clearing surveys by a qualified biologist prior to any clearing activities.

Ongoing Management

Minimal additional clearing of vegetation is anticipated to be required and would be limited to the perimeters of the West and Square Pits during landform shaping.

The ongoing management of flora and floral resources is undertaken in accordance with the existing and approved:

- *Donaldson Open Cut and Abel Underground Coal Mine: Flora and Fauna Management Plan – Care and Maintenance* (June 2019);
- *Donaldson Open Cut and Abel Underground Coal Mine: Rehabilitation Management Plan* (March 2009);
- *Donaldson Open Cut and Abel Underground Coal Mine: Bushland Conservation Area Management Plan* (April 2019); and
- *Donaldson Open Cut and Abel Underground Coal Mine: Tetratheca juncea Management Plan* (November 2000).

In addition, regular monitoring of remnant and rehabilitated areas of the Donaldson and Abel Mine Sites has been undertaken since 2001.

Controls to be Implemented

Target Plant Communities

The target plant communities and vegetation types for the remaining rehabilitation of the Donaldson Mine Site is a mix of native woodland species, typical of the surrounding woodland landscape as similar to that used in existing rehabilitation efforts. Indicative target species are discussed in Section 6.2.5.3.

Material Sourcing

Seed material will preferably be collected from existing remnant and rehabilitated native vegetation to maintain local genetic integrity and to utilise plant species and communities that are adapted to the immediate and local ecological environment. Where plant material is not available in sufficient quality or quantity, or is not able to be collected without avoidable damage to existing plant communities, seed or tubestock material may be sourced from local commercial sources.

Revegetation Techniques

Revegetation will primarily consist of a combination of broadcast seeding and the use of tubestock. Where rapid establishment of groundcover species may be required, the use of Hydroseeding or equivalent techniques may be implemented.

Weed and Pest Management

Regular weed and pest species monitoring will continue to occur within and in the vicinity of the Donaldson Mine Site, including the Abel Mine Site, the Bushland Conservation Area and the *Tetratheca juncea* Conservation Area. Prior to the final rehabilitation of the Donaldson Mine Site, the regular monitoring and management programs will help to maintain the existing integrity of the surrounding bushland. Once the Ecosystem and Land Use Establishment phase of rehabilitation has been reached, the surrounding vegetation and plant communities will act as a passive source of flora species for the rehabilitated areas.

6.2.1.3 Fauna

Existing Environment

Several species identified as Vulnerable in accordance with the NSW *Biodiversity Conservation Act 2016* have been identified as occurring within the Donaldson Mine Site over the life of the Mine. Notwithstanding no specific requirements for the restoration of any given species is included in the Development Consent for the Donaldson Mine.

Ongoing Management

The following control measures have been employed at the Donaldson Coal Mine to ensure a high level of conservation for the threatened fauna species found on the Donaldson Mine Site.

- Establishment of the Bushland Conservation Area to conserve habitat.
- Ongoing survey and management protocols.
- Pre-clearing surveys by a qualified ecologist prior to any clearing activities.
- Routine annual quadrant monitoring.
- Installation of nest boxes in both the rehabilitated areas of the Donaldson Mine Site and the Bushland Conservation Area to replace natural tree hollows removed during clearing operations.
- Minimal clearance to only what is required.
- Ongoing and progressive rehabilitation of disturbed areas of the Donaldson Mine Site.

In general, the management of existing and rehabilitated fauna habitat within and in the vicinity of the Donaldson Mine Site is undertaken in accordance with the existing and approved:

- *Donaldson Open Cut and Abel Underground Coal Mine: Flora and Fauna Management Plan – Care and Maintenance* (June 2019);
- *Donaldson Open Cut and Abel Underground Coal Mine: Rehabilitation Management Plan – Care and Maintenance* (June 2019); and
- *Donaldson Open Cut and Abel Underground Coal Mine: Bushland Conservation Area Management Plan* (April 2019).

Rehabilitation of Fauna

Criteria for rehabilitation success in relation to specific outcomes for native fauna as identified in Section 4.1 relate to the comparison of species assemblages between rehabilitated areas and analogue sites. Although multiple threatened species have been identified as occurring within the surrounding Bushland Conservation Area and within existing rehabilitation areas within the Donaldson Mine Site, no specific criteria exist or are proposed for any given or given number of species. In contrast, restoration success will be measured via similarity indices (i.e. number of shared species). Similarity indices are currently used to monitor rehabilitation performance in existing rehabilitation areas of the Donaldson Mine Site.

6.2.1.4 Rock/overburden emplacement

No further rock or overburden emplacement is anticipated to occur within the Abel and Donaldson Mine Sites.

6.2.1.5 Waste management

Ongoing Management

Non-production Waste Management

Ongoing management of non-production related waste material is undertaken in accordance with the existing and approved *Donaldson Coal Mine and Abel Underground Coal Mine: Waste Management Plan - Care and Maintenance* (June 2019) (the "*Waste Management Plan*"). The following presents an overview of the waste generation, handling and disposal practices detailed in the *Waste Management Plan* for all non-production wastes within the Abel and Donaldson Mine sites.

- Typical waste material generated comprises of:
  - greases, oils, filters, tyres and batteries from maintenance of vehicles and equipment (including maintenance of the idle mining fleet and equipment);
  - bulk scrap metal and plastics from consumables and maintenance;
  - general office wastes e.g. paper;
  - general waste generated by employees – e.g. food scraps, paper, cardboard, aluminium and steel cans;
  - wastewater and sewage from ablution facilities (bathhouses); and
  - drilling muds/tailings and wastewater from exploration drilling.
- Waste is managed as either "hazardous' or "non-hazardous' and 'recyclable' or 'non-recyclable'.
- Wastes are collected in various suitable waste reciprocals across the Abel and Donaldson Mine Sites. Handling and storage of all waste materials is undertaken in accordance with all relevant Australian Standards and/or industry best practice. Where practicable, waste materials are handled and stored separately to maximise potential recycling recovery.
- A monthly summary report is prepared by the licenced contractor for all waste material that is either removed off-site for processing, recycling, and/or disposal or contained on site (effluent). The summary report also includes records of the transport/disposal/treatment facility, including licence details, for all waste types.
- Waste-related statistics for the previous 5 years are reported annually in the *Abel Underground Coal Mine Annual Review*.

Contaminated Soils

Pollution events and associated contamination of land and water are currently managed in accordance with the existing and approved *Donaldson Coal Mine and Abel Underground Coal Mine: Pollution Incident Response Management Plan* (July 2021).

Risk to Rehabilitation

In consideration of the waste management practices outlined above, the potential for waste-related risks to rehabilitation is considered to be low.

6.2.1.6 Geology and geochemistry

No environmental / geochemical constraints have been identified during the operation and existing rehabilitation of the Donaldson Mine Site. Furthermore, as no washing or other beneficiation beyond primary crushing with a feeder breaker has been undertaken within the Abel and Donaldson Mine Sites, no processing wastes have been generated or require management.

6.2.1.7 Material prone to spontaneous combustion

The Upper and Lower Donaldson seams are considered to have a very low propensity for spontaneous combustion, with no history of spontaneous combustion. In June 2009 a study was undertaken to determine the spontaneous combustion potential of coal from the Donaldson Mine's Upper Donaldson Seam, 'C', 'D' and 'E' plies. Results indicate that the Upper Donaldson Seam and the 'C', 'D' and 'E' plies have a medium inherent spontaneous combustibility. The 'D' ply appears to be slightly more reactive and hence more prone to spontaneous combustion than the 'C' and 'E' plies.

In relation to rehabilitation, the following management measures have been undertaken to reduce the potential for spontaneous combustion to occur.

- Any accumulations of carbonaceous material or exposed coal seams within the West and Square Pits have been / will be buried under inert material.
- Where possible, any remaining coal spalling has been removed from the highwall.

No additional management measures will be required during the care and maintenance period.

6.2.1.8 Material prone to generating acid mine drainage

No Acid Mine Drainage issues have been identified or are expected to occur within the Abel and Donaldson Mine Sites.

6.2.1.9 Ore beneficiation waste management (reject and tailings disposal)

As identified in Section 1.1.1, no washing or other beneficiation beyond primary crushing with a feeder breaker has been undertaken within the Abel and Donaldson Mine Sites, no processing wastes have been generated or require management.

6.2.1.10 Erosion and sediment control

Existing Environment

The existing surface water management infrastructure within the Abel and Donaldson Mine Sites is shown on **Figure 5** and in **Appendix** 1.

The *Donaldson Coal Mine Review of Mine Water Storage Quality* (HEC, 2020) has been prepared to address the requirements of the Notice issued to Donaldson Coal by the NSW Resources Regulator under Section 240 of the *NSW Mining Act 1992* on 11 July 2019. The Notice required Donaldson Coal to:

> *"Undertake a review of water quality within mine dams ('clean' and 'dirty') within ML 1461 against their approved final land use. The Review is to:*
>
> i. *Assess observed water quality recorded since March 2015, including (but not limited to) turbidity, Total Suspended Solids (TSS) and Total Dissolved Solids (TDS) against relevant industry guidelines and requirements of the approved final land use.*
>
> ii. *Review and assess the source of elevated turbidity / suspended solids including the construction methodology of each dam with turbidity / suspended solid concentrations greater than relevant industry guidelines and requirements of the approved final land use.*
>
> iii. *Should results exceed relevant industry guidelines and requirements of the approved final land use, develop, and implement a strategy to address elevated turbidity / suspended solids for the long term. The strategy is to be consistent with relevant Project Approval requirements."*

The *Donaldson Coal Mine Review of Mine Water Storage Quality* (HEC, 2020) consists of a desktop assessment of water storage quality. HEC (2020) concludes that:

- *"Elevated turbidity in water storages is typically caused by one of the following:*
  - *elevated suspended solids in inflows due to erosion within the catchment; · resuspension of bottom sediment by flow turbulence and/or wave action in the storage embankment where there are dispersive clays; or*
  - *algae/phytoplankton blooms in the water due to elevated nutrients."*
- *"TSS concentrations in the sediment dams have been consistent with concentrations reported in local streams upstream of the mine site. This suggests that sediment loads being generated from site catchments are consistent with those in the local catchments upstream."*
- *"Whilst it is not known whether there are fine dispersive clays present in the sediment dams or in the drainages upstream of them, the high turbidity levels are consistent with the presence of exposed dispersive clay in the dam catchments."*

In addition to the above, HEC (2020) recommends the following.

1. Conduct Investigation of Water Storage Construction Material.

   "A field reconnaissance of the sediment dams and their influence drainage lines should be undertaken to assess the source of elevated turbidity."

2. Confirm Functional Requirements of Sediment Dams.

   "The sediment dams' short and longer-term functional requirements should be identified."

3. Design Storage Enhancement Works Consistent with Functional Requirements.

   "Any changes need to the sediment dams to meet the agreed functional requirements should be identified. ... Once any works have been implemented, it is recommended that appropriate performance monitoring be incorporated into the site rehabilitation monitoring program."

A follow-up investigation was undertaken, and the associated *Sediment Dam Investigations* report prepared by SLR Consulting Australia Pty Ltd (SLR, 2022) and is presented as **Appendix 1**. The following presents a summary of the key findings of the *Sediment Dam Investigation* report.

Comparison to Background Water Quality

- Exposed dispersive soils are directly contributing to the elevated turbidity / suspended solids observed in the sediment dams. Elevated dispersion is associated with increased magnesium levels. Soil exposure was not considered to be significantly greater than that for undisturbed areas in within and in the vicinity of the Donaldson Mine Site.
- Where vegetation has not become established on sediment dam and channel batters, this was not expected to significantly contribute to sediment loads to the point where further rehabilitation or remediation would be required.
- Water quality within mine water storages is similar to the water quality of surrounding waterways within undisturbed areas within and in the vicinity of the Donaldson Mine Site where dispersive soils naturally occur.
- Where minor increases in water storage quality could be achieved through further rehabilitation and in-fill planting of exposed areas, the associated disturbance would likely result in a greater negative impact than that cause by exposed soils.

Function and Design of Water Storage and Management Infrastructure

- All sediment dams have sufficient capacity to manage runoff from the upslope catchment areas. However, variable capacity may result in more-frequent overflow from Sediment Dams D and E compared to other dams.
- Conveyance Channel 8 and the spillway of Sediment Dam E are currently undersized to manage flows during a 100-year ARI rainfall event.

Final Land Use and Licensing Requirements

- The maximum capacity of the storage dams (approximately 63.39ML) is less than the maximum harvestable rights dam capacity for the Donaldson Mine Site (68.69ML) and therefore no additional licensing would currently be required.
- Consultation by SLR with Natural Resources Access Regulator / Department of Primary Industries – Land and Water confirmed that the West and Square Pits and the Big Kahuna Dam are exempt from the calculation of the maximum storage capacity as they currently function as sediment dams / dirty water storages.
- Once rehabilitation is complete and sediment basins are no longer required (and are therefore no longer exempt from the maximum harvestable rights dam capacity), future licensing requirements may need to be addressed, or dams may be required to be decommissioned.
- To support the decision making prior to relinquishment, SLR recommends:
  - a formal survey of all water storage infrastructure should be undertaken to determine the actual total water storage capacity; and
  - further consultation should be undertaken with relevant stakeholders to determine the effect of the final voids on future calculations.

In addition to the above, the following presents a summary of the recommendations made by SLR.

- Soil amelioration during future rehabilitation works should be undertaken through the application of lime to increase the exchangeable Ca concentration and improve the Ca/Mg ratio. Applications of phosphorus and nitrogen should be avoided to reduce the potential runoff into storage dams.
- Undertake remediation of the downstream environment of Sediment Dam E and Rumbles Dam, and immediately upstream of Sediment Dam A. The use of heavy machinery should be avoided to prevent re-disturbance of rehabilitated areas.
- Consult with TransGrid regarding the existing erosion in the powerline easement (**Appendix 1**) for Conveyance Channel 8 and the surrounding area upslope from Rumbles Dam.
- Undertake augmentation works for Sediment Basin E, including:
  - replace existing vertical walls with sloped batters of 1:3 (V:H) where practicable;
  - increase the spillway depth to 1.3m if practicable to increase freeboard during overflow events; and
  - lining of the spillway with geofabric and rock for increased protection during overflow events.
- Rehabilitate the area of exposed soil immediately prior to the Teds Hole Dam spillway.

- Consider further rehabilitation of exposed areas of dispersive soils in the vicinity of sediment dams.
- Liaise with WaterNSW / NRAR regarding harvestable rights at the site. Discussions should include confirmation that final voids are exempt from the maximum harvestable rights dam capacity calculations and that the Donaldson Coal owned land to the south of John Renshaw Drive does not contribute to the maximum harvestable rights dam capacity volume.
- Liaise with the EPA and the Resources Regulator regarding the Donaldson Mine Site sediment dams and their water quality prior to mine closure works.

Ongoing Management

Erosion and sediment control within the Abel and Donaldson Mine Sites is undertaken in accordance with the existing and approved:

- *Donaldson Coal Mine Erosion and Sediment Control Plan* (April 2000); and
- *Abel Underground Coal Mine Water Management Plan – Care and Maintenance* (June 2019).

In addition to the above, consideration of the potential impacts of erosion and sedimentation on rehabilitation are discussed, including anticipated risks and management strategies, in the existing and approved *Donaldson Open Cut and Abel Underground Coal Mine: Landscape Management Plan* (March 2008) prepared by GSS Environmental Pty Limited and consisting of the:

- *Donaldson Open Cut and Abel Underground Coal Mine: Rehabilitation Management Plan* (March 2008)[2];
- *Donaldson Open Cut and Abel Underground Coal Mine: Final Void Management Plan* (March 2008); and
- *Donaldson Open Cut and Abel Underground Coal Mine: Integrated Mine Closure Plan* (March 2008).

Controls to be Implemented

Donaldson Coal will continue to manage erosion and sediment controls in accordance with approved management plans. In addition, Donaldson Coal will implement the recommendations of the *Sediment Dam Investigation Report.*

6.2.1.11 Ongoing management of biological resources for use in rehabilitation

Stockpile Management

As described in Section 6.2.1.1, Donaldson Coal does not anticipate any further significant stripping and stockpiling of topsoil is likely to be required or to occur during the remaining life of the Mine. In addition, Donaldson Coal would in the first instance seek to immediately re-spread any stripped soils to minimise as far as practicable the need to handle and stockpile growth medium. Notwithstanding the following management practices would be undertaken in the event that any further stripping and/or stockpiling of topsoil and/or growth medium does occur.

[2] Superseded by *Donaldson Coal Mine and Abel Underground Coal Mine: Rehabilitation Management Plan – Care and Maintenance* (July 2019)

Where practicable, native vegetation will be stripped with soils to retained organic matter and the existing seedbank in-situ. Soils will be stockpiled to a maximum height of 3m where practicable to reduce incidences of compaction that may affect seed viability.

Regular monitoring of stockpiled material would be undertaken to monitor weed species presence and to identify the need for weed management or controls. Prior to salvaging stockpiled growth medium, weed species located on stockpiled material may be controlled using chemical or mechanical means.

Topsoil Depth

The existing rehabilitation of the Donaldson Mine Site has implemented a minimum topsoil depth of 100mm to 150mm. All remaining topsoil spreading will be to a minimum depth of 150mm.

Propagation of Seeds

As discussed in Section 6.2.5.4, seed will be collected from within and in the vicinity of the Donaldson Mine Site, including from both remnant and rehabilitated areas. Donaldson Coal anticipates that seed collection and propagation will be undertaken by a suitably qualified contractor and supported by Donaldson Coal environmental staff and resources (i.e. management plans, flora monitoring records, etc.).

Habitat Structures

As discussed in Section 6.2.1.2, further significant clearing of vegetation or habitat is not anticipated to be required or to occur and therefore further opportunities for the salvaging of habitat structures are likely to be limited. Habitat structures/features salvages over the life of the Donaldson Mine were generally immediately able to be relocated within areas undergoing progressive rehabilitation. This would continue for any additional habitat structures identified during any additional clearing.

6.2.1.12 Mine subsidence

No underground mining occurred as part of the Donaldson Mine and therefore no subsidence management is required or is undertaken within the Donaldson Mine Site.

6.2.1.13 Management of potential cultural and heritage issues

Existing Environment

At least six archaeological studies have occurred within or in the vicinity of the Donaldson Mine Site in relation to the Donaldson Mine since 1988. In result of these assessments, 29 Aboriginal sites have been identified as occurring within (10) areas of the Donaldson Mine Site to be disturbed or within Bushland Conservation Area (19). One additional site has been identified outside of these areas.

Ongoing Management

Management of Aboriginal heritage sites within the Donaldson Mine Site, including the Bushland Conservation Area, is undertaken in accordance with the existing and approved the *Aboriginal Sites Management Plan, Year 5: Donaldson Open Cut Coal Mine, Beresfield near Newcastle*

(Umwelt Australia Pty Limited, 2005) (the "*Donaldson Aboriginal Sites Management Plan*"). The Maitland Local Aboriginal Land Council has and continues to be actively involved in the management of Aboriginal sites within the Abel and Donaldson Mine Sites.

In accordance with the approved *Donaldson Aboriginal Sites Management Plan*, where Aboriginal heritage sites were located within areas to be disturbed by mining operations, a Section 90 permit under the *National Parks and Wildlife Act 1977* were obtained.

Monitoring of the condition of Aboriginal heritage and environment within the Bushland Conservation Area is undertaken in accordance with the *Donaldson Aboriginal Sites Management Plan*. The purpose and location of the ten datum points are such that they provide references of environmental change within the Bushland Conservation Area that would not be directly impacted by mining activities.

Controls to be Implemented

During final rehabilitation operation there exists the potential for impacts on known and unknown Aboriginal sites. Prior to decommissioning, Donaldson Coal would engage with suitably qualified heritage specialists to confirm the location of known sites within or in the vicinity of areas to be disturbed and/or rehabilitated. If any sites are identified as being located within areas to be disturbed, rehabilitation plans may be reviewed and the need for disturbance or other management controls will be reviewed. If any Aboriginal sites are required to be disturbed during rehabilitation, Donaldson Coal would manage the Aboriginal site in accordance with the approved *Donaldson Aboriginal Site Management Plan*.

6.2.1.14 Exploration activities

No further surface exploration activities are anticipated to be required or to occur within the Donaldson Mine Site. Notwithstanding, if any further surface exploration activities are undertaken, the rehabilitation of drill sites would be undertaken generally as follows.

Decommissioning of drill sites would include the removal of all equipment and deposited material (including drilling muds). The drill holes would be rehabilitated in accordance with *EDG01 Borehole Sealing Requirements on Land Coal Exploration* (DRE, 2012) and, where necessary, revegetated with native species. Sediment fencing would be retained until the area of disturbance is stabilised and the risk of erosion is negligible. Rehabilitation would be consistent with the *Exploration Code of Practice: Rehabilitation (NSW Resources Regulator, 2022*).

6.2.2 Decommissioning

6.2.2.1 Site security

Existing and Ongoing Management

The principal public safety control for the Abel and Donaldson Mine Sites has been the fencing of the eastern, northern and southern boundaries of ML 1461 which includes the Abel Mine Site's surface infrastructure area together with additional fencing around the southern and western boundary of the Abel Box Cut. Signposting advising the public of the presence of the Abel and Donaldson Mines has also been placed at the entrance and around the fenced perimeter. The fences and signage are inspected on a weekly basis and repairs undertaken as required.

Controls to be Implemented

Safety Fencing

Additional security infrastructure (i.e. security fencing/signage and access controls/barriers) will be constructed as required around the perimeters of the retained West and Square Pit final voids and on retained access roads to prevent inadvertent public access.

Environmental Fencing

Areas of retained vegetation within the surrounding land owned by Donaldson Coal will be appropriately protected from human-induced impacts such as damage to vegetation from vehicles or trampling, increased rubbish dumping and alteration to normal fauna behaviour patterns. As appropriate, fencing will be used to protect existing vegetation from accidental disturbance and will clearly identify areas of vegetation to be retained. The type of fencing used will consider the need for facilitation of fauna movement.

Fencing will also be used as part of the revegetation strategy to control impacts such as grazing and to allow vegetation to regenerate naturally. This option will be used where active disturbance to the soil for replanting is not considered appropriate, such as in areas of archaeological significance or in other places where significant tree cover remains. In such cases, sensitive areas will be fenced to exclude stock and to allow native vegetation to establish.

6.2.2.2 Infrastructure to be removed or demolished

Table 11 presents the infrastructure and services located within the Donaldson Mine Site to be removed or demolished to achieve final land use.

As identified in previously approved management plans, prior to the decommissioning of the infrastructure and services identified in **Table 11** Donaldson Coal will undertake a detailed risk and engineering assessment, namely the *Decommissioning and Demolition Strategy*.

Table 11
Infrastructure to be Removed or Demolished

Page 1 of 2

Mining Domain[1]	Asset	Removal / Demolition Requirements
Infrastructure Area	Buildings: Administration Office, Core Shed, Workshop/Storage, Coal Haulage Contractors Workshop, Washroom, and Lunchroom.	All buildings, sheds and fixed plant will be removed from the Donaldson Mine Site. Where practicable, salvageable items (e.g. freestanding sheds) will be dismantled such that permits re-use off-site. Where practicable, materials recovered during demolition that are suitable for recycling will be salvaged and separated for recycling. All concrete footings and pads will be broken up and removed with waste material and disposed of on-site or at a licenced waste facility.
	Roads and Hardstand: Coal Haulage Road, Mine Access Road, other unsealed access roads and hardstand areas (e.g. carparking areas).	All roads to be retained to support final land use to be reduced in width as required. Gravel will be salvaged where practicable from hardstand areas and unsealed roads for use off-site or on-site disposal. Where roads are reduced/hardstand areas removed, once surface material is removed the land will be shaped and ripped to a minimum depth of 400mm.
	Services: Biocycle Sewerage Plant, various power, water and communications infrastructure.	All services not required to support final land use would be disconnected and decommissioned. The Biocycle Sewerage Plant will be decommissioned and removed from site.

Table 11 (Cont'd)
Infrastructure to be Removed or Demolished

Page 2 of 2

Mining Domain[1]	Asset	Removal / Demolition Requirements
Water Management Area	Big Kahuna, Rumbles Dam, various sediment dams.	Fencing to be inspected and retained as required.
Active Mining Area (Open Cut Void)	Safety fencing. No other major assets associated with Donaldson Mine.	
Other – Rehabilitated Area – Woodland	No major assets.	
Note 1: See **Figure 5**		

Donaldson Coal will engage structural engineers and suitably qualified and experienced demolition experts to undertake an assessment of all infrastructure to be decommissioned and demolished within the Abel and Donaldson Mine Sites. The *Decommissioning and Demolition Strategy* will be prepared in accordance with *Australian Standard AS2601-2001: The Demolition of Structures* (or its latest version) to determine the appropriate demolition techniques, equipment required, and the optimal decommissioning sequencing. Principal activities required to develop the decommissioning and demolition strategy include the following.

- Site Investigations to assess infrastructure and services. Site investigations will include to locate and quantify above ground and buried services, locate and assess all chemical and hydrocarbon tanks and vessels, and identify contaminated materials. In addition, the results of the site investigations will be used to identify the need for any permits/approvals required for the removal and/or retention of any infrastructure.
- Structures Condition Assessment
  - Assess the structural condition of built structures and inform the demolition equipment and techniques required for removal of all buildings and fixed plant. The assessment will also identify opportunities for re-use and/or recycling infrastructure, plant and demolition materials.
  - Assess the structural condition of built structure and other infrastructure to be retained. In addition, the assessment will include a residual risk assessment for the retention of identified infrastructure to identify short- and long-term risks to public and environmental safety including potential modes of failure.

6.2.2.3 Buildings, structures and fixed plant to be retained

Plan 1 shows key infrastructure and structures to be retained as part of the final land use. Existing infrastructure and structures to be retained include the Site Access Road / Haul Road, internal access roads, access controls / barriers, the various sediment dams and water storages including the Big Kahuna Dam, security fencing, and the reshaped West and Square Pits. No fixed plant would be retained at the Donaldson Mine Site. In addition to the existing infrastructure to be retained, additional safety-related infrastructure identified in Section 6.2.2.1 would be installed by Donaldson Coal.

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Short-term risks associated with the retention of nominated infrastructure and structures are relatively low as these features have primarily been retained for safety purposes (e.g. safety bunds, security fences) or to facilitate access to areas of the Donaldson and Abel Mine Site.

Long-term risks to public safety and the environment associated with retained infrastructure and structures would only occur in the absence of regular maintenance. Roads will need to be inspected following high intensity rainfall events to ensure that conditions remained suitable for safe access to publicly accessible areas. Failure of roads would potentially contribute to the generation of sediment laden water which may impact water quality within local watercourses. Security fencing and access controls will also need to be inspected regularly to ensure that entry to historic sites and final void areas by humans, fauna and vehicles remains effectively restricted. Failure of security fences and safety bunds would present a significant risk to public safety.

As part of the decommissioning and landform establishment phases of rehabilitation operations, structural and engineering assessments will be carried out as required prior to the relinquishment of retained and newly constructed infrastructure (see Section 6.2.2.2). Any necessary repair, replacement or re-design works recommended as part of these assessments will be carried out and assessed by a suitably qualified engineer before public access is permitted to the Mine Site.

Any Mine-related infrastructure required for maintenance of third-party service infrastructure and associated easements may be retained if requested to do so. Suitable permits, agreements and other approvals may be required to be sought depending on the infrastructure to be retained.

6.2.2.4 Management of carbonaceous/contaminated material

Existing Environment

Carbonaceous Material

Two principal sources of carbonaceous material are known to occur within the Donaldson and Abel Mine Sites. Exposed coal seams and minor quantities of material at the base of the pit walls within the open cuts. In addition, over the life of the Donaldson and Abel Mines, small spillages along the coal haulage routes are likely to have resulted in elevated amounts of carbonaceous material in these areas.

Contaminated Material

A contamination assessment for the Donaldson Mine’s fuel farm and workshop was undertaken in 2013 by DLA Environmental Pty Limited. The assessment determined the location, depth and concentrations of a variety of contaminates, specifically total petroleum hydrocarbons, BTEX and heavy metals. The information was used to determine the extent of excavations required to remove contamination from these areas which was subsequently undertaken throughout 2013 and 2014. The excavated material was placed in a dedicated land farm area constructed in the West Pit. Fuel storage tanks and associated infrastructure were also relocated to the West Pit. Other contamination sources, such as oil drums, were removed from the Donaldson Mine Site.

Relatively minor levels of contamination are anticipated to have occurred over the life of the Donaldson Mine in the vicinity of workshop areas. Contaminated material would potentially be located within the Mine’s dirty water management infrastructure, namely the sediments within the West Pit and the Big Kahuna dam. In addition, contamination may occur during the decommissioning and demolition of infrastructure.

Ongoing Management

As the Donaldson Mine is currently on care and maintenance, the potential for an event to result in significant contamination is considered to be low. Notwithstanding the above, ongoing management of potential contamination events would be undertaken in accordance with the most current version of the *Donaldson Coal Mine and Abel Underground Coal Mine Pollution Incident Response Management Plan*.

Controls to be Implemented

Contamination Assessment

During the decommissioning phase of rehabilitation and as part of the *Decommissioning and Demolition Strategy*, Donaldson Coal would undertake a contamination assessment to identify the occurrence of carbonaceous and/or contaminated materials within the Donaldson and Abel Mine Sites. The scope of the contamination assessment would include:

- a desktop assessment and site inspection to identify potential sources of carbonaceous/contaminated material and the possible environmental impacts they might present;
- review of the effectiveness of historical contaminated material handling;
- identification of material handling and management practices that may need to be implemented, including an assessment of on-site treatment or disposal options; and
- verification that carbonaceous/contaminated material management recommendations have been undertaken in accordance with any relevant approval, standards or regulations.

Anticipated Material Handling and Management

Carbonaceous material identified within or in the vicinity of coal haulage routes (spillage) will be collected and disposed of within the West and/or Square Pits. Material blasted during highwall shaping will be used to cover exposed coal seams and other carbonaceous material that may be located within the West and Square Pits. Where a deficit of capping material is predicted or identified, Donaldson Coal would seek suitable off-site sources of required materials.

Where hydrocarbon contaminants are identified and on-site remediation is practicable, remediation would be undertaken on site. Where it is not feasible to undertake remediation of contaminated materials at the Mine Site, contaminated materials will be transported to an appropriately licenced facility and remediated prior to being returned to site.

The identification, management and disposal of contaminated materials is likely to occur across multiple Mining Domains which may include varying phases of rehabilitation. Notwithstanding, excluding the sourcing of unknown amounts off-site capping material, Donaldson Coal does not anticipate significant impacts on rehabilitation scheduling.

6.2.2.5 Hazardous materials management

No hazardous materials are proposed to be retained following the cessation of rehabilitation operations. A hazardous materials audit of the Donaldson Mine Site will be conducted by a suitably qualified expert as part of the *Decommissioning and Demolition Strategy* prior to the commencement of decommissioning activities to identify all potentially hazardous materials (e.g. asbestos) and any associated risks.

On-site hydrocarbons and storage will also be retained for use during rehabilitation operations before being removed. All remaining fuel and oil will be removed from site before storage and filling infrastructure is decommissioned and removed. Any soils or material that is identified as being contaminated by hydrocarbons will be removed and treated as outlined in Section 6.2.2.4.

All other hazardous materials identified at the Mine Site will either be disposed of within the Donaldson Mine Site or removed and disposed of at an appropriately licenced facility. Hazardous material types, volumes, removal methods, dates of associated removal works and contractors who completed those works, disposal methods (including the details of any off-site disposal facility) and any waste transportation records and receipts will be recorded in the *Rehabilitation Quality Assurance Register*.

6.2.2.6 Underground infrastructure

Underground infrastructure located within the Donaldson Mine Site is associated with the Abel Mine and therefore is included in the RMP for the Abel Mine Site.

6.2.3 Landform Establishment

6.2.3.1 Water management infrastructure

The location of all water management infrastructure to be retained as part of the final land use is shown on **Figure 5**.

As discussed in Section 6.2.1.10, Donaldson Coal is currently undertaking a review of all water storage infrastructure within the Donaldson Mine Site. During the landform establishment phase of rehabilitation, Donaldson Coal would review the outcomes and recommendations of the *Sediment Dam Investigations*, and would implement those management measures where practicable. Final results and subsequent management actions will be included future versions of this Plan and in annual rehabilitation reporting.

As discussed in Section 6.2.2.4, sediment within the Big Kahuna dam may be tested for contamination as part of the decommissioning phase of rehabilitation. Depending on the results of the testing, amelioration or other rehabilitation of the structure of the Big Kahuna dam may be required.

6.2.3.2 Final landform construction: general requirements

As shown on **Plan 1**, the majority of the Donaldson Mine Site has and will be rehabilitated to achieve the appearance of vegetated natural landforms, with the exception of the variable water heights (and subsequent vegetation extents) within the West and Square Pits. In general, the majority of the Donaldson Mine Site, including the infrastructure to be retained or remain unvegetated, will remain not visible from publicly accessible areas due to existing visual amenity bunding and vegetation screens located along site boundaries and adjacent to public roadways.

Where practicable, the eastern, western and southern highwalls of the West and Square Pits will be shaped to a maximum slope of 18° and the northern low wall will be graded to a maximum slope of 10° to achieve a more-natural slope and to provide a surface conducive to vegetation development and lower erosion potential.

Diversion bunds and other surface water management infrastructure in the vicinity of the final voids will be retained or constructed as required to minimise the total surface water catchment. In remaining areas of the rehabilitated Donaldson Mine Site, the current landform profile will remain as required and progressive revegetation will contribute to a subsequent reduction in erosion and sedimentation. As discussed in Section 6.2.1.10, further remediation of the existing surface water management infrastructure may be required.

6.2.3.3 Final landform construction: reject emplacement areas and tailings dam

No reject emplacement areas or tailings dams are located within the Donaldson Mine Site.

However, the storage of tailings within the Square Pit is an existing approved final land use option. If the storage of tailings within the Square Pit is undertaken at any point over the remaining life of the Donaldson Mine, this Plan will be updated to reflect this change.

6.2.3.4 Final landform construction: final voids, highwalls and low walls

Existing Environment

Final Voids

Two final voids are approved to be retained as part of the final landform of the Donaldson Mine Site; the Square Pit and the West Pit (including the Abel Box Cut) (**Plan 1**). In addition, three approved final landform and land use options exist for the final voids reflecting variable levels of tailings storage (nil, partial and complete) within the Square Pit. As discussed in Section 6.2.3.3 for the purposes of this Plan, no placement of tailings within the Square Pit is anticipated to occur.

No specific conditions regarding final voids are detailed under the combined DA 98/01173 and 118/698/22. As no further surface development or extraction will occur during the remaining life of the Donaldson Mine, the resulting landforms will likely remain relatively unchanged, with exception of final shaping operations. However, if the storage of tailings within the Square Pit is undertaken at any point over the remaining life of the Donaldson Mine, this Plan will be updated to reflect this change.

The Square Pit is approximately 20m to 40m deep, with the top surface around the perimeter occurring generally between approximately 50m AHD and 70m AHD and the base of the pit occurring at approximately 30m AHD. The final volume of the Square Pit will depend on the final landform development yet to be undertaken. The anticipated equilibrium point for the final water level within the Square Pit is at approximately 40m AHD.

The West Pit (including the Abel Box Cut) is approximately 20m deep, with the top surface around the perimeter approximately 50m AHD with the base of the pit occurring at approximately 14m AHD to 20m AHD. The final volume of the West Pit will depend on the final landform development yet to be undertaken. The anticipated equilibrium point for the final water level within the West Pit is at approximately 40m AHD.

Ongoing Management and Investigations

Final Void Management Plan

The progressive development and planned rehabilitation of the final voids within the Donaldson and Abel Mine Sites has been managed in accordance with several iterations of various management plans.

Currently, the general planning and management for the rehabilitation of the final voids, including final land use options, is included in the existing and approved *Donaldson Open Cut and Abel Underground Coal Mine: Final Void Management Plan* (the "*Final Void Management Plan*"), presented as Appendix 4 of the *Donaldson Open Cut and Abel Underground Coal Mine: Landscape Management Plan* (GSS Environmental, 2008). The approved *Final Void Management Plan* states the following summary of rehabilitation methodologies for the final voids.

- *"The eastern, western and southern sides of the final void will be blasted and pushed using a dozer to a maximum slope of 18 degrees.*
- *The northern side will be blasted and regraded to a maximum of 10 degrees, with a permanent vehicle access and egress ramp constructed to allow access to the pit void for ongoing monitoring and management.*
- *During highwall dozer reshaping, water management structures such as contour banks, drains and drop structures will be established to divert as much of the surrounding catchment as possible away from the final void, to limit the amount of water that accumulates in the pit.*
- *Material blasted from the high walls will also be used to cover any exposed coal seams and other carbonaceous material that might be left at the end of mining.*
- *Due to the expected standing water at the bottom of the void, a safety berm and security fence will be provided around the void to prevent unauthorised access. The berm will be designed with a trench to prevent unauthorised vehicle access to the void."*

West and Square Pit Closure Strategy

Donaldson Coal prepared the *Closure Strategy for the West and Square Pits* (the "*Closure Strategy*") (Donaldson Coal, 2020), presented as part of the previously approved Mining Operations Plan and as **Appendix 2** of this Plan.

The *Closure Strategy* addresses the management of the West and Square Pits in the event that underground mining is either resumed at the Abel Mine or no more mining is undertaken prior to closure of the Mines. The *Closure Strategy* provides detailed rehabilitation objectives and completion criteria, as well as a comprehensive rehabilitation risk assessment for each of the closure options for both the West and Square Pits. Furthermore, scenario-specific Trigger Action Response Plans, actions, and rehabilitation timelines are provided in detail. Where relevant, these elements have been reviewed, revised, and incorporated into the relevant sections of this Plan.

The *Closure Strategy* identifies a number of closure studies that will be undertaken as part of the rehabilitation of the West and Square Pits and the wider Abel and Donaldson Mine Sites, summarised as follows.

- Geotechnical Assessment

  The Geotechnical Assessment will confirm the final landform designs for the West and Square Pits, including a review of the final slopes of the final void walls regarding long-term stability and suitability.

- Water Model Review

  The Water Model Review will comprise a review of the existing groundwater model as described in the *Abel Upgrade Modification Groundwater Assessment* (RPS Aquaterra, 2012) to confirm the predicted groundwater inflows into the West and Square Pit final voids, including a review of groundwater licencing requirements.

  The review will also include consideration of surface water inputs and the potential for discharge to occur from the final voids.

- Contamination Assessment

  The Contamination Assessment, undertaken as part of the *Decommissioning and Demolition Strategy* (see Section 6.2.2.2), will assess the potential for the presence of and associated risks from contaminated material within the final voids.

6.2.3.5 Construction of creek/river diversion works

No creek or river diversion works are located within the Donaldson Mine Site.

A culvert crossing of Four Mile Creek is located within the Donaldson Mine Site which allows access to the Square Pit. Donaldson Coal anticipates that this crossing would be retained until rehabilitation has progressed to the point where heavy machinery/vehicle access is no longer required. At this stage, the decommissioning or retention of the culvert will be considered in regard to potential environmental cost and benefit for future land use.

6.2.4 Growth Medium Development

6.2.4.1 Geochemistry

Existing Environment

The geochemical properties of the soils of the Donaldson Mine Site is discussed in Sections 6.2.1.1 and 6.2.1.6. In summary, no significant geochemical constraints (e.g. saline soils, acid mine drainage, etc.) were identified during initial environmental assessments and mine planning, or have been identified as occurring as part of previous rehabilitation operations.

As discussed in Section 6.2.1.10, the *Sediment Dam Investigation Report* identified that the increased occurrence of naturally dispersive soils within and in the vicinity of the Donaldson Mine Site is associated with naturally elevated magnesium levels.

Controls to be Implemented

As discussed in Section 6.2.11, stockpiled growth medium within the Donaldson Mine Site will be subject to a formal survey of growth medium stockpiles to determine available volumes.

Prior to use in rehabilitation, stockpiled and/or imported material would be tested for geochemical properties to identify potential risks and opportunities for use in rehabilitated areas of the Donaldson Mine Site. Soil testing may also be undertaken for in-situ soils in existing rehabilitation areas and within analogue sites to establish appropriate completion criteria.

6.2.4.2 Amelioration

In accordance with the recommendations of the *Sediment Dam Investigation Report*, Donaldson Coal would, where practicable, apply ameliorative lime in areas where excessive occurrences of naturally dispersive soils are resulting in significant negative impacts to water quality within the Donaldson Mine Site.

Based on the results of soil testing, the addition of soil ameliorants such as fertiliser, lime, organic matter, etc., may be undertaken where required with caution applied to the use of phosphorous and nitrogen fertilisers.

6.2.4.3 Erosion and sediment controls

Existing Environment

The existing and approved *Donaldson Coal Mine Erosion and Sediment Control Plan* will continue to be implemented by Donaldson Coal during the growth medium development phase of rehabilitation. The existing surface water management infrastructure is shown on **Figure 5**.

Controls to be Implemented

During rehabilitation operations, all disturbed areas will be ripped prior to the application of topsoil in order to reduce compaction and encourage the integration of topsoil into underlying material. Growth medium spreading will aim to achieve a rough final surface in order to encourage the retention of seeds, infiltration of any rain and to minimise surface erosion. Water carts will be employed to lightly wet growth medium material prior to spreading in order to minimise dust generation. In areas which are vulnerable to wind erosion, polymer- or lignosulphonate-based dust suppressants may be applied following the application of growth medium to minimise the generation of particulate matter prior to vegetation establishment. Growth medium spreading will not be undertaken during excessively wet or windy conditions.

6.2.4.4 Material and surface management

In areas to be rehabilitated, where surfaces are observed or assumed to be compacted due to operational activities (i.e. laydown areas, roadways, etc.), mechanical treatments such as deep-ripping will be implemented prior to the application of growth medium.

After surface preparation is complete, growth medium will be spread to a minimum depth of approximately 150mm where practicable. Growth medium spreading will aim to achieve a rough final surface in order to encourage the retention of seeds, infiltration of any rain and to minimise surface erosion.

In areas which are vulnerable to wind erosion, polymer- or lignosulphonate-based dust suppressants may be applied following the application of growth medium to minimise the generation of particulate matter prior to vegetation establishment. Growth medium spreading will not be undertaken during excessively wet or windy conditions.

6.2.4.5 Seasonal considerations

Seasonal and local meteorological conditions will be monitored to identify conditions which may result in delaying vegetation establishment (e.g. extended drought conditions, periods of high rainfall, etc.). Land preparation and growth medium spreading activities will only be undertaken where conditions are predicted to be favourable (i.e. not unusually unfavourable) to the establishment of vegetation.

Sufficient water resources are also available within the existing water storage infrastructure of the Donaldson Mine Site for use in dust suppression.

6.2.4.6 Habitat augmentation

Existing Environment

In general, habitat features that were salvaged during site clearing activities over the development of surface mining operations were immediately relocated to rehabilitation areas as part of progressive rehabilitation operations. No significant habitat resource stockpiles are present at the Donaldson Mine Site. As no further significant vegetation or site clearing operations are proposed or are required to occur, few opportunities to salvage additional habitat features remain.

Notwithstanding the above, the various water management infrastructure within the existing rehabilitation areas of the Donaldson Mine Site have been shown as part of ongoing rehabilitation monitoring to provide valuable habitat resources for fauna.

Ongoing Management

Donaldson Coal maintains 40 artificial nest boxes (24 terrestrial and 16 arboreal) within existing rehabilitation areas of the Donaldson Mine Site. Regular monitoring of the nest boxes is undertaken in accordance with the existing and approved *Donaldson Coal Mine and Abel Underground Coal Mine: Flora and Fauna Management Plan – Care and Maintenance* (July 2019).

Controls to be Implemented

No specific habitat augmentation relating to the use of pre-salvaged 'natural' habitat features is proposed as part of remaining rehabilitation operations.

However, once no longer required for operational purposes, the water within the West and Square Pits, and the Big Kahuna Dam, would likely provide additional habitat and resources for native flora and fauna.

6.2.4.7 Weed control

Ongoing Management

The management of weed species in relation to selection, stockpiling and use of growth medium is discussed in Section 6.2.1.1 and 6.2.1.11.

Management of weed species is undertaken in accordance with the existing and approved *Donaldson Coal Mine and Abel Underground Coal Mine Flora and Fauna Management Plan – Care and Maintenance* (July 2019). The following presents a summary of the ongoing weed control programs and operations undertaken by Donaldson Coal.

- Regular weed control and monitoring programs targeting high-risk areas such as access roads.
- Inspection/cleaning of vehicles and machinery in dedicated washdown areas prior to entry into the Bushland Conservation Area, *Tetratheca juncea* Conservation Area, and to existing rehabilitation areas.
- Avoidance of known invasive species in site landscaping operations.
- Restriction of access to the Donaldson Mine Site to reduce as far as practicable the potential for illegal dumping of garden waste and other refuse in areas of native vegetation.

Reporting of annual weed species inspection and control programs is recorded in the *Annual Reviews* for the Abel and Donaldson Mines.

Controls to be Implemented

Ongoing weed inspection and control programs across the Abel and Donaldson Mine Sites will continue to be implemented throughout all phases of rehabilitation. Targeted inspection and control operations in the vicinity of areas where growth medium is to be applied may be undertaken if weed species presence or abundance is considered to be a potential risk to rehabilitation. This may include identification and monitoring of target or priority weed species communities and timing control operations based on phenological stage (i.e. during or prior to flowering).

6.2.5 Ecosystem and Land Use Establishment

6.2.5.1 Seasonal considerations

In general, the local and regional climate for the Donaldson Mine Site is typical of the subtropical/temperate climate of the wider Newcastle region. As such, seasonal conditions are not considered to present a specific risk to rehabilitation.

Seasonal and local meteorological conditions will be monitored to identify conditions which may result in delaying vegetation establishment (e.g. extended drought conditions, periods of high rainfall, etc.). Vegetation establishment activities, including the application of hydromulch, direct seeding and/or broadcast seeding, will only occur where favourable climatic conditions are expected to occur.

Water resources are also available within existing water storage infrastructure of the Donaldson Mine Site for use in supplementary watering of establishing vegetation. Water within the West and Square Pits would only be used within the catchment of each void (i.e. where water would drain back into the void) to prevent discharge to surrounding land and waterways.

6.2.5.2 Revegetation methodologies

Vegetation will largely be established by the following.

- Direct and/or broadcast seeding across relatively flat areas which are less susceptible to erosion or where relatively minor areas of vegetation are required to be established.
- Planting of tubestock to ensure target species establishment, including for species where seed propagation may be less effective.
- Hydroseeding in areas where safe access by rehabilitation practitioners or equipment cannot be provided, or areas that may be prone to erosion.
- Allowing natural revegetation to occur from existing seedbanks or from surrounding established native vegetation.

6.2.5.3 Target plant species

Table 12 presents an indicative and non-exhaustive list of native species that Donaldson Coal will use for revegetation of disturbed areas of the Abel and Donaldson Mine Sites.

Table 12
Species for Rehabilitation

Vegetation Strata	Scientific Name	Common Name
Groundcover	*Imperata cylindrica*	Bladey Grass
	Themeda australis	Kangaroo Grass
Understorey (Low Trees & Shrubs)	*Acacia linifolia*	Flax-leafed Wattle
	Acacia ulicifolia	Prickly Moses
Canopy (Large Trees)	*Allocasuarina torulosa*	Forest Oak
	Corymbia gummifera	Red Bloodwood
	Corymbia maculata	Spotted Gum
	Eucalyptus acmenoides	White Mahogany
	Eucalyptus crebra	Narrow-leaved Red Ironbark
	Eucalyptus fibrosa	Broad-leaved Ironbark
	Eucalyptus paniculata	Grey Ironbark
	Eucalyptus punctata	Grey Gum

As discussed in Section 6.2.1.2, the pre-mining environment within and in the vicinity of the Donaldson Mine Site was generally considered to be a degraded mix remnant and regrowth forest subject to, and largely formed by, a highly-altered disturbance regime compared to natural ecological function. As such, no specific target plant community exists for rehabilitation criteria. In contrast, revegetation efforts will, as done for existing rehabilitation areas, focus on the establishment of a mixed native woodland community with species that naturally occur in the surrounding landscape. It is anticipated that the positive flow-on effects of continuing rehabilitation management operations, including pest and weed species monitoring and control will continue to benefit biodiversity values within and in the vicinity of the Donaldson Mine Site, enhancing ecological resilience and maintaining an ecosystem capable of naturally regenerating a wide range of native species.

In areas that are identified as being prone to erosion, such as slopes >10°, rapid coloniser species including grasses may be used exclusively and at increased sowing density to ensure early stabilisation of growth medium. Where propagation material of target or native species may not be available at required volumes, sterile exotic pastoral species may be used to achieve target sowing rates. Natural recruitment of native species will be allowed to occur in these areas.

6.2.5.4 Propagation material handling

Native plant species seed will be collected from within and in the vicinity of the Donaldson Mine Site, including the Bushland Conservation Area and existing rehabilitation areas. As many native species flower and seed irregularly, seed collection may occur opportunistically or over an extended period of time. Where practicable, seed collection will be undertaken by or under the guidance of suitably qualified and experienced persons. Where the collection of seeds or other propagation material may result in risk of environmental harm (e.g. damage to existing vegetation, including existing rehabilitation), collection may be delayed or excluded from these areas. Where suitable species or sufficient quantities are unavailable, alternative local sources will be used.

6.2.5.5 Promotion of vegetation establishment

Hydroseeding and Straw Mulching

Techniques proposed for vegetative stabilisation of the infrastructure area batters include the use of hydroseeding and straw/bitumen (straw mulching).

Where practicable, the use of straw (or equivalent) mulching will be used to support revegetation. Straw will be applied at a rate of 5t/ha to achieve approximately 80% groundcover at a nominal thickness of 100mm to 200mm. The mulch will be fixed to the soil surface to avoid loss by wind or water. This will be achieved by applying a slow-breaking anionic bitumen emulsion with water in a 1:1 mixture at a rate of 2 litres/m^2.

The use of hydroseeding and straw mulching techniques negate the need for irrigation to promote germination and establishment of vegetation.

Fertiliser Application

The application of fertiliser may occur as part of revegetation operations. Fertiliser will either be applied directly to growth medium or as part of the mix used in hydroseeding.

6.2.5.6 Weed and Pest Control

Existing weed and pest control operations are discussed in Sections 6.2.1.2, 6.2.1.3 and 6.2.4.7.

Ongoing weed and pest inspection and control programs will continue to be implemented throughout all phases of rehabilitation. Targeted inspection and control operations in the vicinity of newly sewn or established vegetation. This may include identification and monitoring of target or priority weed species communities and timing control operations based on phenological stage (i.e. during or prior to flowering), as well as increased or additional pest control programs.

6.2.6 Ecosystem and Land Use Development

6.2.6.1 Weed and pest management and monitoring program

Annual weed and pest monitoring of the rehabilitated landforms of the Abel and Donaldson Mine Sites will continue until relinquishment. The results of the weed and pest monitoring program will be detailed in an *Annual Rehabilitation Report* together with a record of any specific control operations that have been undertaken. Monitoring frequency may be increased to include post-control monitoring if required.

6.2.6.2 Erosion and drainage controls

The existing water management infrastructure that will be retained as part of the final land use will continue to be monitored during annual rehabilitation monitoring. The results of all monitoring will be detailed in an *Annual Rehabilitation Report* together with a record of any specific management operations that have been undertaken.

Further information on erosion and sediment controls in relation to the *Sediment Dam Investigation Report* are provided in Section 6.2.1.10

6.2.6.3 Environmental management and monitoring program

Surface Water

Surface water monitoring has been ongoing since June 2000 in accordance with various revisions of approved Water Management Plans and other environmental monitoring programs and strategies. In addition, surface water monitoring is undertaken in accordance with EPL 12856.

The location of the water monitoring sites relevant to the Donaldson Mine Site are shown on **Figure 2** In summary, routine sampling and analysis is undertaken at six (6) permanent surface water stream monitoring locations, when in flow. Opportunistic samples are also taken from various other locations around the mine area as required (sediment dams and mine water storage dams). The surface stream water monitoring sites include:

- Four Mile Creek Upstream (FMCU) (EM1);
- Four Mile Creek Downstream (FMCD) (EM2);
- Scotch Dairy Creek Upstream (SDCU) (EM3);
- Scotch Dairy Creek Downstream (SDCD) (EM4);

- Weakleys Flat Creek Downstream (WFCD) (EM5); and
- Weakleys Flat Creek Upstream (WFCU) (EM6).

In addition to the above, surface water monitoring is undertaken for the Abel Mine at additional locations.

During the remaining rehabilitation of the Donaldson Mine Site, no additional surface water monitoring is anticipated to be required outside of existing monitoring programs. Based on rehabilitation progress against the proposed rehabilitation criteria, monitoring programs may be reviewed, revised and reduced in intensity and/or frequency prior to site relinquishment. The results of all monitoring will be detailed in an *Annual Rehabilitation Report* together with a record of any specific management actions (i.e. reviews) that have been undertaken.

Groundwater

Groundwater monitoring has been ongoing since June 2000 in accordance with various revisions of approved Water Management Plans and other environmental monitoring programs and strategies. In addition, groundwater monitoring is undertaken in accordance with EPL 12856.

There are six (6) current monitoring sites, the locations of which are provided on **Figure 2**. The groundwater piezometers are monitored to determine impacts on both Standing Water Levels and groundwater quality. A regional site, REG DPZ1, is also included in the monitoring program and is located in Avalon Estate approximately 1.2km north of the Donaldson Mine Site. In addition to the above, groundwater inflows are monitored through the recording of water volumes pumped from underground workings.

In addition to the above, groundwater monitoring is undertaken for the Abel Mine at additional locations.

During the remaining rehabilitation of the Donaldson Mine Site, no additional groundwater monitoring is anticipated to be required outside of existing monitoring programs. Based on rehabilitation progress against the proposed rehabilitation criteria, monitoring programs may be reviewed, revised and reduced in intensity and/or frequency prior to site relinquishment. The results of all monitoring will be detailed in an *Annual Rehabilitation Report* together with a record of any specific management actions (i.e. reviews) that have been undertaken.

Flora and Fauna

Monitoring of existing rehabilitation areas within the Donaldson Mine Site has been undertaken since 2008. Fauna and habitat monitoring aims to determine the effectiveness of the rehabilitation program in re-establishing pre-mining / natural biodiversity levels. Surveys are undertaken within a total of four monitoring plots, including one control plot, and four nesting box plots. Monitoring commenced in 2008. The flora monitoring includes one control plot in the remnant bushland (Plot 1) and nine monitoring plots in the rehabilitated areas of the Donaldson Mine Site (Plots 2 to 10). The plots have been progressively established as rehabilitation progressed and show a varying age of rehabilitation. The results of this monitoring are used to track rehabilitation progress against previously approved rehabilitation completion criteria.

Details on the flora and fauna monitoring program to be implemented by Donaldson Coal are provided in Section 8.1.

6.2.6.4 Revegetation management and monitoring

Vegetation establishment activities at the Donaldson Mine, including growth medium spreading and seeding operations, will occur only where favourable climatic conditions are expected to occur. Consequently, unfavourable meteorological conditions may result in extended delays to these rehabilitation conditions. In the event that extended unfavourable periods occur at the Donaldson Mine Site, rehabilitation schedules will be updated to prioritise other rehabilitation activities and opportunities to prepare additional areas for revegetation once favourable conditions return will be investigated.

Where rehabilitation monitoring identifies significant areas of germination failure, plant loss, damage to vegetation, the absence of target plant species or the presence of unsuitable plant species, Donaldson Coal may undertake remedial action which may include the following.

- Investigation into the potential causes of the phenomena, including consultation with suitably qualified persons, where required.
- Installation of temporary surface stabiliser (e.g. sterile groundcover, binding polymer) and/or temporary erosion and sediment controls.
- Consider alternative method of vegetation establishment (e.g. use of hydroseed)
- Undertake in-fill planting of target species to achieve as far as practicable target densities.
- Undertake targeted and short-term control strategies to remove un-suitable plant species.

6.2.6.5 Land management and infrastructure maintenance

In general, ongoing management of infrastructure such as tracks, security infrastructure and stock fencing occur on an as-needed basis. Regular inspections are undertaken by Donaldson Coal personnel. Regular inspections will continue to occur until relinquishment. The results of ongoing monitoring will be detailed in an *Annual Rehabilitation Report* together with a record of any specific management operations that have been undertaken.

6.3 REHABILITATION OF AREAS AFFECTED BY SUBSIDENCE

No areas affected by subsidence are located within the Donaldson Mine Site.

Information on the management of subsidence within the Abel Mine Site is provided in the RMP for the Abel Mine.

7. REHABILITATION QUALITY ASSURANCE PROCESS

The following section details the rehabilitation quality assurance process for the Donaldson Mine that has been developed in consideration of *Guideline: Rehabilitation Controls (July 2021)* and the current status of rehabilitation of the Donaldson Mine Site.

In general, the majority of the Donaldson Mine Site is considered to be in the Ecosystem and Land Use Development stage of rehabilitation, as presented in the previously approved MOP for the Donaldson Mine. Therefore many of the risk controls outlined in *Guideline: Rehabilitation Controls* (e.g. baseline assessments and monitoring) have either been completed or form part of ongoing investigations to be undertaken during rehabilitation monitoring and maintenance. As such, **Appendix 3** presents a condensed risk control checklist containing items applicable to the remaining active mining and planned rehabilitation phases of the Donaldson Mine Site. The checklist is intended to be used as an indicative guide for rehabilitation operation managers and practitioners responsible for the rehabilitation of the Donaldson Mine Site. It is noted that rehabilitation progress through the planned rehabilitation phases will not occur at the same rate across all mining and final land use domains identified in **Figure 5** and **Plan 1**. Therefore the quality assurance records of rehabilitation for each domain will be recorded as appropriate to the respective phase of rehabilitation for that domain. In some instances, validation and monitoring records that apply to all/multiple domains may occur following completion of the relevant phase for all domains.

As part of the rehabilitation quality assurance process, relevant records and documentation will be recorded in a Rehabilitation Quality Assurance Register and reported as part of the Annual Rehabilitation Report. The Rehabilitation Quality Assurance Register will, as a minimum, include a copy of the checklists presented in **Appendix 3** as well as a compliance register used to assess the status of compliance with requirements under relevant development consents, leases and licences. The Rehabilitation Quality Assurance Register will be maintained, reviewed and refined by the Operations Manager and Environment and Community Relations Superintendent to ensure that it is reflective of current rehabilitation progress, risk controls implemented at the Donaldson Mine Site and the outcomes of any updated rehabilitation risk assessments.

Table 13 outlines key responsibilities for Donaldson Coal personnel with regards to rehabilitation operations.

Table 13
Roles and Responsibilities for Rehabilitation Implementation

Role	Responsibilities
Operations Manager	Accountable for the overall environmental performance of the operations, including the outcomes of this Plan. Ensure that operations are compliant with the requirements of this Plan and applicable approvals. Provide necessary resources required to implement the rehabilitation process outlined within this Plan. Ensure employees are competent through training and awareness programs.
Environment and Community Relations Superintendent	Ensure the implementation of this Plan, including reporting of non-compliances, and subsequent implementation of the relevant action plan. Ensure that monitoring, report review and preparation are undertaken as outlined within this Plan and associated management plans. Report the progress of rehabilitation and monitoring in the relevant *Annual Rehabilitation Report*.
All employees	Follow direction provided by the Operations Manager and the Environment and Community Relations Superintendent. Ensure operations are consistent with the plans and objectives detailed in this Plan.

8. REHABILITATION MONITORING PROGRAM

8.1 ANALOGUE SITE BASELINE MONITORING

8.1.1 Existing Analogue Site Monitoring Programs

8.1.1.1 Bushland conservation area

Flora

Annual flora quadrat monitoring has been conducted in the Bushland Conservation Area since 2001. Nine 20m x 20m quadrats are monitored for species richness, density, floristic composition and biomass parameters. Quadrat monitoring occurs in late spring to early summer each year and aims to monitor the influence of mining activities on flora around the Donaldson Mine Site.

To date, a total of 305 flora species have been recorded across all survey events. Since commencement of monitoring the cumulative number of species steadily increased until 2009 and has since levelled and stabilised. This is consistent with expected ecological processes, weather patterns, and other variables.

Despite minor year-to-year fluctuations, all biomass variables examined (i.e. basal area, height, foliage projective cover (FPC), and stand volume) have also shown substantial increases over the last 20 years since the baseline survey in 2001. The regression analyses also confirmed that the relationship between time and increases in FPC and stand volume were highly significant indicating that the community biomass has increased substantially over time. Notwithstanding the significant increase since 2001, the FPC and stand volume parameters have remained relatively constant since the 2010 survey. The protection of the Bushland Conservation Area from a history of logging, clearing, frequent fire, firewood collection and rubbish dumping has likely contributed to the significant increase in biomass at all monitored sites since 2001.

Overall, the recorded trends are indicative of a dynamic plant community with high recruitment from the seed pool, normally an indicator of a healthy, regenerating native plant community. Overall, the results show that there have been no significant negative impacts on floristic diversity within the Donaldson Bushland Conservation Area over the last 20 years.

The results of the existing monitoring of the Bushland Conservation Area have been considered during the preparation of the proposed rehabilitation completion criteria for Native Ecosystem Areas domains as presented in Section 4.1. Where existing metrics have shown to be less-suitable as measures of rehabilitation success, these have been revised to develop more effective, meaningful and achievable completion criteria.

Fauna

Fauna monitoring within the Bushland Conservation Area has been conducted since 2001. Monitoring locations are consistent with the nine quadrats used for flora monitoring. Fauna monitoring techniques have included:

- terrestrial and arboreal mammal trapping;
- microbat trapping;
- microbat call detection;
- owl call playback;

- spotlighting;
- bird surveys;
- nest box monitoring; and
- opportunistic herpetofauna recording.

A total of 180 fauna species have been recorded since monitoring began in 2001, with a yearly average of 83 species as of 2021. Similarity analysis of faunal assemblages for all years (to 2021) indicates a similarity of 68%. Analysis of habitat preference (i.e. specialist vs. generalists) is also undertaken on an approximately 4 yearly basis. Variation is species assemblages has been associated with both on-site (mining) and off-site (surrounding development) operations. Notwithstanding the maturation of existing rehabilitation areas is predicted to positively impact on the surrounding Bushland Conservation Area. Nest box monitoring has shown successful results in regard to utilisation by various fauna species. However, nest box age and condition significantly affect utilisation rates with a 50% occupancy taking up to 4 years and peak occupancy being reached after 8 years.

The results of the existing monitoring of the Bushland Conservation Area have been considered during the preparation of the proposed rehabilitation completion criteria for Native Ecosystem Areas domains as presented in Section 4.1. Where existing metrics have shown to be less-suitable as measures of rehabilitation success, these have been revised to develop more effective, meaningful and achievable completion criteria.

8.1.1.2 Rehabilitation monitoring

Monitoring of existing rehabilitation areas within the Donaldson Mine Site has been undertaken since 2009. Fauna and habitat monitoring aims to determine the effectiveness of the rehabilitation program in re-establishing pre-mining / natural biodiversity levels. Surveys are undertaken within a total of four monitoring plots, including one control plot, and four nesting box plots. The flora monitoring includes one control plot in the remnant bushland (Plot 1) and nine monitoring plots in the rehabilitated areas of the Donaldson Mine Site (Plots 2 to 10). In addition, an erosion monitoring transect has been defined at each plot. The plots have been progressively established as rehabilitation progressed and show a varying age of rehabilitation.

To date, the monitoring has found that several of the rehabilitated areas have already met the previously approved completion criteria and that all rehabilitated areas assessed are on track to meet the previously approved completion criteria.

The results of the existing rehabilitation monitoring have been considered during the preparation of the proposed rehabilitation completion criteria as presented in Section 4.1. Where existing metrics have shown to be less-suitable as measures of rehabilitation success, these have been revised to develop more effective, meaningful and achievable completion criteria.

8.1.2 Additional Analogue Sites

Once all rehabilitation areas have reached the Ecosystem and Land Use Establishment phase of rehabilitation, Donaldson Coal may consult with suitably qualified persons regarding the current effectiveness and/or suitability of the existing analogue sites to determine the need for the establishment of additional analogue sites to better monitor the progress of existing and future rehabilitation efforts. Any additional sites would be established by or under the guidance of suitably qualified persons and included in the *Annual Rehabilitation Report*.

8.2 REHABILITATION ESTABLISHMENT MONITORING

Rehabilitation establishment monitoring methods and associated parameters are included in **Table 9** in Section 4.1. In summary, the monitoring parameters associated with each of the proposed rehabilitation completion criteria have been developed in consideration of the results and information collected by Donaldson Coal since 2009. By comparing rehabilitation progress against both analogue sites within the Bushland Conservation Area and the extensive existing rehabilitation, Donaldson Coal will be able to track short term progress as well as assess long-term rehabilitation trajectory.

Rehabilitation establishment monitoring methods will generally be consistent with existing monitoring methods, namely the establishment of permanent monitoring quadrats located within the remaining areas to be rehabilitated.

The location and density of any additional permanent monitoring quadrats will be determined by or under the guidance of a suitably qualified person(s). It is anticipated that the establishment of permanent monitoring locations within each area to be rehabilitated will occur within 1 year of the completion of ecosystem establishment activities.

As each permanent monitoring location is established, information on target vegetation types, species mix used, sowing/planting densities, and soil amelioration including fertiliser applications will be recorded. Each site will be added to the formal rehabilitation monitoring regime at the time of the next site-wide monitoring event.

Prior to the initial formal survey, establishment monitoring will consist of the following.

- Photo monitoring of rehabilitated areas, including photos prior to seeding, immediately following seeding and at least quarterly until first formal survey is undertaken. Additional photo monitoring may be undertaken on an opportunistic basis or as directed by rehabilitation experts.
- Visual inspections, including photographs, following significant rainfall events to identify any signs of erosion and detail any follow up actions required (e.g. repairs, installation of additional erosion and sediment controls)
- Recording of all monitoring and inspection events, including the results of monitoring and any follow up activities, in accordance with the Rehabilitation Quality Assurance Register.

As indicated in **Table 9**, ecological monitoring frequency will be determined in consultation with a suitably qualified person(s) (i.e. an ecologist). The reduction of monitoring intensity and frequency has previously occurred as part of approved revisions of various environmental monitoring plans or the advice of independent specialist consultants. Donaldson Coal anticipates that monitoring frequency will largely reflect rehabilitation age, and monitoring frequency is likely to vary across the Donaldson Mine Site depending on observed rehabilitation progress.

The results of any rehabilitation establishment monitoring will be detailed in the respective *Annual Rehabilitation Report* together with a record of any specific management actions (i.e. reviews) that have been undertaken.

8.3 MEASURING PERFORMANCE AGAINST REHABILITATION OBJECTIVES AND REHABILITATION COMPLETION CRITERIA

Details of validation methods and indicators to be employed during monitoring to assess performance against the rehabilitation completion criteria for the Donaldson Mine Site are provided in Section 4.1 and **Table 9**.

Established ecological monitoring methodologies will be the foundation of long-term monitoring at the Donaldson Mine Site. As outlined in Section 8.2, the progressive establishment of additional permanent monitoring locations will be undertaken within 1 year following the completion of growth medium spreading and seed application activities. Subsequent monitoring events will be undertaken at a frequency determined by suitably qualified persons that reflects observed and predicted rehabilitation progress and success as measured against rehabilitation completion criteria listed in Section 4.1.

As detailed in Section 8.1, long-term analogue site monitoring within the Bushland Conservation Area has provided extensive information on the ecological performance of the surrounding ecological communities. This data will continue to be used to infer local and regional patterns in biodiversity and ecological function. Combined with the long-term data collected from the existing rehabilitation monitoring locations, Donaldson Coal will be able to infer rehabilitation performance against background processes (i.e. outside of the control of Donaldson Coal) and previous rehabilitation success.

The results of relevant rehabilitation monitoring parameters will be graphed and compared against target values to determine:

- the relative performance of rehabilitated areas compared to other rehabilitation monitoring sites within the Donaldson Mine Site and the established analogue sites;
- the rate of development towards target values, including a timeline for the achievement of target values and/or rehabilitation completion criteria; and
- whether additional controls, management measures or specialist assessments to identify issues and provide recommendations are required based on trigger values (see Section 10).

The Rehabilitation Quality Assurance Register will be used to record details of any additional management measures or risk controls implemented during the ecosystem development phase in response to the analysis of rehabilitation monitoring results. The result of all rehabilitation monitoring will be included in the respective *Annual Rehabilitation Report*.

9. REHABILITATION RESEARCH AND TRIALS

9.1 CURRENT REHABILITATION RESEARCH, MODELLING AND TRIALS

No specific or formal rehabilitation research, modelling, or trials are currently or have ever been undertaken by Donaldson Coal for the rehabilitation of the Donaldson Mine Site.

9.2 FUTURE REHABILITATION RESEARCH, MODELLING AND TRIALS

9.2.1 Research, Modelling and Trials

No future rehabilitation research, modelling or trials are proposed or are anticipated to be required for the remaining rehabilitation of the Donaldson Mine Site. Donaldson Coal has undertaken progressive rehabilitation of the Donaldson Mine Site since 2003 and as such has extensive experience in local rehabilitation operations. In addition, the proposed rehabilitation operations are considered to be widely understood and unlikely to present any significant challenges that may warrant specific rehabilitation research.

10. INTERVENTION AND ADAPTIVE MANAGEMENT

Table 14 presents the Trigger Action Response Plan for each of the rehabilitation threats and potential adverse outcomes identified in **Table 8** as having a risk rating of moderate or above and relating to the Donaldson Mine.

The results of ongoing rehabilitation monitoring will be continually reviewed and reported in the respective *Annual Rehabilitation Report* for the Donaldson Mine. Where rehabilitation monitoring outcomes suggest that rehabilitation methods outlined in this Plan may not support the realisation of rehabilitation completion criteria, this Plan will be updated to detail additional or alternative rehabilitation methods as required.

Table 14
Trigger Action Response Plan

Rehabilitation Risk	Potential Adverse Outcome	Trigger	Response
General			
Insufficient resourcing: • skills and experience of rehabilitation personnel. • funding for or prioritisation of rehabilitation activities. • ongoing maintenance of rehabilitation requirements.	Rehabilitation signoff not given by Regulator.	Significant unforeseen increase or additional rehabilitation cost identified not covered by current Rehabilitation Cost Estimate.	Revise Rehabilitation Cost Estimate. Review and revise rehabilitation schedule.
Active Mining Phase of Rehabilitation			
Contamination resulting from storage and handling of hydrocarbons, resins, cement.	Contamination of waterways or land resulting in infringement notice.	Opportunistic visual monitoring identifies potential or actual contamination of surface water. Surface water monitoring identifies contamination.	Investigate potential source and extent of contamination to determine appropriate scale of response. Immediately if practicable isolate source of contamination. Remove contaminated material as far as practicable for disposal either on-site or off-site at appropriately licensed facility.
Decommissioning			
Instability of highwalls and low walls.	Landform failure – public safety.	Geotechnical assessment identifies potential or unacceptable risk of wall failure. Visual monitoring identifies potential or actual significant wall failure.	Inspect all Mine security infrastructure to ensure suitability while investigations are undertaken. Undertaken review of or additional geotechnical assessment to identify potential cause of failure and assess potential for additional failures. If required, undertaken additional stabilisation (e.g. shaping, buttressing, etc.) as recommended through geotechnical assessment / expert engineering advice.
Availability of suitable materials for capping of carbonaceous materials and other unsuitable materials on final landform batters.	Exposed carbonaceous or other unsuitable material impact upon growth medium and ability to establish vegetative cover.	Rehabilitation materials audit identifies likely deficiency in available capping materials.	Investigate potential additional on-site sources and off site sources for suitable capping material.
Landform Establishment			
Diversion of surface water runoff away from catchment areas.	Loss of water flow downstream due to capture of water in West and Square Pit final voids.	Downstream surface water monitoring identifies reduction in water levels after final landform establishment, including water diversion infrastructure, is complete.	Review water management system to confirm all run-on water is diverted back to natural catchments to the maximum extent possible. Review upstream water monitoring results to identify local or regional trends.
Ecosystem and Land Use Establishment			
Weather and climatic influences (e.g. drought, intense rainfall events, bush fire, etc.).	Damage to vegetation due to fire, flood, or drought.	Meteorological monitoring identifies potential or actual extreme or unseasonal climactic conditions coinciding with planned or ongoing rehabilitation operations.	Review and revise rehabilitation scheduling to identify potential proactive controls (e.g. watering of vulnerable vegetation, stabilising exposed surfaces, installation of temporary additional erosion and sediment controls, controlled burns, etc.). Undertake inspections of revegetated areas to identify potential extent of plant loss and, if required, undertake in-fill planting once favourable conditions return.
Erosion and failure of drainage and water management/storage structures.	Impacts on water quality and potential discharge.	Visual monitoring identifies signs of erosion of rehabilitated landforms.	Undertake inspection of rehabilitated areas to identify potential cause of erosion and suitability of existing erosion and sediment control infrastructure. In required, install additional temporary or permanent erosion and sediment control infrastructure and/or surface stabilising treatments.
		Visual monitoring identifies structural failure of water management/storage infrastructure.	Undertaken inspection and review of all water management/storage infrastructure within Mine Site to identify likely cause of failure and suitability for final land use. Undertaken necessary repairs under guidance of suitably qualified persons.
		Surface water monitoring identifies Mine-related impacts to surface water quality.	Undertake investigation to identify potential cause of surface water impacts and identify potential remedial management actions.
Ecosystem and Land Use Development			
Weather and climatic influences (e.g. drought, intense rainfall events, bush fire, etc.).	Damage to vegetation due to fire, flood, or drought.	Meteorological monitoring identifies potential or actual extreme or unseasonal climactic conditions coinciding with planned or ongoing rehabilitation operations.	Review and revise rehabilitation scheduling to identify potential proactive controls (e.g. watering of vulnerable vegetation, stabilising exposed surfaces, installation of temporary additional erosion and sediment controls, controlled burns, etc.). Undertake inspections of revegetated areas to identify potential extent of plant loss and, if required, undertake in-fill planting once favourable conditions return.
Vandalism to revegetation areas.	Damage to vegetation due to vandalism.	Visual inspections identify signs of unauthorised access to rehabilitation areas including damage to vegetation.	Undertake investigation including review/inspection of all security infrastructure. Undertake repairs to security infrastructure and, if necessary, install additional security measures to prevent and/or discourage public access. Undertake inspections of revegetated areas to identify potential extent of plant loss and, if required, undertake in-fill planting once site security is confirmed.

11. REVIEW, REVISION AND IMPLEMENTATION

Table 15 presents the triggers for reviewing this Plan. Following each review, this Plan will be revised if significant structural amendments are necessary. Additionally, further consultation with relevant stakeholders will be undertaken where revisions to this Plan result in changes to the proposed final land uses and final landforms, rehabilitation objectives, rehabilitation completion criteria and/or the rehabilitation schedule. Milestones as documented in this Plan will be updated in the *Annual Rehabilitation Report* and will trigger an update to this Plan in the event that a significant change in rehabilitation risks and/or proposed rehabilitation methodologies is identified.

Table 15
Rehabilitation Management Plan Review Triggers

Trigger	Review
Request from the Resources Regulator or other relevant government agency to review the Plan	As required by any notice
Modification of an existing development consent	Within 3 months
Modification of ML 1461	Within 3 months
Preparation of a revised Rehabilitation Risk Assessment	As soon as practicable
Update of the Rehabilitation Outcomes (objectives and/or criteria)	Within 30 days
Submission of each *Annual Rehabilitation Report* and Forward Program	Within 3 month
Finalisation of the *Rehabilitation Materials Balance Report*	Within 3 months
Receipt of a specialist consultant report prepared in response to a trigger outlined in Section 10	Within 3 months

In addition to reviews of this Plan as outlined in **Table 15**, a *Rehabilitation Quality Assurance Register* will be developed and regularly maintained to ensure that operational (i.e. Care and Maintenance operations) and rehabilitation activities at the Donaldson Mine Site are being conducted in accordance with this Plan. The *Rehabilitation Quality Assurance Register* will include the checklist presented as **Appendix 3** as well as a compliance register used to assess the status of compliance with requirements under relevant development consents, leases and licences. Additionally, the *Rehabilitation Quality Assurance Register* will include:

- records of any contaminated water or hazardous materials collected at the Donaldson Mine Site and disposed of off site;
- the latest map of contamination at the Donaldson Mine Site (once prepared); and
- details of any additional rehabilitation measures and/or risk controls implemented within individual subdomains during rehabilitation operations.

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Appendices

Appendix 1

Sediment Dam Investigations

(Total No. of pages including blank pages = 71)

SEDIMENT DAM INVESTIGATIONS

Prepared for:

Donaldson Coal Pty Ltd

SLR Ref: -R01
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BASIS OF REPORT

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1 Introduction

The Donaldson Coal Mine is currently under care and maintenance with the final rehabilitation works completed in March 2014. A Notice issued under Section 240 of the NSW Mining Act 1992 was issued to Donaldson Coal Pty Ltd (Donaldson Coal) requiring them to:

> Undertake a review of water quality within mine dams ('clean' and 'dirty') within ML 1461 against their approved final land use. The Review is to:
>
> i. Assess observed water quality recorded since March 2015, including (but not limited to) turbidity, Total Suspended Solids (TSS) and Total Dissolved Solids (TDS) against relevant industry guidelines and requirements of the approved final land use.
>
> ii. Review and assess the source of elevated turbidity / suspended solids including the construction methodology of each dam with turbidity / suspended solid concentrations greater than relevant industry guidelines and requirements of the approved final land use.
>
> iii. Should results exceed relevant industry guidelines and requirements of the approved final land use, develop and implement a strategy to address elevated turbidity / suspended solids for the long term. The strategy is to be consistent with relevant Project Approval requirements.

A desktop water quality investigation was completed by HEC in June 2020 (HEC, 2020) and made a number of recommendations for future works including:

- Conduct investigation of water storage construction material;
- Confirm functional requirements of sediment dams; and
- Design storage enhancement works consistent with functional requirements.

SLR Consulting Australia Pty Ltd (SLR) was subsequently engaged by Donaldson Coal to build on the previous HEC desktop investigation into sediment dam turbidity and to undertake further investigations in line with the HEC recommendations to improve discharge water quality from the site. This included investigations into the following sediment dams:

- Sediment Dam A
- Sediment Dam B
- Sediment Dam C
- Sediment Dam D
- Sediment Dam E
- Teds Hole
- Rumbles Dam

A site inspection was undertaken by SLR on 26th February 2021 to undertake soil sampling, ground truth sediment dam catchment areas and to assess the sediment generating potential of the site and the conveyance channels.

2 Water Quality Objectives and Closure Criteria

It is understood that the water storages listed in Section 1 will remain post-mining and will primarily be used as a stock and fauna water source (HEC, 2020). It is understood that the West and Square Pit final voids would remain as permanent water storages should mining of the Abel Underground Mine not be resumed.

The following surface water quality completion criteria are outlined in the Donaldson Coal MOP:

- runoff water Electrical Conductivity to be less than 1,000 µS/cm after five years, and
- the quality of water leaving the site to be in accordance with EPL requirements.

The Donaldson Coal Mine EPL 11080 permits discharge to Four Mile Creek under the following conditions:

- 40 ML each day for the 5 days following 10 mm of rain within 24 hours;
- Maximum salinity measured as Electrical Conductivity: 2,000 µS/cm;
- pH range 6.0 – 8.0; and
- Total suspended solids < 50 mg/L.

In addition, Abel Underground Mine's Water Management Plan (Donaldson Coal Pty Ltd, 2019) includes water quality trigger values of downstream monitoring points in Four Mile and Weakleys Creeks. These are provided in Table 1 below. No water quality triggers have been determined for Scotch Dairy Creek.

Table 1 Adopted Water Quality Triggers – Four Mile Creek and Weakleys Flat Creek

Parameter	Four Mile Creek	Weakleys Flat Creek
pH	6.5 – 7.1	6.6 – 7.2
Electrical Conductivity (µS/cm)	235 - 580	235 – 1,116
Total Suspended Solids (mg/L)	34	30
Manganese (mg/L)	1.6	1.34
Aluminium (mg/L)	0.46	0.47
Iron (mg/L)	5.56	4.12

3 Investigation of Water Storage Construction Material

A field reconnaissance of the sediment dams and their influent drainage lines was undertaken by SLR on 26 February 2021. The inspection was focussed on identifying the source(s) of elevated turbidity in the dams identified in the HEC desktop assessment, Donaldson Coal Mine Review of Mine Water Storage Quality (HEC, 2020). Soil samples were collected for analysis at the SLR Soil Laboratory and also submitted to EAL (a NATA registered laboratory) for subsequent classification and dispersion testing. Water samples were also collected from the sediment dams as per Donaldson Coal monitoring requirements and submitted for the routine analysis with additional analytes; chlorophyll-a, total phosphorus and total nitrogen as recommended in the HEC (2020) report.

The Soil and Water Analysis results are presented in Appendix B as well as the pH classification table documented in 'Interpreting Soil Test Results. What do all the number mean?' (Hazelton/Murphy, 2007).

3.1 Sediment Dam A

Sediment Dam A is a sediment control storage that receives runoff from a small (0.7 ha) area in the north-west of the site. The water quality in Sediment Dam A during the post rehabilitation period can be characterised as having a variable pH, with moderate salinity, variable total suspended solids with elevated and variable turbidity.

Soil samples from the catchment of Sediment Dam A were collected from three locations (D1, D1b and D2). The results from the field observations and soil analysis are summarised in Table 2.

Table 2 Sediment Dam A field observations and soil results

Site description	Photograph

D1
• Field observations:
  ◦ Contour drain
  ◦ Bank is slightly dispersive
  ◦ Natural subsoil which is non-disturbed
• Soil results: Strongly acidic (5.3), non-saline, dispersive on remoulding, low CEC, Ca deficient, marginally sodic, very high Mg (41.8%)
	

D1b
• Field observations:
  ◦ Erosion area above drain
  ◦ Dispersive
• Soil results: Moderately acidic (5.7), non-saline, not dispersive, moderate CEC, Ca deficient, non-sodic, very high Mg (62%)
	

D2
• Field observations
  ◦ Drain inflow is dispersive
  ◦ Soil profile has a bleached A2 horizon
  ◦ Natural soil profile photographed
• Soil results: Moderately acidic (5.6), non-saline, moderately to slightly dispersive, low CEC, Ca deficient, non-sodic, very high Mg (54.8%)
	

3.2 Sediment Dam B

Sediment Dam B captures runoff from a moderately sized catchment (4.8 ha) on the northern side of the site. The water quality in Sediment Dam B is similar to water quality in Sediment Dam A and can be characterised as having a variable pH, with moderate salinity, variable total suspended solids with consistently high turbidity.

Soil samples from the catchment of Sediment Dam B were collected from two locations (D3 and D3b). The results from the field observations and soil analysis are summarised in Table 3.

Table 3 Sediment Dam B field observations and soil results

Site description	Photograph

D3
 	
• Field observations:
    ◦ Dam inflow/spilling influenced by natural landform
    ◦ Dispersive subsoil
• Soil results: Moderately acidic (5.7), non-saline, moderately to slightly dispersive, low CEC, Ca deficient, non-sodic, very high Mg (59.6%)
	

D3b
 	
• Field observations:
    ◦ Natural soil profile
    ◦ A1 – Loam
    ◦ A1 – Bleached
    ◦ B21 – Light clay
    ◦ B22 – Medium clay
• Soil results: Strongly acidic (5.3), non-saline, dispersive on remoulding, moderate CEC, Ca deficient, non-sodic, very high Mg (67.3%)
	

3.3 Sediment Dam C

Sediment Dam C captures runoff from a small (0.9 ha) area in the northern side of the site. The water quality in Sediment Dam C is similar to water quality in Sediment Dam A and Sediment Dam B during the post rehabilitation period and can be characterised as having a variable pH, with low to moderate salinity, variable total suspended solids with consistently high turbidity.

Soil samples from the catchment of Sediment Dam C were collected from one location (D4). The results from the field observations and soil analysis are summarised in

Table 4.

Table 4 Sediment Dam C field observations and soil results

Site description	Photograph

D4
• Field observations:
  ◦ Small dam
  ◦ Dispersive subsoil
• Soil results: Strongly acidic (5.1), non-saline, not dispersive, moderate CEC, Ca deficient, non-sodic, very high Mg (48.2%)
	

3.4 Sediment Dam D

Sediment Dam D captures runoff from a 51 ha area in the eastern side of the site. The water quality in Sediment Dam D during the post rehabilitation period can be characterised as having a near neutral pH, with low to moderate salinity, variable total suspended solids with elevated and variable turbidity.

Soil samples from the catchment of Sediment Dam D were collected from two locations (D6 and D6b). The results from the field observations and soil analysis are summarised in Table 5.

Table 5 Sediment Dam D field observations and soil results

<table>
<tr><th>Site description</th><th>Photograph</th></tr>
<tr><td>D6
• Field observations:
◦ Very weak pedality
◦ Water is very turbid
◦ Dispersive subsoil
• Soil results: Strongly acidic (5.3), non-saline, moderately to slightly dispersive, very low CEC, Ca deficient, non-sodic, very high Mg (31%)</td><td></td></tr>
<tr><td>D6b
• Field observations: Dispersive subsoil
• Soil results: Strongly acidic (5.4), non-saline, moderately to slightly dispersive, moderate CEC, Ca deficient, marginally sodic, very high Mg (56%)</td><td></td></tr>
</table>

3.5 Sediment Dam E

Sediment Dam E captures runoff from a 61 ha area (excluding the Rumbles Dam catchment) in the south-eastern side of the site. The water quality characteristics of Sediment Dam E have been similar to Sediment Dam D and is characterised by near neutral pH, low to moderate salinity, low total suspended solids with elevated and variable turbidity.

Soil samples from the catchment of Sediment Dam E were collected from two locations (D7 and D7b). The results from the field observations and soil analysis are summarised in Table 6.

Table 6 Sediment Dam E field observations and soil results

Site description	Photograph

D7
• Field observations:
  ◦ Sandy bank – loamy sand
  ◦ Water fairly clear
  ◦ Water being filtered by a sandy bank/bar before entering dam
	

D7b
• Field observations:
  ◦ Spillway cut into natural dispersive subsoil
  ◦ Scouring in creek below spillway
  ◦ Subsoil exposed in creek bank erosion
  ◦ Water in drainage line pools is very turbid
• Soil results: Strongly acidic (5.2), non-saline, dispersive on remoulding, very low CEC, Ca low, non-sodic, very high Mg (9.1%)
	

3.6 Ted's Hole

Ted's Hole is used as a sediment control storage. It receives runoff from rehabilitated overburden emplacement areas in the north-eastern side of the site. The water quality in Ted's Hole during the post rehabilitation period can be characterised as being slightly acidic, with relatively low salinity, low total suspended solids with low turbidity.

Soil samples from the catchment of Ted's Hole were collected from three locations (D5, D5b and D5c). The results from the field observations and soil analysis are summarised in Table 7.

Table 7 Ted's Hole field observations and soil results

Site description	Photograph

D5
• Field observations:
  ◦ Rehabilitated soil profile photographed
  ◦ Dispersive subsoil
• Soil results: Strongly acidic (5.3), non-saline, moderately to slightly dispersive, low CEC, Ca deficient, non-sodic, very high exchangeable Mg (45.4%)
	

D5b • Field observations: ◦ Sediment in dam sampled • Soil results: Very strongly acidic (5.0), non-saline, moderately to slightly dispersive, low CEC, Ca deficient, non-sodic, very high exchangeable Mg (53%)	

D5c
• Field observations:
  ◦ Dispersive drain into dam
  ◦ Dam water is clear
  ◦ Vegetation and reeds acting as a filter
  ◦ Water is not stagnant
• Soil results: Very strongly acidic (4.9), non-saline, not dispersive, moderate CEC, Ca deficient, non-sodic, very high exchangeable Mg (24.9%)
	

3.7 Rumbles Dam

Rumbles Dam captures runoff from a 16 ha area near the centre of the site. Overflow from Rumbles Dam would report to Sediment Dam E. The water quality in Rumbles Dam during the post rehabilitation period can be characterised as being near neutral, with low to moderate salinity, low total suspended solids with elevated and variable turbidity.

Soil samples from the catchment of Rumbles Dam were collected from two locations (D8 and D9). The results from the field observations and soil analysis are summarised in Table 8.

Table 8 Rumbles Dam field observations and soil results

Site description	Photograph

D8
• Field observations:
  ◦ Eroded drain reporting directly to Rumbles Dam
  ◦ Exposed dispersive subsoil contributing directly to turbidity
• Soil results: Strongly acidic (5.3), non-saline, moderately to slightly dispersive, moderate CEC, Ca deficient, strongly sodic, very high Mg (47.8%)
	

D9 • Soil results: Strongly acidic (5.0), non-saline, not dispersive, low CEC, Ca deficient, non-sodic, very high Mg (24%)	

3.8 Construction material results

Laboratory certificates are provided in Appendix A and the soil analysis results are provided in Appendix B. The soil and water analysis are summarised in Table 9.

3.8.1 Soil Quality

The soils at the sediment dam sites are generally:

- Moderately to very strongly acidic;
- Non-saline;
- Moderately to non-dispersive;

- Calcium deficient;
- Very low to moderate cation exchange capacity;
- Mostly high exchangeable magnesium percentage; and
- Mostly non-sodic with three sites being marginally to strongly sodic.

A natural subsoil sample was also analysed, from adjacent to Sediment Dam A. The results indicated that the soil was very strongly acidic, non-saline, non-dispersive and Ca deficient. In contrast with all but one of the soils from the sediment dam sites, the natural soil sample had a low exchangeable magnesium percentage.

Based on the exchangeable sodium percentage (ESP) determined for each site, all but three of the 14 soils were non-sodic with most of the samples having an ESP of less than 5%. In contrast to the ESP results, half of the samples were found to be moderately to slightly dispersive based on the Emerson aggregate test (EAT), three samples were dispersive upon remoulding and only four samples displayed no dispersion. This indicates that the exchangeable sodium percentage is most likely not responsible for the dispersion observed in these soils.

Soils often disperse when they are sodic which means they contain enough sodium to interfere with the structural stability of the soil. Clay particles have a negative charge on their surface. This negative charge is balanced by positively charged cations such as calcium, magnesium, potassium and sodium (Ca^{2+}, Mg^{2}, K^{+} and Na^{+}) distributed around the surface of the clay. The cation exchange capacity provides a measure of the total number of exchange sites in a given mass of soil. Generally, when the ratio of sodium to other ions at the exchange sites are high, clay particles are less tightly bound to each other and the soil aggregates easily disperse when the soil becomes wet. High concentrations of magnesium can have the same effect as sodium. The magnesium ions are larger than calcium and forces holding the clay particles together are weaker compared to the forces between calcium and the clay particles.

3.8.2 Dam Water Quality

Water quality testing for chlorophyll-a, total phosphorus and total nitrogen was conducted on samples collected as part of the laboratory analysis conducted during water quality monitoring, and were assessed by SLR as part of this investigation. The water quality analytical results are summarised in Table 9.

Chlorophyll-a is a measure of the amount of algae growing in a waterbody. It can be used to classify the trophic condition of a waterbody. Although algae are a natural part of freshwater ecosystems, too much algae can cause aesthetic problems such as green scums and bad odours, and can result in decreased levels of dissolved oxygen. One of the symptoms of degraded water quality condition is the increase of algae biomass as measured by the concentration of chlorophyll-a.

Surface waters that have high chlorophyll-a conditions are typically high in nutrients, generally phosphorus and nitrogen. The sediment dam water analysed is enriched with both phosphorus and nitrogen. High levels of nitrogen and phosphorus can be indicators of pollution from man-made sources, such as from rehabilitated areas applied with fertiliser or compost.

Phosporous and total nitrogen are measures of the nutrient levels in water. Water discharges with high nutrient levels have the potential to adversely affect the downstream the riparian environment.

Table 9 Dam water quality analysis

Dam	Soil Sample	Soil			Water	
		Dispersion by Emerson Aggregate Test (EAT)	Exchangeable sodium percentage (ESP)	Calcium and magnesium balance	Turbidity trend	Nutrient enrichment
Sediment Dam A	D1	moderately to slightly	non-sodic to marginally sodic	Ca deficient	elevated and variable	enriched
Sediment Dam B	D3	moderately to slightly	non-sodic	Ca deficient	high	enriched
Sediment Dam C	D4	not dispersive	non-sodic	Ca deficient	high	enriched
Sediment Dam D	D6	moderately to slightly	non-sodic	Ca deficient	elevated and variable	enriched
Sediment Dam E	D7	On remoulding	non-sodic	Ca low	elevated and variable	enriched
Teds Hole	D5	moderately to slightly	non-sodic	Ca deficient	low	enriched
Rumbles Dam	D8, D9	moderately to slightly	non-sodic to strongly sodic	Ca deficient	elevated and variable	enriched

The main objective for amelioration of the soils would be to increase the exchangeable Ca concentration which would in turn improve the Ca/Mg ratio. Applications of additional phosphorus and nitrogen should be avoided to reduce the potential runoff into the dams.

4 Functional Requirements of Sediment Dams

4.1 Short Term Functional Requirements

4.1.1 Status of Dams and Upslope Catchments

The dams were observed to be generally stable with good rehabilitation in the upslope catchment areas. Some isolated and small disturbance areas were identified however the extent of this disturbance was not considered to be significantly worse than the virgin bushland areas at the site. Soils in the rehabilitation areas are dispersive. As such, based on the observations made during the site inspection, the water quality in the dams is expected to be similar to those in the surrounding area.

Descriptions of the specific dams and their respective catchment areas are detailed in the sections below. A site catchment plan including the locations of conveyance channels assessed as part of this investigation is provided in Figure 1.

4.1.1.1 Sediment Dam A

Sediment Dam A was observed to be generally stable. The batters are generally well vegetated with only small areas of exposed banks which did not appear to be overly dispersive. The dam has a riser pipe outlet and was holding water during the site inspection.

The dam spillway was also generally stable, however an area of exposed dispersive soil does exist where some sheet flow would enter the spillway laterally. Large rock has been placed in the spillway which actually impedes the flow and concentrates it around the sides. Whilst, it would be preferential to remove these rocks and rehabilitate the exposed soils it would likely do more harm than good to the established rehabilitation. The spillway is generally considered to be stable with the flow path downstream of the spillway showing no visible signs of erosion.

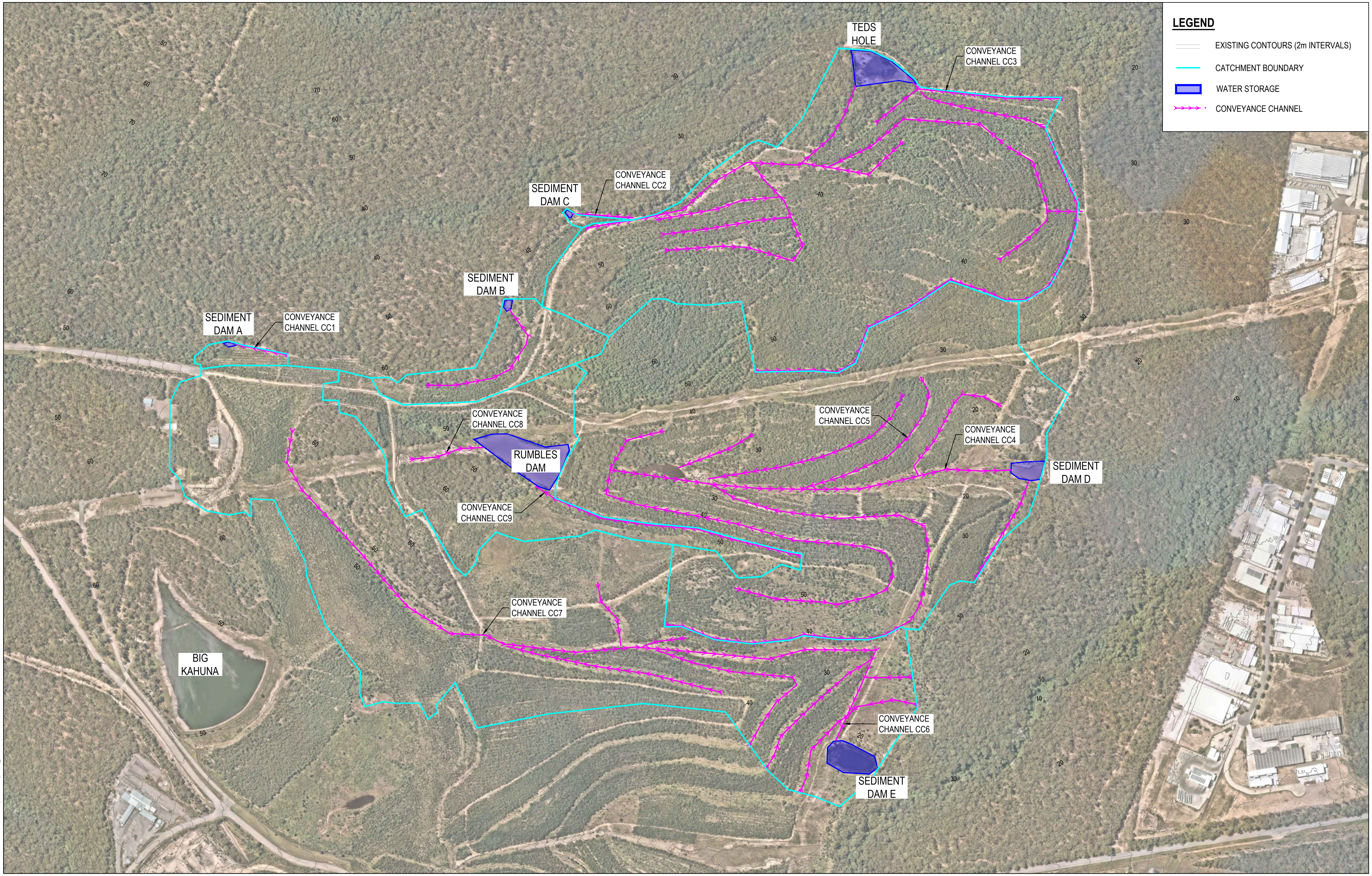
The upslope catchment has generally been well rehabilitated, however some small isolated areas of exposed soils were observed including an area just upslope of the contour bank which conveys runoff into the dam. The contour bank itself has limited vegetation in some areas on the lower bank which could be contributing small volumes of additional sediment to the dam. Some minor erosion was observed in the contour bank immediately upstream of the dam. This isolated erosion could be remediated (i.e. backfilled and seeded) without the need for heavy machinery however this is not the case for additional rehabilitation works within the catchment and on the contour banks. Sediment Dam A is not considered to be at risk of failure and the isolated areas of exposed soils are expected to rehabilitate naturally over time.

Photos of Sediment Dam A and an upslope channel are provided in Plates 1 to 15 in Appendix C.

4.1.1.2 Sediment Dam B

Like Sediment Dam A, Sediment Dam B was observed to be generally stable. The batters are steep but generally well vegetated with only small areas of exposed banks which did not appear to be overly dispersive. The dam has a riser pipe outlet and was holding water during the site inspection.

Good vegetation exists within the dam spillway. This spillway was generally stable with only some very minor erosion observed on the spillway batter at a single location. The downstream flow path was also stable with no visible signs of erosion.



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Project No:	630.30133
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DONALDSON WATER MANAGEMENT

SITE CATCHMENT PLAN

FIGURE 1

The upslope catchment has generally been well rehabilitated however some small isolated areas of exposed soils were observed including an area above the access track. The extent of these disturbances was not considered to be significantly worse than the virgin bushland areas at the site. In addition, any remediation works would likely do more harm than good to the established rehabilitation in the majority of areas.

Photos of Sediment Dam B and an upslope area are provided in Plates 16 to 25 in Appendix C.

4.1.1.3 Sediment Dam C

Sediment Dam C was also observed to be generally stable. The batters are steep but generally well vegetated. The dam has a riser pipe outlet and was holding water during the site inspection. The spillway is also well vegetated and stable with a stable rock lined section of spillway immediately after the dam. Downstream areas also appear to be stable with no apparent erosion. As such, Sediment Dam C is considered to be low risk with no additional remediation works recommended.

The rehabilitated upslope catchment of Sediment Dam C was very good with no significant areas of exposed soils or erosion. It is noted that the Sediment Dam C catchment area presented by HEC in their desktop assessment (HEC, 2020) is not accurate and required adjustment during this investigation.

Photos of Sediment Dam C and an upslope channel are provided in Plates 26 to 32 in Appendix C.

4.1.1.4 Sediment Dam D

Sediment Dam D appears to be generally stable. The dam does have some isolated areas of exposed banks however the sediment load entering the dam from these batters would be insignificant compared to the overall dam capacity and sediment load from the upslope catchment area. However, erosion of the batters due to wave action may make a minor contribution to ongoing turbidity during periods of dry weather and low flow. A riser pipe outlet structure does exist at the dam. The discharge location of this structure could not be found but the area downslope of the dam appeared to be stable, including the concrete vehicle crossing and rock lined sections of the dam spillway.

Like most areas of the site, the rehabilitation of the Sediment D catchment has been very successful with very minimal areas lacking vegetation coverage. The Sediment D catchment does include a section of the powerline easement which includes a slightly eroded access track which could be contributing additional sediment to the dam. This sediment would likely be insignificant with respect to the overall catchment area and SLR were advised that this area is managed by Transgrid and out of Donaldson Coal's control.

It is noted that the Sediment Dam D catchment area presented by HEC in their desktop assessment (HEC, 2020) is not accurate and required adjustment during this investigation.

A large flat gully area does exist prior to the dam which would help to retain sediment prior to entering the dam. Upslope of this area a number of conveyance channels, including some rock lined sections, exist to convey the runoff into the dam. Some small isolated sections of exposed banks were observed on these channels however this was not considered to be significant or accessible enough to warrant any remediation works.

Photos of Sediment Dam D, upslope channels and the upslope powerline easement are provided in Plates 49 to 72 in Appendix C.

4.1.1.5 Sediment Dam E

Sediment Dam E appears to be stable with all banks having a good coverage of vegetation. No riser pipe exists in this dam. The upslope catchment area appears to have been rehabilitated successfully with very mature trees and vegetation. Minimal areas of exposed soils were observed in the catchment during the site inspection. All drainage channels inspected appeared to be stable with good vegetation coverage. A significant rock lined channel also conveys runoff into Sediment Dam E.

It is noted that the Sediment Dam E catchment area presented by HEC in their desktop assessment (HEC, 2020) is not accurate and required adjustment during this investigation.

The spillway has been cut through a rocky section of ground and has near vertical side slopes. This spillway does not have any vegetation establishment but does not appear to be unstable. Nonetheless, stabilisation works are recommended to this spillway including reducing the grade of the batters and rehabilitation works to provide some vegetation coverage.

Severe gully erosion does exist (approximately 20m) downstream of the dam spillway including two large headcuts and a very incised flow path. The erosion has vertical banks with greater than 2m of exposed dispersive soils. A large scour hole also exists further downstream. It is noted that this erosion is located in virgin land (i.e. outside of rehabilitation works) however was possibly formed as a result of historic dam overflows or pipe discharges. It is also possible that the headcut started downstream independently from the mine. Significant remediation works will be required to stabilise the area, especially as the headcut will eventually work its way back up the channel and eventually impact on the stability of the dam. This remediation will likely involve bed level controls, benching, low flow rock armouring and bank stabilisation with jute mesh. It is recommended that a suitably qualified geomorphologist be engaged to assess and design a suitable remediation strategy for the area.

Photos of Sediment Dam E, the downslope erosion and an upslope channel are provided in Plates 73 to 91 in Appendix C.

4.1.1.6 Teds Hole

Teds Hole has a large upslope catchment area with very well established and successful rehabilitation in the catchment and numerous channels / contour banks that convey runoff into the dam. The majority of the channels could not be inspected during the site inspection due to access and time constraints. However, the channels that were inspected appeared to be stable with good vegetation coverage. Some isolated sections of exposed banks were observed on these channels however this was not considered to be significant or accessible enough to warrant any remediation works.

It is noted that the Teds Hole catchment area presented by HEC in their desktop assessment (HEC, 2020) is not accurate and required adjustment during this investigation. The revised catchment is shown on SLR Figure 1.

The dam itself has some exposed batters but appears to be generally stable. Sediment loads entering the dam from these batters would be insignificant compared to the overall dam capacity and sediment load from the upslope catchment area. However, erosion of the batters due to wave action may make a minor contribution to ongoing turbidity during periods of dry weather and low flow. A riser pipe outlet exists at the dam and was observed to have a stable discharge location.

A significant area of exposed soils does exist between the ponded water in the dam and the dam spillway. Rehabilitation works (i.e. topsoil and seed) are recommended in this area. The spillway itself is located at a light vehicle crossing and appears to be stable with good downstream vegetation coverage. Due to the broad nature of this spillway, any overflows would likely fan out over this vegetated slope and be conveyed safely into the downstream creek. This creek does have some significant and steep batters but it appears as though overflows from Teds Hole would enter the creek upstream of this point.

Photos of the Teds Hole dam and upslope channels are provided in Plates 33 to 48 in Appendix C.

4.1.1.7 Rumbles Dam

The Rumbles Dam itself appears to be stable with good vegetation coverage on batters with the exception of some isolated batter areas with exposed soils. A pipe was observed in the dam but SLR were advised that it was no longer used.

Upslope catchment areas are generally well rehabilitated with good vegetation coverage. Based on the contour banks observed they are generally stable with good vegetation coverage. Eroded flow paths were however observed both upstream and downstream of the dam. An upslope drainage channel is located within the powerline easement. Significant areas surrounding this channel are exposed with dispersive soils. The channel is also actively eroding with little vegetation present and is very incised (with vertical 2m batters) due to the dispersive soils present. Rehabilitation and armouring works are recommended within this channel and the surrounding area however SLR were advised that this area is managed by Transgrid and out of Donaldson Coal's control.

Similarly to the erosion downstream of Sediment Dam E, severe gully erosion does exist (approximately 30m) downstream of the dam spillway including a large headcut and a very incised flow path. The erosion has vertical banks with greater than 2m of exposed dispersive soils. This erosion was very likely initiated by a pipe discharge into an unstable area. Significant remediation works will be required to stabilise the area, especially as the headcut will eventually work its way back up the channel and eventually impact on the stability of the dam. This remediation will likely involve bed level controls, benching, low flow rock armouring and bank stabilisation with jute mesh. It is recommended that a suitably qualified geomorphologist be engaged to assess and design a suitable remediation strategy for the area. The actual Rumbles Dam spillway appears stable even though it has some exposed soil in it.

Photos of the Rumbles Dam, the downslope erosion and upslope channels are provided in Plates 92 to 114 in Appendix C.

4.1.2 Sediment Dam Volume Assessment

The purpose of the site sediment dams was to manage sediment laden runoff during the operational phase of the mine and prior to the successful rehabilitation of the upslope catchment areas. As the upslope catchment areas are all successfully rehabilitated the dams are no longer, and do not need to be, actively managed as sediment dams (i.e. dewatered / desilted). Nonetheless, SLR have undertaken capacity calculations of the sediment dams in order to provide some context regarding the individual dam capacities with respect to the upslope catchment areas, which gives a relative indication of how frequently they are likely to overflow.

The parameters, assumptions and results of these calculations are detailed in the sections below.

4.1.2.1 Sediment Dam Capacity Assessment Parameters and Assumptions

The required storage capacity of the existing dams was calculated in accordance with the requirements of the Blue Book and the following design criteria and assumptions:

- Catchments areas were estimated using publicly available existing contour information from 2012 as the contour information provided by Donaldson Coal did not appear to include some of the rehabilitated landforms. Dam catchment areas are shown in Figure 1;
- A rainfall depth of 39.4 mm was adopted for the 5 day, 90th percentile design storm in accordance with the Blue Book for Newcastle / Cessnock (average) with an assumed disturbance duration of more than three years;
- Catchment disturbance areas were conservatively assumed to be 10% of the overall catchment area from Sediment Dam D and the Rumbles Dam with a 5% disturbance area applied to the other dam catchments;
- The dams were classed as a type F and type D dams based on the typical soil types within the area;
- Disturbed runoff coefficient of 0.64 in accordance with Table F-2 of the Blue Book for a type D hydrological group with rainfall between 31 – 40 mm;
- 'Clean' water runoff coefficient of 0.3 was utilised from undisturbed / rehabilitated areas; and
- The Sediment Storage Zone was calculated using the Revised Urban Soil Loss Equation (RUSLE) with various assumptions relating to the soil loss at the site including a sediment management period of 12 months, an erosion control practice factor of 1.0, rainfall erosivity factor of 2500, soil erodibility factor of 0.05, a ground cover and management factor of 1.0 and a various length/slope factors depending on the topography of the upslope catchment.

4.1.2.2 Dam Capacity Assessment Results

The results of the dam capacity assessment are detailed within Table 10.

Table 10 Sediment Dam Capacity Results

Dam	Design Storm	Settling Zone Storage Volume (ML)	Sediment Zone Storage Volume (ML)	Total Volume Required (ML)	Existing Dam Storage Volume (ML)	Sufficient Existing Dam Capacity?
Sediment Dam A	5 day, 90th Percentile	0.10	0.01	0.11	3.00	Yes
Sediment Dam B	5 day, 90th Percentile	0.62	0.05	0.66	3.00	Yes
Sediment Dam C	5 day, 90th Percentile	0.03	0.00	0.03	3.00	Yes
Sediment Dam D	5 day, 90th Percentile	7.53	1.11	8.64	12.00	Yes
Sediment Dam E	5 day, 90th Percentile	6.87	0.52	7.39	12.00	Yes
Teds Hole	5 day, 90th Percentile	5.58	0.42	5.99	16.76	Yes

Rumbles Dam	5 day, 90th Percentile	2.38	0.28	2.66	13.63	Yes

It can be seen from Table 10 that all of the sediment dams have sufficient capacity to manage runoff from the upslope catchment area. Based on the results, Sediment Dams D and E are the dams that are likely to overflow the most frequently.

4.1.3 Conveyance Channel Assessment

4.1.3.1 Rainfall – Runoff Modelling

A hydrological model (using XP-RAFTS) was developed to determine the peak flow rates expected to be generated from the Donaldson landform so that capacity of existing water conveyance structures could be assessed. Rainfall was estimated for the region based on Intensity – Frequency – Duration (IFD) data and design temporal patterns for the Donaldson area in accordance with the data presented in Australian Rainfall and Runoff (ARR, 2016).

The hydrological model was based on the following data/assumptions/parameters:

- Sub-catchments within the Donaldson landform were modelled with grades varying from 1% to 30% depending on the location of the sub-catchment on the landform;
- The existing conveyance channels and dam spillways were assessed to safely convey the estimated runoff from a 1% Annual Exceedance Probability (AEP) design storm event (all durations up to 72hrs). This is equivalent to the 100 year Average Recurrence Interval (ARI) storm event;
- The runoff coefficients used for the steep areas of the final landform were an initial loss of 20mm and a continuing loss of 2.5mm/hr. The runoff coefficients used for the relatively flat areas of the landform were an initial loss of 40mm and a continuing loss of 5mm/hr. There is little published data available for what runoff coefficient should be used for rehabilitated overburden dumps in NSW. The data that is available ranges widely which is a reflection of the range of infiltration rates applicable to overburden, subsoil and topsoil used in mine rehabilitation. The soil parameters used are based on SLR's recommended values from a review of the published data available;
- Contour banks that were not inspected were modelled with standard cross-sectional dimensions and slopes;
- The Mannings 'n' roughness coefficient of the established rehabilitated landform was 0.09; and
- The Mannings 'n' roughness coefficient of the rock and grass lined conveyance channels was 0.045 and 0.03 respectively.

4.1.3.2 Conveyance Channel Assessment Results

Dimensions of specific conveyance channels were measured during the site inspection. Not all channels were measured due to access issues, time constraints and the fact that many of the channels (e.g. contour banks) have the same dimensions. The conveyance channels inspected and measured were considered to be a good representation of the overall runoff conveyance system into the site sediment dams.

Conveyance channels were assessed using the XP-RAFTS model to convey flows during the 100 year ARI storm event in accordance with Australian Rainfall and Runoff 2016. The alignment and naming of the Donaldson conveyance channels are shown in Figure 1.

Table 12 below details the existing conveyance channel parameters measured during the site inspection and the results of the XP-RAFTS modelling.

Table 11 Conveyance Channel Parameters and XP- RAFTS Results

Conveyance Channel	Existing Conveyance Channel Parameters				100 Year ARI XP-RAFT Results			
	Base Width (m)	Side Slopes (H:V)	Channel Depth (m)	Lining	Peak Flow Rate (m^3/s)	Peak Flow Depth (m)	Peak Flow Velocity (m/s)	Is Conveyance Channel Suitable to Convey 100 Year ARI Event?
CC1	4.0	2:1	0.7	Grass	0.190	0.08	0.57	Yes
CC2	1.0	3:1	0.7	Grass	0.073	0.10	0.58	Yes
CC3	2.0	3:1	0.4	Grass	0.422	0.18	0.90	Yes
CC4	3.0	3:1	1.2	Rock (D50 = 200mm)	12.413	1.16	1.78	Yes
CC5	3	3:1	0.5	Grass	0.268	0.11	0.71	Yes
CC6	5.0	3:1	1.5	Rock (D50 = 500mm)	10.005	0.49	3.1	Yes
CC7	3.0	3:1	1.5	Grass	5.922	0.63	1.89	Yes [1]
CC8	2.5	3:1	1.0	Exposed soil / rock	0.467	0.08	2.01	No [2]
CC9	2.0	3:1	0.8	Grass	0.944	0.28	1.16	Yes

1 – The estimated 100 year ARI flow velocity and the associated shear stresses within CC7 exceed the best practice requirements for channels without established vegetation. However, as good grass coverage was observed in the channel it is considered to be stable to convey the anticipated flows.
2 – The requirements for CC8 are discussed below.

It can be seen from Table 11 that the XP-RAFTS modelling indicates that all of the assessed conveyance channels, apart from CC8, have adequate capacity to manage the anticipated flows during a 100 year ARI rainfall event. Highly dispersive soils and significant gully erosion were observed at CC8. The undersized capacity of CC8 and lining would likely have contributed to this erosion. Rehabilitation and armouring works are recommended within this channel and the surrounding area however it is acknowledged that this area is managed by Transgrid and out of Donaldson Coal's control.

Regardless, based on the XP-RAFTS modelling results, it is recommended that CC8 be upgraded to have the following design parameters:

- Minimum base width = 4m;
- Minimum batter slope =3 (H):1 (V);

- Minimum channel depth = 1m; and
- Lining with non-dispersive soil and either Landlok 450 erosion matting or jute mesh.
- Grass seeding

4.1.4 Spillway Assessment

Dimensions of the dam spillways were measured during the site inspection. The dam spillways were assessed using the XP-RAFTS model to manage overflows during the 100 year ARI storm event in accordance with Australian Rainfall and Runoff 2016, the Blue Book and 'Best Practice Erosion & Sediment Control, Book 2' (IECA, 2008). It is noted that many of the dams have riser pipe outlet systems in addition to the dam spillways. This assessment conservatively assumes that these riser pipe outlet systems were blocked in order to assess the dam spillways during a worst-case scenario.

Table 12 below details the existing spillway parameters measured during the site inspection and the results of the XP-RAFTS modelling.

Table 12 Dam Spillway Parameters and XP- RAFTS Results

Dam	Existing Spillway Parameters				100 Year ARI XP-RAFT Results			
	Base Width (m)	Side Slopes (H:V)	Spillway Depth (m)	Lining	Peak Flow Rate (m^3/s)	Peak Flow Depth (m)	Peak Velocity (m/s)	Is Spillway Suitable to Convey 100 Year ARI Event?
Sediment Dam A	4.0	3:1	0.5	Grass	0.378	0.14	0.75	Yes
Sediment Dam B	5.0	3:1	0.6	Grass	1.289	0.26	1.09	Yes
Sediment Dam C	4.0	3:1	0.4	Rock (D50 = 200mm)	0.103	0.06	0.36	Yes
Sediment Dam D	5.0	3:1	1.1	Rock (D50 = 300mm)	14.066	1.07	1.76	Yes [1]
Sediment Dam E	4.0	Vertical	1.0	Exposed Soil	9.89	1.28	2.5	No [2]
Teds Hole	9.0 [1]	5:1	0.6	Grass	7.016	0.52	1.6	Yes [3]
Rumbles Dam	7.0	3:1	1.0	Grass	5.122	0.52	1.6	Yes

1 – Sediment Dam D was calculated to have limited freeboard above the 100 year ARI flows during overflow events however this is not expected to be an issue based on the very stable observations of the spillway.
2 – The requirements for the Sediment Dam E spillway are discussed below.
3 – The Teds Hole Dam spillway is very broad and not easily measured. As such, the limited freeboard estimated is not expected to be an issue especially given that it is a relatively old dam with no signs of erosion at the dam spillway.

It can be seen from Table 12 that the XP-RAFTS modelling indicates that all of the dam spillways, apart from the Sediment Dam E spillway, have adequate capacity to manage overflows during a 100 year ARI rainfall event. The spillways at Sediment Dam D and Teds Hole were shown to have slightly limited freeboard above the simulated 100 Year ARI flow depth. However, this was considered to be acceptable given site observations of these spillways (which indicated that they would be stable during overflow events).

It is expected that any works to increase the capacity and stability of the Sediment Dam E spillway would be undertaken during the remediation of the significant downstream gully erosion (refer to Section 4.1.1.5). Based on the XP-RAFTS modelling results, it is recommended that the Sediment Dam E spillway capacity/stability be increased by undertaking works to:

- Remove the side vertical walls and replace with 3 (H):1 (V) batters.
- Increase the spillway depth to 1.3m (if possible) to increase the freeboard available during overflow events.
- Line the spillway with geofabric and rock (D50 = 150mm) to protect the spillway in the immediate vicinity of the dam embankment from the estimated shear stresses during overflow events.

4.2 Long Term Functional Requirements

4.2.1 Water Quality Assessment

4.2.1.1 General Water Quality Assessment Findings

Based on the findings of this investigation and the HEC desktop water quality investigation, minimal works are required for the dams to meet the water quality closure criteria detailed in Section 2. A summary of historical TSS data within the sediment dams and the upstream creeks was developed by HEC (HEC, 2020) and is provided in Table 13 below.

Table 13 Statistical Summary of Total Suspended Solids Data – Local Streams Upstream of the Mine Site and Sediment Dams (HEC, 2020)

Location	Median	Maximum	Minimum	80th Percentile	20th Percentile
Local Stream Upstream Sites					
FMCU (Four Mile Creek Upstream)	10	208	4	20	5
SDCU (Scotch Dairy Creek Upstream)	21	354	5	49	8
WFCU (Weakleys Creek Upstream)	6	90	4	15	5
Sediment Dam Sites					
Teds Hole	9	119	5	22	5
Sediment Dam A	29	661	6	55	17
Sediment Dam B	31	166	14	57	21
Sediment Dam C	28	134	6	56	18
Sediment Dam D	18	61	5	30	10
Sediment Dam E	12	67	5	19	6
Rumbles Dam	14	35	5	20	8

Water quality assessments of the specific site sediment dams are provided below and whether they are likely to meet closure criteria. Generally, the water quality in the dams is similar to that found in the surrounding virgin land (i.e. not impacted by mining but containing dispersive soils) and downslope creek systems. Sediment loads reporting to Sediment Dams A, B and C could be improved by rehabilitating all the minor and isolated areas of exposed soils in the catchment and within the conveyance channels however, these remediation works would likely do more harm than good to the established rehabilitation in the majority of areas.

4.2.1.2 Sediment Dam A

As discussed in Section 4.1.1.1, the Sediment Dam A catchment contains some small isolated areas of exposed soils including on the contour bank which conveys runoff into the dam. These areas could be contributing small volumes of additional sediment to the dam. Some minor erosion was also observed in the contour bank immediately upstream of the dam. Whilst it is recommended that this isolated erosion be remediated, this is not the case for additional rehabilitation works within the catchment and on the contour banks. These remediation works would likely do more harm than good to the established rehabilitation in the majority of areas.

From the data presented in Table 13, TSS at the dam is only very slightly higher than the TSS value recorded in the downstream Scotch Dairy Creek. As such, sediment loads in the Sediment Dam A catchment are generally considered to be similar to that found in the surrounding virgin land (i.e. not impacted by mining but containing dispersive soils). It is noted that the median TSS concentration of 29 mg/L is below the EPL 11080 requirement. As such, it is considered likely that Sediment Dam A will meet TSS closure criteria requirements.

Both pH and salinity values generally meet closure criteria requirements. The 20th percentile pH value of 6.2 is within the EPL 11080 requirements however some lower pH values have been recorded. It is noted that low pH values have been reported for local streams at upstream sampling sites.

Data indicates elevated aluminium, relative to the ANZECC (2000) default guideline trigger value for protection of aquatic ecosystems (0.055 mg/L for pH > 6.5), with a median concentration of 1.47 mg/L. Similarly, the data also indicates elevated zinc, relative to the ANZECC (2000) default guideline trigger value for protection of aquatic ecosystems (0.008 mg/L) with a median value of 0.024 mg/L.

It is recommended that the completion criteria for water quality in Sediment Dam A be updated and approved by relevant authorities

4.2.1.3 Sediment Dam B

The water quality of Sediment Dam B is similar to that of Sediment Dam A. As discussed in Section 4.1.1.2, the Sediment Dam B catchment has generally been well rehabilitated however some small isolated areas of exposed soils were observed including an area above the access track.

From the data presented in Table 13, TSS at the dam is only very slightly higher than the TSS value recorded in the downstream Scotch Dairy Creek. As such, sediment loads in the Sediment Dam B catchment are generally considered to be similar to that found in the surrounding virgin land (i.e. not impacted by mining but containing dispersive soils). It is noted that the median TSS concentration of 31 mg/L is low. As such, it is considered likely that Sediment Dam B will meet TSS closure criteria requirements.

Salinity in Sediment Dam B is considered to be low.

The dam water quality data also indicates several low readings of pH and some elevated concentrations of aluminium, chromium, lead and zinc relative to the ANZECC (2000) default guideline trigger values for protection of aquatic ecosystems. Although the water quality data is generally in accordance with the ANZECC (2000) guidelines for stock water use, it is recommended that the completion criteria for water quality in Sediment Dam B be updated and approved by relevant authorities

4.2.1.4 Sediment Dam C

As discussed in Section 4.1.1.3, the rehabilitated upslope catchment of Sediment Dam C was very good with no significant areas of exposed soils or erosion. From the data presented in Table 13, TSS at the dam is only very slightly higher than the TSS value recorded in the downstream Scotch Dairy Creek. As such, sediment loads in the Sediment Dam C catchment are generally considered to be similar to that found in the surrounding virgin land (i.e. not impacted by mining but containing dispersive soils). It is noted that the median TSS concentration of 28 mg/L is below the EPL 11080 requirement. As such, it is considered likely that Sediment Dam C will meet TSS closure criteria requirements.

Salinity in Sediment Dam C is considered to be low.

The dam water quality data includes low readings of pH and some elevated concentrations of aluminium, chromium, copper and zinc relative to the ANZECC (2000) default guideline trigger values for protection of aquatic ecosystems. The 20^{th} percentile pH value of 5.7 is low (acidic). It is noted that low pH values have been reported for local streams at upstream sampling sites.

It is recommended that the completion criteria for water quality in Sediment Dam C be updated and approved by relevant authorities

4.2.1.5 Sediment Dam D

As discussed in Section 4.1.1.4, the rehabilitation of the Sediment D catchment has been very successful with very minimal areas lacking vegetation coverage. The Sediment D catchment does include a section of the powerline easement which includes a slightly eroded access track which could be contributing additional sediment to the dam. This sediment would likely be insignificant with respect to the overall catchment area and SLR were advised that this area is managed by Transgrid and out of Donaldson Coal's control.

From the data presented in Table 13 Sediment Dam D will likely meet TSS closure criteria requirements. The dam has near neutral pH although some outlier pH values have been recorded. Salinity in Sediment Dam D is considered to be low.

The dam water quality data also indicates some elevated concentrations of aluminium, chronium, copper and zinc relative to the ANZECC (2000) default guideline trigger values for protection of aquatic ecosystems. Although the water quality data is generally in accordance with the ANZECC (2000) guidelines for stock water use, it is recommended that the completion criteria for water quality in Sediment Dam D be updated and approved by relevant authorities.

4.2.1.6 Sediment Dam E

As discussed in Section 4.1.1.5, the upslope catchment area appears to have been rehabilitated successfully with very mature trees and vegetation. Minimal areas of exposed soils were observed in the catchment during the site inspection. All drainage channels inspected appeared to be stable with good vegetation coverage.

The water quality of Sediment Dam E is similar to that of Sediment Dam D. From the data presented in Table 13 Sediment Dam E will likely meet TSS closure criteria requirements. Some elevated turbidity has been recorded which does not seem to be correlated to the TSS data. Salinity in Sediment Dam E is considered to be low.

The dam has near neutral pH although some outlier values have been recorded.

The dam water quality data also indicates some elevated concentrations of aluminium, chronium, copper and zinc relative to the ANZECC (2000) default guideline trigger values for protection of aquatic ecosystems. Although the water quality data is generally in accordance with the ANZECC (2000) guidelines for stock water use, it is recommended that the completion criteria for water quality in Sediment Dam E be updated and approved by relevant authorities.

4.2.1.7 Teds Hole

As discussed in Section 4.1.1.6,Teds Hole has a large upslope catchment area with very well established and successful rehabilitation in the catchment. The channels that were inspected appeared to be stable with good vegetation coverage. Some isolated sections of exposed banks were observed on these channels however this was not considered to be significant or accessible enough to warrant any remediation works. The dam itself has some exposed batters but appears to be generally stable. Any sediment entering the dam from these batters would be insignificant compared to the overall dam capacity and upslope catchment area. A riser pipe outlet exists at the dam and was observed to have a stable discharge location.

From the data presented in Table 13 Teds Hole will likely meet TSS closure criteria requirements.

Water quality can be characterised as being slightly acidic, with a median pH of 6.5 and a range of 7.5 to 5.3. The median value falls within the ANZECC (2000) default guideline range for the protection of aquatic ecosystems and stock watering. The 20th percentile pH value of 6.1 is within the standard requirements.

Salinity (EC) is relatively low, with a median value of 116 µS/cm and range of 60 to 264 µS/cm.

The only notable exceedance of other parameters relative to ANZECC (2000) guideline default trigger values for the protection of aquatic ecosystems is for aluminium. This had a median concentration of 0.19 mg/L compared to a guideline default trigger value of 0.055 mg/L for pH > 6.5. This may reflect aluminium minerals attached to suspended clay particles. Aluminium concentrations have however been below or consistent with the adopted trigger value for Four Mile Creek of 0.46 mg/L

It is recommended that the completion criteria for water quality in Teds Hole be updated and approved by relevant authorities. It is noted that low pH values have been reported for local streams at upstream sampling sites.

4.2.1.8 Rumbles Dam

As discussed in Section 4.1.1.7, upslope catchment areas are generally well rehabilitated with good vegetation coverage. Based on the contour banks observed they are generally stable with good vegetation coverage. Eroded flow paths were however observed both upstream and downstream of the dam. An upslope drainage channel is located within the powerline easement. Significant areas surrounding this channel are exposed with dispersive soils. The channel is also actively eroding with little vegetation present and is very incised (with vertical 2m batters) due to the dispersive soils present.

When assessing water quality from the Rumbles Dam that overflows would be conveyed to Sediment Dam E and not directly offsite.

From the data presented in Table 13 the Rumbles Dam will likely meet TSS closure criteria requirements although upslope rehabilitation works are recommended. Some elevated turbidity has been recorded which does not seem to be correlated to the TSS data. The dam has near neutral pH although some outlier pH values have been recorded. Salinity in the Rumbles Dam is considered to be low.

Like several of the other sediment dams, the water quality data indicates some elevated concentrations of aluminium, chronium, copper and zinc relative to the ANZECC (2000) default guideline trigger values for protection of aquatic ecosystems. The water quality data is generally in accordance with the ANZECC (2000) guidelines for stock water use. In addition, it is noted that the dam is an internal dam and does not overflow directly offsite.

4.2.2 Compatibility with Proposed Final Land Use

As previously stated , the sediment dams will remain post-mining and will primarily be used as a stock and fauna water source (HEC, 2020). The stability of these dams appears to be appropriate for this purpose provided the significant gully erosion downslope of Sediment Dam E and the Rumbles Dam is successfully remediated.

Slightly elevated TSS water quality in Sediment Dams A, B and C may be attributed to some minor and isolated areas of exposed soils in the catchment and within the conveyance channels. However, the extent of these disturbances was not considered to be significantly worse than the virgin bushland areas at the site. In addition, any remediation works would likely do more harm than good to the established rehabilitation in the majority of areas.

The water quality data is generally in accordance with the ANZECC (2000) guidelines for stock water use and therefore primarily compatible the goals of the final land use. However, it is recommended that the completion criteria for water quality in the dams be updated and approved by relevant authorities.

4.2.3 Maximum Harvestable Rights

The maximum harvestable right dam capacity (MHRDC) licensing requirement details the maximum volume of water which can be legally harvested and used from rainfall/runoff on Donaldson Coal land owned by Yancoal. Sediment dams are considered pollution control dams and can therefore be considered as exempt from harvestable right calculations under the NSW Farm Dams Policy 1999. The purpose of the above-mentioned dams is to prevent the contamination of downstream waterways from pollutants. However, the dams may no longer be exempt once the site has been successfully rehabilitated and the primary purpose of the dams is as a stock and fauna water source.

SLR previously consulted with the Natural Resources Access Regulator (NRAR) / DPI Lands and Water and was advised that the area of final voids does not contribute to the area contributing to the MHRDC. Based on this correspondence and the MHRDC advice from previous NSW mine closure projects SLR understands that the volume of the final voids at the Square Pit, West Pit and Big Kahuna water storages are exempt from the MHRDC calculations.

Donaldson Coal own 763.2 ha of land to the north of John Renshaw Drive. This land area excludes the Square Pit, West Pit and Big Kahuna final void catchment areas (combined area of 67.5 ha). From the DPI Water's online calculation tool, the area of this land equates to a MHRDC of 68.69 ML (refer to Appendix D).

Dams constructed prior to 1 January 1999 do not require licences, provided these dams are only used for stock and domestic watering purposes and are located on a minor stream. SLR were advised that the seven dams listed in Section 1 were all constructed after the year 2000 and contribute to the MHRDC calculations. The storage capacity of some of these dams is unknown but they have an estimated combined capacity of 63.39 ML (based on a combination of known dam storage volumes and estimates based on dam surface areas and observations made during the site inspection). This 63.39 ML estimated combined dam capacity is just below the MHRDC volume of 68.69 ML.

As such, specific licensing relating to MHRDC is not expected to be required as no new dams are proposed at the site for the specific purposes of harvesting water. Although specific MHRDC dam licensing is considered to be unlikely, consultation will be required with WaterNSW / NRAR to confirm specific licensing requirements. If specific licensing is required then the option of filling in dams may be explored. Further information which may be required to inform these discussions with WaterNSW / NRAR include the following:

- Survey of all dams with unknown storages capacities to determine the total water storage capacity post closure; and
- Confirmation from DPI Water that final voids are exempt from the MHRDC calculations and that the Donaldson Coal owned land to the south of John Renshaw Drive does not contribute to the MHRDC volume.

5 Conclusions and Recommendations

5.1 Conclusions

A number of conclusions can be drawn from this investigation into the water quality of the Donaldson Coal sediment dams. These include the following:

- Exposed dispersive soil is contributing directly to the elevated turbidity / suspended solids in the sediment dams. Dispersion is driven by elevated magnesium in the soil. The extent of this dispersive soil exposure was not considered to be significantly worse than the virgin bushland areas at the site.
- The sediment dams and conveyance channels were observed to be generally stable. Vegetation has not been established on some of the dam and channel batters however, this is not expected to contribute significant sediment loads to warrant further rehabilitation works.
- Rehabilitation at the site has generally been very successful with only isolated small areas of the exposed soil observed. The extent of this disturbance was not considered to be significantly worse than the virgin bushland areas at the site.
- Generally, the water quality in the dams is similar to that found in the surrounding virgin land (i.e. not impacted by mining but containing dispersive soils) and downslope creek systems. Sediment loads reporting to Sediment Dams A, B and C could be improved by rehabilitating all the minor and isolated areas of exposed soils in the catchment and within the conveyance channels however, these remediation works would likely do more harm than good to the established rehabilitation in the majority of areas.
- All of the sediment dams have sufficient capacity to manage runoff from the upslope catchment area. Based on the results, Sediment Dams D and E are the dams that are likely to overflow the most frequently.
- Conveyance channel CC8 and the Sediment Dam E spillway are currently undersized to manage flows during a 100 year ARI rainfall event.
- Several eroded areas exist at the site and require remediation. The main areas of concern are located downstream of Sediment Dams E and the Rumbles Dam which contain significant gully erosion.
- Specific licensing relating to MHRDC is not expected to be required as no new dams are proposed at the site for the specific purposes of harvesting water. Although specific MHRDC dam licensing is considered to be unlikely, consultation will be required with WaterNSW / NRAR to confirm specific licensing requirements. If specific licensing is required then the option of filling in dams may be explored.

5.2 Recommendations

Based on the outcomes of the dam construction materials and functional requirements assessments SLR recommends the following:

- It is recommended that the completion criteria for water quality in the sediment dams be updated and approved by relevant authorities.
- Where future stabilisation and rehabilitation works are undertaken the soil shall be ameliorated with lime to increase the exchangeable Ca concentration which would in turn improve the Ca/Mg ratio. Applications of additional phosphorus and nitrogen should be avoided to reduce the potential runoff into the dams.

- Donaldson Coal engage a suitably qualified geomorphologist (e.g. the Soil Conservation Service) to assess and design a suitable remediation strategy for the large gully erosion downstream of Sediment Dam E and the Rumbles Dam.
- Remediate (i.e. backfill with suitable non-dispersive material and seed) the minor erosion in the contour bank immediately upstream of Sediment Dam A. This remediation should be undertaken without the use of heavy machinery to prevent disturbance of the established rehabilitation.
- Liaise with Transgrid regarding the existing erosion in the powerline easement, especially regarding rehabilitation and armouring works of the heavily eroded channel (refer to CC8 recommendations below) and the surrounding area upslope from the Rumbles Dam.
- Consult with Transgrid to upgrade CC8 with the following design parameters:
    - Minimum base width = 4m;
    - Minimum batter slope =3 (H):1 (V);
    - Minimum channel depth = 1m; and
    - Lining with non-dispersive soil and either Landlok 450 erosion matting or jute mesh.
- Sediment Dam E augmentation works including:
    - Removing the side vertical walls and replace with 3 (H):1 (V) batters (if possible).
    - Increasing the spillway depth to 1.3m (if possible) to increase the freeboard available during overflow events.
    - Lining the spillway with geofabric and rock (D50 = 150mm) to protect the spillway in the immediate vicinity of the dam embankment from the estimated shear stresses during overflow events.

  It is envisaged that these works would be undertaken at the same time as the remediation of the downstream gully erosion.
- Rehabilitate (i.e. rip, topsoil and seed) the area of exposed soil immediately prior to the Teds Hole dam spillway.
- Consider treating the areas of exposed dispersive soils on the edge of sediment dams which may marginally improve turbidity in dams. This may involve covering with a blanket of non-dispersive granular soil such as loam and seeding with suitable vegetation.
- Liaise with WaterNSW / NRAR regarding harvestable rights at the site. Discussions should include confirmation that final voids are exempt from the MHRDC calculations and that the Donaldson Coal owned land to the south of John Renshaw Drive does not contribute to the MHRDC volume.

6 References

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APPENDIX A

Water Laboratory Certificates

CERTIFICATE OF ANALYSIS

Work Order	: **ES2109997**	Page	: 1 of 6
Client	: **CBASED ENVIRONMENTAL PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: All Deliverables	Contact	: Helen Simpson
Address	: Unit 3 2 Enterprise Cres Singleton NSW 2330	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: +61 02 6571 3334	Telephone	: +61 2 8784 8555
Project	: DONALDSON SW	Date Samples Received	: 19-Mar-2021 16:01
Order number	: ----	Date Analysis Commenced	: 19-Mar-2021
C-O-C number	: ----	Issue Date	: 26-Mar-2021 15:54
Sampler	: ALEX SMITH		
Site	:		
Quote number	: SYBQ/403/18 - COMPASS		
No. of samples received	: 16		
No. of samples analysed	: 16		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Neil Martin	Team Leader - Chemistry	Chemistry, Newcastle West, NSW

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- TDS by method EA-015 may bias high for various samples due to the presence of fine particulate matter, which may pass through the prescribed GF/C paper.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	TEDS HOLE	SEDIMENT DAM A	SEDIMENT DAM B	SEDIMENT DAM C	SEDIMENT DAM D
			Sampling date / time	19-Mar-2021 12:15	19-Mar-2021 10:55	19-Mar-2021 11:30	19-Mar-2021 11:40	19-Mar-2021 14:00
Compound	CAS Number	LOR	Unit	ES2109997-001	ES2109997-002	ES2109997-003	ES2109997-004	ES2109997-005
				Result	Result	Result	Result	Result
EA005: pH								
pH Value	----	0.01	pH Unit	**5.96**	**5.74**	**5.62**	**5.09**	**5.95**
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**59**	**168**	**172**	**143**	**124**
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**94**	**203**	**258**	**184**	**162**
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	**32**	**27**	**37**	**39**	**20**
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**4**	**20**	**12**	**12**	**9**
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	<0.01	**0.06**	<0.01	<0.01
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**0.4**	**0.8**	**1.2**	**0.9**	**0.8**
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ Total Nitrogen as N	----	0.1	mg/L	**0.4**	**0.8**	**1.3**	**0.9**	**0.8**
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.03**	**0.05**	**0.07**	**0.08**	**0.06**
EP008: Chlorophyll a & Pheophytin a								
Chlorophyll a	----	1	mg/m³	**4**	<1	<1	**1**	<1

Analytical Results

Sub-Matrix: WATER
(Matrix: WATER)

Compound	CAS Number	LOR	Unit	SEDIMENT DAM E	RUMBLES DAM	WEST PIT	SQUARE PIT	FMCD
Sampling date / time				19-Mar-2021 14:10	19-Mar-2021 14:55	19-Mar-2021 09:50	19-Mar-2021 10:00	19-Mar-2021 10:30
				ES2109997-006	ES2109997-007	ES2109997-008	ES2109997-009	ES2109997-010
				Result	Result	Result	Result	Result
EA005: pH								
pH Value	----	0.01	pH Unit	6.72	6.88	7.03	7.75	6.91
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	133	176	498	795	249
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	176	154	356	520	214
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	10	22	98	16	27
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	18	10	164	245	1
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	<0.01	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.7	0.7	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ Total Nitrogen as N	----	0.1	mg/L	0.7	0.7	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	0.06	0.02	----	----	----
EP008: Chlorophyll a & Pheophytin a								
Chlorophyll a	----	1	mg/m³	<1	4	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	SDCU	SDCD	WFCD	SDCD RSS1	SDCD RSS2
			Sampling date / time	19-Mar-2021 11:10	19-Mar-2021 12:50	19-Mar-2021 13:30	19-Mar-2021 12:55	19-Mar-2021 13:00
Compound	CAS Number	LOR	Unit	ES2109997-011	ES2109997-012	ES2109997-013	ES2109997-014	ES2109997-015
				Result	Result	Result	Result	Result
EA005: pH								
pH Value	----	0.01	pH Unit	5.31	5.33	4.76	5.55	5.65
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	183	165	230	176	163
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	258	249	278	435	231
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	12	387	18	92	60
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	7	5	8	9	7

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	SDCD RSS3	----	----	----	----
			Sampling date / time	19-Mar-2021 13:05	----	----	----	----
Compound	CAS Number	LOR	Unit	ES2109997-016	--------	--------	--------	--------
				Result	----	----	----	----
EA005: pH								
pH Value	----	0.01	pH Unit	**5.32**	----	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**134**	----	----	----	----
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**182**	----	----	----	----
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	**35**	----	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	----	----	----	----

Inter-Laboratory Testing

Analysis conducted by ALS Newcastle - Water, NATA accreditation no. 825, site no. 1656 (Chemistry) 9854 (Biology).

(WATER) EA005: pH

APPENDIX B

Soil and Water Analysis

Dam	Sample Site ID	pH (H_2O)		ECe dS/m		EAT		CEC meq/kg	
		Value	Rating	Value	Rating	Score	Rating	Value	Rating
Sediment Dam A	D1	5.3	Strongly Acidic	1.7	Non-Saline	3	Dispersive on remoulding	8	Low
Sediment Dam A	D1b	5.7	Moderately Acidic	0.6	Non-Saline	4	Not dispersive	14.1	Moderate
Sediment Dam A	D2	5.6	Moderately Acidic	0.5	Non-Saline	2	Moderately to slightly dispersive	10.6	Low
Sediment Dam B	D3	5.7	Moderately Acidic	0.3	Non-Saline	2	Moderately to slightly dispersive	6.8	Low
Sediment Dam B	D3b	5.3	Strongly Acidic	0.6	Non-Saline	3	Dispersive on remoulding	13.5	Moderate
Sediment Dam C	D4	5.1	Strongly Acidic	0.7	Non-Saline	4	Not dispersive	13.6	Moderate
Teds Hole	D5	5.3	Strongly Acidic	0.3	Non-Saline	2	Moderately to slightly dispersive	8.6	Low
Teds Hole	D5b	5.0	Very Strongly Acidic	0.4	Non-Saline	2	Moderately to slightly dispersive	11.4	Low
Teds Hole	D5c	4.9	Very Strongly Acidic	0.3	Non-Saline	4	Not dispersive	12.8	Moderate
Sediment Dam D	D6	5.3	Strongly Acidic	0.2	Non-Saline	2	Moderately to slightly dispersive	2.7	Very Low
Sediment Dam D	D6b	5.4	Strongly Acidic	0.5	Non-Saline	2	Moderately to slightly dispersive	12.8	Moderate
Sediment Dam E	D7b	5.2	Strongly Acidic	0.3	Non-Saline	3	Dispersive on remoulding	1.8	Very Low
Rumbles Dam	D8	5.3	Strongly Acidic	1	Non-Saline	2	Moderately to slightly dispersive	16.3	Moderate
Rumbles Dam	D9	5.0	Strongly Acidic	0.6	Non-Saline	4	Not dispersive	7.1	Low
Natural Subsoil	Natural Subsoil	4.4	Very Strongly Acidic	0.6	Non-Saline	4	Not dispersive	14.1	Moderate

Dam	Sample Site ID	Ca/Mg		Base Status		Exchangeable cations (percentage)				
						Ca	Mg	K	Na (ESP)	
		ratio	Rating	ratio	Rating	value	value	value	Value	Rating
Sediment Dam A	D1	0.7	Ca Deficient	78.8	High	27.5	41.8	2.7	6.7	Marginally Sodic
Sediment Dam A	D1b	0.3	Ca Deficient	89.7	Very high	21.5	62	2.2	4	Non Sodic
Sediment Dam A	D2	0.4	Ca Deficient	82.7	Very high	20.5	54.8	2.5	4.9	Non Sodic
Sediment Dam B	D3	0.3	Ca Deficient	84.5	Very high	16.3	59.6	4.2	4.4	Non Sodic
Sediment Dam B	D3b	0.1	Ca Deficient	81.7	Very high	4.6	67.3	4.2	5.5	Non Sodic
Sediment Dam C	D4	0.1	Ca Deficient	61.2	High	5.9	48.2	2.9	4.3	Non Sodic
Teds Hole	D5	0.2	Ca Deficient	57.9	Moderate	7.4	45.4	2.1	3	Non Sodic
Teds Hole	D5b	0.1	Ca Deficient	60.2	High	2.8	53	3.4	1	Non Sodic

Dam	Sample Site ID	Ca/Mg		Base Status		Exchangeable cations (percentage)				
						Ca	Mg	K	Na (ESP)	
		ratio	Rating	ratio	Rating	value	value	value	Value	Rating
Teds Hole	D5c	0.02	Ca Deficient	27.9	Low	0.5	24.9	1.3	1.1	Non Sodic
Sediment Dam D	D6	0.3	Ca Deficient	41.5	Moderate	10.4	31	4.4	2.3	Non Sodic
Sediment Dam D	D6b	0	Ca Deficient	67.2	High	0.4	56	2.7	8.1	Marginally Sodic
Sediment Dam E	D7b	1.7	Ca Low	34.2	Low	15.5	9.1	9.6	2.1	Non Sodic
Rumbles Dam	D8	0	Ca Deficient	66.4	High	0.3	47.8	3.4	14.9	Strongly Sodic
Rumbles Dam	D9	0.1	Ca Deficient	32.5	Low	1.5	24	1.9	5	Non Sodic
Natural Subsoil	Natural Subsoil	0.5	Ca Deficient	12.1	Very Low	3.1	6.0	1.4	1.5	Non Sodic

pH	
Range	Rating
>9.0	Very strongly alkaline
9.0-8.5	Strongly alkaline
8.4-7.9	Moderately alkaline
7.8-7.4	Mildly alkaline
7.3-6.6	Neutral
6.5-6.1	Slightly acid
6.0-5.6	Moderately acid
5.5-5.1	Strongly acid
<5	Very strongly acid

APPENDIX C

Site Photos

Plate 1 – Sediment Dam A Upslope Channel

Plate 2 – Sediment Dam A Upslope Channel

Plate 3 – Sediment Dam A Upslope Channel

Plate 4 – Sediment Dam A Upslope Channel

Plate 5 – Sediment Dam A Upslope Channel

Plate 6 – Sediment Dam A


Plate 7 – Sediment Dam A


Plate 8 – Sediment Dam A


Plate 9 – Sediment Dam A


Plate 10 – Sediment Dam A


Plate 11 – Sediment Dam A Spillway


Plate 12 – Sediment Dam A Spillway

Plate 13 – Sediment Dam A Spillway

Plate 14 – Sediment Dam A Spillway

Plate 15 – Sediment Dam A Downslope of Spillway

Plate 16 – Sediment Dam B

Plate 17 – Sediment Dam B

Plate 18 – Sediment Dam B Spillway

Plate 19 – Sediment Dam B Spillway

Plate 20 – Sediment Dam B Downslope of Spillway

Plate 21 – Sediment Dam B

Plate 22 – Sediment Dam B

Plate 23 – Sediment Dam B

Plate 24 – Sediment Dam B

Plate 25 – Small Disturbance Area in Sediment Dam B Catchment

Plate 26 – Sediment Dam C

Plate 27 – Sediment Dam C

Plate 28 – Sediment Dam C

Plate 29 – Sediment Dam C Spillway

Plate 30 – Sediment Dam C Downslope of Spillway

Plate 31 – Channel Upslope of Sediment Dam C

Plate 32 – Channel Upslope of Sediment Dam C

Plate 33 – Teds Hole

Plate 34 – Teds Hole

Plate 35 – Teds Hole

Plate 36 – Teds Hole Spillway

Plate 37 – Teds Hole Spillway

Plate 38 – Teds Hole Downslope of Spillway

Plate 39 – Teds Hole Downslope of Spillway

Plate 40 – Teds Hole Downslope of Spillway

Plate 41 – Teds Hole

Plate 42 – Teds Hole

Plate 43 – Teds Hole

Plate 44 – Teds Hole

Plate 45 – Teds Hole

Plate 46 – Channel Upslope of Teds Hole

Plate 47 – Channel Upslope of Teds Hole

Plate 48 – Channel Upslope of Teds Hole

Plate 49 – Powerline Easement Upslope of Sediment Dam D

Plate 50 – Powerline Easement Upslope of Sediment Dam D

Plate 51 – Sediment Dam D

Plate 52 – Sediment Dam D

Plate 53 – Sediment Dam D

Plate 54 – Sediment Dam D


Plate 55 – Sediment Dam D


Plate 56 – Sediment Dam D


Plate 57 – Sediment Dam D


Plate 58 – Sediment Dam D


Plate 59 – Sediment Dam D Spillway


Plate 60 – Sediment Dam D Spillway

	
Plate 61 – Sediment Dam D Spillway	Plate 62 – Sediment Dam D Spillway
	
Plate 63 – Sediment Dam D Spillway	Plate 64 – Channel Upslope of Sediment Dam D
	
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Plate 72 – Contour Bank Upslope of Sediment Dam D

Plate 73 – Sediment Dam E

Plate 74 – Sediment Dam E

Plate 75 – Sediment Dam E

Plate 76 – Sediment Dam E

Plate 77 – Sediment Dam E Spillway

Plate 78 – Sediment Dam E Spillway

Plate 79 – Sediment Dam E Spillway

Plate 80 – Sediment Dam E Spillway

Plate 81 – Erosion Downslope of Sediment Dam E

Plate 82 – Erosion Downslope of Sediment Dam E

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Plate 91 – Channel Upslope of Sediment Dam E

Plate 92 – Eroded Channel Upslope of Rumbles Dam

Plate 93 – Eroded Channel Upslope of Rumbles Dam

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Plate 113 – Contour Bank Upslope of Rumbles Dam

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APPENDIX D

Maximum Harvestable Rights Dam Calculations

WaterNSW

Maximum Harvestable Right Dam Capacity

Information provided by the user

1. The location of the proposed dam is:

- Latitude: **-32.810551**
- Longitude: **151.610243**

2. Total property area to use for calculating the size of the dam is **763.2 Hectares**

Result

The maximum Harvestable right dam capacity for your property is **68.688** ML (Megalitres)

Date

22/02/2021

Name

Duncan Barnes

Limitations of the calculator

a) Where to site a dam

You can only construct a harvestable rights dam where the Harvestable Rights Orders apply, refer to NSW Government Gazette 40 dated 31 March 2006 (pages 1628 to 1631).

b) First and Second order streams

The maximum harvestable right calculator does not verify that the location of the proposed dam sits on a first or second order stream. A factsheet : "Where can they be built without a licence?" is available on WaterNSW website to help you work out the stream orders.

You will need to use the legislated topographic map for your area to identify the stream order. This map is the gazetted map as per NSW Government Gazette 37 dated 24 March 2006 (pages 1500-1509).

c) Size of property and dam

The calculator does not take into account other dams already on your property. If you have existing harvestable rights dams on your property, you must take the capacity of these dams into account when constructing a new dam. In the Eastern and Central Divisions other dams must also be taken into account, as described in the NSW Government Gazette 40 dated 31 March 2006 (pages 1628 to 1631).

d) Protected wetlands

The Harvestable Rights Orders specify that you are not allowed to build a dam on or within 3 km of a RAMSAR wetland site. There are 12 RAMSAR wetlands in NSW. Further information on the location of those 12 RAMSAR sites in NSW can be found on the NSW Environment and Heritage government website.

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Appendix 2

Closure Strategy for the West and Square Pits

(Total No. of pages including blank pages = 150)

ABEL UNDERGROUND MINE AND DONALDSON OPEN CUT MINE

CLOSURE STRATEGY FOR THE WEST AND SQUARE PITS

AUGUST 2020
Project No. DCL-20-06
Document No. 01045064

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1 INTRODUCTION

1.1 BACKGROUND

The Abel Underground Mine and the Donaldson Open Cut Mine (the Donaldson Mine) are owned and operated by Donaldson Coal Pty Limited (Donaldson Coal), a wholly owned subsidiary of Yancoal Australia Limited.

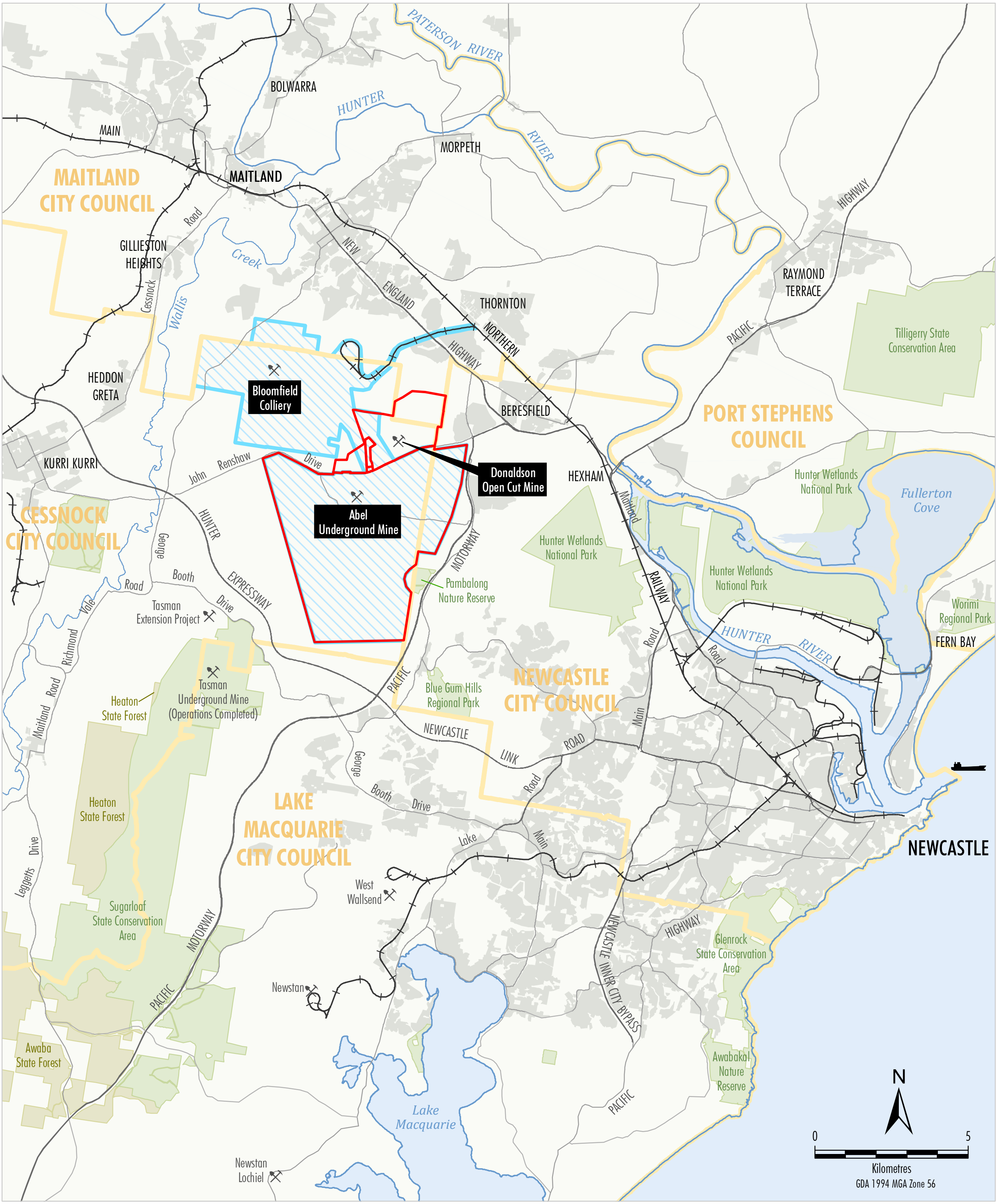
The Abel Underground Mine is located approximately 23 kilometres (km) north-west of the Port of Newcastle in New South Wales (NSW) (Figure 1). The Donaldson Mine is located immediately north of the Abel Underground Mine (Figures 1 and 2).

Development Consents DA 98/01173 and DA 118/698/22 for the Donaldson Mine were granted by the Minister for Urban Affairs and Planning under the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) in December 1999. Development of the Donaldson Mine within Mining Lease (ML) 1461 commenced in January 2001 and involved mining of the Donaldson Open Cut Pit, the West Pit and Square Pit. Mining operations at the Donaldson Mine ceased in April 2013. Rehabilitation works involving backfilling and revegetation of the Donaldson Open Cut Pit and mine disturbance areas were completed in March 2014. The West and Square Pits are approved for use as part of Abel Underground Mine operations (under Project Approval 05_0136), with the Square Pit approved for tailings disposal and/or mine water storage and the West Pit approved as a mine water storage. The Donaldson Mine is currently under care and maintenance.

Project Approval 05_0136 for the Abel Underground Mine was granted in 2007 under the EP&A Act, and approves mining operations until the end of December 2030. Development of the Abel Underground Mine occurs within ML 1618. The Abel Box Cut (surface entry to the Abel Underground Mine) occurs at the south-western extent of the Donaldson Mine West Pit (Figures 2 and 3). Run-of-Mine (ROM) coal from the ROM coal stockpile, located within the Abel Box Cut, is approved to be transported via internal sealed roads to the Bloomfield Coal Handling and Preparation Plant (CHPP) (Figure 2). ROM coal is also approved to be transported by overland conveyor from the ROM coal stockpile to the Bloomfield CHPP. The *Abel Upgrade Modification Environmental Assessment* (Donaldson Coal, 2012) describes the currently approved project. The Abel Underground Mine was placed in care and maintenance in early 2016.

An aerial view of the West and Square Pits in June 2020 is shown on Figure 3. Approximately half of the West Pit has been re-profiled, with the southern and western highwalls retained (Figure 3). Access to the Abel Underground Mine portal and underground areas has been secured (as part of care and maintenance operations), however remains accessible to authorised personnel for inspection and maintenance activities. The West Pit currently stores a small volume of runoff water (Figure 3) from the adjacent surface infrastructure areas. West Pit water is transferred on an as needs basis to the Donaldson Mine Big Kahuna Dam for operational use, such as dust suppression, or is transferred to Lake Kennerson for use at the Bloomfield Colliery or, when conditions permit, discharged to Four Mile Creek (in accordance with the Donaldson Mine Environment Protection Licence [EPL] 11080).

A small area at the northern extent of the Square Pit has been re-profiled (Figure 3). Water stored in the Square Pit's southern extent comprises incident rainfall and catchment water only. Square Pit water is also transferred on an as needs basis to the Donaldson Mine Big Kahuna Dam for operational use, as described above.



LEGEND
- Mining Lease Boundary
- Approved Abel Underground Mine Area
- Existing/Historic Coal Mine
- Local Government Boundary
- Built-up Area
- National Park, State Conservation Area or Nature Reserve
- State Forest

Source: NSW Spatial Services (2020)

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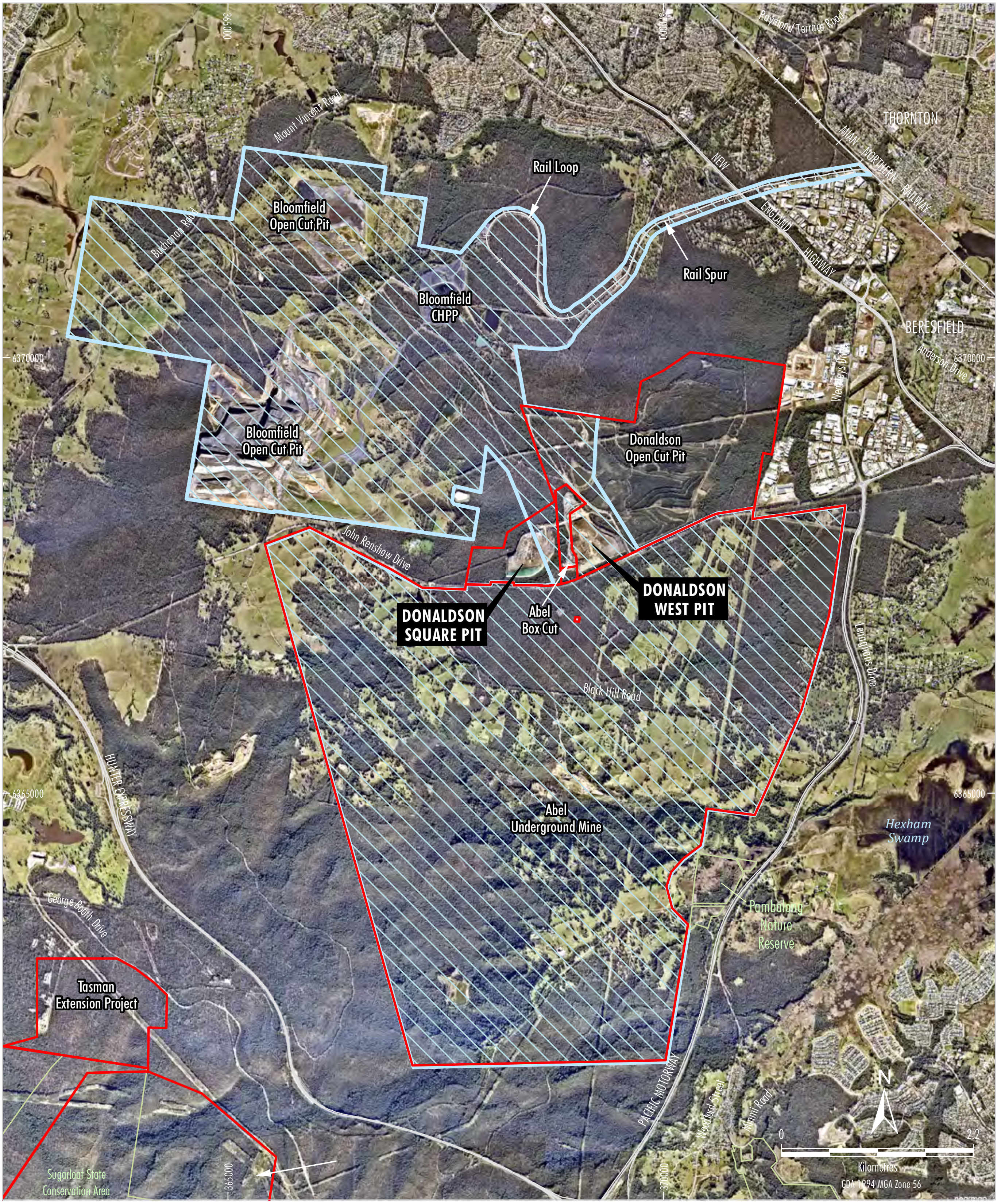
WEST AND SQUARE PITS CLOSURE STRATEGY

Regional Location

Figure 1



LEGEND

- Mining Lease Boundary
- State Conservation Area or Nature Reserve
- Approved Abel Underground Mine Area

Source: Donaldson Coal Pty Ltd (2016); NSW Spatial Services (2020)
Orthophoto: Nearmap (Jun 2020)

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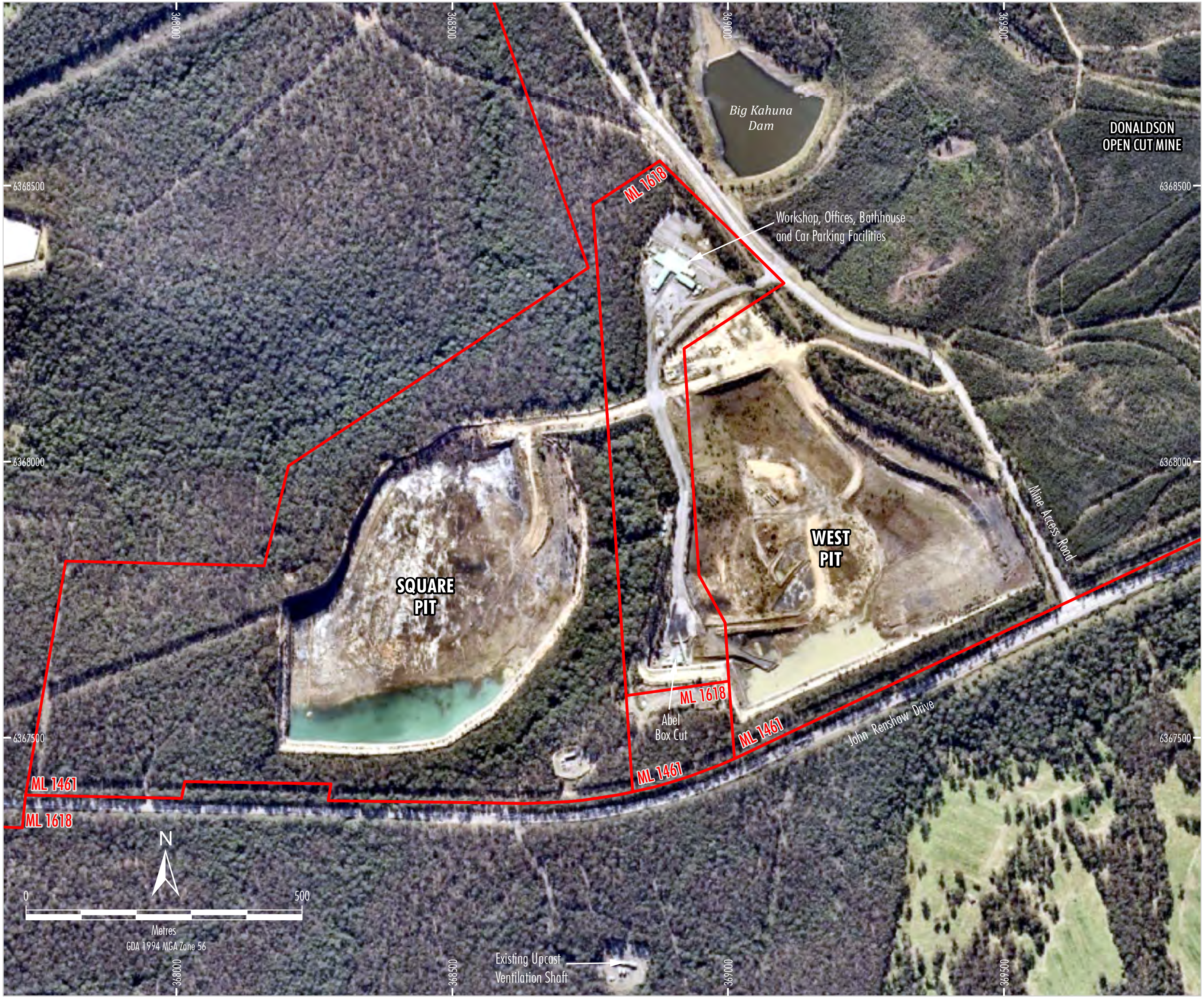
WEST AND SQUARE PITS CLOSURE STRATEGY

Approved Abel Underground Mine and Donaldson Open Cut Mine

Figure 2



LEGEND
ML 1461 (Surface Mining Lease)
ML 1618 (Underground Mining Lease)

Source: NSW Spatial Services (2020)
Orthophoto: Nearmap (Jun 2020)

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WEST AND SQUARE PITS CLOSURE STRATEGY

Status of West and Square Pits (June 2020)

Figure 3

DCL-20-06_ADCS_2020D

An Integrated Mine Closure Plan was prepared for the Abel Underground Mine and Donaldson Mine in 2008 in accordance with the requirements of the Project Approval (05_0136) at the time. The Integrated Mine Closure Plan is provided in Appendix 5 of the Donaldson Open Cut and Abel Underground Coal Mines Landscape Management Plan. The Integrated Mine Closure Plan describes closure concepts, objectives and decommissioning and rehabilitation works, including final void rehabilitation and infrastructure removal activities, for three closure scenarios associated with the Abel Underground Mine and Donaldson Mine. The Donaldson Open Cut and Abel Underground Coal Mines Landscape Management Plan also includes a Final Void Management Plan (as Appendix 4 to the plan) which includes potential final land use options for the West and Square Pits.

1.2 PURPOSE AND SCOPE OF THIS REPORT

The NSW Resources Regulator (under Section 240 of the NSW *Mining Act 1992*) directed Donaldson Coal to prepare a Closure Strategy for the management of the West and Square Pits in the event underground mining is either resumed at the Abel Underground Mine or the mine is closed.

The requirements for the Closure Strategy (as provided in each Section 240 Notice) are reproduced in Table 1 along with the section is this report where the requirement is addressed.

Table 1
Section 240 Notice Requirements for the Closure Strategy

Section 240 Notice Requirement	Section
Develop a Closure Strategy ("Strategy") for the management of the West (inclusive of the Abel Box Cut) and Square Pits. The Strategy is to: *i. Be developed to reflect the following different closure pathways:*	
a. The resumption of mining within the Abel Underground Mine and development of the voids;	Sections 2.1 and 3
b. The closure of the Abel Underground Mine with no resumption of mining.	Sections 2.2 and 4
ii. Include Rehabilitation Objectives and Completion Criteria for both closure pathways identified in Point (i) above.	Sections 3.4 and 4.3
iii. Include a risk assessment that identifies and assesses risks to rehabilitation that are associated with each closure pathway identified in Point (i) above. Following the risk assessment, develop control actions that are incorporated in a Trigger Action Response Plan for each closure pathway.	Sections 3.5 and 3.6 and Sections 4.4 and 4.5 and Appendix A
iv. Incorporate a timeline for completion of rehabilitation works required for each closure pathway identified in Point (i) above.	Section 3.8 and 4.7
v. Reflect Project Approval requirements, including completion of a gap analysis that assesses whether Project Approval modifications are required for intended post mining landforms.	Sections 3.9 and 4.8

This report has been prepared to address the requirements outlined above, and as such provides a Closure Strategy for the West and Square Pits for the following two closure options:

- Option 1: Resumption of Mining at the Abel Underground Mine.
- Option 2: Closure of the Abel Underground Mine, with no resumption of mining.

An overview of Closure Options 1 and 2 is described in Section 2, with Sections 3 and 4 providing a detailed consideration of Closure Options 1 and 2, respectively.

2 CLOSURE OPTIONS

2.1 CLOSURE OPTION 1 – RESUMPTION OF MINING AT ABEL UNDERGROUND MINE

Closure Option 1 for the West and Square Pits reflects the closure options as described in the approved *Abel Upgrade Modification Environmental Assessment* (Donaldson Coal, 2012) (i.e. after complete development of the Abel Underground Mine).

In summary, Closure Option 1 for the West and Square Pits will involve (after the completion of mining at the Abel Underground Mine) (Donaldson Coal, 2012):

Square Pit

Should the Square Pit be used for the storage of tailings (fine reject) material from the Bloomfield CHPP, depending on the volume of tailings required to be stored, the Square Pit will either be:

- Option 1A: a free-draining landform which drains to the surrounding natural topography (subject to suitable runoff water quality) with emplaced tailings material covered and capped with inert material, and the surface topsoiled and revegetated with grassland species; or
- Option 1B: a tailings storage and permanent water storage where tailings material has been emplaced at a lower level, and then water allowed to accumulate over the tailings material; or

Should the pit be used for the storage of mine water from the Abel Underground Mine, the pit will be dewatered with the water returned to the underground workings, and the pit then reshaped and retained as a final void for permanent water storage (Option 1C).

West Pit

During decommissioning of the Abel Underground Mine, minor volumes of underground stowage material (waste rock) will be emplaced in the West Pit. The pit will then be reshaped and retained as a final void for permanent water storage.

Closure Option 1 will also involve the decommissioning and rehabilitation of the Abel Underground Mine Box Cut (underground entry and portals) and associated surface infrastructure as described in the approved *Abel Upgrade Modification Environmental Assessment* (Donaldson Coal, 2012), and will relevantly include:

- sealing of the mine portals and removal of surface infrastructure, including workshops, bathhouse, car parking facilities, ROM coal stockpile infrastructure, conveyors and water management structures; and
- re-shaping and ripping surface disturbance areas, spreading soil and seeding with tree and cover crop species.

Some surface infrastructure that has a beneficial use post-mining (e.g. the site offices, access roads) may be retained, subject to agreement of the Executive Director of the NSW Resources Regulator, as required by Condition 27, Schedule 4, of Project Approval 05_0136.

The rehabilitation concepts, provisional objectives and completion criteria and rehabilitation activities for each final landform option associated with the Closure Option 1 are described in Section 3, as well as the studies that will be undertaken to confirm the stability and safety of the final voids in the long-term.

2.2 CLOSURE OPTION 2 – CLOSURE OF ABEL UNDERGROUND MINE

Closure Option 2 for the West and Square Pits reflects closure of the Abel Underground Mine with no resumption of mining. For this option, the final landforms of the West and Square Pits will be final voids for permanent water storage, which is consistent with the approved final landform options for the pits described in the *Abel Upgrade Modification Environmental Assessment* (Donaldson Coal, 2012).

The existing Abel Underground Mine surface infrastructure will be decommissioned, including permanently sealing of the mine portals and removal of surface infrastructure, including workshops, offices, bathhouse, car parking facilities (Figure 3) and water management structures not required for the post-mining land use.

Some surface infrastructure that has a beneficial use post-mining (e.g. the site offices, access roads) may be retained, subject to agreement of the Executive Director of the NSW Resources Regulator, as required by Condition 27, Schedule 4, of Project Approval 05_0136.

The rehabilitation concepts, provisional objectives and completion criteria, and rehabilitation activities for Closure Option 2 are described in Section 4, as well as the studies that will be undertaken to confirm the stability and safety of the final voids in the long-term.

3 CLOSURE OPTION 1 – RESUMPTION OF MINING AT ABEL UNDERGROUND MINE

3.1 FINAL LANDFORMS

Three final landform options are approved for the Square Pit depending on the use of the pit during operation of the Abel Underground Mine. The Square Pit will be either:

- a final void for tailings storage, and will either be:
  - Option 1A: a free-draining landform which drains to the surrounding natural topography (subject to suitable runoff water quality) where tailings material has been covered under a capping of inert waste rock material, and then topsoiled and revegetated with grassland species (Figure 4a); or
  - Option 1B: a tailings storage and permanent water storage where tailings material has been emplaced at a lower level, and then water allowed to accumulate over the tailings material (Figure 4b); or
- Option 1C: a final void for permanent water storage (Figure 4b).

The West Pit will be a final void for permanent water storage (Figures 4a and b).

Groundwater modelling predictions conducted by Peter Dundon and Associates Pty Ltd (2006) indicate that once water is not being actively managed on-site, water will accumulate in the West and Square Pit final voids to a maximum depth of approximately 24 metres (m) in the deepest part of the void (to a level of approximately 40 m Australian Height Datum [AHD])(Figures 4a and b).

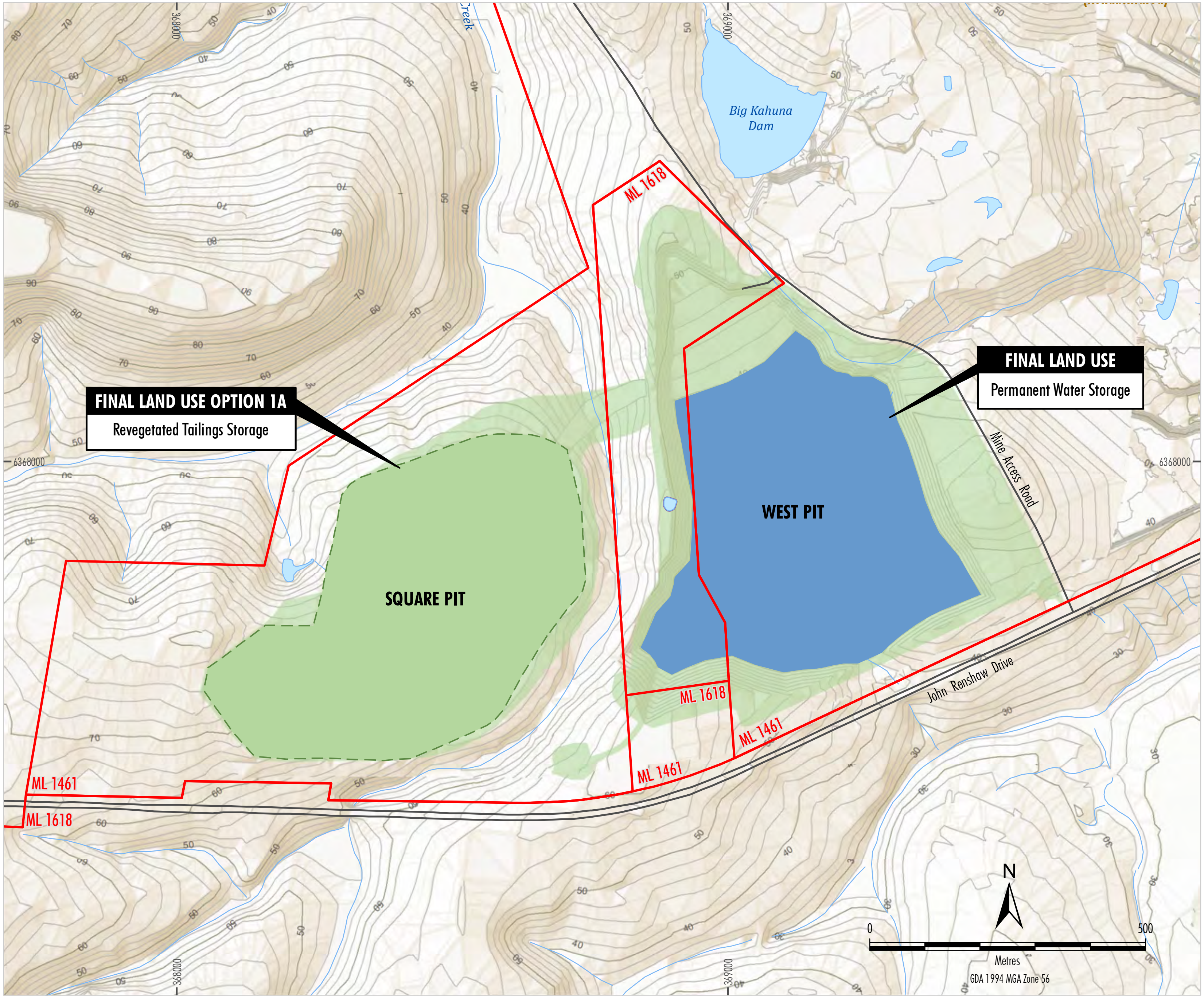
Should mining of the Abel Underground Mine resume, prior to the completion of mining, the existing groundwater model and site water balance will be reviewed to verify the predicted West and Square Pit final void recovery water level once it reaches equilibrium.

3.2 POST-MINING LAND USE

The Final Void Management Plan (provided in Appendix 4 of the *Integrated Mine Closure Plan*) describes potential uses for permanent water storage voids including use as a water supply for nearby mines or other commercial use, or use for recreation, aquaculture or as a wildlife habitat, subject to detailed studies into the suitability of the water storage void for the intended land use. As such, for the permanent water storage options for the West and Square Pits (Closure Options 1B and 1C), the potential post-mining land uses include those outlined above. Potential uses for the revegetated Square Pit (Option 1A) may include fauna habitat (i.e. woodland), recreational or industrial land uses.

The post-mining land use for the Square Pit will be confirmed once the operational use of the Square Pit (and therefore the Square Pit final landform) has been determined. As such, the Square Pit final landform (i.e. Options 1A, 1B or 1C) and post-mining land use will be described in the Abel Underground Mine Mining Operations Plan (MOP) (or Rehabilitation Management Plan) submitted to the Resources Regulator for approval prior to the re-commencement of mining. The post-mining land use for the rehabilitated Square and West Pit final voids will also be described in a revised *Integrated Mine Closure Plan* (which will be prepared closer to the time of mine closure) which will be prepared in consultation with relevant regulatory agencies including the NSW Resources Regulator, relevant local Councils and key stakeholders

A description of the rehabilitation activities that will be undertaken for each final landform option for the Square Pit and West Pit is provided below.



LEGEND

- Mining Lease Boundary
- Indicative Final Void Water Level
- Indicative Rehabilitation Area

Source: NSW Spatial Services (2020)

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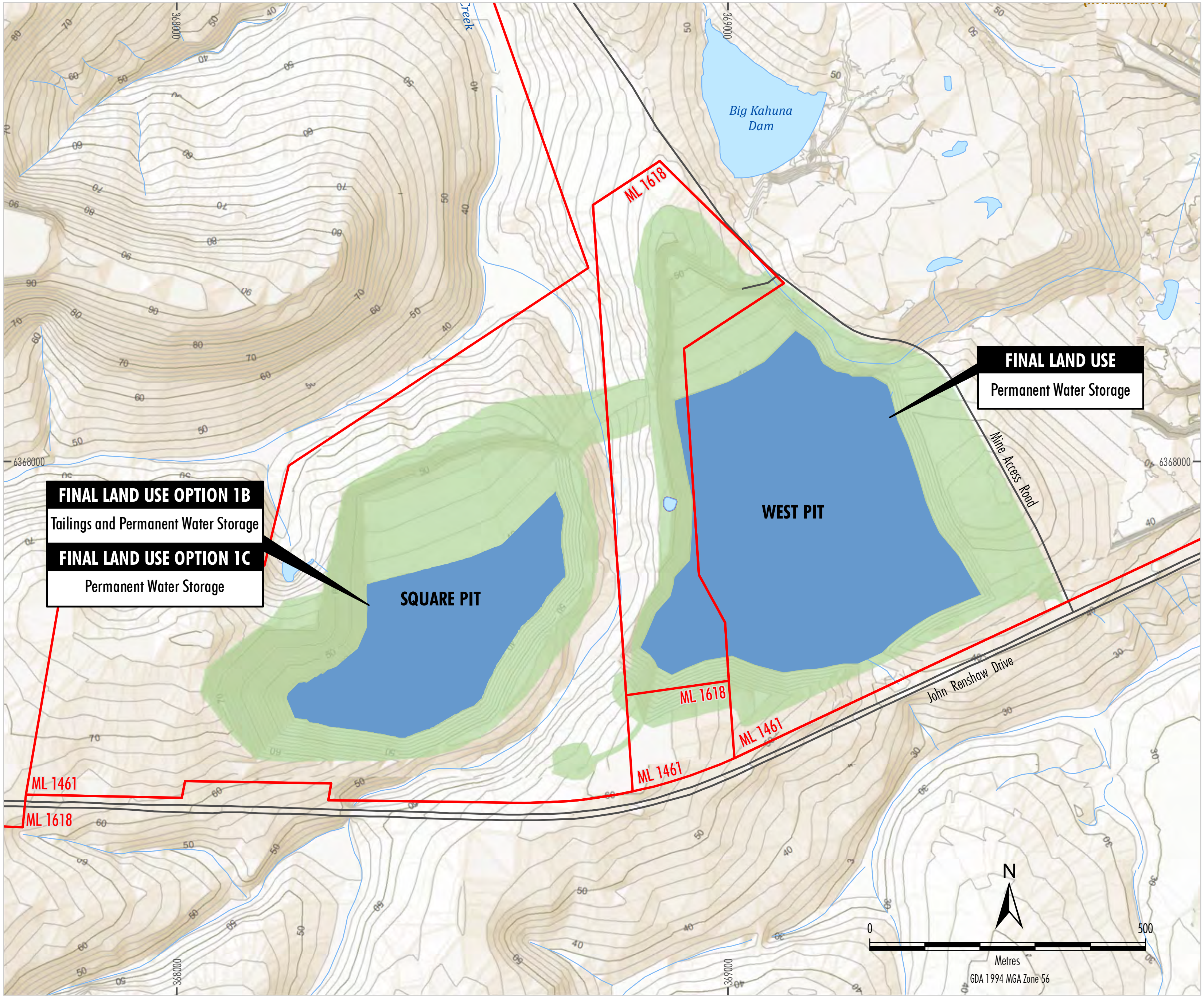
WEST AND SQUARE PITS CLOSURE STRATEGY

Closure Option 1 –
West Pit Final Land Use and
Square Pit Final Land Use Option 1A

Figure 4a

DCL-20-06_ADCS_204A



LEGEND
Mining Lease Boundary
Indicative Final Void Water Level
Indicative Rehabilitation Area

Source: NSW Spatial Services (2020)

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WEST AND SQUARE PITS CLOSURE STRATEGY

Closure Option 1 –
West Pit Final Land Use and
Square Pit Final Land Use Options 1B and 1C

Figure 4b

DCL-20-06_ADCS_206A

3.3 REHABILITATION ACTIVITIES

3.3.1 Square Pit – Revegetated Tailings Storage Option (Closure Option 1A)

A tailings balance was conducted by Evans and Peck (2012) as part of the Site Water Balance for the *Abel Upgrade Modification Environmental Assessment* (Donaldson Coal, 2012). The assessment indicated the storage capacity of the Square Pit is estimated to be 2,900 megalitres (ML).

During operation of the Abel Underground Mine, tailings will be transferred as slurry from the Bloomfield CHPP via a pipeline to the Square Pit. Once capacity is reached, any excess water will be pumped back to the Bloomfield CHPP washery for reuse.

As described in *Abel Upgrade Modification Environmental Assessment* (Donaldson Coal, 2012), the tailings disposal strategy provides that additional tailings storage capacity within the Square Pit may be required if ROM coal production reaches scheduled rates or if consolidated tailings density is found to be greater than predicted. To provide the additional tailings storage, an approved option is to construct an embankment (approximately 4 m in height) around the north-western perimeter of the Square Pit.

Once tailings deposition is complete, the settled tailings material will be covered with inert waste rock material and the surface shaped to be a free-draining landform. The shaped landform will then be covered with a minimum of 150 millimetres (mm) of topsoil and seeded with similar native grassland species used for rehabilitation of the Donaldson Mine. The existing berm around the perimeter of the Square Pit is constructed of topsoil and will be used to cover the inert waste rock material. As described in Section 3.7, a rehabilitation materials balance will be undertaken to confirm the volume of inert waste rock and topsoil material required for the tailings capping system, and to identify the source of the materials.

Based on operational experience, the tailings material from the Abel Underground Mine is geochemically benign. Should mining of the Abel Underground Mine resume, Donaldson Coal will develop a final capping design for the landform which will be informed by geochemical and geotechnical investigations, including characterisation of the emplaced tailings material to verify its benign nature.

As described in the *Abel Upgrade Modification Environmental Assessment* (Donaldson Coal, 2012), the *Donaldson Open Cut and Abel Underground Coal Mines Rehabilitation Management Plan* will be revised prior to the emplacement of tailings within the Square Pit, and will include a detailed description of the rehabilitation concepts for the final void.

3.3.2 Square Pit – Tailings Storage and Permanent Water Storage Option (Closure Option 1B)

During operation of the Abel Underground Mine, the Square Pit may be required to store tailings material and mine water from the Abel Underground Mine (Donaldson Coal, 2012). Under this scenario, tailings emplacement within the Square Pit will not occur up to the pit's capacity, and tailings and mine water transfer will be integrated. At the completion of the mining, the Square Pit final void will remain as a tailings storage and permanent water storage.

At the completion of operations, the Square Pit will be dewatered with the water returned to the Abel Underground Mine. The pit walls will then be reshaped/graded so that they are geotechnically stable in the long-term. It is proposed that the eastern, western and southern high walls will be blasted and battered back to a maximum slope of 18 degrees and the northern low wall will be graded to a maximum slope of 10 degrees. Material blasted from the highwalls will also be used to cover any exposed carbonaceous material. Donaldson Coal will undertake a geotechnical review to confirm the final slopes of the void walls will be geotechnically stable in the long-term. The final slopes of the final void walls will be determined in consultation with the Resources Regulator.

Low wall slopes and the area up to the approximate water recovery level of the Square Pit final void will be topsoiled (using existing stocks on-site or from an external source) and revegetated with similar native woodland species used for rehabilitation of the Donaldson Mine. A list of the native woodland species (which includes key groundcover, understorey and canopy species) is provided in the Abel Underground Mine's MOP. Steeper slopes will be revegetated with native grassland species to enhance the surface stability of the slopes.

Water management structures, such as contour banks/bunds and drains, will be constructed around the perimeter of the void to divert surrounding catchment runoff water away from the void.

The approved site water balance and tailings balance (as described in *Abel Upgrade Modification Environmental Assessment* [Donaldson Coal, 2012]) will be reviewed prior to commencement of integration of tailings and mine water transfer, to verify the predicted final tailings level and water level within the Square Pit final void.

3.3.3 Square Pit – Permanent Water Storage Option (Closure Option 1C)

Should the Square Pit be used for the storage of mine water inflows from the Abel Underground Mine, at the completion of the mining, the Square Pit will be dewatered with the water returned to the Abel Underground Mine. The pit will then be reshaped as described in Section 3.3.2. Material blasted from the highwalls will also be used to cover any exposed carbonaceous material.

Water management structures (e.g. contour banks/bunds and drains) will be constructed around the perimeter of the void to divert the surrounding catchment runoff away from the void, and minimise the volume of water that accumulates within the void. A permanent vehicle access and egress ramp will be constructed to allow access to the void for ongoing monitoring and management. The void will then remain as a permanent water storage.

Low wall slopes with gradients of approximately 10 degrees or less and the area up to the approximate water recovery level of the Square Pit final void will be topsoiled (using existing stocks on-site or from an external source) and revegetated with similar native woodland species used for rehabilitation of the Donaldson Mine. A list of the native woodland species (which includes key groundcover, understorey and canopy species) is provided in the Abel Underground Mine MOP. Steeper slopes will be revegetated with native grassland species to enhance the surface stability of the slopes and to assist native grass vegetation germination and establishment.

The approved site water balance (as described in *Abel Upgrade Modification Environmental Assessment* [Donaldson Coal, 2012]) will be reviewed prior to the completion of mining at Abel, to confirm the predicted final water level within the Square Pit final void.

3.3.4 West Pit – Permanent Water Storage

As part of Abel Underground Mine closure activities, minor volumes of waste rock will be emplaced within the West Pit. Once this is complete, the eastern, western and southern walls of the West Pit will be blasted and battered back to a maximum slope of 18 degrees. The northern wall of the West Pit will also be blasted and graded to a maximum slope of 10 degrees, with a permanent vehicle access and egress ramp constructed to allow access to the pit void for ongoing monitoring and management. As described in Section 3.3.2, Donaldson Coal will undertake a geotechnical review to confirm the final slopes of the void walls will be geotechnically stable in the long-term. Final void wall slopes will be determined in consultation with the Resources Regulator.

During highwall dozer reshaping, water management structures, such as contour banks, drains and drop structures, will be constructed to divert surrounding catchment runoff away from the final void, and therefore minimise the volume of water that accumulates within the pit.

Material blasted from the highwalls will also be used to cover any exposed carbonaceous material. Once blasting and reshaping has been completed, a safety berm and security fence will be constructed around the void perimeter to prevent unauthorised access. The berm design will include a trench to prevent unauthorised vehicle access to the void.

Low wall slopes with gradients of approximately 10 degrees or less and the area up to the approximate water recovery level of the West Pit final void will be topsoiled (using existing stocks on-site or from an external source) and revegetated with similar native woodland species used for rehabilitation of the Donaldson Mine. A list of the native woodland species (which includes key groundcover, understorey and canopy species) is provided in the Abel Underground Mine's MOP. Steeper slopes will be revegetated with native grassland species to enhance the surface stability of the slopes.

3.4 REHABILITATION OBJECTIVES AND COMPLETION CRITERIA

Consistent with the *Donaldson Open Cut and Abel Underground Coal Mines Rehabilitation Management Plan*, the primary rehabilitation objective for the West and Square Pit final voids is to create safe and stable final landforms that are suitable for the intended post-mining land use.

The rehabilitation objectives and completion criteria for each final landform option for the Square Pit and for the West Pit, under Closure Option 1, are provided in Tables 2A to 2D. The rehabilitation objectives and completion criteria are provisional, and will be refined should Donaldson Coal recommence mining of the Abel Underground Mine, and once the operational use of the Square Pit has been determined.

Table 2A
Closure Option 1A – Provisional Rehabilitation Objectives and Completion Criteria for the Revegetated Square Pit Tailings Storage Option

Rehabilitation Objective	Performance Indicator	Completion Criteria
Decommissioning Phase		
Tailings transfer to Square Pit ceased and all associated infrastructure removed.	Tailings transfer infrastructure removal	Tailings transfer infrastructure has been dismantled and removed.
Landform Establishment Phase		
Landform is safe and stable	Highwall and low wall design	Highwalls and low walls constructed in accordance with approved design.
	Geotechnical report	Geotechnical report concludes low risk of highwall failure, pit walls are geotechnically stable and the final landform is consistent with final landform design.
		Geotechnical report confirms the settled tailings material is stable.
Tailings material capped with adequate depth of inert waste rock material	Depth of inert waste rock capping over tailings	Depth of inert waste rock capping over tailings sufficient to prevent capillary rise and considers geochemical characteristics of tailings material, as determined by a geochemical specialist.
	Materials balance	Materials balance completed to confirm availability of waste rock capping volume.
Landform is free-draining	Landform shaping	Landform surface has been shaped to be free-draining.
	Water management structures	Water management structures (bunds and/or drains) have been constructed to facilitate free-draining landform and have been constructed in accordance with design specifications as verified by a suitably qualified person.
Growth Medium Development Phase		
Topsoil applied to support self-sustaining native grassland vegetation.	Topsoil depth	Topsoil applied to a minimum depth of 150 mm.
Growth medium suitable for establishment of native grassland species.	Key soil characteristics within acceptable range for native grassland species.	Analysis of soil samples (1 bulk sample per ha) record parameters as follows. • pH – 4.5 to 8.5. • Electrical conductivity <0.9 deciSiemens per metre (dS/m).

Table 2A (Continued)
Closure Option 1A – Provisional Rehabilitation Objectives and Completion Criteria for the Revegetated Square Pit Tailings Storage Option

Rehabilitation Objective	Performance Indicator	Completion Criteria
Ecosystem and Land Use Establishment Phase		
Native grassland vegetation established including species suited to the landform and were used for rehabilitation of the Donaldson Mine.	Native grassland species mix	Native grassland species mix includes species which are suited to the landform and were used for rehabilitation of the Donaldson Mine.
	Native grass cover and species	Revegetation monitoring reports confirm that at least four key native grass species are present and represent >80% of the total projected foliage cover.
The revegetation areas do not constitute an erosion hazard.	Vegetation cover and Erosion presence	Total foliage cover is greater than or equal to 70%. Any erosion is minor in nature and comparable to that of analogue sites.
Weeds are not significantly impacting revegetation area.	Weed presence	Rehabilitation monitoring confirms that weed species represent less than 20% of projected foliage cover and any noxious weed species are controlled.
Ecosystem and Land Use Sustainability Phase		
Native grassland vegetation to be self-sustaining.	Native grassland cover	Consecutive rehabilitation monitoring reports confirm that key native grassland species represent >90% of the total projected foliage cover.
	Regeneration	Evidence of natural regeneration occurring of at least four key native grass species after 5 years.
	Weed presence	Consecutive rehabilitation monitoring reports confirm that non-target species (weeds) represent less than 10% of projected foliage cover and active control is no greater than analogue site.
	Topsoil characteristics	Topsoil capable of supporting long-term self-sustaining native grassland vegetation and soil analysis results indicate: • pH – comparable to pH range of analogue site after 5 years; • Electrical conductivity <0.9dS/m after 5 years; • Exchangeable Sodium Percentage <5% after 5 years; • Organic content within 20% of levels at analogue sites after 10 years; • Nitrogen and Potassium levels within 20% of analogue site levels after 10 years; and • Soil loss to be less than 60 tonnes (t)/ha/year after 5 years.
Landform to be non-polluting with surface water runoff quality comparable to receiving catchment water.	Runoff water quality	Runoff water quality is comparable to the receiving catchment water.

Table 2B
Closure Option 1B – Provisional Rehabilitation Objectives and Completion Criteria for the Square Pit Tailings and Permanent Water Storage Option

Rehabilitation Objective	Performance Indicator	Completion Criteria
Decommissioning Phase		
Tailings and water transfer to Square Pit ceased and all associated infrastructure removed.	Tailings and water transfer infrastructure removal	Tailings and water transfer infrastructure have been dismantled and removed.
Groundwater monitoring piezometers to be retained or installed for post-closure groundwater monitoring.	Groundwater monitoring piezometers	Groundwater monitoring piezometers for post-closure groundwater monitoring are licensed.
Landform Establishment Phase		
Landform is stable, safe and non-polluting	Site Water Balance, tailings balance and Groundwater modelling	Site Water Balance, tailings balance and groundwater modelling conducted by suitably qualified persons verify the final void is not predicted to spill under all modelled scenarios.
	Highwall and low wall design	Highwalls and low walls constructed in accordance with approved design.
Minimise the final void catchment.	Water management structures	Final void perimeter bund and other water management structures (bunds and/or drains) have been constructed to minimise the final void catchment and have been constructed in accordance with design specifications as verified by a suitably qualified person.
Access to final void restricted.	Access	Access is restricted including installation of fencing around final void perimeter and signage denoting unauthorised access restricted.
Growth Medium Development Phase		
Compacted surfaces to be deep ripped along contour.	Compaction	Compacted surfaces have been deep ripped along contour.
Topsoil applied to low wall slopes with gradients of approximately 10 degrees or less and the area up to the approximate final water level of the final void and to final void perimeter bund.	Topsoil depth	Topsoil applied to a minimum depth of 150 mm.
Growth medium suitable for establishment of selected native woodland species.	Key soil characteristics/parameters.	Analysis of soil samples (1 bulk sample per ha) record parameters as follows. • pH – 4.5 to 8.5. • Electrical conductivity <0.9dS/m.

Table 2B (continued)
Closure Option 1B – Provisional Rehabilitation Objectives and Completion Criteria for the Square Pit Tailings and Permanent Water Storage Option

Rehabilitation Objective	Performance Indicator	Completion Criteria
Ecosystem and Land Use Establishment Phase		
Revegetation established on low wall slopes with gradients of approximately 10 degrees or less and the area up to the approximate final water level of the final void includes native woodland species (including groundcover, understorey and canopy species) consistent with that used for rehabilitation of the Donaldson Mine.	Revegetation species mix	Revegetation species mix includes native woodland species consistent with that used for rehabilitation of the Donaldson Mine (as listed in the Abel Underground Mine MOP).
	Species composition	Revegetation monitoring reports confirm that >80% of the total number of species established comprise the target native woodland species and represent >80% of the total projected foliage cover.
The revegetation areas do not constitute an erosion hazard.	Vegetation cover and Erosion presence	Total projected foliage cover (incorporating trees, shrubs and groundcover) is greater than or equal to 70%. Any erosion is minor in nature and comparable to that of analogue sites.
Weeds are not significantly impacting revegetation area.	Weed presence	Rehabilitation monitoring confirms that weed species represent less than 20% of projected foliage cover or equivalent to analogue site and noxious weed species are controlled.
Ecosystem and Land Use Sustainability Phase		
Landform is stable, safe and non-polluting	Geotechnical report	Geotechnical report conducted to inform Mining Lease relinquishment concludes low risk of highwall failure and the final void walls are geotechnically stable in the long-term.
	Regulatory (e.g. Department of Planning, Industry and Environment [DPIE], Resources Regulator) assessment at mine closure	At mine closure, relevant regulatory agencies (e.g. DPIE, Resources Regulator) confirm that final void is safe, stable and non-polluting.
Woodland vegetation to be self-sustaining.	Woodland species composition	Consecutive rehabilitation monitoring reports confirm that key woodland species (including groundcover, understory and canopy species) represent >90% of the total projected foliage cover.
	Vegetation cover and Erosion presence	Total projected foliage cover (incorporating trees, shrubs and groundcover) is greater than or equal to 70%. Any erosion is minor in nature and comparable to that of analogue sites.
	Regeneration	Evidence of natural regeneration occurring of woodland species after 5 years.
	Weed presence	Consecutive rehabilitation monitoring reports confirm that weed species represent less than 10% of projected foliage cover and active control is no greater than analogue site.

Table 2B (continued)
Closure Option 1B – Provisional Rehabilitation Objectives and Completion Criteria for the Square Pit Tailings and Permanent Water Storage Option

Rehabilitation Objective	Performance Indicator	Completion Criteria
Woodland vegetation to be self-sustaining (continued).	Topsoil characteristics	Topsoil capable of supporting long-term self-sustaining woodland vegetation and soil analysis results indicate: • pH – comparable to pH range of analogue site after 5 years; • Electrical conductivity <0.9dS/m after 5 years; • Exchangeable Sodium Percentage <5% after 5 years; • Organic content within 20% of levels at analogue sites after 10 years; • Nitrogen and Potassium levels within 20% of analogue site levels after 10 years; and • Soil loss to be less than 60t/ha/year after 5 years.

Table 2C
Closure Option 1C – Provisional Rehabilitation Objectives and Completion Criteria for the Square Pit Permanent Water Storage Option

Rehabilitation Objective	Performance Indicator	Completion Criteria
Decommissioning Phase		
Water transfer to Square Pit to cease and all associated infrastructure to be removed.	Water transfer infrastructure removal	Water transfer infrastructure has been dismantled and removed.
Square Pit to be dewatered, with water transferred back to Abel underground workings.	Pit dewatering	Square Pit has been dewatered prior to reshaping, with water transferred back to Abel underground workings.
Groundwater monitoring piezometers to be retained or installed for post-closure groundwater monitoring.	Groundwater monitoring piezometers	Groundwater monitoring piezometers for post-closure groundwater monitoring are licensed.
Landform Establishment Phase		
Landform is stable, safe and non-polluting	Site Water Balance and Groundwater modelling	Site Water Balance and groundwater modelling conducted by suitably qualified persons verify the final void is not predicted to spill under all modelled scenarios.
	Highwall and low wall design	Highwalls and low walls constructed in accordance with approved design.
Minimise the final void catchment.	Water management structures	Final void perimeter bund and other water management structures (bunds and/or drains) have been constructed to minimise the final void catchment and have been constructed in accordance with design specifications as verified by a suitably qualified person.
Access to final void restricted.	Access	Access is restricted including installation of fencing around final void perimeter and signage denoting unauthorised access restricted.
Growth Medium Development Phase		
As per Table 2B.		
Ecosystem and Land Use Establishment and Sustainability Phases		
As per Table 2B.		

Table 2D
Closure Option 1 – Provisional Rehabilitation Objectives and Completion Criteria for the West Pit Permanent Water Storage

Rehabilitation Objective	Performance Indicator	Completion Criteria
Decommissioning Phase		
Waste rock from completion of Abel underground workings to be placed in West Pit.	Completion of waste rock placement.	Waste rock from completion of Abel underground workings has been placed in West Pit.
Groundwater monitoring piezometers to be retained or installed for post-closure groundwater monitoring.	Groundwater monitoring piezometers	Groundwater monitoring piezometers for post-closure groundwater monitoring are licensed.
Abel Box Cut portal and mine ventilation shafts to be decommissioned, sealed and made safe and all surface infrastructure to be removed.	Abel Box Cut portal and mine ventilation shafts	Abel Box Cut portal and mine ventilation shafts have been decommissioned, permanently sealed and made safe.
	Surface infrastructure	All surface infrastructure has been dismantled and removed from site.
Landform Establishment Phase		
Landform is stable, safe and non-polluting	Site Water Balance and Groundwater modelling	Site Water Balance and groundwater modelling conducted by suitably qualified persons verify the final void is not predicted to spill under all modelled scenarios.
	Highwall and low wall design	Highwalls and low walls constructed in accordance with approved design.
Minimise the final void catchment.	Water management structures	Final void perimeter bund and other water management structures (bunds and/or drains) have been constructed to minimise the final void catchment and have been constructed in accordance with design specifications as verified by a suitably qualified person.
Access to final void restricted.	Access	Access is restricted including installation of fencing around final void perimeter and signage denoting unauthorised access restricted.
Growth Medium Development Phase		
As per Table 2B.		
Ecosystem and Land Use Establishment and Sustainability Phases		
As per Table 2B.		

3.5 RISK ASSESSMENT

On 15 July 2020 Donaldson Coal undertook a risk assessment workshop to evaluate the risks associated with achievement of the rehabilitation objectives and completion criteria for both Closure Option 1 and 2 final landform options for the West and Square Pits. Participants at the risk assessment workshop included key Donaldson Coal/Yancoal personnel and representatives from Resource Strategies (Donaldson Coal's environmental assessment and approval consultants). The risk assessment was facilitated by Kylie Hannigan of STAC Consulting Pty Ltd and was conducted in consideration of the *Australian Standard/New Zealand Standard ISO 31000:2018 Risk Management Guidelines* and the Resources Regulator's (2018) *Consultation Draft Guideline 1: Rehabilitation Risk Assessment*.

The risks were assessed during the workshop using the consequence ratings, likelihood ratings and risk matrix provided in Tables 3, 4 and 5 below.

Table 3
Consequence Ratings

Effect / Consequence					
Loss Type	**1** **Insignificant**	**2** **Minor**	**3** **Moderate**	**4** **Major**	**5** **Catastrophic**
Harm to People	**Slight injury or health effects** Reports only or first aid injury	**Minor injury or health effects** Medical treatment injury or restricted work injury	**Serious bodily injury or health effects** Lost time injury	**Single fatality**	**Multiple fatalities**
Environmental Impact	**Environmental nuisance –** trivial or negligible, short term impact to area of low significance, minimal or no physical remediation required Cost < $1,000	**Minor environmental harm –** short term impact to area of limited local significance, limited physical remediation Costs $1,000 - $5,000	**Serious environmental harm –** medium term impact to area of local conservation value, medium term physical remediation, actual community health impacts or significance or pollution or contamination Costs $5k - $50k	**Major environmental harm –** long term reversible impacts to area of regional conservation significance, health statistics in community alter as a result of this incident or pollution or contamination Costs $50k - $500k	**Extreme environmental harm –** irreversible impacts on environmental values of extreme & widespread areas, or those of national conservation significance, community fatalities or pollution or contamination Costs > $500k
Asset Damage and Other Consequential Losses	**Slight damage** < $0.1M	**Minor damage** $0.1M - $1.0M.	**Local damage** $1.0M - $5.0M	**Major damage** $5.0M -$25.0M	**Extreme damage** > $25.0M or > 1 month
Impact on Reputation	**Slight impact** Public awareness may exist but no public concern. Isolated compliance failure	**Limited impact** Some local public concern. Intervention of regulating authority – minimal brand damage	**Considerable impact** Regional public concern. Major compliance failure involving fines – medium brand damage	**National impact** National public concern. Temporary withdrawal of licence to operate – significant brand damage	**International impact** International public attention. Loss of shareholder confidence – irreparable brand damage

Table 4
Likelihood Ratings

Class	Likelihood	Likelihood Description
A	Almost certain	Likely that the unwanted event could occur several times per year in our jurisdiction.
B	Likely	Likely that the unwanted event could happen annually in our jurisdiction.
C	Possible	The unwanted event could happen within 10 years in our jurisdiction.
D	Unlikely	The unwanted event could happen within 50 years in our jurisdiction.
E	Rare	The unwanted event has never been known to occur is highly unlikely that it could ever occur in our jurisdiction.

Table 5
Risk Matrix

Likelihood	Effect/Consequence				
	1	2	3	4	5
A (Almost Certain)	**11** (M)	**16** (H)	**20** (H)	**23** (E)	**25** (E)
B (Likely)	**7** (M)	**12** (M)	**17** (H)	**21** (E)	**24** (E)
C (Possible)	**4** (L)	**8** (M)	**13** (H)	**18** (H)	**22** (E)
D (Unlikely)	**2** (L)	**5** (L)	**9** (M)	**14** (H)	**19** (H)
E (Rare)	**1** (L)	**3** (L)	**6** (M)	**10** (M)	**15** (H)

A detailed description of the risk assessment methodology and results relevant to Closure Option 1 are provided in the *West and Square Pit Closure Strategy Risk Assessment Report* (STAC Consulting, 2020) (Appendix A). A summary of the risk assessment results is provided below.

The risk assessment assessed 88 risks relevant to Closure Options 1A, 1B and 1C. Eleven key risks (i.e. risk scenarios categorised with a moderate or high risk ranking) were identified relevant to Closure Options 1A, 1B and 1C. These risks are summarised in Table 6. Several of these risk scenarios are applicable to each Option 1A to 1C. No risk scenarios had an extreme risk ranking either pre-control or post-control implementation.

As the final landforms for the West and Square Pit under Closure Option 1C and Closure Option 2 are the same (i.e. both pits will be permanent water storages), Table 6 includes the risk scenarios relevant to Closure Option 2 as well.

Table 6
Summary of Risk Sources with a Moderate or High Residual Risk Level

Closure Option	Risk Scenario	Potential Event / Consequences	Risk Level
Option 1A Option 1B Option 1C Option 2	General: Insufficient resourcing: • skills and experience of rehabilitation personnel; • funding for or prioritisation of rehabilitation activities; and • ongoing maintenance of rehabilitation requirements.	Signoff not given by Regulator.	M
Option 1A Option 1B Option 1C Option 2	Decommissioning Phase: Contamination resulting from associated activities: • Stowage in West Pit (may contain hydrocarbons, resins, cement); • Diesel Tanks at West Pit (hydrocarbons); • Runoff from Helipad / Storage Area (hydrocarbons); and • Tailings Emplacement (Square Pit).	Contamination of waterways or land resulting in infringement notice.	M
Option 1A Option 1B Option 1C Option 2	Decommissioning Phase: Unauthorised access to underground workings.	Unauthorised access to underground by public following cessation of mining (no ventilation to underground workings).	M
Option 1B	Decommissioning Phase: Adverse geotechnical and or geochemical issues associated with process waste storage facilities (e.g. tailings, reject emplacements), overburden and waste rock dumps etc.	Contamination of groundwater.	M
Option 1A Option 1B Option 1C Option 2	Landform Establishment Phase: Failure of mine seals: 3 x Portals.	Unauthorised access to underground by public following cessation of mining (no ventilation to underground workings).	M
		Integrity of seals compromised by blasting activities - unauthorised access underground.	M
Option 1A Option 1B Option 1C Option 2	Landform Establishment Phase: Instability of highwalls and low walls.	Landform failure - public safety. Signoff not given by Regulator.	M
Option 1A	Landform Establishment Phase: Availability of suitable materials for capping of hazardous materials and impounded tailings / coarse reject material.	Suitable capping material volume unavailable on site - unable to cap.	M
Option 1A Option 1B Option 1C Option 2	Landform Establishment Phase: Diversion of surface water runoff away from catchment areas.	Loss of water flow downstream due to capture of water in West Pit Void and/or Square Pit Void.	M
Option 1A Option 1B Option 1C Option 2	Ecosystem Establishment Phase and Ecosystem and Land Use Development Phase: Weather and climatic influences (e.g. drought; intense rainfall events; bushfire etc.).	Damage to vegetation due to fire, flood or drought.	M

Table 6
Summary of Risk Sources with a Moderate or High Residual Risk Level

Closure Option	Risk Scenario	Potential Event / Consequences	Risk Level
Option1A Option 1B Option 1C Option 2	Ecosystem and Land Use Development Phase: Vandalism to revegetation areas.	Damage to vegetation due to vandalism.	M
Option1A Option 1B Option 1C Option 2	Ecosystem Establishment Phase: Erosion and failure of drainage and water management/storage structures.	Impacts on water quality and potential discharge.	H

Source: STAC Consulting (2020) (Appendix A).

3.6 TRIGGER ACTION RESPONSE PLAN

A trigger action response plan (TARP) (Table 7) has been developed for the key risks (i.e. risks with a moderate and high risk level) associated with Options 1A, 1B and 1C (Table 6) based on the risk assessment findings (Appendix A). Some risks with a low risk ranking were also assigned control actions. These risks and associated control actions are outlined in the *West and Square Pit Closure Strategy Risk Assessment Report* (STAC Consulting, 2020) in Appendix A.

It should be noted that the timing for implementation of the actions for Options 1A, 1B and 1C is linked to the re-commencement of operations at the Abel Underground Mine.

Table 7
Trigger Action Response Plan – Closure Options 1 and 2

Closure Option	Risk Scenario	Trigger	Existing/ Proposed Risk Treatments/ Controls
Option 1A Option 1B Option 1C Option 2	General – Insufficient resourcing: • skills and experience of rehabilitation personnel; • funding for or prioritisation of rehabilitation activities; • ongoing maintenance of rehabilitation requirements.	Acceptance of final MOP or Mine Closure Plan, including Rehabilitation Cost Estimate, not given by Resources Regulator.	• Current high standard of Rehabilitation on site (past experience of managing similar voids) - accepted as industry best practice. • Environmental Team - Abel (experienced in rehabilitation). • Use of experienced rehabilitation contractors (external) - previously conducted rehabilitation on site. • Use of experienced rehabilitation consultants (external) - industry recognised content / technical experts. • Yancoal Corporate environmental team provide expertise. • Yancoal Corporate Standards - Rehabilitation (in progress). • Existing Environmental Management Strategy and associated Plans (available on Internet/Intelex). • 5 Year Plan and Budget Process. • Cost estimation required when submitting MOP.
Option 1A Option 1B Option 1C Option 2	Decommissioning Phase - Contamination resulting from associated activities: • Stowage in West Pit (may contain hydrocarbons, resins, cement); • Diesel Tanks at West Pit (hydrocarbons); • Runoff from Helipad / Storage Area (hydrocarbons); and • Tailings Emplacement (Square Pit).	Contamination of waterways or land resulting in infringement notice.	Phase 1 Contamination Study to be conducted.
Option 1A Option 1B Option 1C Option 2	Decommissioning Phase - Unauthorised access to underground workings.	Unauthorised access to underground by public following cessation of mining (no ventilation to underground workings).	• Sealing of 3 x Portals and 2 x Shafts. • High Risk Activity Notification for Sealing. • Decommissioning Plan to include prevention of access to underground following cessation of mining. Current access is restricted via use of gates being locked on Portal Entrances.

Table 7 (Continued)
Trigger Action Response Plan – Closure Options 1 and 2

Closure Option	Risk Scenario	Trigger	Existing/ Proposed Risk Treatments/Controls
Option 1B	Decommissioning Phase - Adverse geotechnical and or geochemical issues associated with process waste storage facilities (e.g. tailings, reject emplacements), overburden and waste rock dumps etc.	Contamination of groundwater.	• Emplacement Management Plan. • Final Void Water Balance to determine potential groundwater impacts (with groundwater table). • Donaldson and Abel Water Management Plan. • Geochemical Assessment on Abel Tailings.
Option 1A Option 1B Option 1C Option 2	Landform Establishment Phase - Failure of mine seals - 3 x Portals.	Unauthorised access to underground by public following cessation of mining (no ventilation to underground workings).	• Sealing of 3 x Portals and 2 x Shafts. • High Risk Activity Notification for Sealing.
		Integrity of seals compromised by blasting activities - unauthorised access underground.	• Decommissioning Plan to include prevention of access to underground following cessation of mining including sealing activities and potential impacts from rehabilitation activities (e.g. blasting impacts on seals).
Option 1A Option 1B Option 1C Option 2	Landform Establishment Phase – Instability of highwalls and low walls.	Landform failure - public safety. Signoff not given by Regulator.	• Fencing and signage at property boundary. • Bunding at top of highwalls. • Geotechnical / Final Landform Study to determine slope requirements for highwall to be long-term geotechnically stable. • Design of Blasting to minimise risk. • Current EA commitment for West Pit to have 18 degree slope of highwall (final landform) - Southern and Western Walls and 10 degree slope of highwall for Northern and Eastern Walls.
Option 1A	Landform Establishment Phase – Availability of suitable materials for capping of hazardous materials and impounded tailings / coarse reject material.	Suitable capping material volume unavailable on site - unable to cap.	• Capping material available – potential source is from Bridge to Square Pit. • Determine capping materials required and source of capping material (e.g. internal or external). • Study to determine capping design and conduct capping materials balance based on design.
Option 1A Option 1B Option 1C Option 2	Landform Establishment Phase – Diversion of surface water runoff away from catchment areas.	Loss of water flow downstream due to capture of water in West Pit Void and/or Square Pit Void.	• Final Landform Design to include water management requirements (e.g. diversions, etc.). • Donaldson and Abel Water Management Plan. • Survey Control.

Table 7 (Continued)
Trigger Action Response Plan – Closure Options 1 and 2

Closure Option	Risk Scenario	Trigger	Existing/ Proposed Risk Treatments / Controls
Option 1A Option 1B Option 1C Option 2	Ecosystem Establishment Phase and Ecosystem and Land Use Development Phase - Weather and climatic influences (e.g. Drought; intense rainfall events; bushfire etc.).	Damage to vegetation due to fire, flood or drought.	• Bushfire Management Plan. • Water Management Plan. • Ability to obtain water from West Pit final void (water quality dependent), Big Kahuna Dam and other nearby dams. • Hydrogeological Study (to consider flood capacity as a result of 1 in 250 year rainfall events). • MOP and Rehabilitation Management Plan - includes erosion and sediment controls. • Access to Hunter Water Pipeline. • Local Rural Fire Service (established relationship with local RFS).
Option1A Option 1B Option 1C Option 2	Ecosystem and Land Use Development Phase - Vandalism to revegetation areas.	Damage to vegetation due to vandalism.	• Fencing and signage at property boundary. • Environmental Inspections. • Rehabilitation Monitoring.
Option1A Option 1B Option 1C Option 2	Ecosystem Establishment Phase - Erosion and failure of drainage and water management/storage structures.	Impacts on water quality and potential discharge.	• Final Landform Design to include water management requirements (e.g. diversions, etc.). • MOP and Rehabilitation Management Plan - includes erosion and sediment control measures. • Environmental Inspections. • Rehabilitation Monitoring. • Donaldson and Abel Water Management Plan.

Source: After STAC Consulting (2020) (Appendix A).

3.7 CLOSURE STUDIES AND MANAGEMENT PLAN REVIEW AND REVISION

Closure Studies

A number of studies will be required to inform the detailed design of the final landform options for the West and Square Pits under Closure Option 1, including (but not limited to):

- Detailed design and rehabilitation strategy for the Square Pit tailings storage final void or tailings and water storage final void. It is expected that this strategy will include:
  - quantification of tailings disposal volume and levels;
  - a description of the tailings geochemistry and target tailings density;
  - a tailings capping design, including justifications for the design concepts;
  - predicted groundwater interaction based on verified groundwater modelling;
  - highwall rehabilitation works; and
  - a description of revegetation species.
- Completion of final landform designs for the West and Square Pit permanent water storage final voids prior to rehabilitation activities, including a geotechnical review of the final voids to confirm the final slopes of the final void walls.
- Verification of existing groundwater predictions prepared by Peter Dundon & Associates Pty Ltd (2006) and in the *Abel Upgrade Modification Groundwater Assessment* (RPS Aquaterra, 2012) to confirm the predicted groundwater inflows to the West and Square Pit final voids.
- Verification of the site water balance as described in the *Abel Upgrade Modification Site Water Balance and Surface Water Impact Assessment Review* (Evans and Peck, 2012) to confirm the predicted West and Square Pit final void water level and water quality.
- Rehabilitation materials balance to confirm the volume of inert waste rock and topsoil material required for the tailings capping system for the revegetated tailings storage option is available, including identification of the source of the materials. This rehabilitation materials balance review will occur as part of development of the MOP for the Abel Underground Mine prior to mining re-commencement.

As outlined in the rehabilitation completion criteria (Section 3.4), as part of the Mining Lease relinquishment process, a geotechnical assessment of West and Square Pit final voids will be undertaken to confirm the walls of each final void are geotechnically stable in the long-term and that the reshaped highwalls have a low risk of failure.

Consistent with the findings of the *West and Square Pits Closure Strategy Risk Assessment* (STAC Consulting, 2020) (Appendix A), the Abel Underground Mine and Donaldson Mine MOPs and the *Integrated Mine Closure Plan*, a site-wide decommissioning plan, which will include a land contamination assessment, will be undertaken as part of closure activities for both sites and will include the West and Square Pit areas.

Management Plan Review and Revision

It is anticipated that prior to the resumption of mining of the Abel Underground Mine, a review of the site's environmental management plans will be undertaken to confirm that the plans are consistent with the scope of the re-commenced mining operations. It is anticipated that the following management plans will require revision to reflect the concepts in this Closure Strategy:

- Abel Underground Mine and Donaldson Mine MOPs;
- Abel Underground Mine and Donaldson Mine Rehabilitation Management Plan; and
- Water Management Plan.

The revised plans will be prepared in consultation with relevant regulatory agencies.

3.8 REHABILITATION WORKS TIMELINE

For Closure Option 1, rehabilitation works for the West and Square Pits will commence once mining of the Abel Underground Mine ceases (i.e. once tailings emplacement and/or water transfer requirements cease). At the time of writing (August 2020), the Abel Underground Mine Project Approval (05_0136) permits mining operations up until the end of December 2030.

It is anticipated that a final MOP for the Abel Underground Mine will be prepared, or the *Integrated Mine Closure Plan* revised, at least three years prior to mine closure (i.e. prior to December 2027). It is expected that the plan(s) will include a detailed description of the decommissioning, closure and rehabilitation works for the mine site, including for the West and Square Pits, and will include a timeline for the rehabilitation works.

The final MOP or *Integrated Mine Closure Plan* will be prepared in consultation with relevant regulatory agencies, key stakeholders and the ultimate landholder.

3.9 ANALYSIS OF APPROVAL REQUIREMENTS

As Closure Option 1 does not involve any changes to the approved final landform options for the West and Square Pits, no change to the project as described in the approved *Abel Upgrade Modification Environmental Assessment* (Donaldson Coal, 2012) will be required, and no modifications to Project Approval (05_0136) or Development Consent DA 98/01173 and DA 118/692/22 will be required to reflect this Closure Strategy.

4 CLOSURE OPTION 2 – CLOSURE OF ABEL UNDERGROUND MINE

4.1 FINAL LANDFORM AND POST-MINING LAND USE

Closure Option 2 for the West and Square Pits reflects closure of the Abel Underground Mine with no resumption of mining. For this option, the final landforms of the West and Square Pits will be final voids for permanent water storage (Figure 5), which is consistent with the approved final landform options for the pits described in the *Abel Upgrade Modification Environmental Assessment* (Donaldson Coal, 2012).

As described in Section 3.2, the potential post-mining land uses for permanent water storage final voids may include water supply for nearby mines or other commercial use, or use for recreation, aquaculture or as a wildlife habitat, subject to detailed studies into the suitability of water storage void for the intended land use.

4.2 REHABILITATION ACTIVITIES

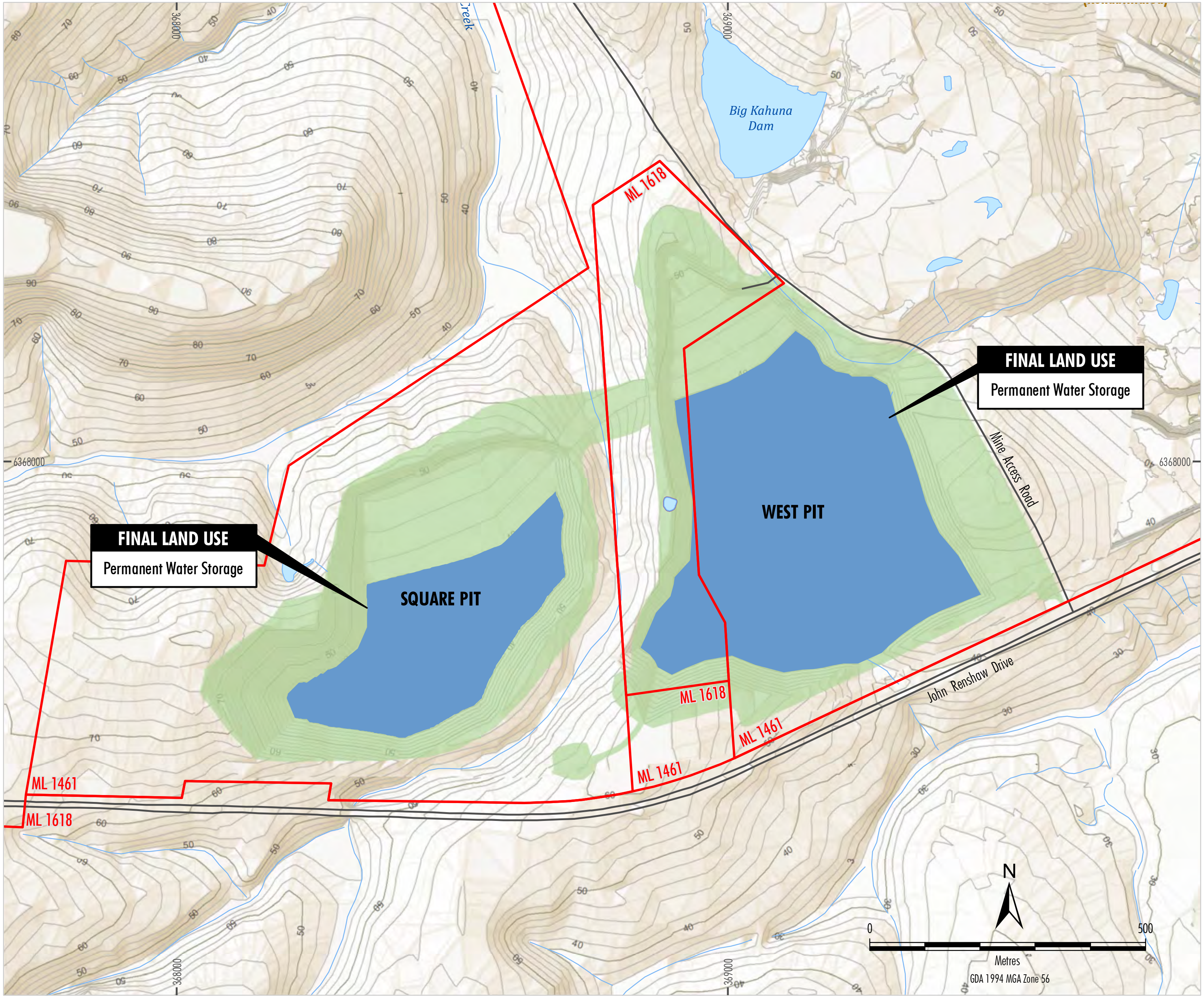
4.2.1 Square Pit – Permanent Water Storage

To facilitate the final rehabilitation activities for the Square pit (i.e. highwall and low wall reshaping), upon closure, the Square Pit may require dewatering, with the accumulated water pumped to the Donaldson Mine Big Kahuna Dam. As the northern walls of the Square Pit have already been reshaped, upon closure and after any necessary dewatering activities, the eastern, western and southern highwalls will be blasted and battered back to a maximum slope of 18 degrees and low walls graded to a maximum slope of 10 degrees. Material blasted from the highwalls will be used to cover any exposed carbonaceous material. As described in Section 3.3.2, Donaldson Coal will undertake a geotechnical review to confirm the final slopes of the void walls will be geotechnically stable in the long-term. Final void wall slopes will be determined in consultation with the Resources Regulator.

The catchment of the Square Pit final void will be minimised as far as practicable with water management structures (e.g. bunds and drains) established around the perimeter of the void to minimise the volume of water that accumulates within the void. The perimeter bund design will include a trench to prevent unauthorised vehicle access to the void. The existing vehicle access and egress ramp (at the north-eastern extent of the pit area) will be retained to allow access for ongoing monitoring and management. Access however to the void will be restricted with a security fence constructed around the perimeter of the void and signage installed denoting authorised access only.

Low wall slopes with gradients of approximately 10 degrees or less and the area up to the approximate water recovery level of the Square Pit final void will be revegetated with similar native woodland species used for rehabilitation of the Donaldson Mine. A list of the native woodland species (which includes key groundcover, understorey and canopy species) is provided in the Abel Underground Mine MOP. Steeper slopes will be revegetated with native grassland species to enhance the surface stability of the slopes.

The approved site water balance (as described in *Abel Upgrade Modification Environmental Assessment* [Donaldson Coal, 2012]) will be reviewed upon closure, to verify the predicted final water level within the Square Pit final void (approximately 40 m AHD) (Evans and Peck, 2012).



LEGEND

- Mining Lease Boundary
- Indicative Final Void Water Level
- Indicative Rehabilitation Area

Source: NSW Spatial Services (2020)

DONALDSONCOAL

WEST AND SQUARE PITS CLOSURE STRATEGY

Closure Option 2 –
West and Square Pits Final Land Use

Figure 5

DCL-20-06_ADCS_205B

4.2.2 West Pit – Permanent Water Storage

The rehabilitation activities for the West Pit will be the same as that described in Section 3.3.4, and will involve the placement of minor volumes of waste rock associated with closure of the Abel Underground Mine.

Once complete, the eastern, western and southern walls of the West Pit will be blasted and battered back to a maximum slope of 18 degrees. The northern walls of the West Pit will also be blasted and will be graded to a maximum slope of 10 degrees. Prior to the completion of mining at the Abel Underground Mine, Donaldson Coal will undertake a geotechnical review of the final voids to confirm the final slopes of the void walls.

During highwall dozer reshaping, a perimeter bund and other water management structures (e.g. drains) will be constructed to divert surrounding catchment runoff away from the final void and therefore minimise the volume of water that accumulates within the void. The existing vehicle access and egress ramp (at the north-eastern extent of the pit area) will be retained to allow access for ongoing monitoring and management.

Material blasted from the highwalls will also be used to cover any exposed carbonaceous material. Once blasting and reshaping has been completed, a security fence will be constructed around the void perimeter to prevent unauthorised access. The perimeter bund design will include a trench to prevent unauthorised vehicle access to the void.

Low wall slopes with gradients of approximately 10 degrees or less and the area up to the approximate water recovery level of the West Pit final void will be revegetated with similar native woodland species used for rehabilitation of the Donaldson Mine. A list of the native woodland species (which includes key groundcover, understorey and canopy species) is provided in the Abel Underground Mine MOP. Steeper slopes will be revegetated with native grassland species to enhance the surface stability of the slopes.

The approved site water balance (as described in *Abel Upgrade Modification Environmental Assessment* [Donaldson Coal, 2012]) will be reviewed upon closure, to verify the predicted final water level within the West Pit final void (approximately 40 m AHD) (Evans and Peck, 2012).

As described in Section 2.1, the Abel Underground Mine surface infrastructure will be decommissioned, dismantled and removed, with the mine portals permanently sealed.

4.3 REHABILITATION OBJECTIVES AND COMPLETION CRITERIA

The rehabilitation objectives and completion criteria for the West and Square Pits under Closure Option 2 (Tables 8A and 8B) are largely the same as that for the Square Pit Permanent Water Storage Option (Table 2C) and the West Pit Permanent Water Storage (Table 2D) for Closure Option 1, except for during the Decommissioning Phase (i.e. for Closure Option 2, no mine water from the Abel Underground Mine will have been transferred to the West and Square Pits).

The rehabilitation objectives and completion criteria are provisional, and will be refined in the event mining of the Abel Underground Mine is not resumed and mine closure commences.

Table 8A
Closure Option 2 – Provisional Rehabilitation Objectives and Completion Criteria for the Square Pit Permanent Water Storage

Rehabilitation Objective	Performance Indicator	Completion Criteria
Decommissioning Phase		
Square Pit to be dewatered of any accumulated water.	Pit dewatering	Square Pit has been dewatered prior to reshaping.
Water management infrastructure to be removed.	Water management infrastructure removal	Water management infrastructure has been dismantled and removed.
Groundwater monitoring piezometers to be retained or installed for post-closure groundwater monitoring.	Groundwater monitoring piezometers	Groundwater monitoring piezometers for post-closure groundwater monitoring are licensed.
Landform Establishment Phase		
Landform is stable, safe and non-polluting	Site Water Balance and Groundwater modelling	Site Water Balance and groundwater modelling conducted by suitably qualified persons verify the final void is not predicted to spill under all modelled scenarios.
	Highwall and low wall design	Highwalls and low walls constructed in accordance with approved design.
Minimise the final void catchment.	Water management structures	Final void perimeter bund and other water management structures (bunds and/or drains) have been constructed to minimise the final void catchment and have been constructed in accordance with design specifications as verified by a suitably qualified person.
Access to final void restricted.	Access	Access is restricted including installation of fencing around final void perimeter and signage denoting unauthorised access restricted.
Growth Medium Development Phase		
Compacted surfaces to be deep ripped along contour.	Compaction	Compacted surfaces have been deep ripped along contour.
Topsoil applied to low wall slopes with gradients of approximately 10 degrees or less and the area up to the approximate final water level of the final void and to final void perimeter bund.	Topsoil depth	Topsoil applied to a minimum depth of 150 mm.
Growth medium suitable for establishment of selected native woodland species.	Key soil characteristics/parameters.	Analysis of soil samples (1 bulk sample per ha) record parameters as follows. • pH – 4.5 to 8.5. • Electrical conductivity <0.9dS/m.

Table 8A (continued)
Closure Option 2 – Provisional Rehabilitation Objectives and Completion Criteria for the Square Pit Permanent Water Storage

Rehabilitation Objective	Performance Indicator	Completion Criteria
Ecosystem and Land Use Establishment Phase		
Revegetation established on low wall slopes with gradients of approximately 10 degrees or less and the area up to the approximate final water level of the final void includes native woodland species (including key groundcover, understorey and canopy species) consistent with that used for rehabilitation of the Donaldson Mine.	Revegetation species mix	Revegetation species mix includes native woodland species consistent with that used for rehabilitation of the Donaldson Mine (as listed in the Abel Underground Mine MOP).
	Species composition	Revegetation monitoring reports confirm that >80% of the total number of species established comprise the target native woodland species and represent >80% of the total projected foliage cover.
The revegetation areas do not constitute an erosion hazard.	Vegetation cover and Erosion presence	Total projected foliage cover (incorporating trees, shrubs and groundcover) is greater than or equal to 70%. Any erosion is minor in nature and comparable to that of analogue sites.
Weeds are not significantly impacting revegetation area.	Weed presence	Rehabilitation monitoring confirms that weed species represent less than 20% of projected foliage cover or equivalent to analogue site and noxious weed species are controlled.
Ecosystem and Land Use Sustainability Phase		
Landform is stable, safe and non-polluting	Geotechnical report	Geotechnical report conducted to inform Mining Lease relinquishment concludes low risk of highwall failure and the final void walls are geotechnically stable in the long-term.
	Regulatory (e.g. DPIE, Resources Regulator) assessment at mine closure	At mine closure, relevant regulatory agencies (e.g. DPIE, Resources Regulator) confirm that final void is safe, stable and non-polluting.
Woodland vegetation to be self-sustaining.	Woodland species composition	Consecutive rehabilitation monitoring reports confirm that key woodland species (including groundcover, understory and canopy species) represent >90% of the total projected foliage cover.
	Vegetation cover and Erosion presence	Total projected foliage cover (incorporating trees, shrubs and groundcover) is greater than or equal to 70%. Any erosion is minor in nature and comparable to that of analogue sites.
	Regeneration	Evidence of natural regeneration occurring of woodland species after 5 years.
	Weed presence	Consecutive rehabilitation monitoring reports confirm that weed species represent less than 10% of projected foliage cover and active control is no greater than analogue site.

Table 8A (continued)
Closure Option 2 – Provisional Rehabilitation Objectives and Completion Criteria for the Square Pit Permanent Water Storage

Rehabilitation Objective	Performance Indicator	Completion Criteria
Ecosystem and Land Use Sustainability Phase (continued)		
Woodland vegetation to be self-sustaining (continued).	Topsoil characteristics	Topsoil capable of supporting long-term self-sustaining woodland vegetation and soil analysis results indicate: • pH – comparable to pH range of analogue site after 5 years; • Electrical conductivity <0.9dS/m after 5 years; • Exchangeable Sodium Percentage <5% after 5 years; • Organic content within 20% of levels at analogue sites after 10 years; • Nitrogen and Potassium levels within 20% of analogue site levels after 10 years; and • Soil loss to be less than 60t/ha/year after 5 years.

Table 8B
Closure Option 2 – Provisional Rehabilitation Objectives and Completion Criteria for the West Pit Permanent Water Storage

Rehabilitation Objective	Performance Indicator	Completion Criteria
Decommissioning Phase		
West Pit to be dewatered of any accumulated water.	Pit dewatering	West Pit has been dewatered prior to reshaping.
Waste rock from completion of Abel underground workings to be placed in West Pit.	Completion of waste rock placement.	Waste rock from completion of Abel underground workings has been placed in West Pit.
Water management infrastructure to be removed.	Water management infrastructure removal	Water management infrastructure has been dismantled and removed.
Groundwater monitoring piezometers to be retained or installed for post-closure groundwater monitoring.	Groundwater monitoring piezometers	Groundwater monitoring piezometers for post-closure groundwater monitoring are licensed.
Abel Box Cut portal and mine ventilation shafts to be decommissioned, sealed and made safe and all surface infrastructure to be removed.	Abel Box Cut portal and mine ventilation shafts	Abel Box Cut portal and mine ventilation shafts have been decommissioned, permanently sealed and made safe.
	Surface infrastructure	All surface infrastructure has been dismantled and removed from site.
Landform Establishment Phase		
Landform is stable, safe and non-polluting	Site Water Balance and Groundwater modelling	Site Water Balance and groundwater modelling conducted by suitably qualified persons verify the final void is not predicted to spill under all modelled scenarios.
	Highwall and low wall design	Highwalls and low walls constructed in accordance with approved design.
Minimise the final void catchment.	Water management structures	Final void perimeter bund and other water management structures (bunds and/or drains) have been constructed to minimise the final void catchment and have been constructed in accordance with design specifications as verified by a suitably qualified person.
Access to final void restricted.	Access	Access is restricted including installation of fencing around final void perimeter and signage denoting unauthorised access restricted.
Growth Medium Development Phase		
As per Table 8A.		
Ecosystem and Land Use Establishment and Sustainability Phases		
As per Table 8A.		

4.4 RISK ASSESSMENT

As described in Section 3.5, Donaldson Coal undertook a risk assessment workshop on 15 July 2020 to evaluate the risks associated with achievement of the rehabilitation objectives and completion criteria for both Closure Option 1 and 2 final landform options for the West and Square Pits.

The risk assessment assessed 28 risks relevant to Closure Option 2. Nine risk scenarios were categorised with a moderate or high risk ranking. These risks are summarised in Table 6 in Section 3.5. As described in Section 3.5, given the final landforms for the West and Square Pit under Closure Option 2 and Closure Option 1C are the same [i.e. both pits will be permanent water storages]), the risk scenarios for these Closure Options are the same. No risk scenarios had an extreme risk ranking either pre-control or post-control implementation.

4.5 TRIGGER ACTION RESPONSE PLAN

The TARP in Table 7 in Section 3.6 details the key risks and associated risk treatment measures/controls relevant to Closure Option 2.

It should be noted that the timing for implementation of the actions relevant to Closure Option 2 is linked to the timing associated with Donaldson Coal's decision to close the Abel Underground Mine, without the resumption of mining.

4.6 CLOSURE STUDIES AND MANAGEMENT PLAN REVIEW AND REVISION

Closure Studies

A number of studies will be undertaken as part of the Abel Underground Mine closure process to confirm the West and Square Pit final voids meet the nominated completion criteria.

- Completion of final landform designs for the West and Square Pit final voids prior to rehabilitation activities, including a geotechnical review of the final voids to confirm the final slopes of the final void walls.
- Revision of existing groundwater model as described in the *Abel Upgrade Modification Groundwater Assessment* (RPS Aquaterra, 2012) to confirm the predicted groundwater inflows to the West and Square Pit final voids.
- Revision of the existing site water balance as described in the *Abel Upgrade Modification Site Water Balance and Surface Water Impact Assessment Review* (Evans and Peck, 2012) to confirm the predicted West and Square Pit final void water level and water quality.

As outlined in the rehabilitation completion criteria (Section 4.3), as part of the Mining Lease relinquishment process, a geotechnical assessment of West and Square Pit final voids will be undertaken to confirm the walls of each final void are geotechnically stable in the long-term and that the reshaped highwalls have a low risk of failure.

As described in Section 3.7, a site-wide land contamination assessment will be undertaken as part of closure activities for both sites and will include the West and Square Pit areas.

Management Plan Review and Revision

It is anticipated that upon the determination to close the Abel Underground Mine, a review of each site's environmental management plans will be undertaken.

It is expected that a number of management plans may become redundant to reflect the cessation of mining and associated operations or require revision to reflect the refined scope of the monitoring programs (e.g. Water Management Plan) and closure of the sites.

Removal and revision of the management plans will be undertaken in consultation with the relevant regulatory agencies required under Project Approval 05_0136.

The following key management plans relevant to closure and rehabilitation of the sites will be revised to describe the closure strategy and closure decommissioning and remaining rehabilitation activities:

- Final Abel Underground Mine and Donaldson Mine MOPs;
- Abel Underground Mine and Donaldson Mine Rehabilitation Management Plan; and
- Water Management Plan.

Should Abel Underground Mine not resume, the final MOPs or revised *Integrated Mine Closure Plan* will be prepared within a year of the decision being made and will include outcomes of the closure studies above. The closure concepts described in the final MOPs or revised *Integrated Mine Closure Plan* will be consistent with this closure strategy and will be prepared in consultation with relevant regulatory agencies, key stakeholders and the ultimate landholder.

4.7 REHABILITATION WORKS TIMELINE

For Closure Option 2, it is anticipated that rehabilitation works for the West and Square Pits will commence once the final MOPs for each site, or a revised *Integrated Mine Closure Plan*, has been approved by the NSW Resources Regulator. As described in Section 4.6 above, the final MOPs or revised *Integrated Mine Closure Plan*, will be prepared within a year of the decision being made and will include outcomes of the closure studies described in Section 4.6.

The final MOP or revised *Integrated Mine Closure Plan* will include a detailed description of the decommissioning, closure and rehabilitation works for the mine sites, including for the West and Square Pits. Donaldson Coal will undertake the rehabilitation works during the term of the final MOP.

4.8 ANALYSIS OF APPROVAL REQUIREMENTS

The final landform concept for the West and Square Pits under Closure Option 2 (i.e. final voids for permanent water storage) is consistent with the approved final landform options for the West and Square Pits as described in the approved *Abel Upgrade Modification Environmental Assessment* (Donaldson Coal, 2012). Therefore, closure of the Abel Underground Mine without the resumption of mining will not involve a change to, or a new, final landform concept, and modifications to Project Approval (05_0136) or Development Consent DA 98/01173 and DA 118/692/22 will not be required.

In the event of closure of the Abel Underground Mine without the resumption of mining, Donaldson Coal will review each site's approvals and ML requirements as part of the mine closure process. The timing for relinquishment/surrendering each approval instrument will be informed by the conditions or requirements associated with each instrument, and the likely consultation requirements involved.

5 REFERENCES

Donaldson Coal (2012) *Abel Upgrade Modification Environmental Assessment*.

Evans and Peck (2012) *Abel Upgrade Modification Site Water Balance and Surface Water Impact Assessment Review*.

Peter Dundon & Associates Pty Ltd (2006) *Abel Coal Project Groundwater Assessment.*

STAC Consulting (2015) *West and Square Pit Closure Strategy Risk Assessment Report*.

Resources Regulator's (2018) *Consultation Draft Guideline 1: Rehabilitation Risk Assessment*.

RPS Aquaterra (2012) Abel Upgrade Modification Groundwater Assessment.

APPENDIX A

WEST AND SQUARE PITS CLOSURE STRATEGY RISK ASSESSMENT REPORT (STAC CONSULTING, 2020)

DONALDSONCOAL

Part of the Yancoal Australia Group

Abel Underground Mine and Donaldson Open Cut Mine

West and Square Pit Closure Strategy Risk Assessment

August 2020

EXECUTIVE SUMMARY

Donaldson Coal Pty Ltd (Donaldson Coal) received two Notices issued by the NSW Resources Regulator under Section 240 of the NSW Mining Act 1992 requiring Donaldson Coal to prepare a Closure Strategy for the management of the West and Square Pits.

A requirement of the Notices was to conduct a risk assessment that identifies and assesses risks to rehabilitation associated with the following different closure pathways:

- The resumption of mining within the Abel Underground Mine and development of the voids;
- The closure of the Abel Underground Mine with no resumption of mining.

Accordingly, a risk assessment was conducted on the 15th July 2020 to assess the risks to rehabilitation of the West and Square Pits associated with the following different closure pathways:

- Closure Option 1 – Resumption of Mining at Abel Underground Mine
  - Closure Option 1 involves three different final landform options i.e.:
    - Option 1A – the Square Pit as a Revegetated Tailings Storage and the West Pit as a Permanent Water Storage;
    - Option 1B – the Square Pit as a Tailings and Permanent Water Storage and the West Pit as a Permanent Water Storage; and
    - Option 1C – the West and Square Pits are both Permanent Water Storages.
- Closure Option 2 – Closure of Abel Underground Mine with No Resumption of Mining
  - Closure Option 2 involves both the West Pit and Square Pit remining as Permanent Water Storages.

The risk assessment was facilitated by Kylie Hannigan (STAC Consulting) and consisted of Donaldson and Abel management representatives and external content / technical consultants (Refer Section 3 – Risk Assessment Participants).

The Risk Assessment:

- Reviewed the relevant closure pathways and risk assessment considerations via presentation from Phillip Brown – Environment and Community Relations Superintendent (Refer Appendix 3);
- Determined the potential event/consequence associated with each rehabilitation risk source; determined loss type; assessed level of risk (using Yancoal Risk Matrix); determined the existing and proposed risk controls; identified any additional risk control measures or actions required; and assessed level of residual risk;
- Utilised the Abel Risk Assessment Methodology including the Yancoal Risk Matrix (Refer Section 2.4 Risk Methodology); and
- Provides the underpinning risk assessment for Abel and Donaldson Coal Mines - West and Square Pit Closure Strategy.

Overall risk rankings for the risk sources pre-controls assessed for each Option were (Figure 1):

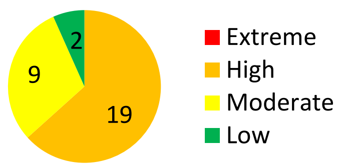
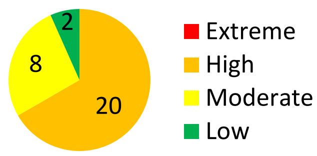
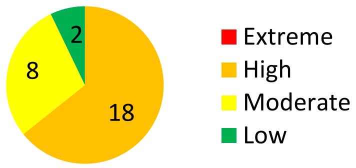
<table>
<tr><td>Option 1 A
(Revegetated Tailings Storage)</td><td>Option 1 B
(Tailings and Permanent Water Storage)</td><td>Option 1 C & Option 2
(Permanent Water Storage)</td></tr>
<tr><td>• Extreme – 0;
• High – 19;
• Moderate – 9; and
• Low – 2.</td><td>• Extreme – 0;
• High – 20;
• Moderate – 8; and
• Low – 2.</td><td>• Extreme – 0;
• High – 7;
• Moderate – 9; and
• Low – 18.</td></tr>
<tr><td>
</td><td>
</td><td>
</td></tr>
</table>

Figure 1: Risk Sources by Risk Level (Pre-Controls)

Overall risk rankings for the risk sources post-controls assessed for each Option were (Figure 2):

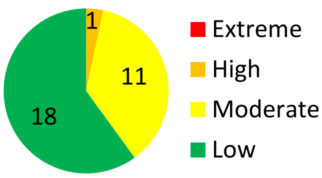
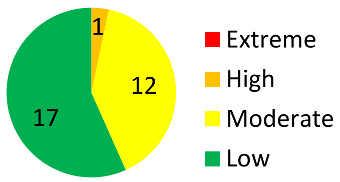
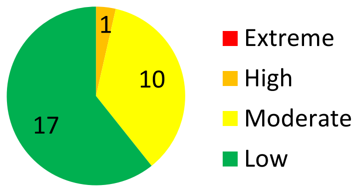
<table>
<tr><td>Option 1 A
(Revegetated Tailings Storage)</td><td>Option 1 B
(Tailings and Permanent Water Storage)</td><td>Option 1 C & Option 2
(Permanent Water Storage)</td></tr>
<tr><td>• Extreme – 0;
• High – 1;
• Moderate – 11; and
• Low – 18.</td><td>• Extreme – 0;
• High – 1;
• Moderate – 12; and
• Low – 17.</td><td>• Extreme – 0;
• High – 1;
• Moderate – 10; and
• Low – 17.</td></tr>
<tr><td>
</td><td>
</td><td>
</td></tr>
</table>

Figure 2: Risk Sources by Risk Level (Post-Controls)

The potential risk sources categorised as high post-control was identified as:

Mine Closure / Rehabilitation Aspect – Risk Source	Potential Event / Consequences	Loss Type	Consequence, Likelihood, Risk Level and Category			
Ecosystem Establishment - Erosion and failure of drainage and water management/storage structures.	Impacts on water quality and potential discharge	(E) Environmental Impact	4	D	14	(H)

Of the risk sources assessed, the maximum reasonable consequences for the potential event consequences (with controls implemented) were assessed as (Figure 3):

Option 1 A (Revegetated Tailings Storage)	Option 1 B (Tailings and Permanent Water Storage)	Option 1 C & Option 2 (Permanent Water Storage)
• 5 Catastrophic – 0; • 4 Major – 4; • 3 Moderate – 4; • 2 Minor – 20; and • 1 Insignificant – 2.	• 5 Catastrophic – 0; • 4 Major – 4; • 3 Moderate – 5; • 2 Minor – 19; and • 1 Insignificant – 2.	• 5 Catastrophic – 0; • 4 Major – 5; • 3 Moderate – 6; • 2 Minor – 13; and • 1 Insignificant – 10.

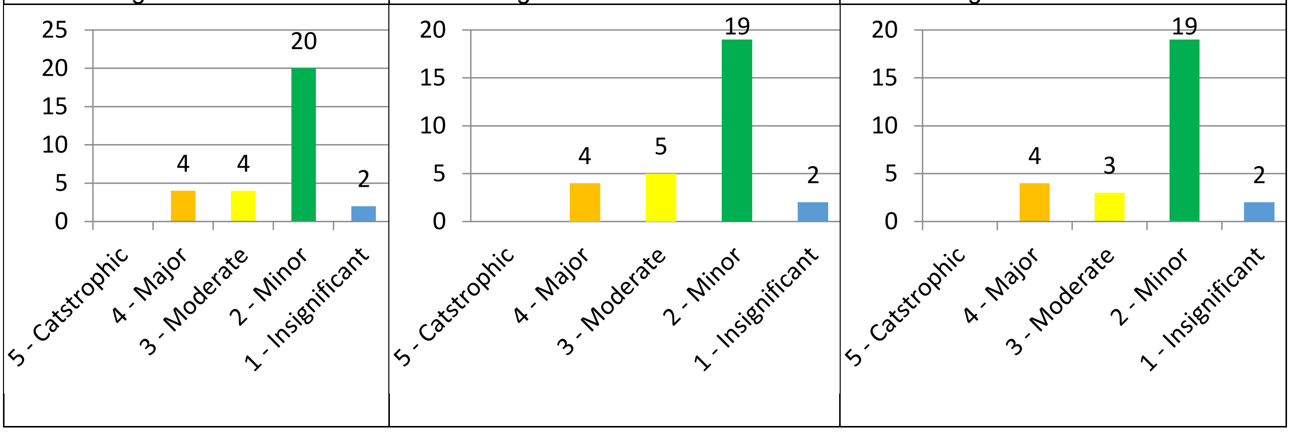


Figure 3: Risk Sources by Effect/Consequence Risk Score

The potential risk sources categorised as major were identified as:

Mine Closure / Rehabilitation Aspect – Risk Source	Potential Event / Consequences	Loss Type	Consequence, Likelihood, Risk Level and Category			
Decommissioning - Unauthorised access to underground workings	Unauthorised access to underground by public following cessation of mining (no ventilation to underground workings)	(P) Harm to People	4	E	10	(M)
Landform Establishment - Failure of mine seals: - 3 x Portals	Unauthorised access to underground by public following cessation of mining (no ventilation to underground workings)	(P) Harm to People	4	E	10	(M)
Landform Establishment - Failure of mine seals: - 3 x Portals	Integrity of seals compromised by blasting activities - unauthorised access underground	(P) Harm to People	4	E	10	(M)
Ecosystem Establishment - Erosion and failure of drainage and water management/storage structures.	Impacts on water quality and potential discharge	(E) Environmental Impact	4	D	14	(H)

Therefore, following implementation of additional controls / actions, the major risks identified (based on the Yancoal Risk Matrix) are Unlikely (i.e. could happen in 50 years).

As a result of the risk assessment, controls / actions have been identified for each closure pathway (Refer to Section 5 Risk Control Action/Implementation Plan).

With the existing controls and further controls / actions to be implemented, the risk assessment team considered the rehabilitation risks of West Pit and Square Pit associated with the different closure pathways at Donaldson and Abel Mines to be as low as reasonably practicable.

Kylie Hannigan (BOHS, MAusIMM)
Risk Assessment Facilitator / RA Report Author
Bachelor of Occupational Health & Safety (BOHS)
MINE7033 Minerals Industry Risk Management – Establish and Maintain Risk Management Systems (G3)
Lead Auditor – OH&S (RABQSA Certification No. 113053)

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1. OPERATIONAL OVERVIEW

The Abel Underground Mine and the Donaldson Open Cut Mine are owned and operated by Donaldson Coal Pty Limited (Donaldson Coal), a wholly owned subsidiary of Yancoal Australia Limited.

The Abel Underground Mine is located approximately 23 kilometres north-west of the Port of Newcastle in New South Wales (NSW). The Donaldson Open Cut Mine (the Donaldson Mine) is located immediately north of the Abel Underground Mine.

Project Approval 05_0136 for the Abel Underground Mine was granted in 2007 pursuant to section 79J of the NSW Environmental Planning and Assessment Act 1979 (EP&A Act) and approves mining operations until the end of December 2030. Development of the Abel Underground Mine occurs within Mining Lease (ML) 1618. Run-of-Mine (ROM) coal from the ROM coal stockpile located within the Abel Box Cut is approved to be transported via internal sealed roads to the Bloomfield Coal Handling and Preparation Plant (CHPP). ROM coal is also approved to be transported by overland conveyor from the ROM coal stockpile to the Bloomfield CHPP. The Abel Upgrade Modification Environmental Assessment (Donaldson Coal, 2012) describes the currently approved project. However, mining operations at the Abel Underground Mine ceased in early 2016, and the mine is currently under care and maintenance.

Development Consent DA 98/01173 and DA 118/698/22 for the Donaldson Mine were granted by the Minister for Urban Affairs and Planning under the EP&A Act in December 1999. Development of the Donaldson Mine within ML 1461 commenced in January 2001 and ceased in April 2013. Rehabilitation works at the Donaldson Mine were completed in March 2014. The rehabilitated site is currently under care and maintenance.

A corridor of ML 1618 for the Abel Underground Mine extends north, with the Donaldson Mine's ML 1461 occurring either side. The Abel Box Cut (surface entry to the Abel Underground Mine) occurs within this corridor and is located at the south-western extent of the Donaldson Mine's West Pit. The Donaldson Mine's Square Pit was later developed to the west of the West Pit in ML 1461.

Approximately half of the West Pit has been re-profiled, with the southern and western highwalls retained. Access to the Abel portal and underground areas has been secured, however remains accessible to authorised personnel for inspection and maintenance activities. The West Pit currently stores a small volume of runoff water from the adjacent surface infrastructure areas. West Pit water is transferred on an as needs basis to Donaldson Mine's Big Kahuna Dam for operational use, such as dust suppression, or is transferred to Lake Kennerson for use at the Bloomfield Colliery or, when conditions permit, discharged to Four Mile Creek (in accordance with the Donaldson Mine's Environment Protection Licence [EPL] 11080).

A small area at the northern extent of the Square Pit has been re-profiled. Water stored in the Square Pit's southern extent comprises incident rainfall and catchment water only. Square Pit water is also transferred on an as needs basis to Donaldson Mine's Big Kahuna Dam for operational use, as described above.

2. RISK ASSESSMENT CONTEXT

Donaldson Coal received two Notices issued by the NSW Resources Regulator under Section 240 of the NSW Mining Act 1992 requiring Donaldson Coal to prepare a Closure Strategy for the management of the West and Square Pits.

A requirement of the Notices was to conduct a risk assessment that identifies and assesses risks to rehabilitation associated with the following different closure pathways:

- The resumption of mining within the Abel Underground Mine and development of the voids;
- The closure of the Abel Underground Mine with no resumption of mining.

2.1 Goal/Objectives

The goal and objectives of this risk assessment review were to:

- Identify, analyze, and assess potential risks to rehabilitation associated with the West Pit and Square Pit Mine Closure Strategy options:
  - Closure Option 1 – Resumption of Mining at Abel Underground Mine
    - Closure Option 1 involves three different final landform options i.e.:
      - Option 1A – the Square Pit as a Revegetated Tailings Storage and the West Pit as a Permanent Water Storage;
      - Option 1B – the Square Pit as a Tailings and Permanent Water Storage and the West Pit as a Permanent Water Storage; and
      - Option 1C – the West and Square Pits are both Permanent Water Storages.
  - Closure Option 2 – Closure of Abel Underground Mine with No Resumption of Mining
    - Closure Option 2 involves both the West Pit and Square Pit remining as Permanent Water Storages.
- Identify existing risk controls; and
- Identify any additional risk controls / actions required to reduce the risk to "As Low as Reasonably Practicable" (ALARP).

The risk assessment review considered requirements to enable compliance with:

- The two Notices issued to Donaldson Coal under Section 240 of the NSW Mining Act 1992;
- NSW Environmental Planning and Assessment Act 1979;
- NSW Mining Act 1992; and
- NSW Government *Consultation Draft Guideline 1: Rehabilitation Risk Assessment (July 2018)*.

The effective implementation of the controls outlined in this risk assessment are intended to reduce the potential impacts to the environment as a result of closure and rehabilitation of the mine.

Following the risk assessment, the Abel and Donaldson Coal Mines - West and Square Pit Closure Strategy will be updated and finalised.

2.2 Scope

The scope of the risk assessment was to conduct an assessment of potential risks to rehabilitation associated with the different closure pathways (Section 2.1) to determine if the risks can be reduced to as low as reasonably practicable.

The scope of the risk assessment was to:

- Review the relevant closure pathways and risk assessment considerations via presentation from Phillip Brown – Environment and Community Relations Superintendent (Refer Appendix 3);
- Determine the potential event/consequence associated with each rehabilitation risk source; determine loss type; assess level of risk (using Yancoal Risk Matrix); determine the existing and proposed risk

controls; identify any additional risk control measures or actions required; and assess for level of residual risk;
- Utilise the Abel Risk Assessment Methodology including the Yancoal Risk Matrix (Refer Section 2.4 Risk Methodology); and
- Provide the underpinning risk assessment for Abel and Donaldson Coal Mines - West and Square Pit Closure Strategy.

2.3 Stakeholders

Internal and external stakeholders considered during the performance of this risk assessment included:
- Donaldson & Abel Coal Mine Employees;
- Donaldson & Abel Coal Mine Contractors;
- Donaldson & Abel Coal Mine Visitors;
- Neighbours;
- Yancoal Corporate;
- Government Regulators;
- Mindaribba Local Aboriginal Land Council; and
- Local Community.

2.4 Risk Methodology

The Workplace Risk Assessment and Control (WRAC) risk assessment methodology was used. The risk assessment followed the principles outlined in AS/NZS ISO 31000:2018 and MDG1010 – Minerals Industry Risk Management Handbook and complied with the Abel Risk Management Procedure.

The Yancoal Risk Matrix (refer to Appendix 1) was used to assess risk.

The following hierarchy of control was used to determine and categorise risk controls (from most effective to least effective):
- Elimination;
- Substitution;
- Isolation;
- Engineering;
- Administrative;
- PPE; and
- Mitigants.

2.5 Unquantifiable Hazards

Nil unquantifiable hazards were identified.

2.6 Reference Material

Reference material that was consulted to assist in the identification of risk sources and controls applicable to the West and Square Pit Closure Strategy included:
- Presentation from Phillip Brown (Environment and Community Relations Superintendent) regarding Closure Options (Refer Appendix 3);
- Draft Abel and Donaldson Coal Mines - West and Square Pit Closure Strategy (RES01033917-002);
- NSW Environmental Planning and Assessment Act 1979;
- NSW Mining Act 1992;
- NSW Government Consultation Draft Guideline 1: Rehabilitation Risk Assessment (July 2018);
- Australian Government Mine Closure Leading Practice Sustainable Development Program for the Mining Industry (September 2016);
- ML1461 (1992) - Donaldson Coal Mine - Section 240(1)(c) Notice NTCE0003222 - Mine Closure;
- ML1618, ML1653 (1992) - Abel Underground Mine - Section 240(1)(c) Notice NTCE0003227 - Mine Closure.

2.7 Assumptions

Assumptions made during the performance of this risk assessment included:
- Scope of Risk Assessment is Closure Risks only applicable to West Pit (including the Abel box cut within the West Pit) and Square Pit;
- No further footprint disturbance for West Pit and Square Pit (i.e. no further mining activities to be undertaken in the area);
- Revegetation areas of the Final Landform is to Native Bushland, except for the Square Pit Revegetated Tailings Storage landform which would be revegetated with grassland species;
- No grazing of the final landforms; and
- Coal at Donaldson / Abel is not acid-forming (based on operational experience, the tailings material from the Abel Underground Mine is geochemically benign as confirmed by Environmental Coordinator – Abel).

Effectiveness of the risk treatment measures outlined in this risk assessment will be assessed through:
- Risk Assessment Action Completion;
- Incident Reporting and Investigation Analysis (closure related); and
- Community Complaints (closure related).

Consequence was assessed as the maximum reasonable outcome of the identified potential event if the event was realised (i.e. controls failed resulting in potential event) and likelihood was based on most likely outcome given the Australian mining industry history if the risk controls were implemented and effective.

2.8 Exclusions

Nil specific exclusions.

The risk assessment did not consider the impacts from:
- Natural disasters (cyclones, tsunami, earthquake); and
- Wilful damage (e.g. sabotage).

2.9 Terminology

Abbreviations used throughout the risk assessment include:
- ALARP – As Low As Reasonably Practicable
- LTA – Less Than Adequate
- RA – Risk Assessment
- RCE – Rehabilitation Cost Estimate
- MOP – Mining Operations Plan
- EPL – Environmental Protection Licence
- RFS – Rural Fire Service
- MLALC - Mindaribba Local Aboriginal Land Council
- RACI Matrix – Matrix that outlines who is responsible, accountable, informed and consulted

2.10 Review Period

This risk assessment is not required to be reviewed as it is specific to the West and Square Pit Closure Strategy. Any changes to the proposed closure options detailed in the West and Square Pit Closure Strategy will require review of this risk assessment.

2.11 Controls Adopted / Rejected

All controls discussed during the conduct of the risk assessment are to be adopted (existing controls) or investigated / implemented (additional controls).

If an additional control is rejected, the reason for rejection will be recorded against the action for the additional control in Yancoal's Safety Electronic Recording Database (i.e. Intelex).

3. RISK ASSESSMENT PARTICIPANTS

No.	Date	Name Full name of person	Role In Business In RA i.e.: Facilitator, Scribe, Content / Technical Expert, Participant	Experience Record: Industry skills and experience generally (including number of years);	Relevance to this assessment Record: Any formal/technical qualifications; Formal risk assessment qualifications NB: experience must demonstrate relevance to the topic being risk assessed	Consensus (Y/N) If no, non-consensus matter must be recorded in applicable section	Signature
1	15/07/2020	Kylie Hannigan (STAC Consulting)	Facilitator / Scribe	24 years mining experience (both underground and open cut) 21 years health, safety, training and HR experience (including management roles) Mining Clients: Yancoal, Glencore/Xstrata, Rio Tinto, BHPBilliton/BMA, AngloAmerican, Peabody, Idemitsu, Various Contractors Previously worked at: Ulan Underground, Crinum/Crinum East Underground, Kestrel Underground, Blair Athol Open Cut	Consultant 20+ Years Risk Assessment Facilitation Bachelor of Occupational Health and Safety (BOHS) G3 Risk Management (University of Queensland) Lead Auditor (RABQSA Cert. No. 113053) Facilitated risk assessments for Yancoal (including Abel) for past 7 years Australian Institute of Mining and Metallurgy (AusIMM) - Member SIA/AIHS - Member Australian Institute of Management - Member	Yes	Refer to Appendix 2
2	15/07/2020	William Farnworth	Participant	40 years mining experience (UG including 1 year OC) 2 years at Abel / 3 years at Austar Previously at Ashton, East Mine, West Mine, Strongman No. 1, Morely, Rapahoe, Mahoenui Valley Colliery, Buchanan Borehole	Mining Engineering Manager (Austar / Abel) Practising Certificate - Mining Engineering Manager Degree in Mining Engineering First and Third Class Certificate of Competency Diploma of Ventilation	Yes	Refer to Appendix 2

No.	Date	Name Full name of person	Role In Business In RA i.e.: Facilitator, Scribe, Content / Technical Expert, Participant	Experience Record: Industry skills and experience generally (including number of years);	Relevance to this assessment Record: Any formal/technical qualifications; Formal risk assessment qualifications NB: experience must demonstrate relevance to the topic being risk assessed	Consensus (Y/N) If no, non-consensus matter must be recorded in applicable section	Signature
3	15/07/2020	Phillip Brown	Participant	22 years experience (environmental - mining), 4 years - Pasminco 17 years at Donaldson Previously at Tasman, Ellalong, Gretley	Environment and Community Relations Superintendent - Abel / Ashton Health Inspection Certificate Bachelor of Applied Science (Environmental Health) Masters in Environmental Studies	Yes	Refer to Appendix 2
4	15/07/2020	Brad Merchant	Participant	22 years mining experience (underground) 11 years at Abel Previously at Ravensworth UG, Myuna	**Site Manager (Ventilation Officer, Undermanager, Roadway Dust Sampling Officer, Fire Officer)** Practising Certificate - Undermanager, Ventilation Officer 2nd Class Certificate of Competency (Undermanager) Fire Officer Course Diploma in Ventilation Roadway Dust Sampling Course Trade - Electrical / Mechanical	Yes	Refer to Appendix 2
5	15/07/2020	Carly McCormack	Participant	21 years experience (environmental science) 5 years at Austar Previously consulting (various sites)	**Environment and Community Superintendent** Bachelor of Environmental Science Graduate Certificate in Environmental Studies	Yes	Refer to Appendix 2

No.	Date	Name Full name of person	Role In Business In RA i.e.: Facilitator, Scribe, Content / Technical Expert, Participant	Experience Record: Industry skills and experience generally (including number of years);	Relevance to this assessment Record: Any formal/technical qualifications; Formal risk assessment qualifications NB: experience must demonstrate relevance to the topic being risk assessed	Consensus (Y/N) If no, non-consensus matter must be recorded in applicable section	Signature
6	15/07/2020	James Benson (CBased Environmental)	Participant	15 years experience (environmental) 3 years at Abel (contracting) Previously at AngloAmerican, Gloucester Coal	Environmental Coordinator (Abel) Bachelor of Science	Yes	Refer to Appendix 2
7	15/07/2020	Margot Robinson (Resources Strategies)	Content / Technical Consultant – Rehabilitation / Mine Closure	Over 10 years of experience in environmental management and project approvals in the resource industry.	Environmental Project Manager Graduate Diploma (Environment Management) Bachelor of Business (International Business)	Yes	Refer to Appendix 2
8	15/07/2020	Lucas Burns (Resources Strategies)	Content / Technical Consultant – Rehabilitation / Mine Closure	Over 15 years of experience in environmental management and project approvals in the resource industry.	Senior Environmental Manager BEng (Environmental) BBus Mgmt (Economics)	Yes	Refer to Appendix 2

4. RISK ASSESSMENT WORKSHEET (WORKPLACE RISK ASSESSMENT AND CONTROL)

OPTION 1A - RESUMPTION OF MINING AT ABEL (FINAL LAND USE OPTION A – SQUARE PIT AS A REVEGETATED TAILINGS STORAGE AND WEST PIT AS A PERMANENT WATER STORAGE)

ID #	Mine Closure / Rehabilitation Aspect	Risk Source	Potential Event /Consequences	Loss Type	Consequence	Likelihood	Existing Risk	Risk Level	Existing / Proposed Risk Treatment / Control	Action	Consequence	Likelihood	Target Risk	Risk Level	Person Responsible for Action	Is Risk Considered ALARP with Proposed Risk Treatments / Actions?
OPTION 1 RESUMPTION OF MINING AT ABEL (FINAL LAND USE OPTION A - SQUARE PIT AS A REVEGETATED TAILINGS STORAGE AND WEST PIT AS A PERMANENT WATER STORAGE)																
1	**General**	Insufficient resourcing: - skills and experience of rehabilitation personnel - funding for or prioritisation of rehabilitation activities - ongoing maintenance of rehabilitation requirements	Signoff not given by Regulator	**(O) Asset Damage and Other**	3	C	13	(H)	Current high standard of Rehabilitation on site (past experience of managing similar voids) - accepted as industry best practice Environmental Team - Abel (experienced in rehabilitation) Use of experienced rehabilitation contractors (external) - previously conducted rehabilitation on site Use of experienced rehabilitation consultants (external) - industry recognised content / technical experts Yancoal Corporate environmental team provide expertise Yancoal Corporate Standards - Rehabilitation (in progress) Existing Environmental Management Strategy and associated Plans (available on Internet/Intelex) 5 Year Plan and Budget Process Cost estimation required when submitting MOP	1. Review budget provisions for rehabilitation of West Pit and Square Pit - determine if budget is from Corporate or required to be budgeted for Abel (follow up with D. Griffin). 2. Review RCE based on Closure Options (Option 1 & Option 2).	3	D	9	(M)	1. W. Farnworth 2. P. Brown	Yes
				(R) Impact on Reputation	2	C	8	(M)			2	D	5	(L)		
2	**General**	Lack of clearly defined responsibilities	Signoff not given by Regulator	**(O) Asset Damage and Other**	1	C	4	(L)	Mining Engineering Manager responsible for seeking approval for funding for closure, provision of resources for rehabilitation and managing rehabilitation activities. Environment and Community Superintendent responsible for design of technical closure plans. Yancoal Corporate Standard - Rehabilitation (includes RACI matrix) MOP - describes responsibilities associated with Closure and Rehabilitation	1. Define specific responsibilities for closure and rehabilitation in the West and Square Pit Closure Strategy and MOP.	1	D	2	(L)	1. P. Brown	Yes
				(R) Impact on Reputation	1	C	4	(L)			1	D	2	(L)		
3	**Decommissioning**	Impacts on European heritage items	N/A - no European heritage items in West Pit and Square Pit													

ID #	Mine Closure / Rehabilitation Aspect	Risk Source	Potential Event /Consequences	Loss Type	Consequence	Likelihood	Existing Risk	Risk Level	Existing / Proposed Risk Treatment / Control	Action	Consequence	Likelihood	Target Risk	Risk Level	Person Responsible for Action	Is Risk Considered ALARP with Proposed Risk Treatments / Actions?
4	**Decommissioning**	Impacts on Aboriginal heritage items: - Four Mile Creek (Aboriginal Conservation Area)	Prosecution	**(E) Environmental Impact**	**4**	**C**	**18**	**(H)**	Survey of areas by local Aboriginal group (Mindaribba Local Aboriginal Land Council) Survey of area completed by Archaeologists and MLALC previously Aboriginal Heritage Management Plan Ground Disturbance Permit	1. Survey of areas by local Aboriginal group (MLALC). 2. Survey of areas by Archaeologists. 3. Obtain Section 90 Permit to relocate any found Aboriginal artefacts if required.	**2**	**D**	**5**	**(L)**	1. P. Brown 2. P. Brown 3. P. Brown	Yes
5	**Decommissioning**	Contamination resulting from associated activities: - Stowage in West Pit (may contain hydrocarbons, resins, cement) - Diesel Tanks at West Pit (hydrocarbons) - Runoff from Helipad / Storage Area (hydrocarbons) - Tailings Emplacement (Square Pit)	Contamination of waterways or land resulting in infringement notice	**(E) Environmental Impact**	**3**	**C**	**13**	**(H)**	Phase 1 Contamination Study to be conducted	1. Phase 1 Contamination Study of West Pit and Square Pit 2. Consider disposal requirement costs as a result of the Phase 1 Contamination Study in budget for Mine Closure and Rehabilitation.	**3**	**D**	**9**	**(M)**	1. P. Brown 2. W. Farnworth	Yes
6	**Decommissioning**	Generation of waste products from demolition process: - Conveyor Gantry - Electrical Substation - Compressors - Services (Pipes / Cables) - Stores / Laydown Areas	Wastes not disposed of correctly (either at licensed disposal facility or in accordance with EPL and Mine Closure MOP) - infringement notice	**(E) Environmental Impact**	**3**	**C**	**13**	**(H)**	Disposal methods to be identified and confirmed in Mine Closure MOP Decommissioning Plan for Mine Closure Reputable waste contract company engaged (licensed) Donaldson and Abel Waste Management Plan	1. Determine disposal methods of waste products (either at licensed disposal facility or in accordance with EPL and Mine Closure MOP) and include in a Decommissioning Plan for Mine Closure.	**2**	**D**	**5**	**(L)**	1. P. Brown	Yes
7	**Decommissioning**	Groundwater accumulation in West Pit final void Note: Seam is down-dip to South from West Pit (West Pit floor is below Lower Donaldson - water will migrate back to underground)	Unknown until hydrogeological study is completed	**(E) Environmental Impact**	**4**	**C**	**18**	**(H)**	Hydrogeological Study (to be conducted to confirm final standing water level and consider flood capacity as a result of 1 in 250 year rainfall events)	1. Conduct hydrogeological Study to confirm final standing water level and consider flood capacity as a result of 1 in 250 year rainfall events. 2. Implement control requirements from hydrogeological study if potential for West Pit to discharge.	**2**	**D**	**5**	**(L)**	1. P. Brown 2. P. Brown	Yes

ID #	Mine Closure / Rehabilitation Aspect	Risk Source	Potential Event /Consequences	Loss Type	Consequence	Likelihood	Existing Risk	Risk Level	Existing / Proposed Risk Treatment / Control	Action	Consequence	Likelihood	Target Risk	Risk Level	Person Responsible for Action	Is Risk Considered ALARP with Proposed Risk Treatments / Actions?
8	**Decommissioning**	Adverse geotechnical and or geochemical issues associated with process waste storage facilities (e.g. tailings, reject emplacements), overburden and waste rock dumps etc.	Spontaneous combustion Note: coal at Donaldson / Abel is not acid-forming	**(E) Environmental Impact**	2	C	8	(M)	Emplacement method design for tailings to limit spontaneous combustion Emplacement Management Plan	1. If resumption of mining and storage of tailings in Square Pit, requirement emplacement design and emplacement management plan to consider: Spontaneous Combustion and Water Management. 2. High Risk Activity Notification for Tailings Storage.	2	D	5	(L)	1. P. Brown 2. W. Farnworth	Yes
			Water runoff from Tailings prior to capping	**(E) Environmental Impact**	4	C	18	(H)	Emplacement design for tailings to consider water runoff Donaldson and Abel Water Management Plan Emplacement Management Plan	1. If resumption of mining and storage of tailings in Square Pit, requirement emplacement design and emplacement management plan to consider: Spontaneous Combustion and Water Management. 2. High Risk Activity Notification for Tailings Storage.	2	D	5	(L)	1. P. Brown 2. W. Farnworth	Yes
9	**Decommissioning**	Unauthorised access to underground workings	Unauthorised access to underground by public following cessation of mining (no ventilation to underground workings)	**(P) Harm to People**	4	D	14	(H)	Sealing of 3 x Portals and 2 x Shafts High Risk Activity Notification for Sealing Decommissioning Plan to include prevention of access to underground following cessation of mining Current access is restricted via use of gates being locked on Portal Entrances	1. Decommissioning Plan to include prevention of access to underground following cessation of mining (including sealing of portals). 2. Current mining status until final sealing of 3 x Portals and 2 x Shafts.	4	E	10	(M)	1. W. Farnworth 2. Current	Yes
10	**Landform Establishment**	Failure of borehole or gas well seals.	N/A - no boreholes or gas wells in Square Pit and West Pit Areas													
11	**Landform Establishment**	Failure of mine seals: - 3 x Portals	Unauthorised access to underground by public following cessation of mining (no ventilation to underground workings)	**(P) Harm to People**	4	D	14	(H)	Sealing of 3 x Portals and 2 x Shafts High Risk Activity Notification for Sealing	1. High Risk Activity Notification for Final Sealing	4	E	10	(M)	1. W. Farnworth	Yes

ID #	Mine Closure / Rehabilitation Aspect	Risk Source	Potential Event /Consequences	Loss Type	Consequence	Likelihood	Existing Risk	Risk Level	Existing / Proposed Risk Treatment / Control	Action	Consequence	Likelihood	Target Risk	Risk Level	Person Responsible for Action	Is Risk Considered ALARP with Proposed Risk Treatments / Actions?
			Integrity of seals compromised by blasting activities - unauthorised access underground	**(P) Harm to People**	**4**	**D**	**14**	**(H)**	Decommissioning Plan to include prevention of access to underground following cessation of mining including sealing activities and potential impacts from rehabilitation activities (e.g. blasting impacts on seals).	1. Decommissioning Plan to include prevention of access to underground following cessation of mining (including sealing of portals).	**4**	**E**	**10**	**(M)**	1. W. Farnworth	Yes
12	**Landform Establishment**	Instability of highwalls and low walls.	Landform failure - public safety	**(P) Harm to People**	**4**	**D**	**14**	**(H)**	Fencing and signage at property boundary Bunding at top of highwalls Geotechnical / Final Landform Study to determine slope requirements for highwall to be long-term geotechnically stable Design of Blasting to minimise risk Current EA commitment for West Pit to have 18 degree slope of highwall (final landform) - Southern and Western Walls and 10 degree slope of highwall for Northern and Eastern Walls	1. Geotechnical / Final Landform Study to determine slope requirements for highwall to be long-term geotechnically stable. 2. If outcomes of Geotechnical / Final Landform Study determine different slope requirements, update relevant Management Plans and MOP.	**2**	**C**	**8**	**(M)**	1. W. Farnworth 2. P. Brown	Yes
			Signoff not given by Regulator	**(O) Asset Damage and Other**	**2**	**C**	**8**	**(M)**	Fencing and signage at property boundary Bunding at top of highwalls Geotechnical / Final Landform Study to determine slope requirements for highwall to be long-term geotechnically stable Design of Blasting to minimise risk Current EA commitment for West Pit to have 18 degree slope of highwall (final landform) - Southern and Western Walls and 10 degree slope of highwall for Northern and Eastern Walls	1. Geotechnical / Final Landform Study to determine slope requirements for highwall to be long-term geotechnically stable. 2. If outcomes of Geotechnical / Final Landform Study determine different slope requirements, update relevant Management Plans and MOP.	**2**	**D**	**5**	**(L)**	1. W. Farnworth 2. P. Brown	Yes
13	**Landform Establishment**	Availability of suitable materials for capping of hazardous materials and impounded tailings / coarse reject material	Suitable capping material volume unavailable on site - unable to cap	**(E) Environmental Impact**	**4**	**C**	**18**	**(H)**	Capping material available – potential source is from Bridge to Square Pit Determine capping materials required and source of capping material (e.g. internal or external) Study to determine capping design and conduct capping materials balance based on design.	1. Study to determine capping design and conduct capping materials balance based on design. 2. Source and budget any external capping materials required.	**3**	**D**	**9**	**(M)**	1. P. Brown 2. W. Farnworth	Yes
14	**Landform Establishment**	Final landform instability (e.g. Steep slopes, erosion etc.) affecting final land use capability.	Water quality impacts	**(E) Environmental Impact**	**3**	**C**	**13**	**(H)**	Final Landform Study to determine appropriate slope considering water management.	1. Conduct Final Landform Study to determine appropriate slope design considering water management.	**2**	**D**	**5**	**(L)**	1. P. Brown	Yes

ID #	Mine Closure / Rehabilitation Aspect	Risk Source	Potential Event /Consequences	Loss Type	Consequence	Likelihood	Existing Risk	Risk Level	Existing / Proposed Risk Treatment / Control	Action	Consequence	Likelihood	Target Risk	Risk Level	Person Responsible for Action	Is Risk Considered ALARP with Proposed Risk Treatments / Actions?
15	**Landform Establishment**	Final landform unsuitable for final land use (e.g. Large rocks present affecting cultivation, settlement and surface subsidence leading to extended ponding etc.).	N/A - Square Pit final landform is to be Native Bushland (no grazing) and West Pit final landform is water storage													
16	**Landform Establishment**	Landform aspect not suitable for intended target plant species. Note: Revegetation with pasture species	N/A - Revegetation with pasture species													
17	**Landform Establishment**	Diversion of surface water runoff away from catchment areas	Final void fills and discharges - unknown consequence until Hydrogeological Study is completed	**(E) Environmental Impact**	**4**	**C**	**18**	**(H)**	Hydrogeological Study (to be conducted to confirm final standing water level and consider flood capacity as a result of 1 in 250 year rainfall events) Final Landform Design to include water management requirements (e.g. diversions, etc.) Donaldson and Abel Water Management Plan	1. Conduct hydrogeological Study to confirm final standing water level and consider flood capacity as a result of 1 in 250 year rainfall events. 2. Implement control requirements from hydrogeological study if potential for West Pit to discharge.	**2**	**D**	**5**	**(L)**	1. P. Brown 2. P. Brown	Yes
			Loss of water flow downstream due to capture of water in West Pit Void	**(E) Environmental Impact**	**3**	**C**	**13**	**(H)**	Final Landform Design to include water management requirements (e.g. diversions, etc.) Donaldson and Abel Water Management Plan Survey Control	1. Final Landform Design to include water management requirements (e.g. diversions, etc.) considering potential impacts on water flow downstream	**3**	**D**	**9**	**(M)**	1. P. Brown	Yes
18	**Landform Establishment**	Groundwater accumulation in voids	Final void fills and discharges - unknown consequence until Hydrogeological Study is completed	**(E) Environmental Impact**	**4**	**C**	**18**	**(H)**	Hydrogeological Study (to be conducted to confirm final standing water level and consider flood capacity as a result of 1 in 250 year rainfall events) Final Landform Design to include water management requirements (e.g. diversions, etc.) Donaldson and Abel Water Management Plan	1. Conduct hydrogeological Study to confirm final standing water level and consider flood capacity as a result of 1 in 250 year rainfall events. 2. Implement control requirements from hydrogeological study if potential for West Pit to discharge. 3. Maintain Groundwater Licence for Final Void/s.	**2**	**D**	**5**	**(L)**	1. P. Brown 2. P. Brown 3. P. Brown	Yes
19	**Landform Establishment**	Groundwater accumulation in	N/A - not in scope of risk assessment													

ID #	Mine Closure / Rehabilitation Aspect	Risk Source	Potential Event /Consequences	Loss Type	Consequence	Likelihood	Existing Risk	Risk Level	Existing / Proposed Risk Treatment / Control	Action	Consequence	Likelihood	Target Risk	Risk Level	Person Responsible for Action	Is Risk Considered ALARP with Proposed Risk Treatments / Actions?
		underground workings														
20	**Landform Establishment**	Watercourse diversion instability affecting riparian health	N/A - no watercourse diversions in place or proposed													
21	**Landform Establishment**	Water availability, on and off site.	N/A - no water has been required for rehabilitation to date at Donaldson / Abel - Big Kahuna water available													
22	**Growth Medium Development**	Adoption of inappropriate or inadequate rehabilitation techniques, including equipment fleet	Impacts on establishing vegetation due to soil compaction	**(E) Environmental Impact**	2	C	8	(M)	Current high standard of Rehabilitation on site (past experience of managing similar voids) - accepted as industry best practice Environmental Team - Abel (experienced in rehabilitation) Use of experienced rehabilitation contractors (external) – preferentially use contractors that previously conducted Donaldson rehabilitation Use of experienced rehabilitation consultants (external) - industry recognised content / technical experts Yancoal Corporate environmental team provide expertise Yancoal Corporate Standards - Rehabilitation (in progress) Existing Environmental Management Strategy and associated Plans (available on Internet/Intelex) Fit for Purpose Equipment used for rehabilitation activities (consideration of weight, compaction, etc.)		2	D	5	(L)		Yes
23	**Growth Medium Development**	Subsoil and topsoil deficit for rehabilitation activities	Suitable subsoil and topsoil material volume unavailable on site	**(E) Environmental Impact**	3	C	13	(H)	Determine materials required and source topsoil or alternative 150mm - current commitment for topsoil replacement	1. Conduct Materials Balance (Capping and Topsoil/Alternative Materials) on site. 2. Source and budget any topsoil materials required.	2	D	5	(L)	1. P. Brown 2. W. Farnworth	Yes

ID #	Mine Closure / Rehabilitation Aspect	Risk Source	Potential Event /Consequences	Loss Type	Consequence	Likelihood	Existing Risk	Risk Level	Existing / Proposed Risk Treatment / Control	Action	Consequence	Likelihood	Target Risk	Risk Level	Person Responsible for Action	Is Risk Considered ALARP with Proposed Risk Treatments / Actions?
24	**Growth Medium Development**	Substrate inadequate to support revegetation (e.g. Lack of organic matter, nutrient deficiency, lack of soil biota, adverse soil chemical properties, exposed hostile geochemical materials, and any other factors impeding the effective rooting depth)	Capping design unsuitable to support target revegetation	**(E) Environmental Impact**	2	C	8	(M)	Landform Design to consider capping design and materials to support native grassland vegetation.	1. Final Landform Design to include capping design and materials to support native grassland vegetation.	2	D	5	(L)	1. P. Brown	Yes
25	**Ecosystem Establishment**	Lack of availability and quality of seed resources, including genetic integrity	N/A - Revegetation with pasture species and native grasses are readily available													
26	**Ecosystem Establishment**	Lack of resources for rehabilitation maintenance	Refer to 1. General (Resourcing)													
27	**Ecosystem Establishment**	Weed and pest control: - weed introduction and control (or lack thereof) - Damage from fauna (e.g. kangaroos, feral goats, etc.) - Insects and plant disease	Impacts on vegetation (establishing and ongoing) - completion criteria not met	**(E) Environmental Impact**	3	C	13	(H)	Flora and Fauna Management Plan includes weed management Annual Weed Management Program Environmental Inspections Rehabilitation Monitoring Current high standard of Rehabilitation on site (past experience of managing similar rehabilitation areas) - accepted as industry best practice		2	D	5	(L)		Yes
28	**Ecosystem Establishment**	Lack of structural integrity of buildings and infrastructure to be retained in final land use	N/A - no buildings or infrastructure to be retained at West Pit and Square Pit landforms													

ID #	Mine Closure / Rehabilitation Aspect	Risk Source	Potential Event /Consequences	Loss Type	Consequence	Likelihood	Existing Risk	Risk Level	Existing / Proposed Risk Treatment / Control	Action	Consequence	Likelihood	Target Risk	Risk Level	Person Responsible for Action	Is Risk Considered ALARP with Proposed Risk Treatments / Actions?
29	**Ecosystem Establishment**	Adoption of inappropriate or inadequate rehabilitation techniques	Impacts on establishing vegetation	**(E) Environmental Impact**	**2**	**C**	**8**	**(M)**	Current high standard of Rehabilitation on site (past experience of managing similar voids) - accepted as industry best practice Environmental Team - Abel (experienced in rehabilitation) Use of experienced rehabilitation contractors (external) - preferentially use contractors that previously conducted Donaldson rehabilitation Use of experienced rehabilitation consultants (external) - industry recognised content / technical experts Yancoal Corporate environmental team provide expertise Yancoal Corporate Standards - Rehabilitation (in progress) Existing Environmental Management Strategy and associated Plans (available on Internet/Intelex) Fit for Purpose Equipment used for rehabilitation activities (consideration of weight, compaction, etc.) Revegetation method limited to direct seeding (i.e. various rehabilitation techniques aren't proposed)		**2**	**D**	**5**	**(L)**		Yes
30	**Ecosystem Establishment**	Weather and climatic influences (e.g. Drought; intense rainfall events; bushfire etc.).	Damage to vegetation due to fire, flood or drought	**(E) Environmental Impact**	**2**	**C**	**8**	**(M)**	Bushfire Management Plan Water Management Plan Ability to obtain water from West Pit final void and Big Kahuna Dam (and potentially other nearby dams) Hydrogeological Study (to consider flood capacity as a result of 1 in 250 year rainfall events) Rehabilitation Management Plan - includes erosion and sediment controls MOP Access to Hunter Water Pipeline Local Rural Fire Service (established relationship with local RFS)		**2**	**C**	**8**	**(M)**		Yes
31	**Ecosystem Establishment**	Insufficient establishment or cover of vegetation	Impacts on vegetation (establishing and ongoing) - completion criteria not met	**(E) Environmental Impact**	**3**	**C**	**13**	**(H)**	Flora and Fauna Management Plan includes weed management Annual Weed Management Program Environmental Inspections Rehabilitation Monitoring Current high standard of Rehabilitation on site (past experience of managing similar voids) - accepted as industry best practice Rehabilitation Management Plan MOP Water available on site - Big Kahuna Dam		**2**	**D**	**5**	**(L)**		Yes

ID #	Mine Closure / Rehabilitation Aspect	Risk Source	Potential Event /Consequences	Loss Type	Consequence	Likelihood	Existing Risk	Risk Level	Existing / Proposed Risk Treatment / Control	Action	Consequence	Likelihood	Target Risk	Risk Level	Person Responsible for Action	Is Risk Considered ALARP with Proposed Risk Treatments / Actions?
32	**Ecosystem Establishment**	Erosion and failure of drainage and water management/storage structures.	Impacts on water quality and potential discharge	**(E) Environmental Impact**	**4**	**C**	**18**	**(H)**	Final Landform Design to include water management requirements (e.g. diversions, etc.) Rehabilitation Management Plan - includes erosion and sediment control measures Environmental Inspections Rehabilitation Monitoring Donaldson and Abel Water Management Plan	1. Ongoing inspection and maintenance of any Water Management structures required as part of final landform design.	**4**	**D**	**14**	**(H)**	1. P. Brown	Yes
33	**Ecosystem Establishment**	Overgrazing of pasture rehabilitation areas.	N/A - no grazing for final landform													
34	**Ecosystem Establishment**	Poor water quality / excessive discharges	Refer to ID#32 Erosion and Failure of Drainage and Water Management / Storage Structures, #18 Groundwater Accumulation in Voids													
35	**Ecosystem and Land Use Development**	Weather and climatic influences (e.g. drought; intense rainfall events; bushfire etc.).	Damage to vegetation due to fire, flood or drought	**(E) Environmental Impact**	**2**	**C**	**8**	**(M)**	Bushfire Management Plan Water Management Plan Ability to obtain water from West Pit and Big Kahuna Dam Hydrogeological Study (to consider flood capacity as a result of 1 in 250 year rainfall events) Rehabilitation Management Plan - includes erosion and sediment controls MOP Access to Hunter Water Pipeline Local Rural Fire Service (established relationship with local RFS)		**2**	**C**	**8**	**(M)**		Yes
36	**Ecosystem and Land Use Development**	Vandalism to revegetation areas.	Damage to vegetation due to vandalism	**(E) Environmental Impact**	**2**	**C**	**8**	**(M)**	Fencing and signage at property boundary Environmental Inspections Rehabilitation Monitoring		**2**	**C**	**8**	**(M)**		Yes
37	**Ecosystem and Land Use Development**	Inadvertent or unauthorised access by mining equipment and vehicles.	N/A - no ongoing mining activities													
38	**Ecosystem and Land Use Development**	Post-closure water quality issues (e.g. high salinity etc.).	Refer to ID#32 Erosion and Failure of Drainage and Water Management / Storage Structures, #18 Groundwater													

ID #	Mine Closure / Rehabilitation Aspect	Risk Source	Potential Event /Consequences	Loss Type	Consequence	Likelihood	Existing Risk	Risk Level	Existing / Proposed Risk Treatment / Control	Action	Consequence	Likelihood	Target Risk	Risk Level	Person Responsible for Action	Is Risk Considered ALARP with Proposed Risk Treatments / Actions?
			Accumulation in Voids													
39	**Ecosystem and Land Use Development**	Insects and plant disease.	Refer to #27 Weed & Pest Control													
40	**Ecosystem and Land Use Development**	Overgrazing of pasture rehabilitation areas.	N/A - no grazing for final landform													
41	**Ecosystem and Land Use Development**	Lack of resources for rehabilitation maintenance.	Refer to #1 General - Resourcing													
42	**Ecosystem and Land Use Development**	Re-disturbance of established rehabilitation areas.	N/A - no redisturbance of areas proposed once rehabilitated													

OPTION 1B - RESUMPTION OF MINING AT ABEL (FINAL LAND USE OPTION B – SQUARE PIT AS A TAILINGS AND PERMANENT WATER STORAGE AND WEST PIT AS PERMANENT WATER STORAGE)

ID #	Mine Closure / Rehabilitation Aspect	Risk Source	Potential Event /Consequences	Loss Type	Consequence	Likelihood	Existing Risk	Risk Level	Existing / Proposed Risk Treatment / Control	Action	Consequence	Likelihood	Target Risk	Risk Level	Person Responsible for Action	Is Risk Considered ALARP with Proposed Risk Treatments / Actions?
OPTION 1 RESUMPTION OF MINING AT ABEL (FINAL LAND USE OPTION B – SQUARE PIT AS A TAILINGS AND PERMANENT WATER STORAGE AND WEST PIT AS PERMANENT WATER STORAGE)																
1	**General**	Insufficient resourcing: - skills and experience of rehabilitation personnel - funding for or prioritisation of rehabilitation activities - ongoing maintenance of rehabilitation requirements	Signoff not given by Regulator	**(O) Asset Damage and Other**	**3**	**C**	**13**	**(H)**	Current high standard of Rehabilitation on site (past experience of managing similar voids) - accepted as industry best practice Environmental Team - Abel (experienced in rehabilitation) Use of experienced rehabilitation contractors (external) – preferentially use contractors that previously conducted Donaldson rehabilitation Use of experienced rehabilitation consultants (external) - industry recognised content / technical experts Yancoal Corporate environmental team provide expertise Yancoal Corporate Standards - Rehabilitation (in progress) Existing Environmental Management Strategy and associated Plans (available on Internet/Intelex) 5 Year Plan and Budget Process Cost estimation required when submitting MOP	1. Review budget provisions for rehabilitation of West Pit and Square Pit - determine if budget is from Corporate or required to be budgeted for Abel (follow up with D. Griffin). 2. Review RCE based on Closure Options (Option 1 & Option 2).	**3**	**D**	**9**	**(M)**	1. W. Farnworth 2. P. Brown	Yes
				(R) Impact on Reputation	**2**	**C**	**8**	**(M)**			**2**	**D**	**5**	**(L)**		
2	**General**	Lack of clearly defined responsibilities	Signoff not given by Regulator	**(O) Asset Damage and Other**	**1**	**C**	**4**	**(L)**	Mining Engineering Manager responsible for seeking approval for funding for closure, provision of resources for rehabilitation and managing rehabilitation activities. Environment and Community Superintendent responsible for design of technical closure plans. Yancoal Corporate Standard - Rehabilitation (includes RACI matrix) MOP - describes responsibilities associated with Closure and Rehabilitation	1. Define specific responsibilities for closure and rehabilitation in the West and Square Pit Closure Strategy and MOP.	**1**	**D**	**2**	**(L)**	1. P. Brown	Yes
				(R) Impact on Reputation	**1**	**C**	**4**	**(L)**			**1**	**D**	**2**	**(L)**		
3	**Decommissioning**	Impacts on European heritage items	N/A - no European heritage items in West Pit and Square Pit													

ID #	Mine Closure / Rehabilitation Aspect	Risk Source	Potential Event /Consequences	Loss Type	Consequence	Likelihood	Existing Risk	Risk Level	Existing / Proposed Risk Treatment / Control	Action	Consequence	Likelihood	Target Risk	Risk Level	Person Responsible for Action	Is Risk Considered ALARP with Proposed Risk Treatments / Actions?
4	**Decommissioning**	Impacts on Aboriginal heritage items: - Four Mile Creek (Aboriginal Conservation Area)	Prosecution	**(E) Environmental Impact**	4	C	18	(H)	Survey of areas by local Aboriginal group (Mindaribba Local Aboriginal Land Council) Survey of area completed by Archaeologists and MLALC previously Aboriginal Heritage Management Plan Ground Disturbance Permit	1. Survey of areas by local Aboriginal group (MLALC). 2. Survey of areas by Archaeologists. 3. Obtain Section 90 Permit to relocate any found Aboriginal artefacts if required.	2	D	5	(L)	1. P. Brown 2. P. Brown 3. P. Brown	Yes
5	**Decommissioning**	Contamination resulting from associated activities: - Stowage in West Pit (may contain hydrocarbons, resins, cement) - Diesel Tanks at West Pit (hydrocarbons) - Runoff from Helipad / Storage Area (hydrocarbons) - Tailings Emplacement (Square Pit)	Contamination of waterways or land resulting in infringement notice	**(E) Environmental Impact**	3	C	13	(H)	Phase 1 Contamination Study to be conducted	1. Phase 1 Contamination Study of West Pit and Square Pit 2. Consider disposal requirement costs as a result of the Phase 1 Contamination Study in budget for Mine Closure and Rehabilitation.	3	D	9	(M)	1. P. Brown 2. W. Farnworth	Yes
6	**Decommissioning**	Generation of waste products from demolition process: - Conveyor Gantry - Electrical Substation - Compressors - Services (Pipes / Cables) - Stores / Laydown Areas	Wastes not disposed of correctly (either at licensed disposal facility or in accordance with EPL and Mine Closure MOP) - infringement notice	**(E) Environmental Impact**	3	C	13	(H)	Disposal methods to be identified and confirmed in Mine Closure MOP Decommissioning Plan for Mine Closure Reputable waste contract company engaged (licensed) Donaldson and Abel Waste Management Plan	1. Determine disposal methods of waste products (either at licensed disposal facility or in accordance with EPL and Mine Closure MOP) and include in a Decommissioning Plan for Mine Closure.	2	D	5	(L)	1. P. Brown	Yes
7	**Decommissioning**	Groundwater accumulation in West Pit final void Note: Seam is down-dip to South from West Pit (West Pit floor is below Lower Donaldson - water will migrate back to underground)	Unknown until hydrogeological study is completed	**(E) Environmental Impact**	4	C	18	(H)	Hydrogeological Study (to be conducted to confirm final standing water level and consider flood capacity as a result of 1 in 250 year rainfall events)	1. Conduct hydrogeological Study to confirm final standing water level and consider flood capacity as a result of 1 in 250 year rainfall events. 2. Implement control requirements from hydrogeological study if potential for West Pit to discharge.	2	D	5	(L)	1. P. Brown 2. P. Brown	Yes

ID #	Mine Closure / Rehabilitation Aspect	Risk Source	Potential Event /Consequences	Loss Type	Consequence	Likelihood	Existing Risk	Risk Level	Existing / Proposed Risk Treatment / Control	Action	Consequence	Likelihood	Target Risk	Risk Level	Person Responsible for Action	Is Risk Considered ALARP with Proposed Risk Treatments / Actions?
8	**Decommissioning**	Groundwater accumulation in Square Pit final void Note: Potential for spill half way along Eastern Wall in Square Pit (low point) and discharge into Four Mile Creek	Unknown until hydrogeological study is completed	**(E) Environmental Impact**	**4**	**C**	**18**	**(H)**	Hydrogeological Study (to be conducted to confirm final standing water level and consider flood capacity as a result of 1 in 250 year rainfall events) - consider both voids and both Option 1B and Option 1C for Square Pit	1. Conduct hydrogeological Study to confirm final standing water level and consider flood capacity as a result of 1 in 250 year rainfall events - consider both voids and both Option 1B and Option 1C for Square Pit. 2. Implement control requirements from hydrogeological study if potential for Square Pit to discharge.	**2**	**D**	**5**	**(L)**	1. P. Brown 2. P. Brown	Yes
9	**Decommissioning**	Adverse geotechnical and or geochemical issues associated with process waste storage facilities (e.g. tailings, reject emplacements), overburden and waste rock dumps etc.	Contamination of groundwater	**(E) Environmental Impact**	**3**	**C**	**13**	**(H)**	Emplacement Management Plan Final Void Water Balance to determine potential groundwater impacts (with groundwater table) Donaldson and Abel Water Management Plan Geochemical Assessment on Abel Tailings	1. Final Void Water Balance Study to determine potential groundwater impacts (with groundwater table) and implement recommendations from study. 2. High Risk Activity Notification for Tailings Storage. 3. Conduct Geochemical Assessment on Abel Tailings.	**3**	**D**	**9**	**(M)**	1. P. Brown 2. W. Farnworth 3. W. Farnworth	Yes
10	**Decommissioning**	Unauthorised access to underground workings	Unauthorised access to underground by public following cessation of mining (no ventilation to underground workings)	**(P) Harm to People**	**4**	**D**	**14**	**(H)**	Sealing of 3 x Portals and 2 x Shafts High Risk Activity Notification for Sealing Decommissioning Plan to include prevention of access to underground following cessation of mining Current access is restricted via use of gates being locked on Portal Entrances	1. Decommissioning Plan to include prevention of access to underground following cessation of mining (including sealing of portals). 2. Current mining status until final sealing of 3 x Portals and 2 x Shafts.	**4**	**E**	**10**	**(M)**	1. W. Farnworth 2. Current	Yes
11	**Landform Establishment**	Failure of borehole or gas well seals.	N/A - no boreholes or gas wells in Square Pit and West Pit Areas													
12	**Landform Establishment**	Failure of mine seals: - 3 x Portals	Unauthorised access to underground by public following cessation of mining (no ventilation to underground workings)	**(P) Harm to People**	**4**	**D**	**14**	**(H)**	Sealing of 3 x Portals and 2 x Shafts High Risk Activity Notification for Sealing	1. High Risk Activity Notification for Final Sealing	**4**	**E**	**10**	**(M)**	1. W. Farnworth	Yes
			Integrity of seals compromised by blasting activities - unauthorised access underground	**(P) Harm to People**	**4**	**D**	**14**	**(H)**	Decommissioning Plan to include prevention of access to underground following cessation of mining including sealing activities and potential impacts from rehabilitation	1. Decommissioning Plan to include prevention of access to underground following cessation of mining (including sealing of portals).	**4**	**E**	**10**	**(M)**	1. W. Farnworth	Yes

ID #	Mine Closure / Rehabilitation Aspect	Risk Source	Potential Event /Consequences	Loss Type	Consequence	Likelihood	Existing Risk	Risk Level	Existing / Proposed Risk Treatment / Control	Action	Consequence	Likelihood	Target Risk	Risk Level	Person Responsible for Action	Is Risk Considered ALARP with Proposed Risk Treatments / Actions?
									activities (e.g. blasting impacts on seals).							
13	**Landform Establishment**	Instability of highwalls and low walls.	Landform failure - public safety	**(P) Harm to People**	**4**	**D**	**14**	**(H)**	Fencing and signage at property boundary and around perimeter of final void(s) Bunding at top of highwalls Geotechnical / Final Landform Study to determine slope requirements for highwall to be long-term geotechnically stable Design of Blasting to minimise risk Current EA commitment for West Pit to have 18 degree slope of highwall (final landform) - Southern and Western Walls and 10 degree slope of highwall for Northern and Eastern Walls	1. Geotechnical / Final Landform Study to determine slope requirements for highwall to be long-term geotechnically stable (West Pit and Square Pit) based on final standing water level for Square Pit. 2. If outcomes of Geotechnical / Final Landform Study determine different slope requirements, update relevant Management Plans and MOP.	**2**	**C**	**8**	**(M)**	1. W. Farnworth 2. P. Brown	Yes
			Signoff not given by Regulator	**(O) Asset Damage and Other**	**2**	**C**	**8**	**(M)**	Fencing and signage at property boundary and around perimeter of final void(s) Bunding at top of highwalls Geotechnical / Final Landform Study to determine slope requirements for highwall to be long-term geotechnically stable Design of Blasting to minimise risk Current EA commitment for West Pit to have 18 degree slope of highwall (final landform) - Southern and Western Walls and 10 degree slope of highwall for Northern and Eastern Walls	1. Geotechnical / Final Landform Study to determine slope requirements for highwall to be long-term geotechnically stable. 2. If outcomes of Geotechnical / Final Landform Study determine different slope requirements, update relevant Management Plans and MOP.	**2**	**D**	**5**	**(L)**	1. W. Farnworth 2. P. Brown	Yes
14	**Landform Establishment**	Availability of suitable materials for capping of hazardous materials and impounded tailings / coarse reject material Note: Square Pit will not have exposed tailings under this option - tailings will be under water (based on final landform design)	Suitable capping material volume unavailable on site - unable to cap	**(E) Environmental Impact**	**4**	**C**	**18**	**(H)**	Capping material available - Bridge to Square Pit Determine capping materials required and source of capping material (e.g. internal or external) Study to determine capping design and conduct capping materials balance based on design.	1. Study to determine capping design and conduct capping materials balance based on design. 2. Source and budget any external capping materials required.	**3**	**D**	**9**	**(M)**	1. P. Brown 2. W. Farnworth	Yes
15	**Landform Establishment**	Final landform instability (e.g. Steep slopes, erosion etc.)	Water quality impacts	**(E) Environmental Impact**	**3**	**C**	**13**	**(H)**	Final Landform Study to determine appropriate slope considering water management.	1. Conduct Final Landform Study to determine appropriate slope design considering water management.	**2**	**D**	**5**	**(L)**	1. P. Brown	Yes

ID #	Mine Closure / Rehabilitation Aspect	Risk Source	Potential Event /Consequences	Loss Type	Consequence	Likelihood	Existing Risk	Risk Level	Existing / Proposed Risk Treatment / Control	Action	Consequence	Likelihood	Target Risk	Risk Level	Person Responsible for Action	Is Risk Considered ALARP with Proposed Risk Treatments / Actions?
		affecting final land use capability.														
16	**Landform Establishment**	Final landform unsuitable for final land use (e.g. Large rocks present affecting cultivation, settlement and surface subsidence leading to extended ponding etc.).	N/A - Square Pit final landform is to be water storage surrounded by native grasses / bushland and West Pit final landform is water storage													
17	**Landform Establishment**	Landform aspect not suitable for intended target plant species. Note: Revegetation with pasture species	N/A - Revegetation with pasture species and bushland species													
18	**Landform Establishment**	Diversion of surface water runoff away from catchment areas	Final voids (Square Pit and West Pit) fill and discharge - unknown consequence until Hydrogeological Study is completed	**(E) Environmental Impact**	4	C	18	(H)	Hydrogeological Study (to be conducted to confirm final standing water level and consider flood capacity as a result of 1 in 250 year rainfall events) Final Landform Design to include water management requirements (e.g. diversions, etc.) Donaldson and Abel Water Management Plan	1. Conduct hydrogeological Study to confirm final standing water levels (for Square Pit and West Pit) and consider flood capacity as a result of 1 in 250 year rainfall events. 2. Implement control requirements from hydrogeological study if potential for West Pit or Square Pit to discharge.	2	D	5	(L)	1. P. Brown 2. P. Brown	Yes
			Loss of water flow downstream due to capture of water in West Pit Void and Square Pit Void	**(E) Environmental Impact**	3	C	13	(H)	Final Landform Design to include water management requirements (e.g. diversions, etc.) Donaldson and Abel Water Management Plan Survey Control	1. Final Landform Design to include water management requirements (e.g. diversions, etc.) considering potential impacts on water flow downstream	3	D	9	(M)	1. P. Brown	Yes
19	**Landform Establishment**	Groundwater accumulation in voids	Final void fills and discharges - unknown consequence until Hydrogeological Study is completed	**(E) Environmental Impact**	4	C	18	(H)	Hydrogeological Study (to be conducted to confirm final standing water level and consider flood capacity as a result of 1 in 250 year rainfall events) Final Landform Design to include water management requirements (e.g. diversions, etc.) Donaldson and Abel Water Management Plan	1. Conduct hydrogeological Study to confirm final standing water level and consider flood capacity as a result of 1 in 250 year rainfall events. 2. Implement control requirements from hydrogeological study if potential for West Pit or Square Pit to discharge. 3. Maintain Groundwater Licence for Final Void/s.	2	D	5	(L)	1. P. Brown 2. P. Brown 3. P. Brown	Yes
20	**Landform Establishment**	Groundwater accumulation in	N/A - not in scope of risk assessment													

ID #	Mine Closure / Rehabilitation Aspect	Risk Source	Potential Event /Consequences	Loss Type	Consequence	Likelihood	Existing Risk	Risk Level	Existing / Proposed Risk Treatment / Control	Action	Consequence	Likelihood	Target Risk	Risk Level	Person Responsible for Action	Is Risk Considered ALARP with Proposed Risk Treatments / Actions?
		underground workings														
21	**Landform Establishment**	Watercourse diversion instability affecting riparian health	N/A - no watercourse diversions in place or proposed													
22	**Landform Establishment**	Water availability, on and off site.	N/A - no water has been required for rehabilitation to date at Donaldson / Abel - Big Kahuna water available													
23	**Growth Medium Development**	Adoption of inappropriate or inadequate rehabilitation techniques, including equipment fleet	Impacts on establishing vegetation due to soil compaction	**(E) Environmental Impact**	**2**	**C**	**8**	**(M)**	Current high standard of Rehabilitation on site (past experience of managing similar voids) - accepted as industry best practice Environmental Team - Abel (experience in rehabilitation) Use of experienced rehabilitation contractors (external) – preferentially use contractors that previously conducted rehabilitation at Donaldson Use of experienced rehabilitation consultants (external) - industry recognised content / technical experts Yancoal Corporate environmental team provide expertise Yancoal Corporate Standards - Rehabilitation (in progress) Existing Environmental Management Strategy and associated Plans (available on Internet/Intelex) Fit for Purpose Equipment used for rehabilitation activities (consideration of weight, compaction, etc.)		**2**	**D**	**5**	**(L)**		Yes
24	**Growth Medium Development**	Subsoil and topsoil deficit for rehabilitation activities	Suitable subsoil and topsoil material volume unavailable on site	**(E) Environmental Impact**	**3**	**C**	**13**	**(H)**	Determine materials required and source topsoil or alternative 150mm - current commitment for topsoil replacement	1. Conduct Materials Balance (Capping and Topsoil/Alternative Materials) on site. 2. Source and budget any topsoil materials required.	**2**	**D**	**5**	**(L)**	1. P. Brown 2. W. Farnworth	Yes

ID #	Mine Closure / Rehabilitation Aspect	Risk Source	Potential Event /Consequences	Loss Type	Consequence	Likelihood	Existing Risk	Risk Level	Existing / Proposed Risk Treatment / Control	Action	Consequence	Likelihood	Target Risk	Risk Level	Person Responsible for Action	Is Risk Considered ALARP with Proposed Risk Treatments / Actions?
25	**Growth Medium Development**	Substrate inadequate to support revegetation (e.g. Lack of organic matter, nutrient deficiency, lack of soil biota, adverse soil chemical properties, exposed hostile geochemical materials, and any other factors impeding the effective rooting depth)	Soil depth unsuitable to support revegetation	**(E) Environmental Impact**	**2**	**C**	**8**	**(M)**	Landform Design to consider soil depth to support native vegetation.	1. Final Landform Design to include soil depth to support native vegetation for Square Pit.	**2**	**D**	**5**	**(L)**	1. P. Brown	Yes
26	**Ecosystem Establishment**	Lack of availability and quality of seed resources, including genetic integrity	N/A - Revegetation with pasture species, bushland and native grasses are readily available													
27	**Ecosystem Establishment**	Lack of resources for rehabilitation maintenance	Refer to 1. General (Resourcing)													
28	**Ecosystem Establishment**	Weed and pest control: - weed introduction and control (or lack thereof) - Damage from fauna (e.g. kangaroos, feral goats, etc.) - Insects and plant disease	Impacts on vegetation (establishing and ongoing) - completion criteria not met	**(E) Environmental Impact**	**3**	**C**	**13**	**(H)**	Flora and Fauna Management Plan includes weed management Annual Weed Management Program Environmental Inspections Rehabilitation Monitoring Current high standard of Rehabilitation on site (past experience of managing similar voids) - accepted as industry best practice		**2**	**D**	**5**	**(L)**		Yes
29	**Ecosystem Establishment**	Lack of structural integrity of buildings and infrastructure to be retained in final land use	N/A - no buildings or infrastructure to be retained at West Pit and Square Pit landforms													

ID #	Mine Closure / Rehabilitation Aspect	Risk Source	Potential Event /Consequences	Loss Type	Consequence	Likelihood	Existing Risk	Risk Level	Existing / Proposed Risk Treatment / Control	Action	Consequence	Likelihood	Target Risk	Risk Level	Person Responsible for Action	Is Risk Considered ALARP with Proposed Risk Treatments / Actions?
30	**Ecosystem Establishment**	Adoption of inappropriate or inadequate rehabilitation techniques	Impacts on establishing vegetation	**(E) Environmental Impact**	**2**	**C**	**8**	**(M)**	Current high standard of Rehabilitation on site (past experience of managing similar voids) - accepted as industry best practice Environmental Team - Abel (experience in rehabilitation) Use of experienced rehabilitation contractors (external) – preferentially use contractors that previously conducted rehabilitation at Donaldson Use of experienced rehabilitation consultants (external) - industry recognised content / technical experts Yancoal Corporate environmental team provide expertise Yancoal Corporate Standards - Rehabilitation (in progress) Existing Environmental Management Strategy and associated Plans (available on Internet/Intelex) Fit for Purpose Equipment used for rehabilitation activities (consideration of weight, compaction, etc.) Direct seeding		**2**	**D**	**5**	**(L)**		Yes
31	**Ecosystem Establishment**	Weather and climatic influences (e.g. Drought; intense rainfall events; bushfire etc.).	Damage to vegetation due to fire, flood or drought	**(E) Environmental Impact**	**2**	**C**	**8**	**(M)**	Bushfire Management Plan Water Management Plan Ability to obtain water from West Pit and Big Kahuna Dam Hydrogeological Study (to consider flood capacity as a result of 1 in 250 year rainfall events) Rehabilitation Management Plan - includes erosion and sediment controls MOP Access to Hunter Water Pipeline Local Rural Fire Service (established relationship with local RFS)		**2**	**C**	**8**	**(M)**		Yes
32	**Ecosystem Establishment**	Insufficient establishment or cover of vegetation	Impacts on vegetation (establishing and ongoing) - completion criteria not met	**(E) Environmental Impact**	**3**	**C**	**13**	**(H)**	Flora and Fauna Management Plan includes weed management Annual Weed Management Program Environmental Inspections Rehabilitation Monitoring Current high standard of Rehabilitation on site (past experience of managing similar voids) - accepted as industry best practice Rehabilitation Management Plan		**2**	**D**	**5**	**(L)**		Yes

ID #	Mine Closure / Rehabilitation Aspect	Risk Source	Potential Event /Consequences	Loss Type	Consequence	Likelihood	Existing Risk	Risk Level	Existing / Proposed Risk Treatment / Control	Action	Consequence	Likelihood	Target Risk	Risk Level	Person Responsible for Action	Is Risk Considered ALARP with Proposed Risk Treatments / Actions?
									MOP Water available on site - Big Kahuna Dam							
33	**Ecosystem Establishment**	Erosion and failure of drainage and water management/storage structures.	Impacts on water quality and potential discharge	**(E) Environmental Impact**	**4**	**C**	**18**	**(H)**	Final Landform Design to include water management requirements (e.g. diversions, etc.) Rehabilitation Management Plan - includes erosion and sediment control Environmental Inspections Rehabilitation Monitoring Donaldson and Abel Water Management Plan	1. Ongoing inspection and maintenance of any Water Management structures required as part of final landform design.	**4**	**D**	**14**	**(H)**	1. P. Brown	Yes
34	**Ecosystem Establishment**	Overgrazing of pasture rehabilitation areas.	N/A - no grazing for final landform													
35	**Ecosystem Establishment**	Poor water quality / excessive discharges	Refer to #33 Erosion and Failure of Drainage and Water Management / Storage Structures and #19 Groundwater Accumulation in Voids													
36	**Ecosystem and Land Use Development**	Weather and climatic influences (e.g. drought; intense rainfall events; bushfire etc.).	Damage to vegetation due to fire, flood or drought	**(E) Environmental Impact**	**2**	**C**	**8**	**(M)**	Bushfire Management Plan Water Management Plan Ability to obtain water from West Pit and Big Kahuna Dam Hydrogeological Study (to consider flood capacity as a result of 1 in 250 year rainfall events) Rehabilitation Management Plan - includes erosion and sediment controls MOP Access to Hunter Water Pipeline Local Rural Fire Service (established relationship with local RFS)		**2**	**C**	**8**	**(M)**		Yes

ID #	Mine Closure / Rehabilitation Aspect	Risk Source	Potential Event /Consequences	Loss Type	Consequence	Likelihood	Existing Risk	Risk Level	Existing / Proposed Risk Treatment / Control	Action	Consequence	Likelihood	Target Risk	Risk Level	Person Responsible for Action	Is Risk Considered ALARP with Proposed Risk Treatments / Actions?
37	**Ecosystem and Land Use Development**	Vandalism to revegetation areas.	Damage to vegetation due to vandalism	**(E) Environmental Impact**	**2**	**C**	**8**	**(M)**	Fencing and signage at property boundary Environmental Inspections Rehabilitation Monitoring		**2**	**C**	**8**	**(M)**		Yes
38	**Ecosystem and Land Use Development**	Inadvertent or unauthorised access by mining equipment and vehicles.	N/A - no ongoing mining activities													
39	**Ecosystem and Land Use Development**	Post-closure water quality issues (e.g. acid drainage, high salinity etc.).	Refer to #33 Erosion and Failure of Drainage and Water Management / Storage Structures and #19 Groundwater Accumulation in Voids													
40	**Ecosystem and Land Use Development**	Insects and plant disease.	Refer to #28 Weed & Pest Control													
41	**Ecosystem and Land Use Development**	Overgrazing of pasture rehabilitation areas.	N/A - no grazing for final landform													
42	**Ecosystem and Land Use Development**	Lack of resources for rehabilitation maintenance.	Refer to #1 General (Resourcing)													
43	**Ecosystem and Land Use Development**	Re-disturbance of established rehabilitation areas.	N/A - no redisturbance of areas proposed once rehabilitated													

OPTION 1C RESUMPTION OF MINING AT ABEL (FINAL LAND USE OPTION C – BOTH SQUARE AND WEST PITS AS PERMANENT WATER STORAGES) & OPTION 2 CLOSURE OF ABEL (NO MINING) BOTH SQUARE AND WEST PITS AS PERMANENT WATER STORAGES

ID #	Mine Closure / Rehabilitation Aspect	Risk Source	Potential Event /Consequences	Loss Type	Consequence	Likelihood	Existing Risk	Risk Level	Existing / Proposed Risk Treatment / Control	Action	Consequence	Likelihood	Target Risk	Risk Level	Person Responsible for Action	Is Risk Considered ALARP with Proposed Risk Treatments / Actions?
OPTION 1 RESUMPTION OF MINING AT ABEL (FINAL LAND USE OPTION C – BOTH SQUARE AND WEST PITS AS PERMANENT WATER STORAGES) & OPTION 2 CLOSURE OF ABEL (NO MINING) – BOTH SQUARE AND WEST PITS AS PERMANENT WATER STORAGES																
1	**General**	Insufficient resourcing: - skills and experience of rehabilitation personnel - funding for or prioritisation of rehabilitation activities - ongoing maintenance of rehabilitation requirements	Signoff not given by Regulator	**(O) Asset Damage and Other**	3	C	13	**(H)**	Current high standard of Rehabilitation on site (past experience of managing similar voids) - accepted as industry best practice Environmental Team - Abel (experience in rehabilitation) Use of experienced rehabilitation contractors (external) - previously conducted rehabilitation on site Use of experienced rehabilitation consultants (external) - industry recognised content / technical experts Yancoal Corporate environmental team provide expertise Yancoal Corporate Standards - Rehabilitation (in progress) Existing Environmental Management Strategy and associated Plans (available on Internet/Intelex) 5 Year Plan and Budget Process Cost estimation required when submitting MOP	1. Review budget provisions for rehabilitation of West Pit and Square Pit - determine if budget is from Corporate or required to be budgeted for Abel (follow up with D. Griffin). 2. Review RCE based on Closure Options (Option 1 & Option 2).	3	D	9	**(M)**	1. W. Farnworth 2. P. Brown	Yes
				(R) Impact on Reputation	2	C	8	**(M)**			2	D	5	**(L)**		
2	**General**	Lack of clearly defined responsibilities	Signoff not given by Regulator	**(O) Asset Damage and Other**	1	C	4	**(L)**	Mining Engineering Manager responsible for seeking approval for funding for closure, provision of resources for rehabilitation and managing rehabilitation activities. Environment and Community Superintendent responsible for design of technical closure plans. Yancoal Corporate Standard - Rehabilitation (includes RACI matrix) MOP - describes responsibilities associated with Closure and Rehabilitation	1. Define specific responsibilities for closure and rehabilitation in the West and Square Pit Closure Strategy and MOP.	1	D	2	**(L)**	1. P. Brown	Yes
				(R) Impact on Reputation	1	C	4	**(L)**			1	D	2	**(L)**		
3	**Decommissioning**	Impacts on European heritage items	N/A - no European heritage items in West Pit and Square Pit													

ID #	Mine Closure / Rehabilitation Aspect	Risk Source	Potential Event /Consequences	Loss Type	Consequence	Likelihood	Existing Risk	Risk Level	Existing / Proposed Risk Treatment / Control	Action	Consequence	Likelihood	Target Risk	Risk Level	Person Responsible for Action	Is Risk Considered ALARP with Proposed Risk Treatments / Actions?
4	**Decommissioning**	Impacts on Aboriginal heritage items: - Four Mile Creek (Aboriginal Conservation Area)	Prosecution	**(E) Environmental Impact**	**4**	**C**	**18**	**(H)**	Survey of areas by local Aboriginal group (Mindaribba Local Aboriginal Land Council) Survey of area completed by Archaeologists and MLALC previously Aboriginal Heritage Management Plan Ground Disturbance Permit	1. Survey of areas by local Aboriginal group (MLALC). 2. Survey of areas by Archaeologists. 3. Obtain Section 90 Permit if required to relocate any found Aboriginal artefacts.	**2**	**D**	**5**	**(L)**	1. P. Brown 2. P. Brown 3. P. Brown	Yes
5	**Decommissioning**	Contamination resulting from associated activities: - Stowage in West Pit (may contain hydrocarbons, resins, cement) - Diesel Tanks at West Pit (hydrocarbons) - Runoff from Helipad / Storage Area (hydrocarbons) - Tailings Emplacement (Square Pit)	Contamination of waterways or land resulting in infringement notice	**(E) Environmental Impact**	**3**	**C**	**13**	**(H)**	Phase 1 Contamination Study to be conducted	1. Phase 1 Contamination Study of West Pit and Square Pit 2. Consider disposal requirement costs as a result of the Phase 1 Contamination Study in budget for Mine Closure and Rehabilitation.	**3**	**D**	**9**	**(M)**	1. P. Brown 2. W. Farnworth	Yes
6	**Decommissioning**	Generation of waste products from demolition process: - Conveyor Gantry - Electrical Substation - Compressors - Services (Pipes / Cables) - Stores / Laydown Areas	Wastes not disposed of correctly (either at licensed disposal facility or in accordance with EPL and Mine Closure MOP) - infringement notice	**(E) Environmental Impact**	**3**	**C**	**13**	**(H)**	Disposal methods to be identified and confirmed in Mine Closure MOP Decommissioning Plan for Mine Closure Reputable waste contract company engaged (licensed) Donaldson and Abel Waste Management Plan	1. Determine disposal methods of waste products (either at licensed disposal facility or in accordance with EPL and Mine Closure MOP) and include in a Decommissioning Plan for Mine Closure.	**2**	**D**	**5**	**(L)**	1. P. Brown	Yes
7	**Decommissioning**	Groundwater accumulation in West Pit final void Note: Seam is down-dip to South from West Pit (West Pit floor is below Lower Donaldson - water will migrate back to underground)	Unknown until hydrogeological study is completed	**(E) Environmental Impact**	**4**	**C**	**18**	**(H)**	Hydrogeological Study (to be conducted to confirm final standing water level and consider flood capacity as a result of 1 in 250 year rainfall events)	1. Conduct hydrogeological Study to confirm final standing water level and consider flood capacity as a result of 1 in 250 year rainfall events. 2. Implement control requirements from hydrogeological study if potential for West Pit to discharge.	**2**	**D**	**5**	**(L)**	1. P. Brown 2. P. Brown	Yes

ID #	Mine Closure / Rehabilitation Aspect	Risk Source	Potential Event /Consequences	Loss Type	Consequence	Likelihood	Existing Risk	Risk Level	Existing / Proposed Risk Treatment / Control	Action	Consequence	Likelihood	Target Risk	Risk Level	Person Responsible for Action	Is Risk Considered ALARP with Proposed Risk Treatments / Actions?
8	**Decommissioning**	Groundwater accumulation in Square Pit final void Note: Potential for spill half way along Eastern Wall in Square Pit (low point) and discharge into Four Mile Creek	Unknown until hydrogeological study is completed	**(E) Environmental Impact**	4	C	18	(H)	Hydrogeological Study (to be conducted to confirm final standing water level and consider flood capacity as a result of 1 in 250 year rainfall events) - consider both voids and both Option 1B and Option 1C for Square Pit	1. Conduct hydrogeological Study to confirm final standing water level and consider flood capacity as a result of 1 in 250 year rainfall events - consider both voids and both Option 1B and Option 1C for Square Pit. 2. Implement control requirements from hydrogeological study if potential for Square Pit to discharge.	2	D	5	(L)	1. P. Brown 2. P. Brown	Yes
9	**Decommissioning**	Adverse geotechnical and or geochemical issues associated with process waste storage facilities (e.g. tailings, reject emplacements), overburden and waste rock dumps etc.	N/A - No placement of tailings in either Square Pit or West Pit Voids													
10	**Decommissioning**	Unauthorised access to underground workings	Unauthorised access to underground by public following cessation of mining (no ventilation to underground workings)	**(P) Harm to People**	4	D	14	(H)	Sealing of 3 x Portals and 2 x Shafts High Risk Activity Notification for Sealing Decommissioning Plan to include prevention of access to underground following cessation of mining Current access is restricted via use of gates being locked on Portal Entrances	1. Decommissioning Plan to include prevention of access to underground following cessation of mining (including sealing of portals). 2. Current mining status until final sealing of 3 x Portals and 2 x Shafts.	4	E	10	(M)	1. W. Farnworth 2. Current	Yes
11	**Landform Establishment**	Failure of borehole or gas well seals.	N/A - no boreholes or gas wells in Square Pit and West Pit Areas													
12	**Landform Establishment**	Failure of mine seals: - 3 x Portals	Unauthorised access to underground by public following cessation of mining (no ventilation to underground workings)	**(P) Harm to People**	4	D	14	(H)	Sealing of 3 x Portals and 2 x Shafts High Risk Activity Notification for Sealing	1. High Risk Activity Notification for Final Sealing	4	E	10	(M)	1. W. Farnworth	Yes
			Integrity of seals compromised by blasting activities - unauthorised access underground	**(P) Harm to People**	4	D	14	(H)	Decommissioning Plan to include prevention of access to underground following cessation of mining including sealing activities and potential impacts from rehabilitation	1. Decommissioning Plan to include prevention of access to underground following cessation of mining (including sealing of portals).	4	E	10	(M)	1. W. Farnworth	Yes

ID #	Mine Closure / Rehabilitation Aspect	Risk Source	Potential Event /Consequences	Loss Type	Consequence	Likelihood	Existing Risk	Risk Level	Existing / Proposed Risk Treatment / Control	Action	Consequence	Likelihood	Target Risk	Risk Level	Person Responsible for Action	Is Risk Considered ALARP with Proposed Risk Treatments / Actions?
									activities (e.g. blasting impacts on seals).							
13	**Landform Establishment**	Instability of highwalls and low walls.	Landform failure - public safety	**(P) Harm to People**	**4**	**D**	**14**	**(H)**	Fencing and signage at property boundary and around the perimeter of the final voids Bunding at top of highwalls Geotechnical / Final Landform Study to determine slope requirements for highwall to be long-term geotechnically stable Design of Blasting to minimise risk Current EA commitment for West Pit to have 18 degree slope of highwall (final landform) - Southern and Western Walls and 10 degree slope of highwall for Northern and Eastern Walls	1. Geotechnical / Final Landform Study to determine slope requirements for highwall to be long-term geotechnically stable (West Pit and Square Pit) based on final standing water level for Square Pit. 2. If outcomes of Geotechnical / Final Landform Study determine different slope requirements, update relevant Management Plans and MOP.	**2**	**C**	**8**	**(M)**	1. W. Farnworth 2. P. Brown	Yes
			Signoff not given by Regulator	**(O) Asset Damage and Other**	**2**	**C**	**8**	**(M)**	Fencing and signage at property boundary and around the perimeter of the final voids Bunding at top of highwalls Geotechnical / Final Landform Study to determine slope requirements for highwall to be long-term geotechnically stable Design of Blasting to minimise risk Current EA commitment for West Pit to have 18 degree slope of highwall (final landform) - Southern and Western Walls and 10 degree slope of highwall for Northern and Eastern Walls	1. Geotechnical / Final Landform Study to determine slope requirements for highwall to be long-term geotechnically stable. 2. If outcomes of Geotechnical / Final Landform Study determine different slope requirements, update relevant Management Plans and MOP.	**2**	**D**	**5**	**(L)**	1. W. Farnworth 2. P. Brown	Yes
14	**Landform Establishment**	Availability of suitable materials for capping of hazardous materials and impounded tailings / coarse reject material	N/A - No placement of tailings in either Square Pit or West Pit Voids													
15	**Landform Establishment**	Final landform instability (e.g. Steep slopes, erosion etc.) affecting final land use capability.	Water quality impacts	**(E) Environmental Impact**	**3**	**C**	**13**	**(H)**	Final Landform Study to determine appropriate slope considering water management.	1. Conduct Final Landform Study to determine appropriate slope design considering water management.	**2**	**D**	**5**	**(L)**	1. P. Brown	Yes

ID #	Mine Closure / Rehabilitation Aspect	Risk Source	Potential Event /Consequences	Loss Type	Consequence	Likelihood	Existing Risk	Risk Level	Existing / Proposed Risk Treatment / Control	Action	Consequence	Likelihood	Target Risk	Risk Level	Person Responsible for Action	Is Risk Considered ALARP with Proposed Risk Treatments / Actions?
16	**Landform Establishment**	Final landform unsuitable for final land use (e.g. Large rocks present affecting cultivation, settlement and surface subsidence leading to extended ponding etc.).	N/A - Square Pit final landform is to be water storage surrounded by native grasses / bushland and West Pit final landform is water storage													
17	**Landform Establishment**	Landform aspect not suitable for intended target plant species. Note: Revegetation with pasture species	N/A - Revegetation with pasture species and bushland species													
18	**Landform Establishment**	Diversion of surface water runoff away from catchment areas	Final voids (Square Pit and West Pit) fill and discharge - unknown consequence until Hydrogeological Study is completed	**(E) Environmental Impact**	**4**	**C**	**18**	**(H)**	Hydrogeological Study (to be conducted to confirm final standing water level and consider flood capacity as a result of 1 in 250 year rainfall events) Final Landform Design to include water management requirements (e.g. diversions, etc.) Donaldson and Abel Water Management Plan	1. Conduct hydrogeological Study to confirm final standing water levels (for Square Pit and West Pit) and consider flood capacity as a result of 1 in 250 year rainfall events. 2. Implement control requirements from hydrogeological study if potential for West Pit or Square Pit to discharge.	**2**	**D**	**5**	**(L)**	1. P. Brown 2. P. Brown	Yes
			Loss of water flow downstream due to capture of water in West Pit Void and Square Pit Void	**(E) Environmental Impact**	**3**	**C**	**13**	**(H)**	Final Landform Design to include water management requirements (e.g. diversions, etc.) Donaldson and Abel Water Management Plan Survey Control	1. Final Landform Design to include water management requirements (e.g. diversions, etc.) considering potential impacts on water flow downstream	**3**	**D**	**9**	**(M)**	1. P. Brown	Yes
19	**Landform Establishment**	Groundwater accumulation in voids	Final void fills and discharges - unknown consequence until Hydrogeological Study is completed	**(E) Environmental Impact**	**4**	**C**	**18**	**(H)**	Hydrogeological Study (to be conducted to confirm final standing water level and consider flood capacity as a result of 1 in 250 year rainfall events) Final Landform Design to include water management requirements (e.g. diversions, etc.) Donaldson and Abel Water Management Plan	1. Conduct hydrogeological Study to confirm final standing water level and consider flood capacity as a result of 1 in 250 year rainfall events. 2. Implement control requirements from hydrogeological study if potential for West Pit or Square Pit to discharge. 3. Maintain Groundwater Licence for Final Void/s.	**2**	**D**	**5**	**(L)**	1. P. Brown 2. P. Brown 3. P. Brown	Yes
20	**Landform Establishment**	Groundwater accumulation in underground workings	N/A - not in scope of risk assessment													
21	**Landform Establishment**	Watercourse diversion instability	N/A - no watercourse													

ID #	Mine Closure / Rehabilitation Aspect	Risk Source	Potential Event /Consequences	Loss Type	Consequence	Likelihood	Existing Risk	Risk Level	Existing / Proposed Risk Treatment / Control	Action	Consequence	Likelihood	Target Risk	Risk Level	Person Responsible for Action	Is Risk Considered ALARP with Proposed Risk Treatments / Actions?
		affecting riparian health	diversions in place or proposed													
22	**Landform Establishment**	Water availability, on and off site.	N/A - no water has been required for rehabilitation to date at Donaldson / Abel. West Pit and Big Kahuna water available													
23	**Growth Medium Development**	Adoption of inappropriate or inadequate rehabilitation techniques, including equipment fleet	Impacts on establishing vegetation due to soil compaction	**(E) Environmental Impact**	2	C	8	(M)	Current high standard of Rehabilitation on site (past experience of managing similar voids) - accepted as industry best practice Environmental Team - Abel (experience in rehabilitation) Use of experienced rehabilitation contractors (external) - previously conducted rehabilitation on site Use of experienced rehabilitation consultants (external) - industry recognised content / technical experts Yancoal Corporate environmental team provide expertise Yancoal Corporate Standards - Rehabilitation (in progress) Existing Environmental Management Strategy and associated Plans (available on Internet/Intelex) Fit for Purpose Equipment used for rehabilitation activities (consideration of weight, compaction, etc.)		2	D	5	(L)		Yes
24	**Growth Medium Development**	Subsoil and topsoil deficit for rehabilitation activities	Suitable subsoil and topsoil material volume unavailable on site	**(E) Environmental Impact**	3	C	13	(H)	Determine materials required and source topsoil or alternative 150mm - current commitment for topsoil replacement	1. Conduct Materials Balance (Capping and Topsoil/Alternative Materials) on site. 2. Source and budget any topsoil materials required.	2	D	5	(L)	1. P. Brown 2. W. Farnworth	Yes
25	**Growth Medium Development**	Substrate inadequate to support revegetation (e.g. Lack of organic matter, nutrient deficiency, lack of soil biota, adverse soil chemical properties, exposed	Soil depth unsuitable to support revegetation	**(E) Environmental Impact**	2	C	8	(M)	Landform Design to consider soil depth to support native vegetation.	1. Final Landform Design to include soil depth to support native vegetation for Square Pit.	2	D	5	(L)	1. P. Brown	Yes

ID #	Mine Closure / Rehabilitation Aspect	Risk Source	Potential Event /Consequences	Loss Type	Consequence	Likelihood	Existing Risk	Risk Level	Existing / Proposed Risk Treatment / Control	Action	Consequence	Likelihood	Target Risk	Risk Level	Person Responsible for Action	Is Risk Considered ALARP with Proposed Risk Treatments / Actions?
		hostile geochemical materials, and any other factors impeding the effective rooting depth)														
26	**Ecosystem Establishment**	Lack of availability and quality of seed resources, including genetic integrity	N/A - Revegetation with pasture species, bushland and native grasses are readily available													
27	**Ecosystem Establishment**	Lack of resources for rehabilitation maintenance	Refer to #1 General (Resourcing)													
28	**Ecosystem Establishment**	Weed and pest control: - weed introduction and control (or lack thereof) - Damage from fauna (e.g. kangaroos, feral goats, etc.) - Insects and plant disease	Impacts on vegetation (establishing and ongoing) - completion criteria not met	**(E) Environmental Impact**	**3**	**C**	**13**	**(H)**	Flora and Fauna Management Plan includes weed management Annual Weed Management Program Environmental Inspections Rehabilitation Monitoring Current high standard of Rehabilitation on site (past experience of managing similar voids) - accepted as industry best practice		**2**	**D**	**5**	**(L)**		Yes
29	**Ecosystem Establishment**	Lack of structural integrity of buildings and infrastructure to be retained in final land use	N/A - no buildings or infrastructure to be retained at West Pit and Square Pit landforms													
30	**Ecosystem Establishment**	Adoption of inappropriate or inadequate rehabilitation techniques	Impacts on establishing vegetation	**(E) Environmental Impact**	**2**	**C**	**8**	**(M)**	Current high standard of Rehabilitation on site (past experience of managing similar voids) - accepted as industry best practice Environmental Team - Abel (experience in rehabilitation) Use of experienced rehabilitation contractors (external) - previously conducted rehabilitation on site Use of experienced rehabilitation consultants (external) - industry recognised content / technical experts Yancoal Corporate environmental		**2**	**D**	**5**	**(L)**		Yes

ID #	Mine Closure / Rehabilitation Aspect	Risk Source	Potential Event /Consequences	Loss Type	Consequence	Likelihood	Existing Risk	Risk Level	Existing / Proposed Risk Treatment / Control	Action	Consequence	Likelihood	Target Risk	Risk Level	Person Responsible for Action	Is Risk Considered ALARP with Proposed Risk Treatments / Actions?
									team provide expertise Yancoal Corporate Standards - Rehabilitation (in progress) Existing Environmental Management Strategy and associated Plans (available on Internet/Intelex) Fit for Purpose Equipment used for rehabilitation activities (consideration of weight, compaction, etc.) Direct seeding							
31	**Ecosystem Establishment**	Weather and climatic influences (e.g. Drought; intense rainfall events; bushfire etc.).	Damage to vegetation due to fire, flood or drought	**(E) Environmental Impact**	2	C	8	(M)	Bushfire Management Plan Water Management Plan Ability to obtain water from West Pit and Big Kahuna Dam Hydrogeological Study (to consider flood capacity as a result of 1 in 250 year rainfall events) Rehabilitation Management Plan - includes erosion and sediment controls MOP Access to Hunter Water Pipeline Local Rural Fire Service (established relationship with local RFS)		2	C	8	(M)		Yes
32	**Ecosystem Establishment**	Insufficient establishment or cover of vegetation	Impacts on vegetation (establishing and ongoing) - completion criteria not met	**(E) Environmental Impact**	3	C	13	(H)	Flora and Fauna Management Plan includes weed management Annual Weed Management Program Environmental Inspections Rehabilitation Monitoring Current high standard of Rehabilitation on site (past experience of managing similar voids) - accepted as industry best practice Rehabilitation Management Plan MOP Water available on site - Big Kahuna Dam		2	D	5	(L)		Yes
33	**Ecosystem Establishment**	Erosion and failure of drainage and water management/storage structures.	Impacts on water quality and potential discharge	**(E) Environmental Impact**	4	C	18	(H)	Final Landform Design to include water management requirements (e.g. diversions, etc.) Rehabilitation Management Plan - includes erosion and sediment control Environmental Inspections Rehabilitation Monitoring Donaldson and Abel Water Management Plan	1. Ongoing inspection and maintenance of any Water Management structures required as part of final landform design.	4	D	14	(H)	1. P. Brown	Yes

ID #	Mine Closure / Rehabilitation Aspect	Risk Source	Potential Event /Consequences	Loss Type	Consequence	Likelihood	Existing Risk	Risk Level	Existing / Proposed Risk Treatment / Control	Action	Consequence	Likelihood	Target Risk	Risk Level	Person Responsible for Action	Is Risk Considered ALARP with Proposed Risk Treatments / Actions?
34	**Ecosystem Establishment**	Overgrazing of pasture rehabilitation areas.	N/A - no grazing for final landform													
35	**Ecosystem Establishment**	Poor water quality / excessive discharges	Refer to #33 Erosion and Failure of Drainage and Water Management / Storage Structures, #19 Groundwater Accumulation in Voids													
36	**Ecosystem and Land Use Development**	Weather and climatic influences (e.g. drought; intense rainfall events; bushfire etc.).	Damage to vegetation due to fire, flood or drought	**(E) Environmental Impact**	**2**	**C**	**8**	**(M)**	Bushfire Management Plan Water Management Plan Ability to obtain water from West Pit and Big Kahuna Dam Hydrogeological Study (to consider flood capacity as a result of 1 in 250 year rainfall events) Rehabilitation Management Plan - includes erosion and sediment controls MOP Access to Hunter Water Pipeline Local Rural Fire Service (established relationship with local RFS)		**2**	**C**	**8**	**(M)**		Yes
37	**Ecosystem and Land Use Development**	Vandalism to revegetation areas.	Damage to vegetation due to vandalism	**(E) Environmental Impact**	**2**	**C**	**8**	**(M)**	Fencing and signage at property boundary Environmental Inspections Rehabilitation Monitoring		**2**	**C**	**8**	**(M)**		Yes
38	**Ecosystem and Land Use Development**	Inadvertent or unauthorised access by mining equipment and vehicles.	N/A - no ongoing mining activities													
39	**Ecosystem and Land Use Development**	Post-closure water quality issues (e.g. high salinity etc.).	Refer to #33 Erosion and Failure of Drainage and Water Management / Storage Structures, #19 Groundwater Accumulation in Voids													
40	**Ecosystem and Land Use Development**	Insects and plant disease.	Refer to #28 Weed & Pest Control													

ID #	Mine Closure / Rehabilitation Aspect	Risk Source	Potential Event /Consequences	Loss Type	Consequence	Likelihood	Existing Risk	Risk Level	Existing / Proposed Risk Treatment / Control	Action	Consequence	Likelihood	Target Risk	Risk Level	Person Responsible for Action	Is Risk Considered ALARP with Proposed Risk Treatments / Actions?
41	**Ecosystem and Land Use Development**	Overgrazing of pasture rehabilitation areas.	N/A - no grazing for final landform													
42	**Ecosystem and Land Use Development**	Lack of resources for rehabilitation maintenance.	Refer to #1 General (Resourcing)													
43	**Ecosystem and Land Use Development**	Re-disturbance of established rehabilitation areas.	N/A - no redisturbance of areas proposed once rehabilitated													

5. RISK CONTROL ACTION / IMPLEMENTATION PLANS

OPTION 1A - RESUMPTION OF MINING AT ABEL (FINAL LAND USE OPTION A - REVEGETATED TAILINGS STORAGE)

Timing for the actions below is linked to the re-commencement of operations at the Abel Underground Mine, except for Action No's 1 to 3, which would be undertaken as part of the *West and Square Pit Closure Strategy* works.

Action No.	RA Item/s	Action	Accountable Person
1	**1**	Review budget provisions for rehabilitation of West Pit and Square Pit - determine if budget is from Corporate or required to be budgeted for Abel (follow up with D. Griffin).	W. Farnworth
2	**1**	Review RCE based on Closure Options (Option 1 & Option 2).	P. Brown
3	**2**	Define specific responsibilities for closure and rehabilitation in the West and Square Pit Closure Strategy and MOP.	P. Brown
4	**4**	Obtain Section 90 Permit if required to relocate any found Aboriginal artefacts.	P. Brown
5	**4**	Survey of areas by Archaeologists.	P. Brown
6	**4**	Survey of areas by local Aboriginal group (MLALC).	P. Brown
7	**5**	Consider disposal requirement costs as a result of the Phase 1 Contamination Study in budget for Mine Closure and Rehabilitation.	W. Farnworth
8	**5**	Phase 1 Contamination Study of West Pit and Square Pit	P. Brown
9	**6**	Determine disposal methods of waste products (either at licensed disposal facility or in accordance with EPL and Mine Closure MOP) and include in a Decommissioning Plan for Mine Closure.	P. Brown
10	**7, 17, 18**	Conduct hydrogeological Study to confirm final standing water level and consider flood capacity as a result of 1 in 250 year rainfall events.	P. Brown
11	**7, 17, 18**	Implement control requirements from hydrogeological study if potential for West Pit to discharge.	P. Brown
12	**8**	High Risk Activity Notification for Tailings Storage.	W. Farnworth
13	**8**	If resumption of mining and storage of tailings in Square Pit, requirement emplacement design and emplacement management plan to consider: Spontaneous Combustion and Water Management.	P. Brown
14	**9**	Current mining status until final sealing of 3 x Portals and 2 x Shafts.	Current
15	**9, 11**	Decommissioning Plan to include prevention of access to underground following cessation of mining (including sealing of portals).	W. Farnworth
16	**11**	High Risk Activity Notification for Final Sealing	W. Farnworth
17	**12**	If outcomes of Geotechnical / Final Landform Study determine different slope requirements, update relevant Management Plans and MOP.	P. Brown
18	**12**	Geotechnical / Final Landform Study to determine slope requirements for highwall to be long-term geotechnically stable.	W. Farnworth

Action No.	RA Item/s	Action	Accountable Person
19	**13**	Source and budget any external capping materials required.	W. Farnworth
20	**13**	Study to determine capping design and conduct capping materials balance based on design.	P. Brown
21	**14**	Conduct Final Landform Study to determine appropriate slope design considering water management.	P. Brown
22	**17**	Final Landform Design to include water management requirements (e.g. diversions, etc.) considering potential impacts on water flow downstream	P. Brown
23	**18**	Maintain Groundwater Licence for Final Void/s.	P. Brown
24	**23**	Conduct Materials Balance (Capping and Topsoil/Alternative Materials) on site.	P. Brown
25	**23**	Source and budget any topsoil materials required.	W. Farnworth
26	**24**	Final Landform Design to include capping design and materials to support native vegetation.	P. Brown
27	**32**	Ongoing inspection and maintenance of any Water Management structures required as part of final landform design.	P. Brown

OPTION 1B - RESUMPTION OF MINING AT ABEL (FINAL LAND USE OPTION B - TAILINGS AND PERMANENT WATER STORAGE)

Timing for the actions below is linked to the re-commencement of operations at the Abel Underground Mine, except for Action No's 1 to 3, which would be undertaken as part of the *West and Square Pit Closure Strategy* works.

Action No.	RA Item/s	Action	Accountable Person
1	**1**	Review budget provisions for rehabilitation of West Pit and Square Pit - determine if budget is from Corporate or required to be budgeted for Abel (follow up with D. Griffin).	W. Farnworth
2	**1**	Review RCE based on Closure Options (Option 1 & Option 2).	P. Brown
3	**2**	Define specific responsibilities for closure and rehabilitation in the West and Square Pit Closure Strategy and MOP.	P. Brown
4	**4**	Survey of areas by Archaeologists.	P. Brown
5	**4**	Survey of areas by local Aboriginal group (MLALC).	P. Brown
6	**4**	Obtain Section 90 Permit if required to relocate any found Aboriginal artefacts.	P. Brown
7	**5**	Consider disposal requirement costs as a result of the Phase 1 Contamination Study in budget for Mine Closure and Rehabilitation.	W. Farnworth
8	**5**	Phase 1 Contamination Study of West Pit and Square Pit	P. Brown
9	**6**	Determine disposal methods of waste products (either at licensed disposal facility or in accordance with EPL and Mine Closure MOP) and include in a Decommissioning Plan for Mine Closure.	P. Brown
10	**7, 8, 18, 19**	Conduct hydrogeological Study to confirm final standing water level and consider flood capacity as a result of 1 in 250 year rainfall events - consider both voids (Square Pit and West Pit) and both Option 1B and Option 1C for Square Pit.	P. Brown
11	**7, 8, 18, 19**	Implement control requirements from hydrogeological study if potential for West Pit or Square Pit to discharge.	P. Brown
12	**9**	Final Void Water Balance Study to determine potential groundwater impacts (with groundwater table) and implement recommendations from study.	P. Brown
13	**9**	Conduct Geochemical Assessment on Abel Tailings.	W. Farnworth
14	**9**	High Risk Activity Notification for Tailings Storage.	W. Farnworth
15	**10**	Current mining status until final sealing of 3 x Portals and 2 x Shafts.	Current
16	**10, 12**	Decommissioning Plan to include prevention of access to underground following cessation of mining (including sealing of portals).	W. Farnworth
17	**12**	High Risk Activity Notification for Final Sealing	W. Farnworth
18	**13**	Geotechnical / Final Landform Study to determine slope requirements for highwall to be long-term geotechnically stable (West Pit and Square Pit) based on final standing water level for Square Pit.	W. Farnworth

Action No.	RA Item/s	Action	Accountable Person
19	**13**	If outcomes of Geotechnical / Final Landform Study determine different slope requirements, update relevant Management Plans and MOP.	P. Brown
20	**14**	Source and budget any external capping materials required.	W. Farnworth
21	**14**	Study to determine capping design and conduct capping materials balance based on design.	P. Brown
22	**15**	Conduct Final Landform Study to determine appropriate slope design considering water management.	P. Brown
23	**18**	Final Landform Design to include water management requirements (e.g. diversions, etc.) considering potential impacts on water flow downstream	P. Brown
24	**19**	Maintain Groundwater Licence for Final Void/s.	P. Brown
25	**24**	Conduct Materials Balance (Capping and Topsoil/Alternative Materials) on site.	P. Brown
26	**24**	Source and budget any topsoil materials required.	W. Farnworth
27	**25**	Final Landform Design to include soil depth to support native vegetation for Square Pit.	P. Brown
28	**33**	Ongoing inspection and maintenance of any Water Management structures required as part of final landform design.	P. Brown

OPTION 1C RESUMPTION OF MINING AT ABEL (FINAL LAND USE OPTION C - PERMANENT WATER STORAGE) & OPTION 2 CLOSURE OF ABEL (NO MINING) PERMANENT WATER STORAGE

Timing for the actions below is linked to the re-commencement of operations at the Abel Underground Mine or a decision by Yancoal to close Abel without the resumption of mining, except for Action No's 1 to 3, which would be undertaken as part of the *West and Square Pit Closure Strategy* works.

Action No.	RA Item/s	Action	Accountable Person
1	**1**	Review budget provisions for rehabilitation of West Pit and Square Pit - determine if budget is from Corporate or required to be budgeted for Abel (follow up with D. Griffin).	W. Farnworth
2	**1**	Review RCE based on Closure Options (Option 1 & Option 2).	P. Brown
3	**2**	Define specific responsibilities for closure and rehabilitation in the West and Square Pit Closure Strategy and MOP.	P. Brown
4	**4**	Survey of areas by Archaeologists.	P. Brown
5	**4**	Survey of areas by local Aboriginal group (MLALC).	P. Brown
6	**4**	Obtain Section 90 Permit if required to relocate any found Aboriginal artefacts.	P. Brown
7	**5**	Consider disposal requirement costs as a result of the Phase 1 Contamination Study in budget for Mine Closure and Rehabilitation.	W. Farnworth
8	**5**	Phase 1 Contamination Study of West Pit and Square Pit	P. Brown
9	**6**	Determine disposal methods of waste products (either at licensed disposal facility or in accordance with EPL and Mine Closure MOP) and include in a Decommissioning Plan for Mine Closure.	P. Brown
10	**7, 8, 18, 19**	Conduct hydrogeological Study to confirm final standing water level and consider flood capacity as a result of 1 in 250 year rainfall events - consider both voids and both Option 1B and Option 1C for Square Pit.	P. Brown
11	**7, 8, 18, 19**	Implement control requirements from hydrogeological study if potential for West Pit or Square Pit to discharge.	P. Brown
12	**10**	Current mining status until final sealing of 3 x Portals and 2 x Shafts.	Current
13	**10, 12**	Decommissioning Plan to include prevention of access to underground following cessation of mining (including sealing of portals).	W. Farnworth
14	**12**	High Risk Activity Notification for Final Sealing	W. Farnworth
15	**13**	Geotechnical / Final Landform Study to determine slope requirements for highwall to be long-term geotechnically stable (West Pit and Square Pit) based on final standing water level for Square Pit.	W. Farnworth
16	**13**	If outcomes of Geotechnical / Final Landform Study determine different slope requirements, update relevant Management Plans and MOP.	P. Brown
17	**15**	Conduct Final Landform Study to determine appropriate slope design considering water management.	P. Brown

Action No.	RA Item/s	Action	Accountable Person
18	**18**	Final Landform Design to include water management requirements (e.g. diversions, etc.) considering potential impacts on water flow downstream	P. Brown
19	**19**	Maintain Groundwater Licence for Final Void/s.	P. Brown
20	**24**	Conduct Materials Balance (Capping and Topsoil/Alternative Materials) on site.	P. Brown
21	**24**	Source and budget any topsoil materials required.	W. Farnworth
22	**25**	Final Landform Design to include soil depth to support native vegetation for Square Pit.	P. Brown
23	**33**	Ongoing inspection and maintenance of any Water Management structures required as part of final landform design.	P. Brown

6. RISK ASSESSMENT AUTHORISATION / APPROVAL

Non Consensus Matters
Nil

Approval			
I confirm that I have reviewed the outcomes of the risk assessment and, agree to the proposed action plan (if any actions not agreed – comment below) and will provide a framework of adequate resources to effectively implement the action plan requirements:			
Risk Assessment Owner/s			
Name	Position	Signature	Date
Phillip Brown	*Environment & Community Superintendent*		
Mining Engineering Manager (Legislated Risk Assessments)			
Name	Position	Signature	Date
William Farnworth	*Mining Engineering Manager*		

Operations Manager Approval for High and Extreme Residual Risk Levels			
I confirm that I have reviewed the identified risks that have an assessed residual risk level (in accordance with the Yancoal Risk Matrix) of High or Extreme and am satisfied they are as low as reasonably practicable (ALARP) providing the identified current and additional controls are implemented and effective and that the following additional controls are also included (if any additional actions required to what has already been identified in the risk assessment – comment below): *1.* *2.* *3.*			
Name	Position	Signature	Date
William Farnworth	*Mining Engineering Manager*		

7. APPENDICES

7.1 Appendix 1 – Yancoal Risk Matrix

Yancoal Risk Matrix		Effect / Consequence				
Loss Type		1 Insignificant	2 Minor	3 Moderate	4 Major	5 Catastrophic
(P) Harm to People		**Slight injury or health effects** report only (RO) or first aid injury (FAI)	**Minor injury or health effects** – medical treatment injury (MTI) or restricted work injury (RWI)	**Serious bodily injury or health effects** – lost time injury	**Single Fatality**	**Multiple fatalities**
(E) Environmental Impact		**Environmental nuisance** – trivial or negligible, short term impact to area of low significance, minimal or no physical remediation required No regulation. Cost < $1,000	**Minor environmental harm** – short term impact to area of limited local significance, limited physical remediation . Reportable Breach /Minor Non Compliance, potential warning notice, other notices (infringement / prosecution) unlikely. Costs $1K - $50K	**Serious environmental harm** – medium term impact to area of local conservation value, medium term physical remediation, actual community health impacts or significance or pollution or contamination Infringement Notice but Prosecution unlikely Costs $50k - $250k	**Major environmental harm** – long term reversible impacts to area of regional conservation significance, health statistics in community alter as a result of this incident or pollution or contamination Prosecution Costs $250k - $1M	**Extreme environmental harm** – irreversible impacts on environmental values of extreme & widespread areas, or those of national conservation significance, community fatalities or pollution or contamination Prosecution, License revoked Costs > $1M
(O) Asset Damage and Other Consequential Losses		**Slight damage** < $1M or < 1 day disruption to operation	**Minor damage** $1M - $5M or <1 week disruption to operation	**Local damage** $5M - $20M or <1 month disruption to operation	**Major damage** $20M -$100M or <6 months partial loss of operation	**Extreme damage** > $100M or 6 months Substantial or total loss of operation
(R) Impact on Reputation		**Slight impact –** Public awareness may exist but no public concern Isolated compliance failure – no brand damage	**Limited impact –** Some local public concern Intervention of regulating authority – minimal brand damage	**Considerable impact -** Regional public concern Major compliance failure involving fines – medium brand damage	**National impact –** National public concern Temporary withdrawal of license to operate – significant brand damage	**International impact -** International public attention Loss of shareholder confidence – irreparable brand damage
Likelihood	**Likelihood Examples (Guide)**	**Level of Risk**				
A (Almost Certain)	Likely that the unwanted event could occur several times per year in our jurisdiction	11 (M)	16 (H)	20 (H)	23 (E)	25 (E)
B (Likely)	Likely that the unwanted event could happen annually in our jurisdiction	7 (M)	12 (M)	17 (H)	21 (E)	24 (E)
C (Possible)	The unwanted event could happen within 10 years in our jurisdiction	4 (L)	8 (M)	13 (H)	18 (H)	22 (E)
D (Unlikely)	The unwanted event could happen within 50 years in our jurisdiction	2 (L)	5 (L)	9 (M)	14 (H)	19 (H)
E (Rare)	The unwanted event has never been known to occur is highly unlikely that it could ever occur in our jurisdiction	1 (L)	3 (L)	6 (M)	10 (M)	15 (H)

7.2 Appendix 2 – Risk Assessment Participants (Signed Copy)

West and Square Pit Rehabilitation and Closure Strategy Risk Assessment - Participants

No.	Date	Name Full name of person	Role In Business In RA i.e.: Facilitator, Scribe, Content / Technical Expert, Participant	Experience Record: Industry skills and experience generally (including number of years);	Relevance to this assessment Record: Any formal/technical qualifications; Formal risk assessment qualifications NB: experience must demonstrate relevance to the topic being risk assessed	Consensus (Y/N) If no, non-consensus matter must be recorded in applicable section	Signature
1	15/07/2020	Kylie Hannigan (STAC Consulting)	Facilitator / Scribe	24 years mining experience (both underground and open cut) 21 years health, safety, training and HR experience (including management roles) **Mining Clients:** Yancoal, Glencore/Xstrata, Rio Tinto, BHPBilliton/BMA, AngloAmerican, Peabody, Idemitsu, Various Contractors **Previously worked at:** Ulan Underground, Crinum/Crinum East Underground, Kestrel Underground, Blair Athol Open Cut	**Consultant** 20+ Years Risk Assessment Facilitation Bachelor of Occupational Health and Safety (BOHS) G3 Risk Management (University of Queensland) Lead Auditor (RABQSA Cert. No. 113053) Facilitated risk assessments for Yancoal (including Abel) for past 7 years Australian Institute of Mining and Metallurgy (AusIMM) - Member SIA/AIHS - Member Australian Institute of Management - Member	Yes	[signature]
2	15/07/2020	William Farnworth	Participant	40 years mining experience (UG including 1 year OC) 2 years at Abel / 3 years at Austar Previously at Ashton, East Mine, West Mine, Strongman No. 1, Morely, Rapahoe, Mahoenui Valley Colliery, Buchanan Borehole	**Mining Engineering Manager (Austar / Abel)** Practising Certificate - Mining Engineering Manager Degree in Mining Engineering First and Third Class Certificate of Competency Diploma of Ventilation	Yes	[signature]

No.	Date	Name Full name of person	Role In Business In RA i.e.: Facilitator, Scribe, Content / Technical Expert, Participant	Experience Record: Industry skills and experience generally (including number of years);	Relevance to this assessment Record: Any formal/technical qualifications; Formal risk assessment qualifications NB: experience must demonstrate relevance to the topic being risk assessed	Consensus (Y/N) If no, non-consensus matter must be recorded in applicable section	Signature
3	15/07/2020	Phil Brown	Participant	22 years experience (environmental - mining), 4 years - Pasminco 17 years at Donaldson Previously at Tasman, Ellalong, Gretley	**Environment and Community Relations Superintendent - Abel / Ashton** Health Inspection Certificate Bachelor of Applied Science (Environmental Health) Masters in Environmental Studies	Y	
4	15/07/2020	Brad Merchant	Participant	22 years mining experience (underground) 11 years at Abel Previously at Ravensworth UG, Myuna	**Site Manager (Ventilation Officer, Undermanager, Roadway Dust Sampling Officer, Fire Officer)** Practising Certificate - Undermanager, Ventilation Officer 2nd Class Certificate of Competency (Undermanager) Fire Officer Course Diploma in Ventilation Roadway Dust Sampling Course Trade - Electrical / Mechanical	Y	
5	15/07/2020	Carly McCormack	Participant	21 years experience (environmental science) 5 years at Austar Previously consulting (various sites)	**Environment and Community Superintendent** Bachelor of Environmental Science Graduate Certificate in Environmental Studies	Y	

No.	Date	Name Full name of person	Role In Business In RA i.e.: Facilitator, Scribe, Content / Technical Expert, Participant	Experience Record: Industry skills and experience generally (including number of years);	Relevance to this assessment Record: Any formal/technical qualifications; Formal risk assessment qualifications NB: experience must demonstrate relevance to the topic being risk assessed	Consensus (Y/N) If no, non-consensus matter must be recorded in applicable section	Signature
6	15/07/2020	James Benson (CBased Environmental)	Participant	15 years experience (environmental) 3 years at Abel (contracting) Previously at AngloAmerican, Gloucester Coal	**Environmental Coordinator (Abel)** Bachelor of Science	Y	
7	15/07/2020	Margot Robinson (Resources Strategies)	Content / Technical Expert – Rehabilitation / Mine Closure	Over 10 years of experience in environmental management and project approvals in the resource industry.	**Environmental Project Manager** Graduate Diploma (Environment Management) Bachelor of Business (International Business)	Y	M Robinson
8	15/07/2020	Lucas Burns (Resources Strategies)	Content / Technical Expert – Rehabilitation / Mine Closure	Over 15 years of experience in environmental management and project approvals in the resource industry.	**Senior Environmental Manager** BEng (Environmental) BBus Mgmt (Economics)	Y	

7.3 Appendix 3 – Donaldson & Abel Closure West and Square Pit Rehabilitation – Risk Assessment Context Presentation

Agenda

- **Introduction**
  - Section 240 Notice
  - Closure Strategy Requirements
- **Current Status of West and Square Pits – June 2020**
- **Closure Strategy**
  - **Option 1 (Resumption of mining at Abel)**
  - **Option 2 (Closure of Abel, no mining)**
- **Risk Assessment**

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Introduction

- NSW Resources Regulator issued two Notices under Section 240 of NSW *Mining Act 1992* requiring Donaldson Coal to:
  - Develop a Closure Strategy for the West and Square Pits which reflects two closure pathways:
    1. Resumption of mining at Abel Underground Mine, involving development of the two pits.
    2. Closure of the Abel Underground Mine, with no resumption of mining.

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Introduction

- Closure Strategy requirements:

  Develop a Closure Strategy ("Strategy") for the management of the West (inclusive of the Abel Box Cut) and Square Pits. The Strategy is to:

  - *Be developed to reflect the following different closure pathways:*

    a) The resumption of mining within the Abel Underground Mine and development of the voids;

    b) The closure of the Abel Underground Mine with no resumption of mining.

  ....

  - ***Include a risk assessment that identifies and assesses risks to rehabilitation that are associated with each closure pathway identified in Point (i) above. Following the risk assessment, develop control actions that are incorporated in a Trigger Action Response Plan for each closure pathway.***

  ...

4 30 July 2020

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Current Status of West and Square Pits – June 2020

Square Pit

- Partially re-profiled, cover vegetation
- Western, southern and north-western highwalls retained
- Eastern low wall reprofiled
- Pit catchment water transferred to Big Kahuna Dam

West Pit and Abel Box Cut

- Access to Abel Box Cut secured
- Western, southern and northern highwalls retained
- Eastern low wall partially reprofiled
- Pit catchment water transferred to Big Kahuna Dam

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5 30 July 2020

Option 1 – Resumption of Mining at Abel

- Square Pit – 3 x approved final landform options:
  - **A tailings storage** that would be either:
    - **a free-draining landform** with emplaced tailings material covered and capped with inert material, and the surface topsoiled and **revegetated with pasture species**; **or**
    - **a permanent water storage** where tailings material has been emplaced at a lower level, and then water allowed to accumulate over the tailings material; or
  - **A final void for permanent water storage** - should the pit have been used for the storage of groundwater inflows from Abel.
- West Pit – approved final landform option:
  - **A final void for permanent water storage.**

6 30 July 2020

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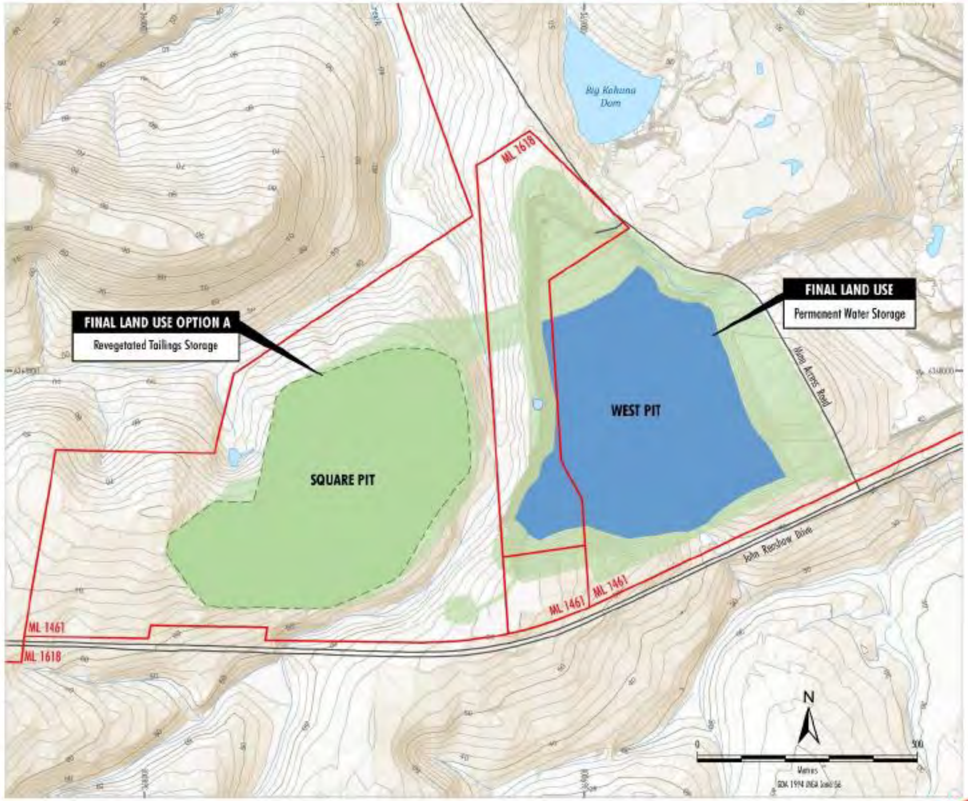
Option 1 – Resumption of Mining at Abel



7 30 July 2020

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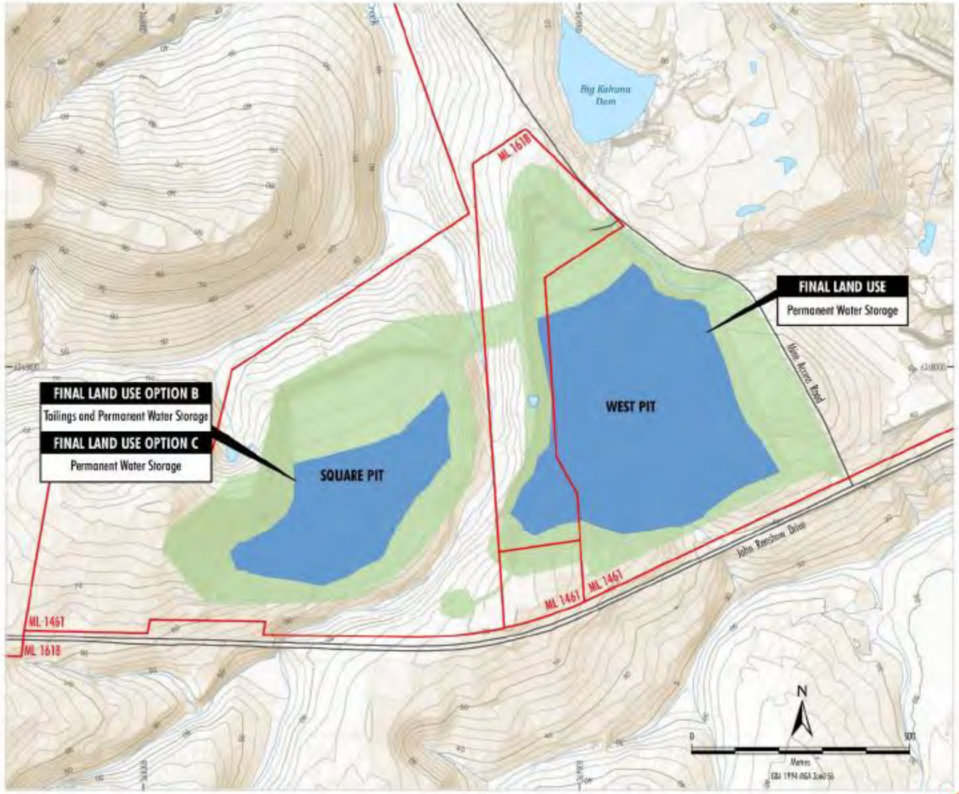
Option 1 – Resumption of Mining at Abel



8 30 July 2020

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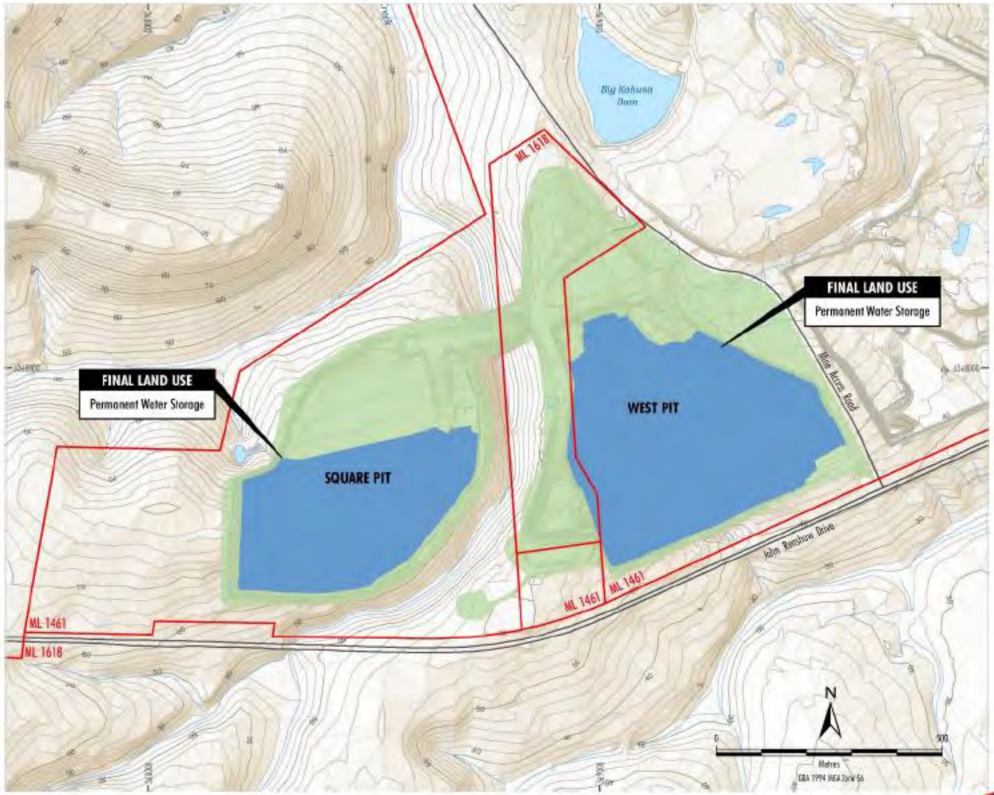
Option 2 – Closure of Abel (No Mining)

- Square Pit – approved final landform option:
  - **A final void for permanent water storage.**
- West Pit – approved final landform option:
  - **A final void for permanent water storage.**

Option 2 – Closure of Abel (No Mining)



10 30 July 2020

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Questions

- Any questions on current status or these options?

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Risk Assessment

- Participant Listing and Introduction
- 2 Resources Strategies content experts – via BlueJeans
- Screen Sharing is on permanently for content experts
- Scoping Session – Facilitator and Resources Strategies
- Brainstorming Session of Potential Risks – Prompts based on Consultation Draft Guideline 1: Rehabilitation Risk Assessment
- Closure Options: 1 A, B, C & Option 2
- Be specific with Controls
- Risk Matrix – Yancoal Risk Matrix
- Breaks – Mid-Morning and Lunch

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Attachment 2

Donaldson Coal Mine Review of Mine Water Storage Quality (HEC, 2020)

HYDRO ENGINEERING & CONSULTING PTY LTD

REPORT

Donaldson Coal Mine

Review of Mine Water Storage Quality

Prepared for: Donaldson Coal Pty Ltd

Revision List

Revision	Description	Author	Reviewer	Approved	Date
a	Preliminary Draft	LMG	TSM	TSM	6/6/2020
b	Draft	LMG	TSM	TSM	9/6/2020
c	Draft	LMG	TSM	TSM	9/6/2020
d	Revised following external review	TSM	RS	TSM	19/6/2020
e	Revised following external review	LMG	RS	TSM	19/6/2020
f	Revised following client review	TSM	Client	TSM	26/6/2020
g	Revised following provision of site rainfall data	TSM	-	TSM	16/7/2020

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1.0 INTRODUCTION

The Donaldson Coal Mine is a completed open cut mine located approximately 23 kilometres (km) north-west of the Port of Newcastle, in the Hunter Valley of NSW. The mine is owned and was operated by Donaldson Coal Pty Ltd (Donaldson Coal), a wholly-owned subsidiary of Yancoal Australia Limited. Donaldson Coal's Abel Underground Mine is located immediately south of the Donaldson Coal Mine (south of John Renshaw Drive) (refer Figure 1).

Following completion of mining operations at the Donaldson Coal Mine in April 2013, the final site rehabilitation works were undertaken and completed in March 2014[1]. The Donaldson Coal Mine site is currently under care and maintenance with activities on-site primarily associated with implementation of environmental monitoring and maintenance programs.

Following an inspection of the Donaldson Coal Mine site by inspectors from the NSW Resources Regulator on 7 June 2019, Donaldson Coal received a Notice issued under Section 240 of the NSW *Mining Act 1992* requiring Donaldson Coal to:

> *Undertake a review of water quality within mine dams ('clean' and 'dirty') within ML 1461 against their approved final land use. The Review is to:*
>
> *i. Assess observed water quality recorded since March 2015, including (but not limited to) turbidity, Total Suspended Solids (TSS) and Total Dissolved Solids (TDS) against relevant industry guidelines and requirements of the approved final land use.*
>
> *ii. Review and assess the source of elevated turbidity / suspended solids including the construction methodology of each dam with turbidity / suspended solid concentrations greater than relevant industry guidelines and requirements of the approved final land use.*
>
> *iii. Should results exceed relevant industry guidelines and requirements of the approved final land use, develop and implement a strategy to address elevated turbidity / suspended solids for the long term. The strategy is to be consistent with relevant Project Approval requirements.*

This report presents the results of the water quality review and recommended actions in response to the findings of the review, which was undertaken by Hydro Engineering & Consulting Pty Ltd (HEC) on behalf of Donaldson Coal.

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[1] Donaldson Coal Pty Ltd (2014).

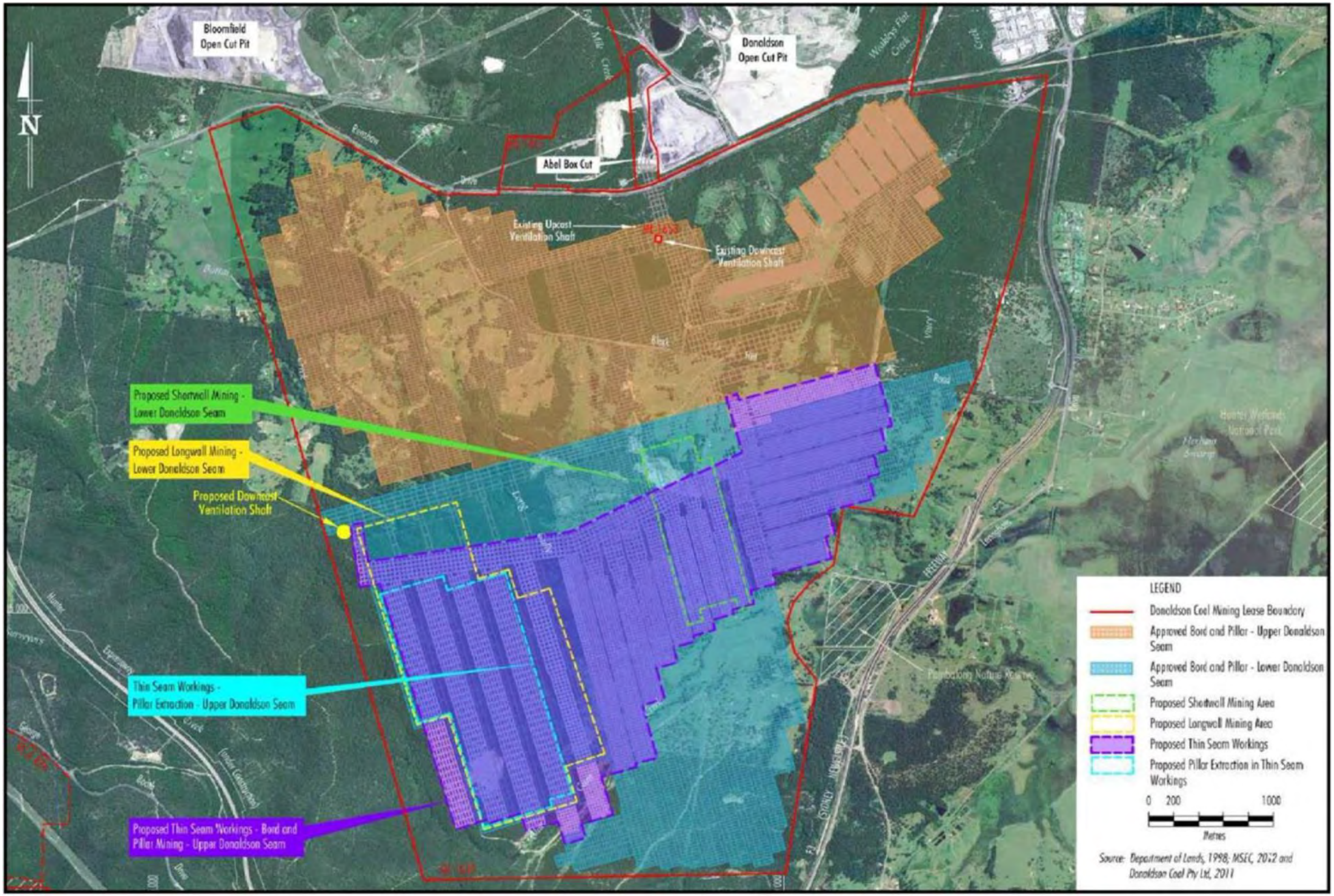

Figure 1 Abel Underground Mine Lease Area

2.0 LOCAL HYDROLOGY AND DONALDSON COAL MINE WATER STORAGES

2.1 Local Hydrology

The Donaldson Coal Mine is located within the catchment of the Hunter River. At its nearest point, the Hunter River is located approximately 6 km east of the Donaldson Coal Mine. The local creek system in the vicinity of the Donaldson Coal Mine comprises a number of small headwater creeks – these are indicated on Figure 2. These comprise Four Mile Creek to the west, Weakleys Flat Creek to the east and Scotch Dairy Creek to the north. The head of the catchments of Four Mile Creek and Weakleys Flat Creek are located to the south of John Renshaw Drive, with the catchments comprising either timbered areas or grassland overlying the Abel Underground Mine. The head of the catchment of Scotch Dairy Creek is located in timbered land just north of the Donaldson Coal Mine rehabilitated areas. Four Mile Creek drains northwards, combining with several other drainages, including urban drainage from the town of Maitland, before joining the Hunter River near Morpeth. Weakleys Flat Creek and Scotch Dairy Creek combine with Viney Creek as well as capturing drainage from the towns of Thornton and Beresfield, before draining into the Woodberry Swamp which eventually discharges to the Hunter River near Woodberry.

2.2 Water Quality Trigger Values

The Abel Underground Mine's Water Management Plan (Donaldson Coal Pty Ltd, 2019) provides water quality trigger values for upstream monitoring locations in Four Mile and Weakleys Creeks (refer Table 1). These trigger levels are based on calculation of the 80th and 20th percentile statistics[2].

Table 1 Adopted Water Quality Triggers – Four Mile Creek and Weakleys Flat Creek

Parameter	Four Mile Creek	Weakleys Flat Creek
pH	6.5 – 7.1	6.6 – 7.2
Electrical Conductivity (µS/cm)	235 - 580	235 – 1,116
Total Suspended Solids (mg/L)	34	30
Manganese (mg/L)	1.6	1.34
Aluminium (mg/L)	0.46	0.47
Iron (mg/L)	5.56	4.12

2.3 Water Storages

There are currently ten active water storages on the Donaldson Coal Mine Mining Lease 1461 area. The quality of water held in the ten water storages on site was assessed using water quality monitoring data provided by Donaldson Coal. The location of these storages and the catchments reporting to them is shown in Figure 2. Further details of the storages and their current function are summarised in Table 2.

[2] Donaldson Coal Pty Ltd (2019). 20th percentile for pH only.

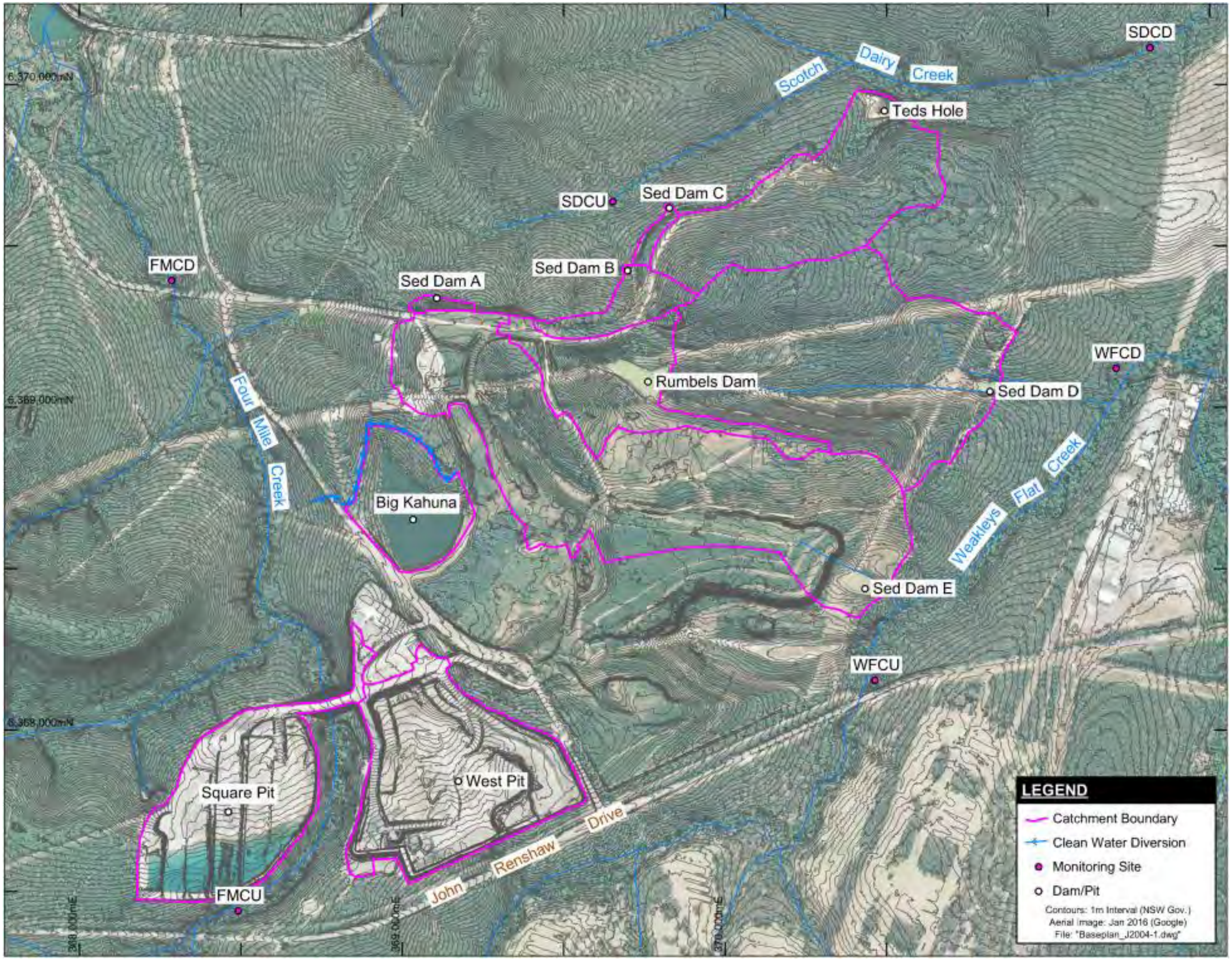

Figure 2 Local Drainage, Location of Water Storages and Surface Water Sampling Sites

Following mine closure, minor quantities of waste rock from the adjacent Abel Underground Mine have been placed in the West Pit void (refer Figure 2). Water from mine dewatering at the Abel Underground Mine was also previously transferred to the West Pit void sump which was operated as a staging storage for longer term storage in the Big Kahuna Dam[3]. Since 2013, dewatering from the Abel Underground Mine has been pumped directly to the Big Kahuna Dam[4]. Water in the Big Kahuna Dam is transferred to Lake Kennerson (located approximately 1.5 km to the north-west) for use in the Coal Handling and Preparation Plant (CHPP) at the Bloomfield Colliery[5], or, when conditions permit, is discharged to Four Mile Creek (in accordance with the Donaldson Coal Mine's Environment Protection Licence (EPL) 11080.

Table 2 Summary of Donaldson Coal Mine Water Storage Functions

Name	Surface Catchment Area (ha)	Receiving Water Catchment	Current Purpose
Teds Hole	28	Scotch Dairy Creek	Rehabilitated Area Sediment Control Storage
Big Kahuna	15.6	Licenced discharge to Four Mile Creek[6]	Mine disturbance area runoff and mine water containment
Sediment Dam A	0.7	Four Mile Creek	Rehabilitated Area Sediment Control Storage
Sediment Dam B	4.8	Scotch Dairy Creek	Rehabilitated Area Sediment Control Storage
Sediment Dam C	0.9	Scotch Dairy Creek	Rehabilitated Area Sediment Control Storage
Sediment Dam D	51.1	Weakleys Flat Creek	Rehabilitated Area Sediment Control Storage
Sediment Dam E	61.4	Weakleys Flat Creek	Rehabilitated Area Sediment Control Storage
Rumbles Dam	15.6	Overflow would report to Sediment Dam E	Rehabilitated Area Sediment Control Storage
West Pit Void Sump	31.2	Internally contained	Final Void
Square Pit Void Sump	25.5	Internally contained	Final Void

[3] Donaldson Coal Pty Ltd (2019).
[4] Ibid.
[5]Donaldson Coal Pty Ltd (2019)
[6].Ibid

3.0 SURFACE WATER RELATED REHABILITATION OBJECTIVES AND COMPLETION CRITERIA

It is understood that the water storages listed in Table 2 will remain post-mining. The proposed final land use for the sediment control storages is as a stock and fauna water source. It is understood that the West and Square Pit final voids would remain as permanent water storages should mining of the Abel Underground Mine not be resumed.

The following completion criteria in relation to surface water quality are also outlined in the MOP:

- runoff water Electrical Conductivity to be less than 1,000 µS/cm after five years, and
- the quality of water leaving the site to be in accordance with EPL[7] requirements.

The Donaldson Coal Mine EPL 11080 permits discharge to Four Mile Creek under the following conditions:

- 40 ML each day for the 5 days following 10 mm of rain within 24 hours;
- Maximum salinity measured as Electrical Conductivity: 2,000 µS/cm;
- pH range 6.0 – 8.0; and
- Total suspended solids < 50 mg/L.

[7] Environmental Protection Licence 11080, Version 2 Dec 2011.

4.0 WATER QUALITY ASSESSMENT

This section provides an assessment of the mine water storage water quality since March 2015 against relevant industry guidelines.

4.1 Water Quality Guidelines

National guidelines for planning and managing water quality in fresh and marine waters have been widely adopted including by planning and regulatory authorities in NSW. The guidelines[8] contain trigger values which can be used, in the absence of locally derived objective triggers, to assess suitability of water to meet environmental values. Default guideline trigger values for protection of aquatic ecosystems (at the 95% level of protection) and stock watering have been used in this review to reflect the presumed post-mine land use of a nature reserve.

4.2 Teds Hole

Teds Hole is used as a sediment control storage. It receives runoff from rehabilitated overburden emplacement areas on the north-eastern side of the site. A statistical summary of the water quality data provided for the post-rehabilitation period (i.e. March 2015 to March 2020) is given in Table 3.

The water quality in Teds Hole during the post rehabilitation period can be characterised as being slightly acidic, with a median pH of 6.5 and a range of 7.5 to 5.3. The median value falls within the ANZECC (2000) default guideline range for the protection of aquatic ecosystems and stock watering. The twentieth percentile statistic is however below the lower limit of the guideline for both protection of aquatic ecosystems and stock watering.

Salinity (EC) has been relatively low, with a median value of 116 µS/cm and range of 60 to 264 µS/cm.

TSS concentrations have generally been low varying between less than 5 and 119 mg/L with a median concentration[9] of 9 mg/L. Turbidity measurements have also been low, with a median of 8.1 and maximum of 36.5 NTU. In surface water there can be a correlation between TSS concentration and the turbidity of water, where the sediment suspended in the water causes elevated turbidity. This does not appear to be the case at Teds Hole (refer Figure 3) where there is no visually apparent correlation between TSS and turbidity.

[8] ANZECC, 2000

[9] Calculated assuming that when the recorded TSS was below the laboratory limit of detection (5 mg/L) it was equal to this value.

Table 3 Statistical Summary of Water Quality Data - Teds Hole

Parameter	Units	No. Samples	Median†	Maximum	Minimum	80th Percentile†	20th Percentile†	ANZECC (2000) Default Guideline Trigger Value for Protection of Aquatic Ecosystems	ANZECC (2000) Default Guideline Trigger Value for Primary Industries (Stock Water)
pH	pH Unit	60	6.5	7.5	5.3	6.8	6.1	6.5 – 8.5	6.5 – 8.5
Electrical Conductivity (EC)	µS/cm	60	116	264	60.3	142	98	200 - 300	-
Total Dissolved Solids	mg/L	60	96	237	50	120	77	-	2,000 – 4,000
Total Suspended Solids	mg/L	60	9	119	<5	21.6	<5	50	-
Turbidity	NTU	19	8.1	36.5	0.8	16.9	4.7	6 - 50	-
Alkalinity	mg/L	19	12	44	2	23	5.2	-	-
Acidity	mg/L	19	3	8	1	4	2	-	-
Sulphate	mg/L	60	12	41	1	27.4	5	-	1,000
Chloride	mg/L	19	15	28	9	18.4	12.2	-	-
Calcium	mg/L	19	<1	2	<1	2	<1	-	1,000
Magnesium	mg/L	19	4	6	2	6	3	-	-
Sodium	mg/L	19	14	32	11	19.4	12	-	-
Potassium	mg/L	19	<1	5	<1	3.4	<1	-	-
Aluminium	mg/L	19	0.19	1.36	0.05	0.46	0.11	0.055	5
Arsenic	mg/L	19	<0.001	0.002	<0.001	<0.001	<0.001	0.013	0.5
Barium	mg/L	19	0.014	0.027	0.005	0.02	0.0096	-	-
Cadmium	mg/L	19	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0002	0.01
Chromium	mg/L	19	<0.001	0.002	<0.001	<0.001	<0.001	0.001	1
Cobalt	mg/L	19	<0.001	0.008	<0.001	<0.0018	<0.001	-	1
Copper	mg/L	19	<0.001	0.003	<0.001	<0.001	<0.001	0.0014	0.5
Lead	mg/L	11	<0.001	0.001	<0.001	<0.001	<0.001	0.0034	0.1
Manganese	mg/L	19	0.02	0.384	0.002	0.0414	0.008	1.9	
Selenium	mg/L	2	*	<0.01	<0.01	*	*	0.011	0.02
Zinc	mg/L	11	0.007	0.04	<0.005	0.022	<0.005	0.008	20
Iron	mg/L	19	1.83	5.29	0.2	2.422	0.802	-	-
Fluoride	mg/L	19	0.2	0.3	<0.1	0.2	0.1	-	1
Nitrate	mg/L	19	<0.01	0.02	<0.01	0.014	<0.01	0.7	400
Reactive Phosphorous	mg/L	19	<0.01	0.09	<0.01	0.02	<0.01	0.008	-

* Insufficient data. † In the calculation of these statistics, where a result was recorded as less than the laboratory limit of detection, it was assumed to equal the limit of detection for calculation purposes. Where a result of a calculation has been affected by the presence of a limit of detection value the result has been reported as < the result.

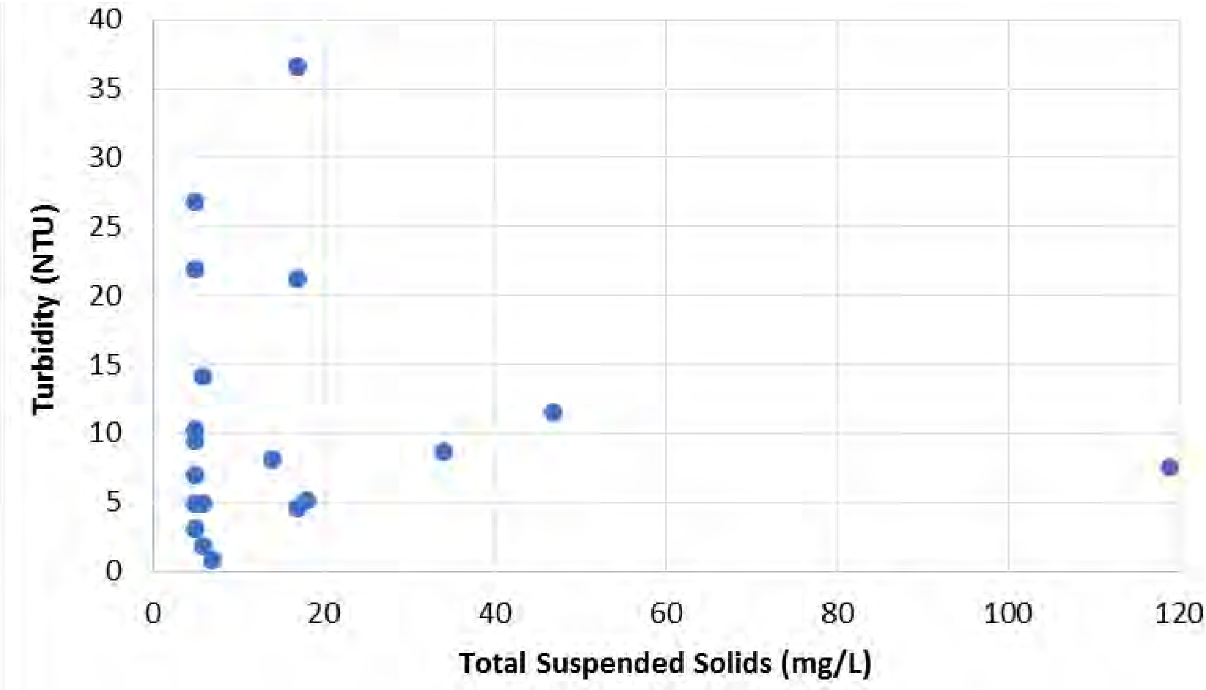

Figure 3 Total Suspended Solids versus Turbidity – Teds Hole

The highest TSS concentration of 119 mg/L, sampled on 25/1/2018, corresponded to a low turbidity measurement of 7.5 NTU. This also corresponded to a relatively low rainfall period with 4 mm of rainfall being recorded at the Donaldson Coal Mine rainfall station in the two weeks prior to this date. This may indicate that the high TSS value may be erroneous. All other values are below the EPL limit of 50 mg/L and all but three are below the adopted trigger level for Four Mile Creek of 34 mg/L.

The highest recorded turbidity measurement of 36.5 NTU corresponded to a low TSS concentration of 17 mg/L on 21/1/2016. There had been significant rainfall recorded at the Donaldson Coal Mine rainfall station prior to that sampling event, with 294 mm being recorded from 3 to 7/1/2016 and a further 92 mm in the seven days leading up to the date of sampling.

All recorded turbidity levels have been below the ANZECC (2000) guideline default trigger value for the protection of aquatic ecosystems (low land rivers) of 50 NTU.

The only notable exceedance of other parameters relative to ANZECC (2000) guideline default trigger values for the protection of aquatic ecosystems is for aluminium. This had a median concentration of 0.19 mg/L compared to a guideline default trigger value of 0.055 mg/L for pH > 6.5. This may reflect aluminium minerals attached to suspended clay particles. Aluminium concentrations have however been below or consistent with the adopted trigger value for Four Mile Creek of 0.46 mg/L (refer Table 1).

Water quality data provided are generally consistent with the ANZECC (2000) guidelines for stock water use. Minimum (5.3) and twentieth percentile (6.1) pH values were however below the lower guideline limit of 6.5 for protection of aquatic ecosystems and stock watering. It is noted that low pH values have been reported for local streams at sampling sites upstream of the mine site - specifically: a pH value of 5.1 was reported on Scotch Dairy Creek; a pH value of 5.4 was reported on Four Mile Creek and a pH value of 5.5 was reported on Weakleys Flat Creek all upstream of the mine site.

4.2 Sediment Dam A

Sediment Dam A is a sediment control storage. It receives runoff from a small (0.7 ha) area on the north-western side of the site. A statistical summary of the water quality data provided for this site from March 2015 to March 2020 is given in Table 4 below.

Table 4 Statistical Summary of Water Quality Data - Sediment Dam A

Parameter	Units	Samples	Median†	Maximum	Minimum	80th Percentile†	20th Percentile†	ANZECC (2000) Default Guideline Trigger Value for Protection of Aquatic Ecosystems	ANZECC (2000) Default Guideline Trigger Value for Primary Industries (Stock Water)
pH	pH Unit	61	6.8	8.9	4.7	7.5	6.2	6.5 – 8.5	6.5 – 8.5
EC	µS/cm	61	351	722	129	469	224	200 - 300	
Total Dissolved Solids	mg/L	61	275	462	172	338	232		2,000 – 4,000
Total Suspended Solids	mg/L	61	29	661	6	55	17	50	
Turbidity	NTU	20	62.8	252	25.7	195	44.4	6 - 50	
Alkalinity	mg/L	20	6	72	<1	16.2	1.8		
Acidity	mg/L	20	2	5	<1	3.2	1		
Sulphate	mg/L	61	42	107	11	62	21		1,000
Chloride	mg/L	20	65	156	21	94.4	41.2		
Calcium	mg/L	20	4	9	1	5.4	2		1,000
Magnesium	mg/L	20	8.5	21	3	12.2	4.8		
Sodium	mg/L	20	47.5	109	18	66	30.6		
Potassium	mg/L	20	4	9	2	5	3		
Aluminium	mg/L	20	1.47	8.08	0.31	4.84	0.72	0.055	5
Arsenic	mg/L	20	0.002	0.003	<0.001	0.003	0.001	0.013	0.5
Barium	mg/L	20	0.095	0.209	0.068	0.131	0.075		
Cadmium	mg/L	20	<0.0001	0.0002	<0.0001	<0.0001	<0.0001	0.0002	0.01
Chromium	mg/L	20	0.002	0.008	<0.001	0.004	<0.001	0.001	1
Cobalt	mg/L	20	0.004	0.021	<0.001	0.008	0.002		1
Copper	mg/L	20	0.002	0.043	<0.001	0.004	<0.001	0.0014	0.5
Lead	mg/L	12	0.0015	0.005	<0.001	0.004	<0.001	0.0034	0.1
Manganese	mg/L	20	0.238	1.000	0.045	0.371	0.131	1.9	
Selenium	mg/L	2	*	<0.01	<0.01	*	*	0.011	0.02
Zinc	mg/L	10	0.024	0.038	<0.005	0.0346	0.0188	0.008	20
Iron	mg/L	20	3.0	6.4	0.8	4.6	1.6		
Fluoride	mg/L	20	0.1	0.4	<0.1	0.2	<0.1		1
Nitrate	mg/L	20	0.015	0.07	<0.01	0.042	<0.01	0.7	400
Reactive Phosphorous	mg/L	20	<0.01	0.1	<0.01	0.034	<0.01	0.008	

† In the calculation of these statistics, where a result was recorded as less than the laboratory limit of detection, it was assumed to equal the limit of detection for calculation purposes. Where a result of a calculation has been affected by the presence of a limit of detection value the result has been reported as < the result.

* Insufficient data

The water quality in Sediment Dam A during the post rehabilitation period can be characterised as having a variable pH with a near neutral median value of 6.8 and a range of 8.7 to 4.7.

Salinity has been moderate, with a median value of 351 µS/cm and range of 129 to 722 µS/cm. The eightieth percentile value (469 µS/cm) is however below the adopted upper trigger value for Four Mile Creek (580 µS/cm) and the EPL discharge limit of 2,000 µS/cm.

TSS concentrations have generally been variable varying ranging from 6 mg/L (low) to 661mg/L (high). The median concentration of 29 mg/L is below both the trigger level for Four Mile Creek (34 mg/L) and the EPL discharge limit (50mg/L).

Turbidity measurements have been elevated and variable with a range of 25.7 to 252 NTU. The median value of 62.8 NTU is above the upper bound ANZECC (2000) default guideline trigger value. The plot of TSS concentration and turbidity is shown in Figure 4 below.

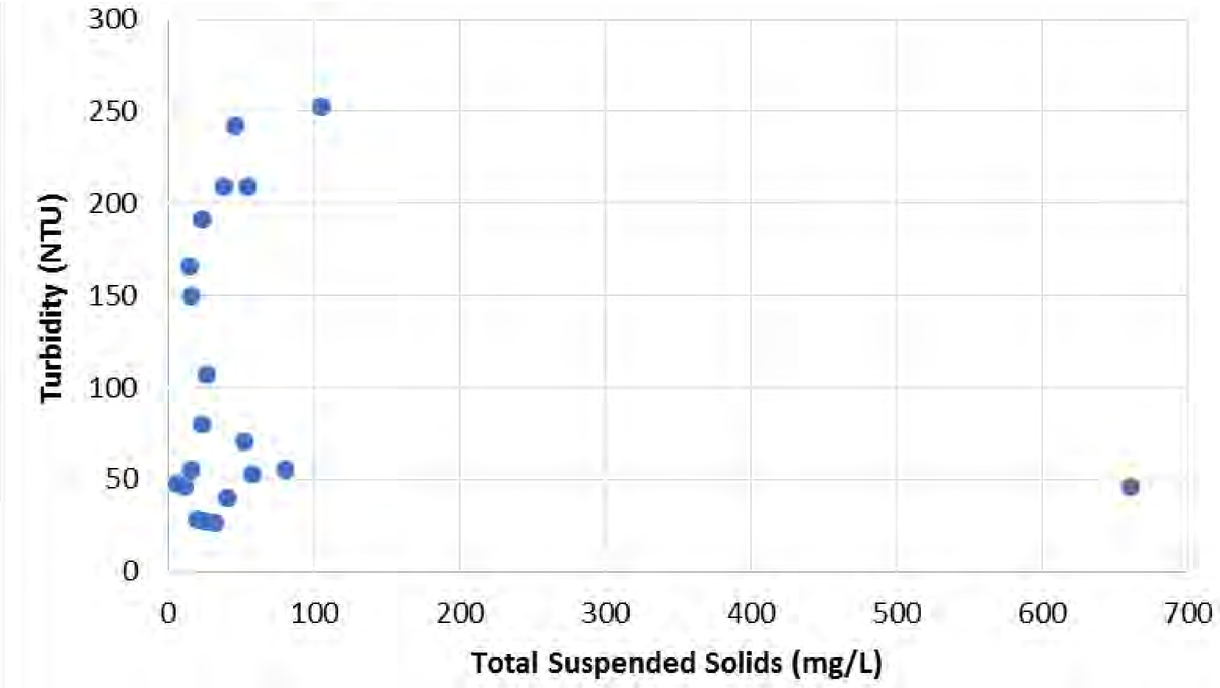

Figure 4 Total Suspended Solids versus Turbidity – Sediment Dam A

There is an apparent TSS outlier value (TSS concentration of 661 mg/L and turbidity of 45.8 NTU on 15/1/2020). January 2020 was a low rainfall month with only 3 mm recorded at the Donaldson Coal Mine rainfall station prior to the date of sampling. There is there no obvious reason for this very high TSS concentration. The effect of removing that data pair is shown in the revised plot of TSS concentration and turbidity shown in Figure 5.

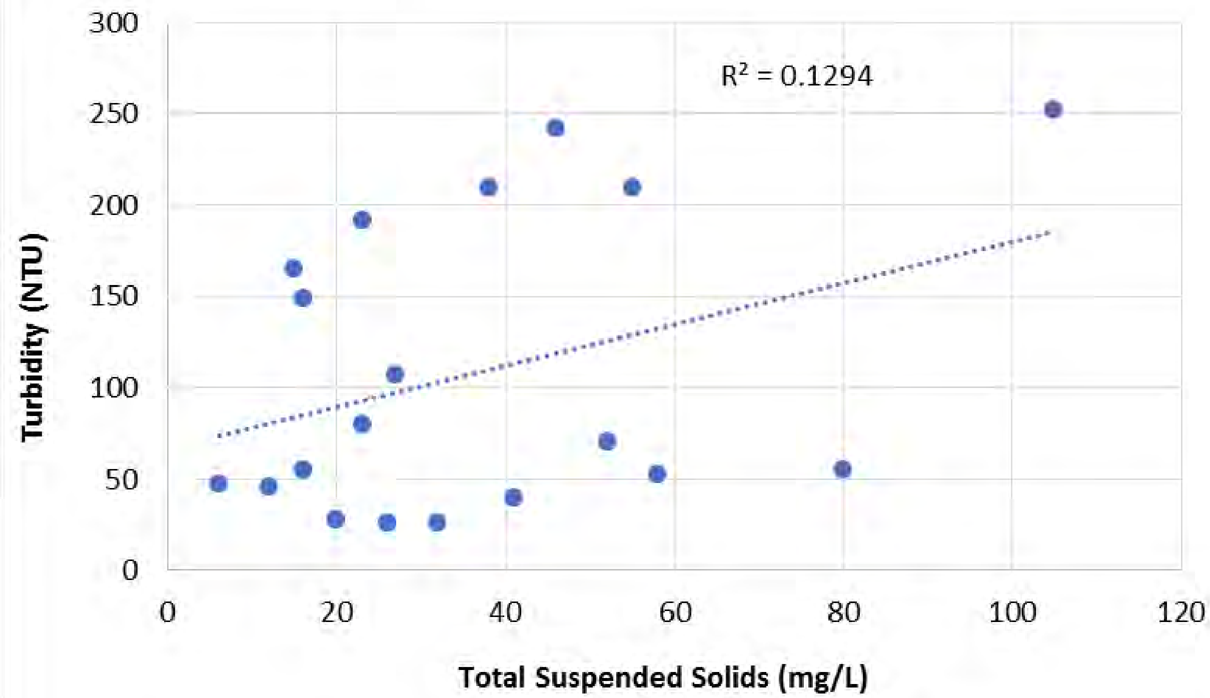

Figure 5 Adjusted Total Suspended Solids versus Turbidity – Sediment Dam A

Even with the removal of the outlier, there is no discernible relationship between suspended solids and turbidity at this site.

Time series plots of the historical total suspended solids concentrations and turbidity measurements in Sediment Dam A are shown in Figure 6 together with coincident rainfall recorded at the Donaldson Coal Mine rainfall station. The loose correlation between suspended solids and turbidity is evident as are the much higher turbidity levels. The "spikes" in turbidity appear to be unrelated to rainfall events (the high turbidity recorded on 17/4/2015 occurred before the significant rainfall event from 20-22/4/2015).

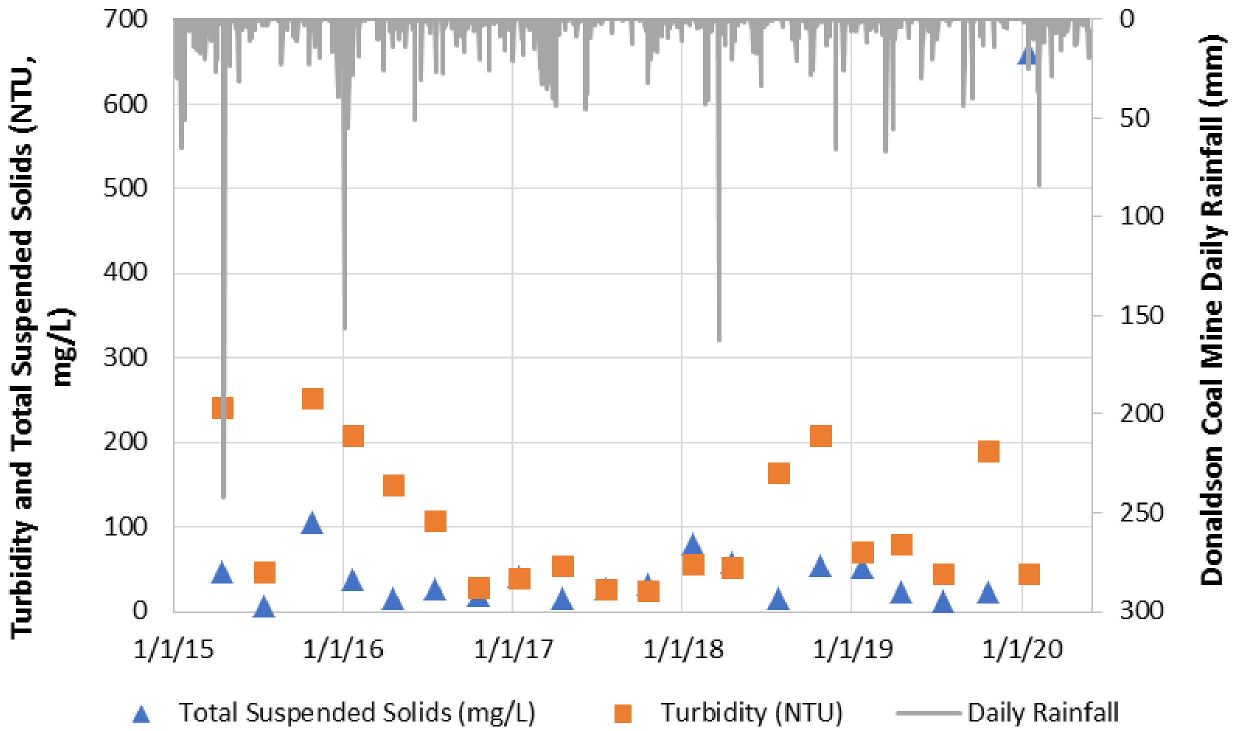

Figure 6 Change in Sediment Dam A Total Suspended Solids and Turbidity over the Monitoring Period

Nitrate and reactive phosphorus concentrations in Sediment Dam A have been relatively low – i.e. median concentrations of 0.015 and 0.01 mg/L respectively and eightieth percentile values of 0.042 and 0.034 mg/L respectively. ANZECC default guideline trigger values for aquatic ecosystems are 0.5 mg/L for total nitrogen (including nitrate) and 0.02 mg/L for filterable reactive phosphorous. This suggests that there has been insufficient nutrient build up to trigger a significant algal growth response.

A recent rehabilitation monitoring report[10] suggests that whilst very high apparent soil loss rates have been measured at many of the rehabilitation monitoring plots these were considered to have resulted from cyclical/seasonal changes in the thickness of the surface organic layer (i.e. phases of litter accumulation and degradation), rather than an actual soil loss or erosion. There was reportedly no visual indication of erosion on the plots and it was also noted that similar results were observed at control monitoring plots.

It is possible that fine colloidal sediment may have been transported to Sediment Dam A from the catchment drainage paths or that it may have been mobilised from the sediment dam embankment and/or the storage basin. We understand that it is not known what materials were used in the sediment dam embankment construction or what materials have been exposed in the floor of the storage.

Data indicates elevated aluminium, relative to the ANZECC (2000) default guideline trigger value for protection of aquatic ecosystems (0.055 mg/L for pH > 6.5), with a median concentration of 1.47 mg/L.

Data indicates elevated zinc, relative to the ANZECC (2000) default guideline trigger value for protection of aquatic ecosystems (0.008 mg/L) with a median value of 0.024 mg/L.

Water quality data provided are generally consistent with stock water use. Recorded pH values were however below the ANZECC (2000) default lower guideline value of 6.5 for protection of aquatic ecosystems and stock watering with a minimum of 4.7 and a twentieth percentile of 6.2. It is noted that low pH values have been reported for local streams at sampling sites upstream of the mine site - specifically: a pH value of 5.1 was reported on Scotch Dairy Creek; a pH value of 5.4 was reported on Four Mile Creek and a pH value of 5.5 was reported on Weakleys Flat Creek all upstream of the mine site.

[10] Global Soil Systems (2019).

4.3 Sediment Dam B

Sediment Dam B captures runoff from a moderately sized catchment (some 4.8 ha in area) on the northern side of the site. A statistical summary of the water quality data provided for this site from March 2015 to March 2020 is given in Table 5 below.

Table 5 Statistical Summary of Water Quality data - Sediment Dam B

Parameter	Units	Samples	Median†	Maximum	Minimum	80^{th} Percentile†	20^{th} Percentile†	ANZECC (2000) Default Guideline Trigger Value for Protection of Aquatic Ecosystems	ANZECC (2000) Default Guideline Trigger Value for Primary Industries (Stock Water)
pH	pH Unit	61	6.8	8.2	5.6	7.2	6.3	6.5 – 8.5	6.5 – 8.5
EC	µS/cm	61	237	382	131	300	189	200 - 300	
Total Dissolved Solids	mg/L	61	331	729	231	395	296		2,000 – 4,000
Total Suspended Solids	mg/L	61	31	166	14	57	21	50	
Turbidity	NTU	20	200	411	124	231	153	6 - 50	
Alkalinity	mg/L	19	6.0	35.0	3.0	13.6	4.6		
Acidity	mg/L	20	3	6	2	4.2	2		
Sulphate	mg/L	61	21	40	8	28	14		1,000
Chloride	mg/L	20	46.5	82	33	60.6	35.6		
Calcium	mg/L	20	2.5	4	1	3	2		1,000
Magnesium	mg/L	20	4	7	2	6	3		
Sodium	mg/L	20	34.5	63	20	43.8	24.8		
Potassium	mg/L	20	3	6	2	3	2		
Aluminium	mg/L	20	6.49	12.10	1.80	7.17	4.87	0.055	5
Arsenic	mg/L	20	0.0030	0.0100	0.0020	0.0052	0.0030	0.013	0.5
Barium	mg/L	20	0.090	0.178	0.038	0.103	0.084		
Cadmium	mg/L	20	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0002	0.01
Chromium	mg/L	20	0.0055	0.301	0.002	0.007	0.004	0.001	1
Cobalt	mg/L	20	0.001	0.006	<0.001	0.002	0.001		1
Copper	mg/L	20	0.005	0.026	0.002	0.006	0.004	0.0014	0.5
Lead	mg/L	12	0.007	0.016	0.003	0.0088	0.0044	0.0034	0.1
Manganese	mg/L	20	0.083	0.170	0.044	0.146	0.058	1.9	
Selenium	mg/L	2	*	<0.01	<0.01	*	*	0.011	0.02
Zinc	mg/L	11	0.022	0.034	0.014	0.029	0.018	0.008	20
Iron	mg/L	20	6.1	27.0	3.4	10.8	5.2		
Fluoride	mg/L	20	0.10	0.40	<0.01	0.20	<0.10		1
Nitrate	mg/L	20	<0.015	0.180	<0.010	0.032	<0.010	0.7	400
Reactive Phosphorous	mg/L	20	<0.01	0.25	<0.01	0.10	<0.01	0.008	

† In the calculation of these statistics, where a result was recorded as less than the laboratory limit of detection, it was assumed to equal the limit of detection for calculation purposes. Where a result of a calculation has been affected by the presence of a limit of detection value the result has been reported as < the result.

* Insufficient data

The water quality characteristics of Sediment Dam B have been similar to Sediment Dam A, with the following specific observations noted:

- Variable pH with a near neutral median value of 6.8 and a range of 8.2 to 5.6.
- Moderate salinity, with a median value of 237 µS/cm and range of 131 to 382 µS/cm.
- Elevated aluminium relative to the ANZECC (2000) default guideline trigger value for protection of aquatic ecosystems (0.055 mg/L for pH > 6.5), with a median concentration of 6.49 mg/L.
- Elevated chromium, relative to the ANZECC default guideline trigger value for protection of aquatic ecosystems (0.001 mg/L), with a median value of 0.0055 mg/L.
- Elevated lead, relative to the ANZECC default guideline trigger value for protection of aquatic ecosystems (0.007 mg/L), with a median value of 0.0034 mg/L.
- Elevated zinc, relative to the ANZECC default guideline trigger value for protection of aquatic ecosystems (0.008 mg/L), with a median value of 0.022 mg/L. Variable TSS concentrations, from 14 mg/L (low) to 166 mg/L. The median concentration of 31 mg/L is below both the trigger level for Four Mile Creek (34 mg/L) and the EPL discharge limit (50 mg/L).
- Consistently high turbidity ranging from 124 to 411 NTU. A plot of TSS concentration and turbidity is given in Figure 7 below. There is some correlation present, although the magnitude of the turbidity measurements was much higher than would be expected from the TSS concentrations (on the basis of experience with data from similar sites).

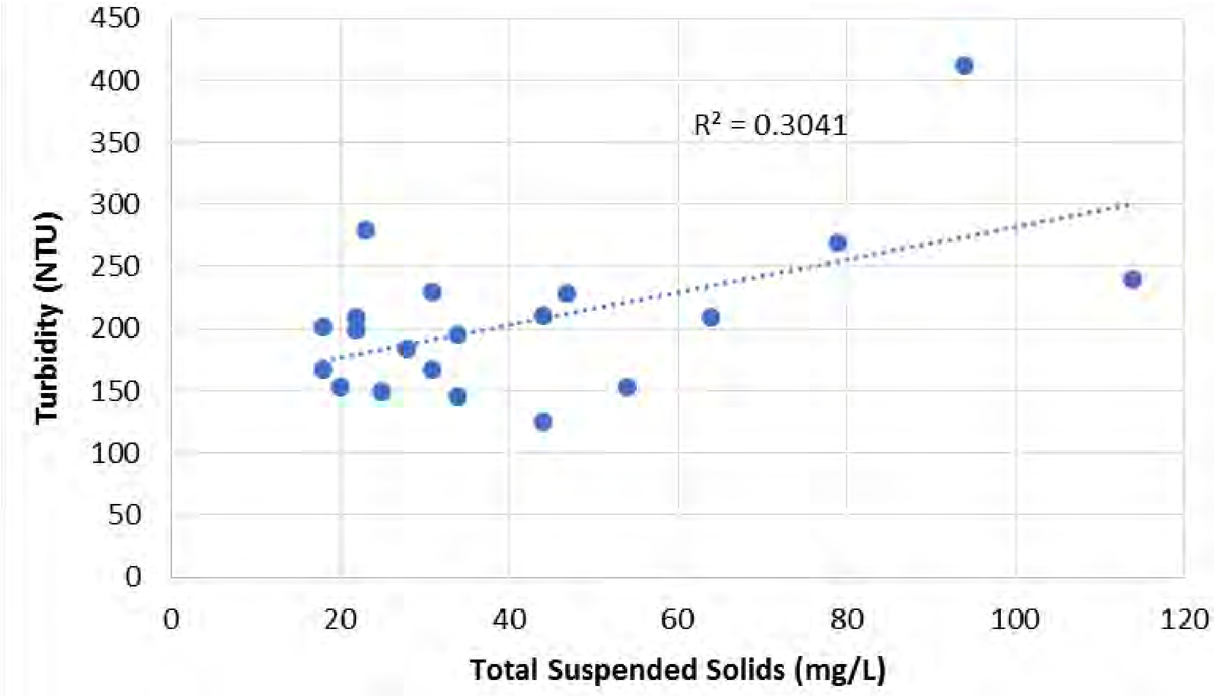

Figure 7 Total Suspended Solids versus Turbidity – Sediment Dam B

Water quality data provided are generally consistent with the ANZECC (2000) guidelines for stock water use. Recorded pH values were however below the ANZECC (2000) default lower guideline value of 6.5 for protection of aquatic ecosystems and stock watering with a minimum of 5.6 and a twentieth percentile of 6.3. It is noted that low pH values have been reported for local streams at sampling sites upstream of the mine site - specifically: a pH value of 5.1 was reported on Scotch Dairy Creek; a pH value of 5.4 was reported on Four Mile Creek and a pH value of 5.5 was reported on Weakleys Flat Creek all upstream of the mine site.

4.4 Sediment Dam C

Sediment Dam C captures runoff from a small (0.9 ha) area on the northern side of the site. A statistical summary of the water quality data provided for this site from March 2015 to March 2020 is given in Table 6 below.

Table 6 Statistical Summary of Water Quality Data - Sediment Dam C

Parameter	Units	Samples	Median†	Maximum	Minimum	80th Percentile†	20th Percentile†	ANZECC (2000) Default Guideline Trigger Value for Protection of Aquatic Ecosystems	ANZECC (2000) Default Guideline Trigger Value for Primary Industries (Stock Water)
pH	pH Unit	59	6.5	8.3	4.5	7.0	5.7	6.5 – 8.5	6.5 – 8.5
EC	µS/cm	59	103	297	41	159	78	200 - 300	
Total Dissolved Solids	mg/L	59	142	270	87	196	125		2,000 – 4,000
Total Suspended Solids	mg/L	59	28.0	134.0	6.0	56.0	17.6	50	
Turbidity	NTU	19	92	268	51	118	76	6 - 50	
Alkalinity	mg/L	19	3	17	<1	6.8	<1		
Acidity	mg/L	19	3	8	<1	4.4	2		
Sulphate	mg/L	59	13	36	3	21	7.6		1,000
Chloride	mg/L	19	18	43	10	33	12.6		
Calcium	mg/L	19	<1	2	<1	1	<1		1,000
Magnesium	mg/L	19	2	5	<1	4.4	1.6		
Sodium	mg/L	19	15	35	6	26	9.2		
Potassium	mg/L	19	2	6	1	3	2		
Aluminium	mg/L	19	2.11	6.5	0.8	3.6	1.6	0.055	5
Arsenic	mg/L	18	0.002	0.006	0.001	0.0036	0.0014	0.013	0.5
Barium	mg/L	19	0.038	0.067	0.022	0.0516	0.033		
Cadmium	mg/L	19	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0002	0.01
Chromium	mg/L	19	0.002	0.357	<0.001	0.0034	0.002	0.001	1
Cobalt	mg/L	19	0.003	0.018	<0.001	0.0072	0.002		1
Copper	mg/L	19	0.002	0.028	<0.001	0.004	0.002	0.0014	0.5
Lead	mg/L	11	0.003	0.006	0.001	0.004	0.002	0.0034	0.1
Manganese	mg/L	19	0.071	0.164	0.022	0.109	0.048	1.9	
Selenium	mg/L	2	*	<0.01	<0.01	*	*	0.011	0.02
Zinc	mg/L	11	0.024	0.125	0.007	0.066	0.012	0.008	20
Iron	mg/L	19	3.29	8.2	1.15	4.004	2.184		
Fluoride	mg/L	19	0.1	0.2	<0.1	0.2	<0.1		1
Nitrate	mg/L	19	<0.01	0.25	<0.01	0.024	<0.01	0.7	400
Reactive Phosphorous	mg/L	19	<0.01	0.1	<0.01	0.052	<0.01	0.008	

† In the calculation of these statistics, where a result was recorded as less than the laboratory limit of detection, it was assumed to equal the limit of detection for calculation purposes. Where a result of a calculation has been affected by the presence of a limit of detection value the result has been reported as < the result.

* Insufficient data

The water quality characteristics of Sediment Dam C have been similar to Sediment Dam A, with the following specific observations noted:

- Variable pH with a near neutral median value of 6.5 and a range of 8.3 to 4.5;
- Low to moderate salinity, with a median value of 103 µS/cm and range of 47 to 291 µS/cm.
- Elevated aluminium, relative the ANZECC (2000) default guideline trigger value for protection of aquatic ecosystems (0.055 mg/L for pH > 6.5), with a median concentration of 2.11 mg/L.
- Elevated chromium, relative to the ANZECC default guideline trigger value for protection of aquatic ecosystems (0.001 mg/L), with a median value of 0.002 mg/L.
- Elevated copper, relative to the ANZECC default guideline trigger value for protection of aquatic ecosystems (0.0014 mg/L), with a median value of 0.002 mg/L.
- Elevated zinc, relative to the ANZECC default guideline trigger value for protection of aquatic ecosystems (0.008 mg/L) with a median value of 0.024 mg/L.
- Variable TSS concentrations, from 4 mg/L (low) to 134 mg/L. The median concentration of 28 mg/L is below both the trigger level for Four Mile Creek (34 mg/L) and the EPL discharge limit (50 mg/L).
- Consistently elevated turbidity ranging from 51 to 268 NTU, which is above the ANZECC (2000) guideline default trigger value for the protection of aquatic ecosystems (lowland rivers).

A plot of TSS concentration and turbidity is given in Figure 8 below. There is at best a weak correlation evident. The turbidity levels are generally higher than would be expected from the total suspended solids concentrations (on the basis of experience with data from similar sites).

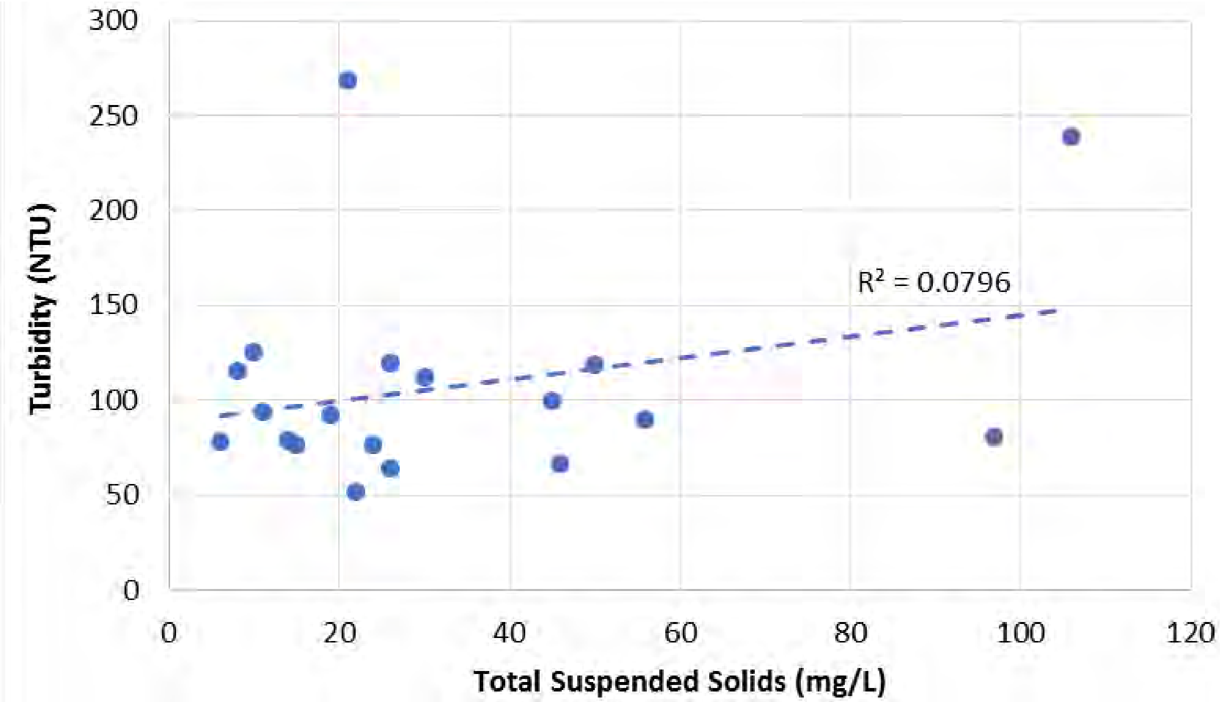

Figure 8 Total Suspended Solids versus Turbidity – Sediment Dam C

Water quality data provided are generally consistent with the ANZECC guidelines for stock water use. Recorded pH values were however below the ANZECC (2000) default lower guideline value of 6.5 for protection of aquatic ecosystems and stock watering with a minimum of 4.5 and a twentieth percentile of 5.7. It is noted that low pH values have been reported for local streams at sampling sites upstream of the mine site - specifically: a pH value of 5.1 was reported on Scotch Dairy Creek; a pH value of 5.4 was reported on Four Mile Creek and a pH value of 5.5 was reported on Weakleys Flat Creek all upstream of the mine site.

4.5 Sediment Dam D

Sediment Dam D captures runoff from a 51 ha area on the eastern side of the site. A statistical summary of the water quality data provided for this site from March 2015 to March 2020 is given in Table 7 below.

Table 7 Statistical Summary of Water Quality Data – Sediment Dam D

Parameter	Units	Samples	Median†	Maximum	Minimum	80th Percentile†	20th Percentile†	ANZECC (2000) Default Guideline Trigger Value for Protection of Aquatic Ecosystems	ANZECC (2000) Default Guideline Trigger Value for Primary Industries (Stock Water)
pH	pH Unit	61	7.4	8.3	5.0	7.8	7.0	6.5 – 8.5	6.5 – 8.5
EC	µS/cm	61	168	311	64	216	119	200 - 300	
Total Dissolved Solids	mg/L	61	165	282	75	202	128		2,000 – 4,000
Total Suspended Solids	mg/L	61	18	61	<5	30	10	50	
Turbidity	NTU	20	50	127	8	103	25	6 - 50	
Alkalinity	mg/L	20	3.5	12	<1	7.4	2		
Acidity	mg/L	19	2	5	<1	4	2		
Sulphate	mg/L	61	25	40	10	30	18		1,000
Chloride	mg/L	20	26.5	58	13	37.2	20.6		
Calcium	mg/L	20	1	2	<1	2	<1		1,000
Magnesium	mg/L	20	4.5	7	2	6	3		
Sodium	mg/L	20	19	44	10	27.2	13		
Potassium	mg/L	20	3	5	2	4	2.8		
Aluminium	mg/L	20	1.35	5.28	0.17	3.38	0.71	0.055	5
Arsenic	mg/L	20	0.001	0.003	<0.001	0.002	<0.001	0.013	0.5
Barium	mg/L	20	0.045	0.082	0.026	0.057	0.029		
Cadmium	mg/L	20	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0002	0.01
Chromium	mg/L	20	0.002	0.006	<0.001	0.004	<0.001	0.001	1
Cobalt	mg/L	20	0.001	0.01	<0.001	0.0022	<0.001		1
Copper	mg/L	19	0.002	0.004	<0.001	0.002	<0.001	0.0014	0.5
Lead	mg/L	12	0.001	0.003	<0.001	0.003	<0.001	0.0034	0.1
Manganese	mg/L	20	0.0425	0.21	0.014	0.1012	0.0272	1.9	
Selenium	mg/L	2	*	<0.01	<0.01	*	*	0.011	0.02
Zinc	mg/L	10	0.024	0.056	0.006	0.051	0.014	0.008	20
Iron	mg/L	20	1.73	6.28	0.26	3.03	1.12		
Fluoride	mg/L	20	0.1	0.4	<0.1	0.2	<0.1		1
Nitrate	mg/L	20	<0.01	0.06	<0.01	0.022	<0.01	0.7	400
Reactive Phosphorous	mg/L	20	<0.01	0.13	<0.01	0.04	<0.01	0.008	

† In the calculation of these statistics, where a result was recorded as less than the laboratory limit of detection, it was assumed to equal the limit of detection for calculation purposes. Where a result of a calculation has been affected by the presence of a limit of detection value the result has been reported as < the result.

* Insufficient data

The water quality in Sediment Dam D can be characterised as having a near neutral pH with a median value of 7.4 and a range of 8.3 to 5.0. The following additional observations are noted:

- Elevated aluminium, relative to the ANZECC (2000) default guideline trigger value for protection of aquatic ecosystems (0.055 mg/L for pH > 6.5), with a median concentration of 1.35 mg/L.
- Elevated chromium, relative to the ANZECC default guideline trigger value for protection of aquatic ecosystems (0.001 mg/L), with median value of 0.002 mg/L.
- Elevated copper, relative to the ANZECC default guideline trigger value for protection of aquatic ecosystems (0.0014 mg/L), with median value of 0.002 mg/L.
- Elevated zinc, relative to the ANZECC default guideline trigger value for protection of aquatic ecosystems (0.008 mg/L), with a median value of 0.024 mg/L.
- Salinity has been low to moderate, with a median value of 168 µS/cm and range of 64 to 131 µS/cm.
- TSS concentrations have been variable ranging from 5 to 61 mg/L. The median concentration of 18 mg/L is low relative to the trigger level for Four Mile Creek (34 mg/L) and the EPL discharge limit (50 mg/L).
- Turbidity measurements have been elevated and variable ranging from 8 to 127 NTU. The median value of 50 NTU is equal to the ANZECC (2000) guideline default trigger value for the protection of aquatic ecosystems (low land rivers). A plot of TSS concentration and turbidity is given in Figure 9 below. There is a high degree of scatter and correspondingly weak correlation evident. The turbidity levels are relatively higher than might be expected from the total suspended solids concentrations (on the basis of experience with data from similar sites).

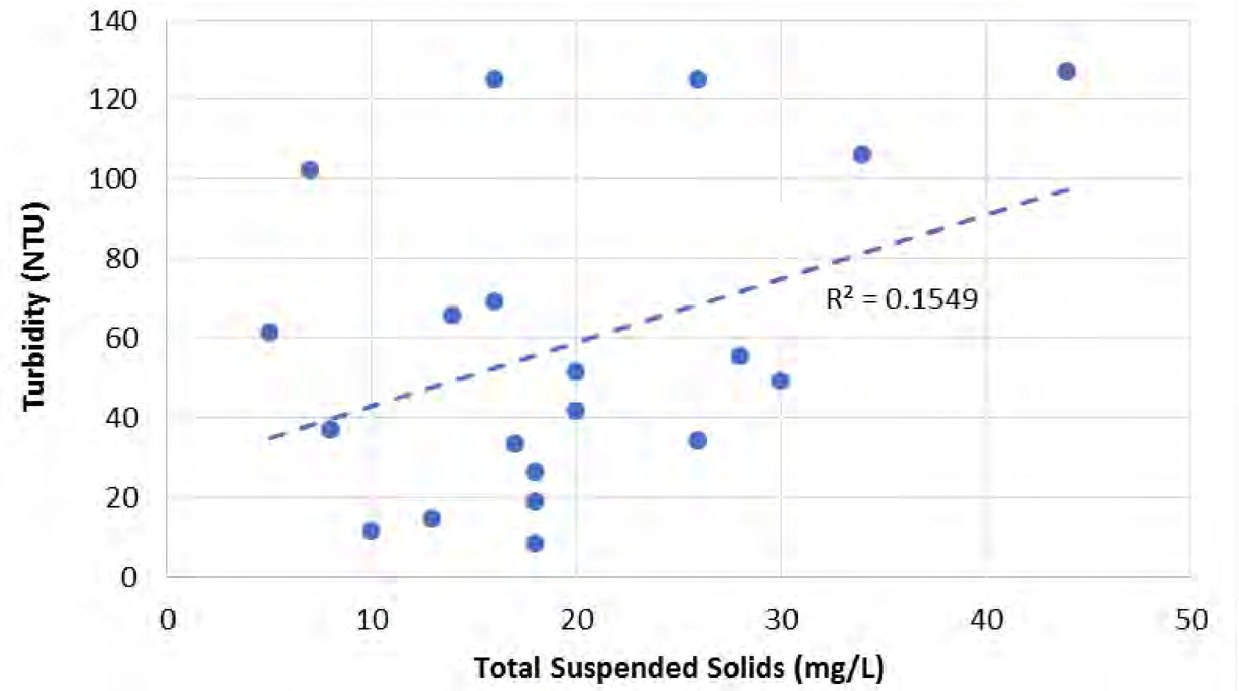

Figure 9 Total Suspended Solids versus Turbidity – Sediment Dam D

As with other sediment dams, aluminium concentration has been elevated – probably due to an abundance of suspended clay particles in the water column.

Water quality data provided are generally consistent with the ANZECC (2000) guidelines for stock water use.

4.6 Sediment Dam E

Sediment Dam E captures runoff from a 61 ha area (excluding the Rumbles Dam catchment) on the south-eastern side of the site. A statistical summary of the water quality data provided for this site from March 2015 to March 2020 is given in Table 8 below.

Table 8 Statistical Summary of Water Quality Data – Sediment Dam E

Parameter	Units	Samples	Median†	Maximum	Minimum	80th Percentile†	20th Percentile†	ANZECC (2000) Default Guideline Trigger Value for Protection of Aquatic Ecosystems	ANZECC (2000) Default Guideline Trigger Value for Primary Industries (Stock Water)
pH	pH Unit	61	7.1	7.9	5.3	7.5	6.6	6.5 – 8.5	6.5 – 8.5
EC	µS/cm	61	125	201	83	161	105	200 - 300	
Total Dissolved Solids	mg/L	61	136	244	59	183	110		2,000 – 4,000
Total Suspended Solids	mg/L	61	12	67	<5	19	6	50	
Turbidity	NTU	20	45	154	9.7	76.1	34.8	6 - 50	
Alkalinity	mg/L	20	6.5	21	<1	10	3.6		
Acidity	mg/L	20	2	4	<1	3	<1		
Sulphate	mg/L	61	20	37	8	27	13		1,000
Chloride	mg/L	20	19	28	15	23	17		
Calcium	mg/L	20	2	3	1	2	1.8		1,000
Magnesium	mg/L	20	3	5	2	4	2		
Sodium	mg/L	20	16	24	11	19	12		
Potassium	mg/L	20	3	4	2	4	3		
Aluminium	mg/L	20	1.58	5.79	0.38	3.36	1.09	0.055	5
Arsenic	mg/L	20	0.002	0.005	0.001	0.003	0.001	0.013	0.5
Barium	mg/L	20	0.044	0.085	0.022	0.0532	0.0352		
Cadmium	mg/L	20	<0.0001	0.0002	<0.0001	<0.0001	<0.0001	0.0002	0.01
Chromium	mg/L	20	0.002	0.006	<0.001	0.0032	<0.001	0.001	1
Cobalt	mg/L	20	<0.001	0.002	<0.001	<0.001	<0.001		1
Copper	mg/L	20	0.002	0.003	<0.001	0.002	<0.001	0.0014	0.5
Lead	mg/L	12	0.002	0.004	<0.001	0.002	<0.001	0.0034	0.1
Manganese	mg/L	20	0.037	0.082	0.01	0.0486	0.026	1.9	
Selenium	mg/L	2	*	<0.01	<0.01	*	*	0.011	0.02
Zinc	mg/L	11	0.011	0.019	<0.005	0.013	<0.005	0.008	20
Iron	mg/L	20	2.33	4.82	1.04	3.182	1.634		
Fluoride	mg/L	20	0.1	0.2	<0.1	0.2	<0.1		1
Nitrate	mg/L	20	0.01	0.14	<0.01	0.1	<0.01	0.7	400
Reactive Phosphorous	mg/L	20	<0.01	0.24	<0.01	0.036	<0.01	0.008	

† In the calculation of these statistics, where a result was recorded as less than the laboratory limit of detection, it was assumed to equal the limit of detection for calculation purposes. Where a result of a calculation has been affected by the presence of a limit of detection value the result has been reported as < the result.

* Insufficient data

The water quality characteristics of Sediment Dam E have been similar to Sediment Dam D, with the following specific observations noted:

- Near neutral pH with a median value of 7.1 and a range of 7.9 to 5.3.
- Low to moderate salinity, with a median value of 125 µS/cm and range of 83 to 201 µS/cm.
- Generally low TSS concentration ranging from 5 to 67 mg/L with a median value of 12 mg/L.
- Elevated and variable turbidity – ranging from 9.7 to 154 NTU, with a median value of 45 NTU which is below the ANZECC (2000) guideline default trigger value for the protection of aquatic ecosystems (lowland rivers).
- Elevated aluminium relative to the ANZECC (2000) default guideline trigger value for protection of aquatic ecosystems (0.055 mg/L for pH > 6.5), with a median value of 1.58 mg/L.
- Elevated chromium relative to the ANZECC default guideline trigger value for protection of aquatic ecosystems (0.001 mg/L) with a median value of 0.002 mg/L.
- Elevated copper relative to the ANZECC default guideline trigger value for protection of aquatic ecosystems (0.0014 mg/L) with a median value of 0.002 mg/L.
- Elevated zinc relative to the ANZECC default guideline trigger value for protection of aquatic ecosystems (0.011 mg/L) with a median value of 0.024 mg/L.

A plot of TSS concentration and turbidity is given in Figure 10 below. There is a high degree of scatter and correspondingly weak correlation evident. The turbidity levels are relatively higher than might be expected from the total suspended solids concentrations (on the basis of experience with data from similar sites).

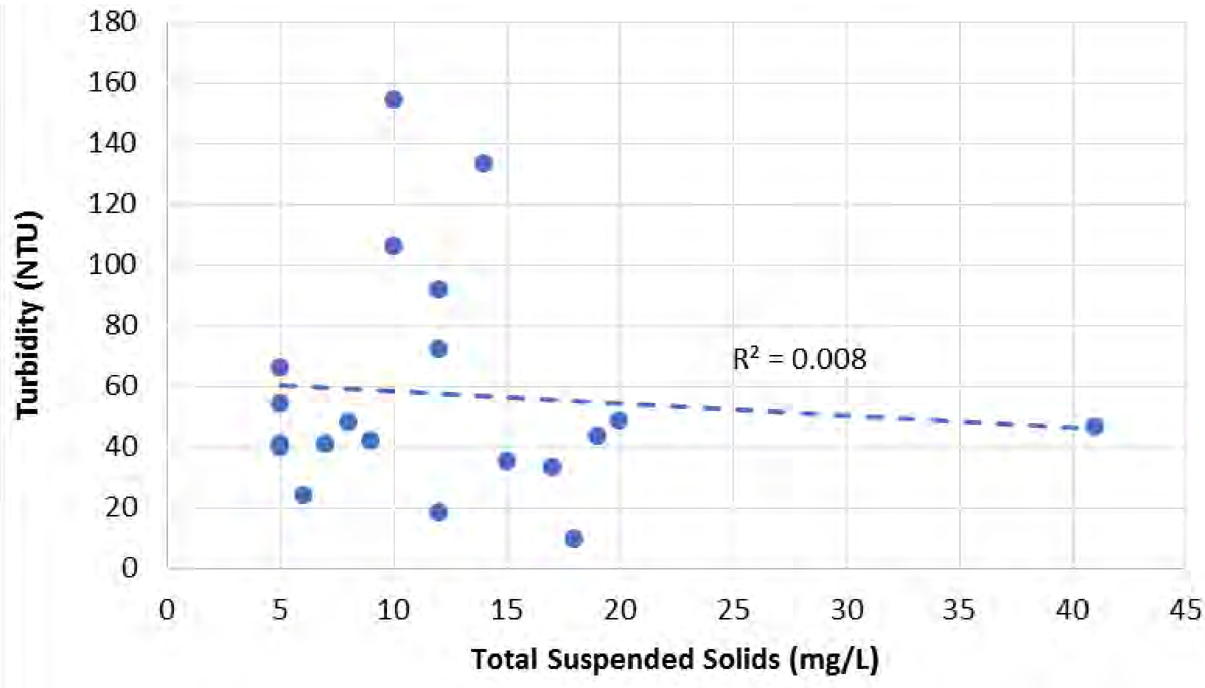

Figure 10 Total Suspended Solids versus Turbidity – Sediment Dam E

There is no apparent correlation between total suspended solids concentration and turbidity.

Water quality data provided are generally consistent with the ANZECC (2000) guidelines for stock water use.

4.7 Rumbles Dam

Rumbles Dam captures runoff from a 16 ha area near the centre of the site. Overflow from Rumbles Dam would report to Sediment Dam E. A statistical summary of the water quality data provided for this site from March 2015 to March 2020 is given in Table 9 below.

Table 9 Statistical Summary of Water Quality Data – Rumbles Dam

Parameter	Units	Samples	Median†	Maximum	Minimum	80th Percentile†	20th Percentile†	ANZECC (2000) Default Guideline Trigger Value for Protection of Aquatic Ecosystems	ANZECC (2000) Default Guideline Trigger Value for Primary Industries (Stock Water)
pH	pH Unit	61	7.0	8.1	5.6	7.3	6.7	6.5 – 8.5	6.5 – 8.5
EC	µS/cm	61	154	282	100	192	129	200 - 300	
Total Dissolved Solids	mg/L	61	159	245	104	184	136		2,000 – 4,000
Total Suspended Solids	mg/L	61	14	35	<5	20	8	50	
Turbidity	NTU	20	55	108	21	87	31	6 - 50	
Alkalinity	mg/L	20	11	25	3	14.2	7		
Acidity	mg/L	20	2	3	<1	2	<1		
Sulphate	mg/L	61	15	21	9	17	12		1,000
Chloride	mg/L	20	29	39	18	34.2	22.8		
Calcium	mg/L	20	1	2	<1	2	1		1,000
Magnesium	mg/L	20	3	6	2	4	3		
Sodium	mg/L	20	21.5	32	14	27	17		
Potassium	mg/L	20	3	4	2	3	3		
Aluminium	mg/L	20	1.62	4.92	0.44	3.14	0.82	0.055	5
Arsenic	mg/L	20	0.002	0.003	0.001	0.003	0.002	0.013	0.5
Barium	mg/L	20	0.07	0.08	0.04	0.08	0.05		
Cadmium	mg/L	20	<0.0001	0.0002	<0.0001	<0.0001	<0.0001	0.0002	0.01
Chromium	mg/L	20	0.002	0.005	<0.001	0.004	<0.001	0.001	1
Cobalt	mg/L	20	<0.001	0.001	<0.001	<0.001	<0.001		1
Copper	mg/L	20	0.002	0.01	<0.001	0.003	0.0018	0.0014	0.5
Lead	mg/L	12	0.0025	0.003	<0.001	<0.003	0.0012	0.0034	0.1
Manganese	mg/L	20	0.03	0.06	0.01	0.04	0.02	1.9	
Selenium	mg/L	2	*	0.01	0.01	*	*	0.011	0.02
Zinc	mg/L	11	0.01	0.021	<0.005	0.015	0.007	0.008	20
Iron	mg/L	20	2.12	4.25	1.36	2.84	1.50		
Fluoride	mg/L	20	0.2	0.3	<0.1	0.2	0.1		1
Nitrate	mg/L	19	<0.01	0.69	<0.01	0.03	<0.01	0.7	400
Reactive Phosphorous	mg/L	20	<0.01	0.06	<0.01	<0.01	<0.01	0.008	

† In the calculation of these statistics, where a result was recorded as less than the laboratory limit of detection, it was assumed to equal the limit of detection for calculation purposes. Where a result of a calculation has been affected by the presence of a limit of detection value the result has been reported as < the result.

* Insufficient data.

The water quality characteristics of Rumbles Dam have generally been similar to Sediment Dam E, with the following specific observations noted:

- Near neutral pH with a median value of 7.0 and a range of 8.1 to 5.6.
- Low to moderate salinity, with a median value of 154 µS/cm and range of 100 to 282 µS/cm.
- Generally low TSS concentration ranging from 5 to 35 mg/L with a median value of 14 mg/L.
- Elevated and variable turbidity – ranging from 21 to 108 NTU, with a median value of 55 NTU which is slightly above the ANZECC (2000) guideline default trigger value for the protection of aquatic ecosystems (low land rivers) of 50 NTU.
- Elevated aluminium, relative to the ANZECC (2000) guideline default trigger value (0.055 mg/L) for the protection of aquatic ecosystems median value of 1.62 mg/L, with a median value of 1.62 mg/L.
- Elevated chromium, relative to the ANZECC (2000) guideline default trigger value (0.001 mg/L) for the protection of aquatic ecosystems with a median value of 0.002 mg/L.
- Elevated copper, relative to the ANZECC (2000) guideline default trigger value (0.0014 mg/L) for the protection of aquatic ecosystems, with a median value of 0.002 mg/L.
- Elevated zinc, relative to the ANZECC (2000) guideline default trigger value (0.008 mg/L) for the protection of aquatic ecosystems, with a median value of 0.01 mg/L.

A plot of TSS concentration and turbidity is given in Figure 11 below. There is a high degree of scatter and correspondingly weak correlation evident.

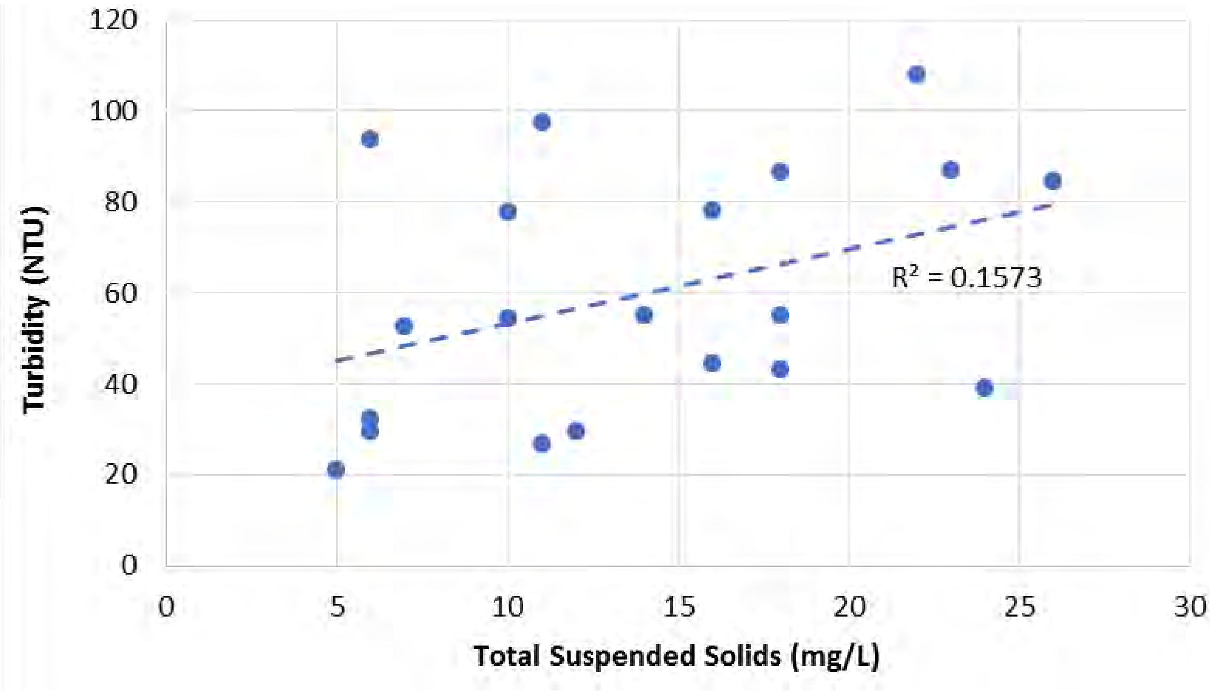

Figure 11 Total Suspended Solids versus Turbidity – Rumbles Dam

A time series plot of TSS concentration and turbidity together with Donaldson Coal Mine daily rainfall is given in Figure 12 below.

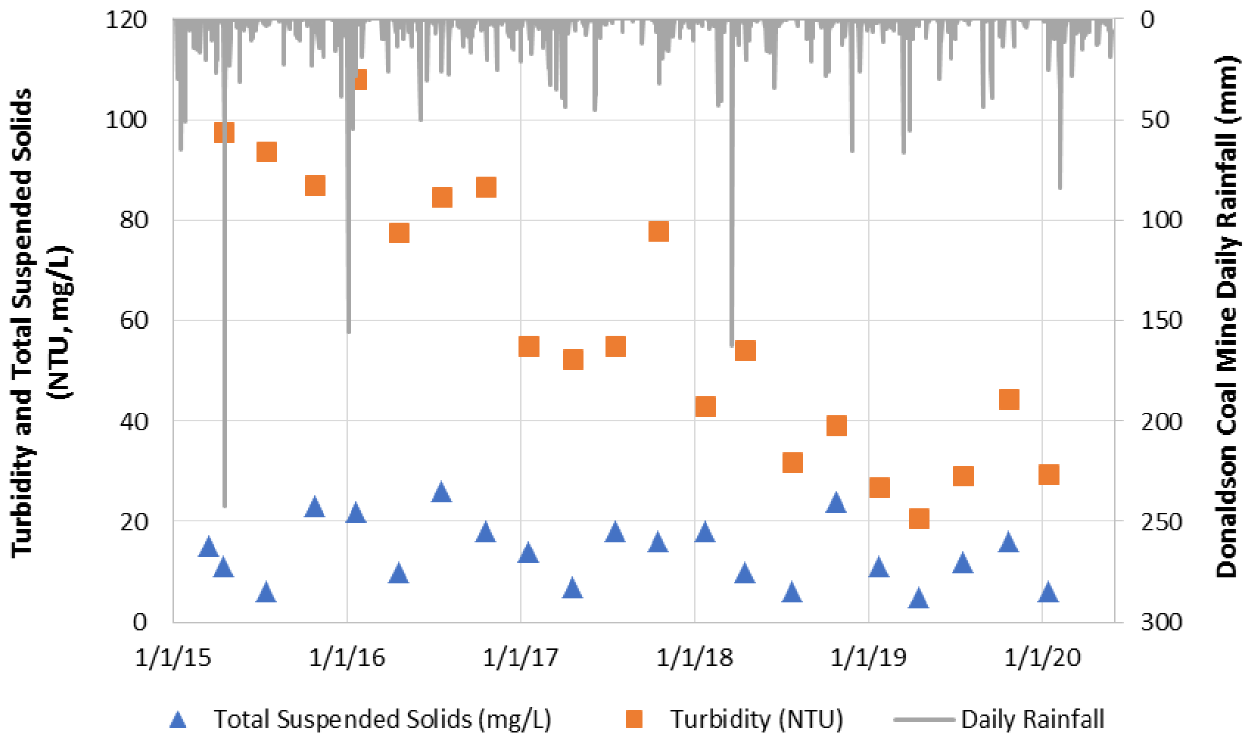

Figure 12 Change in Rumbles Dam Total Suspended Solids and Turbidity over the Monitoring Period

Noteworthy features in Figure 12 are the general and persistent decline in turbidity with time contrasting with generally steady, although also slightly declining, TSS values. There is also some consistency in the pattern of higher and lower values which implies both suspended solids and turbidity have responded to the same processes. There does not appear to be any direct correlation between rainfall and changes in turbidity or TSS in the dam.

Water quality data provided are generally consistent with the ANZECC (2000) guidelines for stock water use.

4.8 Big Kahuna Dam

The Big Kahuna Dam has been used to store water recovered from the adjacent Abel underground mine. It has an estimated catchment area of 11.4 ha. A statistical summary of the water quality data provided for this site from March 2015 to March 2020 is given in Table 10 below.

Table 10 Statistical Summary of Water Quality Data - Big Kahuna Dam

Parameter	Units	Samples	Median†	Maximum	Minimum	80th Percentile†	20th Percentile†	ANZECC (2000) Default Guideline Trigger Value for Protection of Aquatic Ecosystems	ANZECC (2000) Default Guideline Trigger Value for Primary Industries (Stock Water)
pH	pH Unit	61	8.7	9.8	7.0	9.1	8.4	6.5 – 8.5	6.5 – 8.5
EC	µS/cm	61	3,090	4,230	1,555	3,600	1,999	200 - 300	
Total Dissolved Solids	mg/L	61	1,810	2,880	724	2,240	1,110		2,000 – 4,000
Total Suspended Solids	mg/L	61	14	84	<5	30	<5	50	
Turbidity	NTU	20	8.5	70	1	17	1.8	6 - 50	
Alkalinity	mg/L	20	667	1,180	110	934	364		
Acidity	mg/L	20	<1	4	<1	<1	<1		
Sulphate	mg/L	61	275	397	162	327	219		1,000
Chloride	mg/L	20	447	667	210	526.4	359		
Calcium	mg/L	20	12.5	29	3	23.2	8		1,000
Magnesium	mg/L	20	14	28	5	24	9.8		
Sodium	mg/L	20	709	1,050	294	827	409		
Potassium	mg/L	20	4	7	3	5.2	4		
Aluminium	mg/L	20	0.195	1.01	<0.001	0.552	0.04	0.055	5
Arsenic	mg/L	20	<0.001	0.003	<0.001	0.002	<0.001	0.013	0.5
Barium	mg/L	20	0.0485	0.143	0.006	0.0684	0.0408		
Cadmium	mg/L	20	<0.0001	0.0003	<0.0001	0.0001	<0.0001	0.0002	0.01
Chromium	mg/L	20	<0.001	0.002	<0.001	<0.001	<0.001	0.001	1
Cobalt	mg/L	20	0.004	0.028	<0.001	0.0082	0.002		1
Copper	mg/L	20	0.0015	0.039	<0.001	0.003	<0.001	0.0014	0.5
Lead	mg/L	12	<0.001	0.002	<0.001	<0.001	<0.001	0.0034	0.1
Manganese	mg/L	20	0.067	1.18	0.006	0.1678	0.0488	1.9	
Selenium	mg/L	2	*	<0.01	<0.01	*	*	0.011	0.02
Zinc	mg/L	11	0.013	0.058	<0.005	0.042	<0.009	0.008	20
Iron	mg/L	20	0.16	30.7	0.05	0.402	0.07		
Fluoride	mg/L	20	0.9	1.4	0.2	1.12	0.5		1
Nitrate	mg/L	20	<0.01	0.08	<0.01	0.02	<0.01	0.7	400
Reactive Phosphorous	mg/L	19	<0.01	0.1	<0.01	0.014	<0.01	0.008	

† In the calculation of these statistics, where a result was recorded as less than the laboratory limit of detection, it was assumed to equal the limit of detection for calculation purposes. Where a result of a calculation has been affected by the presence of a limit of detection value the result has been reported as < the result.

* Insufficient data.

The water quality characteristics of the Big Kahuna Dam reflect inflows from mine dewatering. These can be summarised as follows:

- Consistently elevated salinity, ranging from 1,555 to 4,230 µS/cm, dominated by sodium, sulphate and chloride ions.
- Elevated alkalinity ranging from 1,180 to 110 mg/L
- Typically low TSS concentrations, with a median of 14 mg/L and an 80th percentile value of 30 mg/L.
- Low to moderate turbidity levels, with a median 8.5 NTU and an 80th percentile of 17 NTU.
- Elevated aluminium, relative to the ANZECC (2000) guideline default trigger value (0.055 mg/L) for the protection of aquatic ecosystems, with a median value of 0.195
- Elevated copper, relative to the ANZECC (2000) guideline default trigger value (0.0014 mg/L) for the protection of aquatic ecosystems, with a median value of 0.0015mg/L.
- Elevated zinc, relative to the ANZECC (2000) guideline default trigger value (0.008 mg/L) for the protection of aquatic ecosystems, with a median value of 0.013mg/L.
- Water quality data are generally consistent with the ANZECC guidelines for stock water use. Recorded pH values were however above the ANZECC (2000) default upper guideline value of 8.5 for protection of aquatic ecosystems and stock watering with a maximum (9.8) and eightieth percentile (9.1). The elevated pH values likely reflect the influence of pumped transfer of water from underground mine dewatering operations to the storage.

4.9 Square Pit Sump

The Square Pit Sump is a residual open pit void with a catchment of some 26 ha. A statistical summary of the water quality data provided for this site from March 2015 to March 2020 is given in Table 11 below.

Table 11 Summary of Water Quality Data – Square Pit Sump

Parameter	Units	Samples	Median†	Maximum	Minimum	80th Percentile†	20th Percentile†	ANZECC (2000) Default Guideline Trigger Value for Protection of Aquatic Ecosystems	ANZECC (2000) Default Guideline Trigger Value for Primary Industries (Stock Water)
pH	pH Unit	62	5.7	8.5	4.2	7.6	4.8	6.5 – 8.5	6.5 – 8.5
EC	μS/cm	62	1111	2486	906	1225	1059	200 - 300	
Total Dissolved Solids	mg/L	62	757	1400	526	811	679		2,000 – 4,000
Total Suspended Solids	mg/L	62	<5	26	<5	6	<5	50	
Turbidity	NTU	20	0.75	2.1	0.2	1.32	0.48	6 - 50	
Alkalinity	mg/L	20	<1	54	<1	22.2	<1		
Acidity	mg/L	20	7	23	<1	13	2.8		
Sulphate	mg/L	62	415	615	213	456	364.2		1,000
Chloride	mg/L	20	74	124	60	88.2	64.8		
Calcium	mg/L	20	44	68	37	47.4	43		1,000
Magnesium	mg/L	20	44.5	62	36	47.2	41.6		
Sodium	mg/L	20	113.5	154	90	130	102.8		
Potassium	mg/L	20	5	8	3	6	4.8		
Aluminium	mg/L	20	1.16	2.66	0.02	1.62	0.05	0.055	5
Arsenic	mg/L	20	<0.001	0.001	<0.001	<0.001	<0.001	0.013	0.5
Barium	mg/L	20	0.0225	0.028	0.014	0.0242	0.0188		
Cadmium	mg/L	20	0.0015	0.0023	<0.0001	0.00166	0.00124	0.0002	0.01
Chromium	mg/L	20	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	1
Cobalt	mg/L	20	0.129	0.188	<0.001	0.1424	0.021		1
Copper	mg/L	20	0.009	0.039	<0.001	0.0202	<0.001	0.0014	0.5
Lead	mg/L	12	<0.001	<0.001	<0.001	<0.001	<0.001	0.0034	0.1
Manganese	mg/L	20	2.21	3.55	0.004	2.42	0.88	1.9	
Selenium	mg/L	2	*	0.02	<0.01	*	*	0.011	0.02
Zinc	mg/L	11	0.575	0.89	0.447	0.647	0.506	0.008	20
Iron	mg/L	19	0.13	0.38	0.05	0.22	<0.05		
Fluoride	mg/L	20	0.4	0.69	<0.1	0.42	0.4		1
Nitrate	mg/L	19	<0.01	0.05	<0.01	0.024	<0.01	0.7	400
Reactive Phosphorous	mg/L	20	<0.01	<0.01	0.01	<0.01	<0.01	0.008	

† In the calculation of these statistics, where a result was recorded as less than the laboratory limit of detection, it was assumed to equal the limit of detection for calculation purposes. Where a result of a calculation has been affected by the presence of a limit of detection value the result has been reported as < the result.

* Insufficient data.

The water quality characteristics of the Square Pit Sump can be summarised as follows:

- Variable and typically slightly acidic pH values, ranging from 8.5 to 4.2 with a median of 5.7.
- Consistently elevated salinity, ranging from 906 to 2,486 µS/cm, dominated by sulphate, chloride, sodium and magnesium ions.
- Low TSS concentrations and turbidity.
- Elevated aluminium, relative to the ANZECC (2000) guideline default trigger value (0.055 mg/L) for the protection of aquatic ecosystems, with a median value of 1.16 mg/L.
- Elevated manganese relative to the ANZECC (2000) guideline default trigger value (1.9 mg/L) for the protection of aquatic ecosystems, with a median value of 2.21 mg/L.
- Elevated zinc, relative to the ANZECC (2000) guideline default trigger value (0.008 mg/L) for the protection of aquatic ecosystems, with a median value of 0.575 mg/L.
- Water quality data provided are generally consistent with the ANZECC guidelines for stock water use. Recorded pH values were however below the ANZECC (2000) default lower guideline value of 6.5 for protection of aquatic ecosystems and stock watering with a minimum of 4.2 and twentieth percentile of 4.8. It is noted that low pH values have been reported for local streams at sampling sites upstream of the mine site - specifically: a pH value of 5.1 was reported on Scotch Dairy Creek; a pH value of 5.4 was reported on Four Mile Creek and a pH value of 5.5 was reported on Weakleys Flat Creek all upstream of the mine site.

4.10 West Pit Sump

The West Pit Sump is a residual open pit void with a catchment of some 31 ha. A statistical summary of the water quality data provided for this site from March 2015 to March 2020 is given in Table 12 below.

Table 12 Statistical Summary of Water Quality Data – West Pit Sump

Parameter	Units	Samples	Median†	Maximum	Minimum	80th Percentile†	20th Percentile†	ANZECC (2000) Default Guideline Trigger Value for Protection of Aquatic Ecosystems	ANZECC (2000) Default Guideline Trigger Value for Primary Industries (Stock Water)
pH	pH Unit	59	8.4	9.3	5.5	8.9	7.5	6.5 – 8.5	6.5 – 8.5
EC	µS/cm	59	2,330	4,740	359	3364	1158	200 - 300	
Total Dissolved Solids	mg/L	59	1,560	2,950	198	2,290	702		2,000 – 4,000
Total Suspended Solids	mg/L	59	8	4,460	<5	18.4	<5	50	
Turbidity	NTU	20	13	43.9	2.6	25.24	5.38	6 - 50	
Alkalinity	mg/L	20	279	1170	34	830	85.2		
Acidity	mg/L	20	<1	3	<1	2	<1		
Sulphate	mg/L	59	332	1290	101	421.4	229.6		1,000
Chloride	mg/L	20	260.5	660	46	481.2	114.8		
Calcium	mg/L	20	16.5	104	4	44	7.8		1,000
Magnesium	mg/L	20	16.5	90	6	35.4	9		
Sodium	mg/L	20	365.5	964	82	832.2	167.4		
Potassium	mg/L	20	5	9	2	7.2	4		
Aluminium	mg/L	20	0.39	1.11	0.05	0.64	0.09	0.055	5
Arsenic	mg/L	20	0.001	0.005	<0.001	0.002	<0.001	0.013	0.5
Barium	mg/L	20	0.030	0.052	0.017	0.042	0.023		
Cadmium	mg/L	20	<0.0001	0.0002	<0.0001	<0.0001	<0.0001	0.0002	0.01
Chromium	mg/L	19	<0.001	0.003	<0.001	<0.001	<0.001	0.001	1
Cobalt	mg/L	20	0.003	0.02	<0.001	0.0072	0.001		1
Copper	mg/L	20	0.001	0.006	<0.001	0.002	<0.001	0.0014	0.5
Lead	mg/L	12	<0.001	<0.001	<0.001	<0.001	<0.001	0.0034	0.1
Manganese	mg/L	20	0.065	0.40	0.006	0.25	0.037	1.9	
Selenium	mg/L	2	*	0.01	<0.01	*	*	0.011	0.02
Zinc	mg/L	11	0.016	0.037	0.007	0.022	0.01	0.008	20
Iron	mg/L	20	0.255	0.560	0.050	0.360	0.136		
Fluoride	mg/L	20	0.6	1.2	0.2	1.02	0.3		1
Nitrate	mg/L	20	0.02	0.17	<0.01	0.08	<0.01	0.7	400
Reactive Phosphorous	mg/L	20	<0.01	0.11	<0.01	0.024	<0.01	0.008	

† In the calculation of these statistics, where a result was recorded as less than the laboratory limit of detection, it was assumed to equal the limit of detection for calculation purposes. Where a result of a calculation has been affected by the presence of a limit of detection value the result has been reported as < the result.

* Insufficient data

The water quality characteristics of the West Pit Sump can be summarised as follows:

- Variable and typically slightly alkaline pH levels, ranging from 9.3 to 5.5 with a median of 8.4.
- Consistently elevated salinity compared to the ANZECC (2000) default guideline value for the protection of aquatic ecosystems - ranging from 359 to 4,740 µS/cm. Salinity is dominated by sulphate, chloride and sodium ions.
- Elevated aluminium, relative to the ANZECC (2000) guideline default trigger value (0.055 mg/L) for the protection of aquatic ecosystems, with a median value of 0.39 mg/L.
- Elevated zinc, relative to the ANZECC (2000) guideline default trigger value (0.008 mg/L) for the protection of aquatic ecosystems, with a median value of 0.016mg/L.
- Water quality data provided are generally consistent with the ANZECC guidelines for stock water use.

4.10 Water Quality Assessment Summary

Water quality in the sediment storages (Teds Hole, Sediment Dams A to E and Rumbles Dam) has been generally consistent with the ANZECC (2000) guidelines for stock water use. Turbidity levels have tended to be consistently high relative to the ANZECC (2000) default guideline for protection of aquatic ecosystems. pH has tended to be slightly acidic and occasionally below the ANZECC (2000) default trigger values for the protection of aquatic ecosystems. Some metals have been elevated relative to the ANZECC (2000) default guidelines for the protection of aquatic ecosystems – most notably aluminium and to a lesser extent chromium, copper and zinc. The value of the sediment dams as aquatic habitat is likely being compromised by the elevated turbidity.

Water quality in the main mine water dam (The Big Kahuna), the West Pit Sump and the Square Pit Sump has had high salinity relative to the sediment dams and the ANZECC (2000) default guidelines for protection of aquatic ecosystems. Salinity has been dominated by sulphate, chloride, sodium and magnesium. pH and aluminium have been elevated relative to the ANZECC (2000) default guidelines for the protection of aquatic ecosystems. The elevated salinity in these storages exceeds the EPL 11080 discharge limits, however no discharge has occurred from these storages during the review period (the limit applies to the piped discharge point in Four Mile Creek). Water quality in these storages has been generally consistent with the ANZECC (2000) guidelines for stock water use.

5.0 REVIEW OF POTENTIAL SOURCES OF ELEVATED TURBIDITY AND TOTAL SUSUPENDED SOLIDS

Based on the assessment of the post-rehabilitation water quality data for sediment dams[11] at the Donaldson Coal Mine (Section 4.0), the key issue appears to be frequently high to occasionally very high turbidity levels in all the sediment dams[12]. Elevated turbidity in water storages is typically caused by one of the following:

- elevated suspended solids in inflows due to erosion within the catchment;
- resuspension of bottom sediment by flow turbulence and/or wave action in the storage embankment were there are dispersive clays; or
- algae/phytoplankton blooms in the water due to elevated nutrients.

TSS concentrations in the sediment dams have been consistent with concentrations reported in local streams upstream of the mine site – refer Table 13. This suggests that sediment loads being generated from site catchments are consistent with those in the local catchments upstream.

Table 13 Statistical Summary of Total Suspended Solids Data – Local Streams Upstream of the Mine Site and Sediment Dams

Location	Median	Maximum	Minimum	80th Percentile	20th Percentile
Local Stream Upstream Sites					
FMCU (Four Mile Creek Upstream)	10	208	4	20	5
SDCU (Scotch Dairy Creek Upstream)	21	354	5	49	8
WFCU (Weakleys Creek Upstream)	6	90	4	15	5
Sediment Dam Sites					
Teds Hole	9	119	5	22	5
Sediment Dam A	29	661	6	55	17
Sediment Dam B	31	166	14	57	21
Sediment Dam C	28	134	6	56	18
Sediment Dam D	18	61	5	30	10
Sediment Dam E	12	67	5	19	6
Rumbles Dam	14	35	5	20	8

It was not possible to conduct a site inspection as part of the current investigation due to restrictions associated with the COVID 19 pandemic. A series of recent photographs taken at the Sediment Dams suggests that there are dispersive soils around the edges of Teds Hole Dam and Sediment Dams D and E refer Photographs 1, 2 and 3 below. A thorough reconnaissance, soils testing and mapping exercise would however be required confirm the presence and extent of dispersive clays.

Whilst it is not known whether there are fine dispersive clays present in the sediment dams or in the drainages upstream of them, the high turbidity levels are consistent with the presence of exposed dispersive clay in the dam catchments.

[11] The Big Kahuna has been excluded because it is an active component of the Abel mine water management system. The West Pit and Square Pit sumps have also been excluded as they are final voids.

[12] With the exception of Teds Hole.

Aluminium has been elevated in most sediment dams compared to ANZECC (2000) default guideline trigger values for protection of aquatic ecosystems and the adopted trigger values for Four Mile Creek.

Photograph 1 Potentially Dispersive Soils in Banks of Teds Hole Storage

Photograph 2 Potentially Dispersive Soils around Foreshore of Sediment Dam D

Photograph 3 Potentially Dispersive Soils in Banks of Sediment Dam 3 Storage

Measured nitrate and reactive phosphorous concentrations have generally been consistent with ANZECC (2000) default guideline trigger values for protection of aquatic ecosystems which suggests that algal blooms are unlikely to have occurred.

6.0 RECOMMENDED ACTIONS

Based on the inferences described in Section 5, the follow-up actions given in the following sub-sections are recommended:

6.1 Conduct Investigation of Water Storage Construction Material

A field reconnaissance of the sediment dams and their influent drainage lines should be undertaken to assess the source of elevated turbidity.

Field classification[13] should be undertaken of the materials exposed in the upstream face of each embankment, the embankment crest and on the exposed floor of the storage area. Representative soil samples should be collected for subsequent classification and dispersion testing[14] in a NATA registered laboratory. The reconnaissance and sample collection should be undertaken by a suitably qualified soils scientist or engineer. The turbidity, EC and pH within each storage should be recorded at the time of the inspection. Water samples should be collected for subsequent laboratory analysis of total nitrogen, total phosphorous and chlorophyll-a[15]. Photographs should be taken of the embankments, storages perimeters, spillways and influent drains at the time of the inspection. The presence of dispersive soils and actively eroding areas should be mapped.

The drainage features upstream of each dam should also be inspected, looking for evidence of erosion in the drain invert or banks. Field classification should also be undertaken of typical soils exposed in the drainage features. Representative soil samples should be collected for subsequent classification and dispersion testing in a NATA registered laboratory.

Following completion of testing, a summary report should be prepared to assist with the follow-up activities outlined below.

6.2 Confirm Functional Requirements of Sediment Dams

The sediment dams' short and longer-term functional requirements should be identified. It is typically the case in mine rehabilitation, that larger sediment dams used during the operational phase are retained to trap sediment liberated from revegetated catchment surfaces during the vegetation establishment phase. Depending on the final land-use, they may be usefully retained in the longer term for stock or fauna water supply or as aquatic habitats. However, where their original form, size, depth and stability is incompatible with this longer-term function they may need to be modified. In some circumstances they may serve no useful purpose in the long term and it may be preferable to remove them - i.e. to convert them into a non-water retaining feature compatible with the remainder of the stream system.

In considering these aspects, the nature and area of the upstream catchment is likely to be a key consideration at the Donaldson Coal Mine site; as would be measurement of water quality outflows from the individual storage dams. We understand there is currently no data on the water quality exiting individual sediment dams and a targeted[16] program of testing of outflows is recommended.

It is also recommended that constraints associated with any formal commitments to either remove or retain storages be identified.

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[13] Refer - http://soilquality.org.au/factsheets/soil-texture.

[14] In accordance with AS 1289.3.8.1 (2017).

[15] Chlorophyll a is an indicator of phytoplankton abundance.

[16] This might involve deployment of automatic sampling devices or manual/sampling and testing depending on available resources.

6.3 Design Storage Enhancement Works Consistent with Functional Requirements

Any changes needed to the sediment dams to meet the agreed functional requirements should be identified. These might include:

- stabilising the storages in short-term (e.g. use of gypsum treatment, or removal or isolation of dispersive material; or placement of rock stabilisation in actively eroding sections of drains/spillways);
- enhancing performance by reshaping storage areas, enlarging sediment capture capacity and planting aquatic reeds to enhance sediment filtering and reducing in-basin erosion; and
- substantial removal/lowering of the embankment and reshaping of the storage area to convert the storage into an ephemeral wetland.

Once any works have been implemented, it is recommended that appropriate performance monitoring be incorporated into the site rehabilitation monitoring program.

7.0 REFERENCES

ANZECC (2000). *Australian Water Quality Guidelines for Fresh and Marine Water Quality*, Australian and New Zealand Environment and Conservation Council, October, Paper No. 4, Canberra.

Donaldson Coal Pty Ltd (2014) *Mining Operations Plan Amendment A Changes to West Pit and Square Pit Usage for the Donaldson Coal Mine 1 May 2014 to 1 May 2021,* November.

Donaldson Coal Pty Ltd (2019). *Abel Underground Coal Mine Water Management Plan - Care and Maintenance*, Version 4, June.

Global Soil Systems (2019). *2019 Rehabilitation Monitoring Report Donaldson Coal Mine.* September.

Appendix 3

Rehabilitation Risk Control Checklist

(Total No. of pages including blank pages = 10)

Table A
Rehabilitation Risk Control Checklist

Rehabilitation Phase / Activity	**Status / Comment**
Phase: Active Mining (Care and Maintenance)	
Soil and Materials Management	
Develop and maintain a materials and growth medium balance and database to include the following information. • Volume of inert capping material, topsoil, subsoil and other growth material stockpiled. • Location, age and quality of stockpiles. • Chronology of treatments (e.g. weed control, application of cover crop) undertaken on the stockpile. • Volume of material required for application to current and future disturbance areas (e.g. capping material for carbonaceous material). • An estimate of the volume of suitable alternative material required to be imported onto site to supplement potential material deficits. • Record data on the location of the stockpiled material including date stripped, source area, indicative volume, pre-strip plant community type.	
Locate material stockpiles away from traffic areas and at an appropriate distance from watercourses.	
Locate growth medium stockpiles on level or gently sloping areas to minimise the potential for erosion and soil loss.	
Limit soil stockpiles to less than 3m high and set out in windrows to maximise surface exposure and biological activity.	
Install appropriate erosion, dust and sediment controls around soil stockpiles to reduce the potential for soil loss.	
Appropriately sign-post growth medium stockpiles to identify the area and minimise the potential for unauthorised use or disturbance.	
Monitor and control weed growth on growth medium stockpiles.	
Materials Handling	
Develop and maintain a register of any contaminated areas, on-site waste placement sites and bioremediation areas and where they are located.	

Table A (Cont'd)
Rehabilitation Risk Control Checklist

Rehabilitation Phase / Activity	Status / Comment
Phase: Active Mining (Care and Maintenance) (Cont'd)	
Environmental Monitoring	
Develop, maintain and document an environmental monitoring program that includes: • surface and groundwater • flora • land contamination • Aboriginal heritage	
Phase: Decommissioning	
Management of Aboriginal heritage	
Before demolition activities, undertake any necessary assessments to determine potential Aboriginal heritage approvals and or management measures that may be required.	
Site Services	
Electricity services to any infrastructure scheduled for demolition will be appropriately disconnected/isolated and/or removed before the start of building demolition works.	
Telecommunications, water supply and other services will also be disconnected and/or removed where practical.	
Where services are buried (e.g. pipelines, cables) and their retrieval may lead to further disturbance, the infrastructure may be left in situ (subject to any necessary approvals or agreements) if they don't pose constraints to the final land use. In this situation, the location of the services will be surveyed and marked on the site plan and a suitable caveat developed to provide that they are readily identifiable for future land holders.	
Buildings, Fixed Plant and Structures	
Before demolition, the infrastructure should be evaluated in terms of the presence of hazardous substances (e.g. asbestos, radiation devices and sources) and appropriate management strategies developed to protect employees, the public and minimise potential environmental harm. This includes the identification of the various waste streams and development of management strategies in accordance with the appropriate waste legislation.	

Table A (Cont'd)
Rehabilitation Risk Control Checklist

Rehabilitation Phase / Activity	Status / Comment
Phase: Decommissioning (Cont'd)	
Buildings, Fixed Plant and Structures (Cont'd)	
All buildings, fixed plant and other infrastructure that are not required as part of the final land use will be demolished and removed. Demolition will be carried out in accordance with the relevant Australian Standard.	
Any remaining structures (including access tracks and bunds/barriers) will be surveyed and recorded on a plan, with a suitable caveat developed to provide that they are readily identifiable for future land holders.	
Equipment Storage Areas, Hardstand Areas, Roadways, Sealed and Unsealed Roads and Car Parks	
Any redundant plant or equipment will either be sold for reuse, recycled (e.g. scrap metal) or disposed of at an authorised landfill facility.	
Removal of coal spillages and hazardous materials.	
Storage areas and hardstands will be assessed for potential contamination (e.g. hydrocarbons, salt accumulation) and remediation undertaken as required.	
Waste material (e.g. bitumen, concrete) generated as part of the removal of car parks and hardstands is to be managed in accordance with relevant guidelines under the *Protection of the Environment Operations Act 1991*. The relevant guidelines can be found on the Environment Protection Authority's website. Where authorised to dispose of on the site, waste material must be buried at depth or suitably capped to ensure that it does not compromise the final land use.	
Management of Contaminated Material	
Any coal or carbonaceous material remaining at closure will be scraped up and disposed of within the West or Square Pits.	
Any contaminated material should be managed in accordance with relevant guidelines under the *Contaminated Land Management Act 1997*. Records will need to be retained to validate that contamination has been remediated or managed effectively to meet the final land use rehabilitation objectives and rehabilitation completion criteria.	

Table A (Cont'd)
Rehabilitation Risk Control Checklist

Rehabilitation Phase / Activity	Status / Comment
Phase: Decommissioning (Cont'd)	
Hazardous Materials Management	
All remaining hydrocarbons such as diesel and lubricants and other hazardous materials will be either used or disposed of by an authorised waste contractor.	
Removal of any oily water treatment system, following the demolition of the workshop and associated facilities.	
Removal of sewage treatments systems and associated sewerage network.	
Storage tanks of hazardous materials will be removed and, depending on their condition, either sold or disposed at an authorised facility.	
Phase: Landform Establishment	
Final Voids	
Develop specific strategies (e.g. selective handling and placement) for mine materials management to address potential geochemical constraints for rehabilitation (e.g. saline and sodic materials) based on sampling and testing of overburden/interburden materials used to construct the final landform.	
The design of the final West and Square Pits will be undertaken in consideration of the following. • A geotechnical assessment to determine the likely long-term stability risks associated with the proposed final landform. Based on the outcome of this assessment, suitable measures (e.g. bunding and fencing) are to be implemented to minimise potential risks to public safety as well as support the final land use(s). • Updated surface and groundwater assessments in relation to the likely final water level in the void and post mining water take (groundwater inflows into the void and surface water capture). This should include an assessment of the potential for fill and spill, along with measures required to be implemented to minimise associated impacts to the environment and downstream water users.	
The final void must address any relevant approval requirements of regulatory authorities and demonstrate the satisfaction of licensing requirements under the relevant legislation (e.g. *Water Management Act 2000*).	
The final stabilisation and revegetation strategy associated with the final void should be designed and implemented based on the outcomes of the above assessments.	

Table A (Cont'd)
Rehabilitation Risk Control Checklist

Rehabilitation Phase / Activity	Status / Comment
Phase: Landform Establishment (Cont'd)	
Water Management Infrastructure	
Ensure appropriate sediment and erosion control measures are installed.	
Survey retained clean water storages and confirm capacity is within maximum harvestable right dam capacity or appropriate licencing is in place.	
As-Constructed Drawings	
Prepare 'as-constructed' drawings to verify that drainage and landform have been completed in accordance with design.	
Phase: Growth Medium Development	
Before Commencing Rehabilitation (substrate preparation)	
Develop rehabilitation methodologies in consideration of site-specific constraints (e.g. topsoil and subsoil availability and quality, presence of contamination) required to achieve the approved, or if not yet approved, proposed rehabilitation objectives and rehabilitation completion criteria.	
Prior to application of growth medium, collect and analyse samples to characterise material to determine any potential impacts to vegetation.	
Use the results to determine specific amelioration techniques (e.g. addition of gypsum, lime, organic matter, fertiliser) that will be used to overcome potential limitations to landform stability, vegetation establishment and growth. Apply ameliorants (e.g. gypsum or lime) and organic material (e.g. mulch) based on the outcomes of the substrate characterisation analysis (as appropriate to address limitations in the revegetation substrate).	
Implement suitable erosion control measures (e.g. catch drains, sediments dams, silt fences, mulches, cover crops) to minimise soil loss from areas undergoing rehabilitation.	
Preferentially schedule and undertake revegetation activities in or just before suitable seasonal conditions.	
Where permissible, should revegetation be delayed due to unsuitable seasonal conditions, undertake temporary stabilisation measures (e.g. sterile cover crops, erosion and sediment controls) to avoid erosion and further land degradation.	

Table A (Cont'd)
Rehabilitation Risk Control Checklist

Rehabilitation Phase / Activity	Status / Comment
Phase: Growth Medium Development (Cont'd)	
During Rehabilitation (general methodologies)	
Use appropriate earthmoving equipment to avoid compacting the rehabilitation substrate.	
Restore soil structure by scarifying or ripping (if soil compaction or erosion has occurred) in parallel with the contour. Apply soil ameliorants (where required) such as fertiliser to the substrate before the start of revegetation activities.	
Implement erosion and sediment controls in accordance with Managing Urban Stormwater: Soils and Construction Volume 2E, Mines and Quarries (DECC, 2008b).	
Where direct seeding is planned, rip final surfaces parallel with the contour before the application of seed to provide for an adequate seed bed.	
Where access tracks are to be removed (e.g. not to be left as part of the final land use as defined by rehabilitation objectives and rehabilitation completion criteria), remove imported fill material (where used) and reprofile the disturbance area generally in accordance with the pre-existing landform.	
Phase: Ecosystem and Land Use Establishment	
During Rehabilitation (revegetation – native ecosystem)	
Native revegetation activities in rehabilitation areas should preferentially use local provenance seed for direct seeding or tube stock propagation.	
Consider techniques such as brush-matting where disturbed areas are situated directly adjacent to mature native ecosystems/area of clearing associated with mining that provide a good source of local seed, to stabilise the site while natural recruitment occurs.	
Where adverse seasonal conditions (e.g. drought) or other factors affect the availability of local provenance seed and supplementary non-local provenance seed is required, seed stock should be purchased from reputable suppliers with quality control processes including seed viability testing. (It is good practice to record the name of the supplier and batch of seed being applied. Recording such details may assist in prevention/management of misidentified seeds).	
If revegetation is delayed due to unsuitable seasonal conditions, undertake temporary stabilisation measures (e.g. sterile cover crops, erosion and sediment controls) to avoid erosion and further land degradation.	

Table A (Cont'd)
Rehabilitation Risk Control Checklist

Rehabilitation Phase / Activity	Status / Comment
Phase: Ecosystem and Land Use Establishment (Cont'd)	
During Rehabilitation (revegetation – native ecosystem) (Cont'd)	
If required, undertake treatment of seed to address issues such as seed dormancy and insect predation. Timing of treatment is to be aligned to timing of application with a focus on reducing the storage time of treated seed.	
Confirm the availability of seed and plant material and amend the seed mix or schedule of revegetation based on material supply.	
Spread seed as soon as possible following ripping/scarifying. If seeding is delayed following ripping/scarifying, undertake an assessment to determine whether further re-ripping/tilling is required before applying seed to ensure sufficient surface roughness (e.g. to break up any crusting that may have resulted from rainfall events).	
Use appropriate earthmoving equipment to avoid compacting the rehabilitation substrate.	
Weed/pathogen control on equipment for sensitive sites to prevent the spread of pathogens.	
Rehabilitation can include direct seeding and/or tube stock planting. Seed germination and seeding/seedling rate records are to be retained so that future rates can be assessed to ensure that target densities are achieved.	
Maximise the number of target species (groundcover, mid-story and canopy) within the first round of revegetation activities to facilitate species richness. If the target vegetation type requires a staged seeding approach to achieve the species mix, underrepresented species may be prioritised in subsequent revegetation rounds.	
Stock control fencing should be erected where required to protect ecological rehabilitation areas.	
Rehabilitation Establishment Inspections	
Conduct an initial establishment inspection no later than three months following the completion of each rehabilitation campaign to determine whether performance issues have occurred or are emerging, which have the potential to delay revegetation establishment.	
Conduct regular site inspections to assess soil conditions and erosion, drainage and sediment control structures, runoff water quality, revegetation germination rates, plant health and weed infestation, until vegetation has become well established and the site can be considered stable.	

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Table A (Cont'd)
Rehabilitation Risk Control Checklist

Rehabilitation Phase / Activity	Status / Comment
Phase: Ecosystem and Land Use Establishment (Cont'd)	
Rehabilitation Establishment Inspections (Cont'd)	
Record outcomes of inspections and implement any required intervention/adaptive management actions as soon as practicable after a monitoring program indicates that rehabilitation performance is unsatisfactory as part of the rehabilitation management and maintenance program.	
Rehabilitation Monitoring Programs	
Implement long-term rehabilitation monitoring program and evaluate trajectory of rehabilitation against achieving rehabilitation objectives and rehabilitation completion criteria, including photographic monitoring from fixed points.	
Rehabilitation Management and Maintenance Program	
Develop and implement a rehabilitation management and maintenance program including: • weed and feral animal control; • erosion and drainage control works; • monitoring and control of changes to surface and groundwater quality over time; • reseeding/planting of failed rehabilitation areas (e.g. through lack of germination, high plant mortality rate); • repairing fence lines, access tracks and other general related land management activities; and • regular site inspections to assess rehabilitation performance. The objective of this program is to facilitate rehabilitation progressing towards achieving the rehabilitation objectives and rehabilitation completion criteria in accordance with an approved progressive rehabilitation schedule (forward program).	

Table A (Cont'd)
Rehabilitation Risk Control Checklist

Rehabilitation Phase / Activity	Status / Comment
Phase: Ecosystem and Land Use Development (Management of Rehabilitated Lands)	
During Rehabilitation (revegetation – native ecosystem)	
Continue rehabilitation management and maintenance program (refer to Ecosystem Establishment Phase) until rehabilitation can be demonstrated to have achieved the approved rehabilitation objectives, rehabilitation completion criteria and (for large mines) the final landform and rehabilitation plan.	
Continue rehabilitation monitoring programs (refer to Ecosystem Establishment Phase) until rehabilitation can be demonstrated to have achieved the approved rehabilitation objectives, rehabilitation completion criteria and (for large mines) the final landform and rehabilitation plan.	
Actively manage rehabilitated lands to achieve the approved final land use(s).	