ADANI CARMICHAEL MINE

BASELINE CLOSURE COST AND FINANCIAL ASSURANCE ESTIMATION

MAY 2017

LOCK THE GATE

Contents

Summary

The Adani Carmichael Mine will be the largest coal mine in the State's and Australia's history. Rehabilitating a mine of this size has never been contemplated before. The level of financial assurance (FA) needed to protect the interests of the QLD tax payer will be at least double that of any current financial assurance held for a coal mine in Queensland.

Recently there has been speculation that Adani is contemplating "downsizing" the project to 25 mtpa. However Adani has made no public statement to that effect and, as far as we know, there has not been a revised proposal submitted to the Queensland Department of Natural Resources and Mines or the Department of Environment and Heritage Protection. Indeed the Prime Minister and others persist in quoting grossly inflated jobs figures based on the existing 60mtpa proposal.

This document is based on the only existing information available in the public domain which is based on the 2014 project proposal. That is the project that has been approved by both Queensland and Federal governments, and is the only valid information available from which to assess the rehabilitation costs of the project.

This document estimates the cost of rehabilitating Adani's Carmichael Mine at two points in the mine's life based on a subset of the overall closure and rehabilitation costs. As such it is designed to inform the Department of Environment and Heritage Protection, industry analysts, investors and the broader public as to the likely order of magnitude of the financial assurance required to protect the interests of the Queensland taxpayer. It is not presented as a definitive estimate of the financial assurance but as a baseline for a more detailed financial assurance calculation.

The Carmichael Mine Closure and Rehabilitation Plan is a conceptual level plan meaning a significant number of key elements of the rehabilitation plan remain ill-defined and lack detail including but not limited to the final pit void design, final waste rock dump design, the ground water rehabilitation plan and the volume of contaminated water that will have to be treated.

This lack of detailed design means that there is a limited ability to develop detailed and accurate costings for the major components of mine site rehabilitation at this stage. The numerous closure and rehabilitation studies which must be undertaken during the life of the mine to better understand the mine's impacts, risks and therefore mitigation strategies will allow more accurate costings. At this stage the accuracy of any cost estimate for the Carmichael Mine can only be conceptual meaning there is a high level of inaccuracy.

As such any estimate of the cost of rehabilitation and the associated financial assurance must be based on the use of default values where they exist in the QLD Financial Assurance calculator and must include a contingency allowance to manage the unknowns in the plans and the associated risks and additional costs. The use of contingency is standard engineering practice in the early stages of project development. The use of default values is valid because Adani does not have the detailed information it needs to substitute no-default values in the Queensland Government's financial assurance calculator.

This analysis focused on a subset of costs – although the chosen components are generally the highest cost elements - associated with the Carmichael Mine's closure and rehabilitation including open cut voids and slopes, out of pit dumps, mine affected water dams and stream diversions.

The cost estimates for this subset was calculated in 2017 Australian dollars for the first 5 years of disturbance and disturbance in year 30 (net of assumed rehabilitation). In summary the baseline level of financial assurance needed to cover just these cost elements in year 5 and year 30 of the Carmichael Mine's operation are;

Year	Financial Assurance Baseline Estimate
Year 5	$1,277,000,000
Year 30 (net of planned progressive	$2,290,000,000 (2017 $)

Conclusion

Based on this conservative baseline estimate of a subset of key mine closure and rehabilitation elements we would conclude that the initial financial assurance (first 5 years of development) for the Adani Carmichael Mine based on its current 60 year, 60mtpa plan would conservatively be between $AUD1.5bn and $AUD2bn once all additional rehabilitation and mine closure elements are also addressed.

Measures to Protect the Queensland Taxpayer

Historically the mining industry has taken full advantage of weak regulation and a flawed financial assurance calculation process to reduce its rehabilitation liability thus exposing the Queensland taxpayer to the gap between the assumed financial assurance and the actual cost of closing and rehabilitating mine sites.

The Adani Carmichael Mine's size, complexity and residual impacts demand that the "business as usual" approach to mine rehabilitation that has led to Queensland's current massive financial assurance deficit[1] be jettisoned and the Government ensures that the rights of Queenslanders is put ahead of Adani's shareholders. To ensure the interests of the Queensland taxpayer is fully protected, the Queensland Government must adopt the following measures;

Financial Assurance (FA)

Due to the parlous financial state of Adani Mining Ltd (the proponent of the coal mine) which is only solvent due to support from its parent company in India, they should be required to provide a full upfront cash bond to ensure that funds will be available if needed to complete rehabilitation and closure of the mine. This is necessary because Adani Mining Ltd is a company without substantial on-going equity bases in Australia, and thus represents a substantial default risk in relation to rehabilitation costs.

While cash bonds is a departure from the norm it is not unprecedented in Queensland. In early 2016 Rio Tinto lodged $80m in cash[2] in a Government escrow account to cover part of the cost of rehabilitating the Blair Athol mine in an attempt to facilitate the transfer of the mining lease to junior miner TerraCom.

A transparent, independent expert review of the required financial assurance must also be conducted based on best practice industry standards for calculating closure costs. There should be no discounts and Adani must not be able to use its own calculator. This is needed due to the unprecedented size of the project and the known current failings of the financial assurance system.

Any financial assurance must also include a contingency of 40% in the first Plan of Operations period due to the incompleteness of this concept level closure and rehabilitation plan and the size and complexity of the project. This is consistent with standard engineering project cost assessment[3].

Final Voids

Adani must not be allowed to leave final voids, and must instead be required to restore the approximate original contour (AOC) of the land by backfilling, grading, and compacting.

Progressive Rehabilitation

Condition H4 in the Carmichael Environmental Authority must be amended to require that '*A progressive rehabilitation ratio of 1:1 – disturbance (net of required operating area) to rehabilitated area – must be implemented*'.

Currently, condition H4 merely states that *'Rehabilitation must commence progressively in accordance with the plan of operations'.* However, Adani's current proposed rehabilitation strategy doesn't require rehabilitation of pit voids for 39 years after mining commences and waste rock dumps until 10 years after the project commences.

This current rehabilitation schedule should be rejected and replaced with that above because it exposes the Queensland taxpayer to too much risk due to:

1. Adani's financial status
2. The size and complexity of the project.
3. The likelihood of early closure due to the decline of seaborne thermal coal

If there are any pit voids or waste dumps included in the rehabilitation schedule, then the EA should also be amended to require that progressive rehabilitation "*must be commenced no later than 2 years after first coal is shipped for pit voids and 3 years for waste rock dumps".*

Mine Closure

Prior to sign off on any Plan of Operations (PoO) by EHP Adani must be required to provide a fully-costed mine closure plan, including detailed final land form design and stakeholder sign off, for inclusion in the PoO.

1 Targeted Compliance Programme Report on Financial Assurance for Queensland Coal Mines(TCP-009) 29 January 2016
2 TerraCom investor update presentation, April 2017, slide 8
3 Note NSW has a contingency in their calculator but is set at an inadequate default of 10% regardless of the status of the plan.

Purpose of this document

Adani's Carmichael Mine is the largest proposed coal mine in Australia's history. To date the debate regarding the mine has focused on its likely operational impacts, its contribution to climate change and the impacts of port development and increased bulk cargo vessel traffic on the values of the Great Barrier Reef. While Carmichael's operational impacts – particularly those on Australia's scarce groundwater resources - deserves extraordinary scrutiny, so too should the mine's environmental legacy in terms of its impacts at the point of closure and its likely residual impacts after assumed rehabilitation is complete.

The purpose of this document and analysis is to understand the order of magnitude costs of rehabilitating the Carmichael Mine. The Queensland Department of Environment and Heritage Protection (EHP) is yet to approve Carmichael's Plan of Operations and its financial assurance (FA). Historically FAs have been underestimated in Queensland [4],[5] due to a combination of mining companies using their own calculators and EHP's lack of capacity and inability to independently assess and challenge the calculations. There is every reason to believe Adani will attempt to minimize its FA and will leverage the complexity of this "mega-mine" to have its own un-verified calculation adopted.

In a submission to the Queensland Land Court, Adani has claimed that the initial amount of financial assurance for the first year of operation in the vicinity of $116m[6]. Unfortunately the submission did not include a year 5 calculation. However, based on Adani's mine stage maps,[7] the area of disturbance is ramped up substantially in the following 4 years of production to a disturbance area of approximately 6400ha[8] in year 5. Extrapolating the Adani number out to year 5 puts the required assurance in that year at $580m. While substantial, this figure is manifestly inadequate if the Queensland Government's financial assurance default values for various mine site domains is applied. The Adani number lacks any transparency and must be treated with a high degree of skepticism. The mining industry has a history of submitting their own, unverified calculations to the EHP who have accepted these costings at face value lacking the knowledge and the capacity to challenge them. It is imperative that the Department does not accept Adani's financial assurance calculations and instead mandates a transparent, independent expert review of the required FA based on best practice industry standards for calculating closure costs.

This analysis was undertaken in order to inform decision makers and the public at large as to the likely "order of magnitude" level of financial assurance required to protect the public interest.

What this is and what it isn't

In order to manage the tax payers potential exposure to the Carmichael Mine's rehabilitation liabilities, the FA must reflect real costs of rehabilitation should Adani default at any point during the mine's long life (estimated to be 60 years). The FA calculation will inevitably differ from the company's internal closure cost estimates as only they have the detailed information on which to base a truly accurate closure cost estimate. Historically mining companies do not release their own calculations as they are deemed by them to be "commercial in confidence".

The Queensland Government's FA Calculator[9] (used in this analysis) is not a rigorous mine closure and rehabilitation cost estimation tool. It has a number of key omissions that results in the under-estimation of mine rehabilitation costs.[10] Nonetheless for the purpose of this exercise, the Calculator is a useful tool for estimating the likely order of magnitude of the Carmichael FA.

The cost estimate is not being presented as a definitive estimate of the FA because of the following reasons;

1) It is based on a subset of mine closure and rehabilitation cost elements, and

2) It is based on publicly available information not Adani's more detailed data.

What this analysis is designed to do is establish is a conservative baseline estimate which is likely to be at the lower end of the real FA calculation for the Carmichael Mine.

There is no doubt the estimates in this analysis will be contested by Adani and the industry. However from a public interest perspective we hope that this paper will provoke an informed and fulsome debate on what the FA for Carmichael should be and ensure there is far greater transparency regarding its calculation than is the norm.

We also hope those that contest this analysis will make their alternative calculation and any associated methodology available for public scrutiny.

4 QLD Auditor General, 2014

5 Targeted Compliance Programme Report on Financial Assurance for Queensland Coal Mines(TCP-009) 29 January 2016

6 Submission to the Land Court of Queensland, Jerome Gregory Fahrer, Director, ACIL Allen Consulting, Carmichael Coal and Rail Project, Economic Assessment, Table B1, January 30, 2015

7 Carmichael Coal Mine and Rail Project SEIS Report for Updated Mine Project Description 18 October 2013

8 Calculated using Arc GIS based on Carmichael Coal Mine and Rail Project SEIS Report for Updated Mine Project Description 18 October 2013, Figure 12 Mine Stage Year 2019

9 https://www.business.qld.gov.au/running-business/environment/licences-permits/rehabilitation/security-deposit

10 Deficiencies on the Queensland Mining Financial Assurance Calculator, Lock the Gate, 2016

Methodology & Assumptions

All information relating to the mine and its rehabilitation is sourced from either;

- The Carmichael Coal Mine Closure and Rehabilitation Strategy (EMGA Mitchell McLennan March 2014)
- The 2012 Carmichael Coal Mine and Rail Project Executive Summary (GHD)
- Updated Mine Project Description report for the Carmichael Coal Mine and Rail Project SEIS 18 October 2013
- Coordinator-General's evaluation report on the environmental impact statement, May 2014

The analysis uses the Queensland Financial Assurance Calculator - https://www.business.qld.gov.au/running-business/environment/licences-permits/rehabilitation/security-deposit

An FA is calculated on the basis of the maximum planned area of disturbance during the period covered by the current plan of operations. Areas of disturbance not quantified in company documents were estimated by measuring domain areas in mine plan diagrams.

What's included

This estimation only includes the major landforms and domains including;

- Open cut voids and slopes
- Out of pit dumps
- Mine affected water (MAW) dams
- Stream diversions, and
- Contingency (on the above costs only)

What's not included

- Tailings dams
- Rehabilitation of underground mining areas and associated infrastructure
- Groundwater aquifer rehabilitation
- Crushers and other minerals processing plant, equipment and structures
- Other (non-MAW) water storage dams
- Run of Mine (ROM) pads
- Haul roads
- Stockpiles
- Administrative infrastructure
- Mine village and infrastructure
- Services infrastructure – power, sewage and water
- Train and rail infrastructure
- Roads
- Airstrips
- Contaminated sites
- Post-closure management and monitoring costs
- Residual risk costs (post relinquishment) including the potential cost of "making good" or repair of impacted ground water resources on and off site
- Management Team - costs include salaries benefits, travel, accommodation office rental, communication and running costs;
- Engineering, procurement, and construction management (EPCM). EPCM costs are commonly defined at a factor of 8% of direct costs.
- Council and local government rates;
- Land leasing costs, including mining leases and tenement holding costs, office accommodation and lease rentals;
- Insurances including construction insurance costs, motor vehicle insurance. Public and professional liability;
- Consultants
- Future Study Costs – this is the cost of all future studies, including test-work, financial evaluations / modelling, environmental and native title impact.

Given the number of exclusions this is a conservative estimate.

Incompleteness of the Carmichael Closure Plan

The level of completeness of the plan is very relevant to the analysis. The more incomplete the plan, the greater the unknowns and risks. Mature closure and rehabilitation plans are based on a large number of detailed and specific studies related to the mine's physical impacts and knowledge derived from "continuous improvement" or "learning by doing" strategies deployed and completed during the life of the mine. Closure and rehabilitation plans developed at the approvals stage – such as the Carmichael Mine's plan – are typically classified as "order of magnitude" or "conceptual".

The Carmichael Mine's closure and rehabilitation plan acknowledges that it is conceptual only;

"The objectives of the closure and rehabilitation strategies are to:

- *…provide conceptual rehabilitation management and mitigation procedures for site personnel;*
- *… describe indicators and rehabilitation indicators of success where they can be identified, where they cannot be identified, document this so that future iterations of the strategy can include a schedule for continuous improvement;*
- *… The closure and rehabilitation strategy will evolve over time as activities progress and additional technical studies and investigations are completed. It is envisaged that with each review a continuous improvement schedule will be developed to include new items resulting from the review process."*[11]

And

"Conceptual landform design features for open-cut voids is shown in Figure 6.1."[12]

Given the unknowns due to incomplete technical studies relating to key features such as final void design or waste rock dump cover designs – which are major cost elements – standard industry closure cost accounting methods would apply a contingency (see below) to manage this technical and cost uncertainty. Note that the Queensland FA Calculator does not include a contingency (unlike its NSW counterpart).

Use of default values in the Queensland Calculator

In regards to the use of the QLD FA Calculator, given that the studies related to final waste rock cover design and final void designs (amongst other elements) are incomplete this analysis applies the default values for these landforms (see below). The use of default values is justified because in the absence of final detailed design studies, Adani cannot possibly cost these elements. We are assuming, as does the Queensland Government, that the default values in the QLD FA Calculator represent a fair estimate of actual costs in the absence of detailed alternatives.

Application of a contingency to the Carmichael FA

A conceptual level plan is generally required to be completed at the time of mine design and development, and may continue through the operational phases and potentially up to 10 years prior to closure. Conceptual level plans are often low-cost and therefore inaccurate cost assessments because they are based on limited data which does not allow a full, detailed assessment of the the key risks and closure issues. The final post closure land use and completion criteria may not have been finalised at this stage meaning the cost estimate maybe highly inaccurate as the closure plan may be based on false assumptions including the amount of material to be moved to achieve the final landform which could add significant amounts to the cost estimate.

The table below is drawn from various mining industry sources and illustrates the rationale for various levels of contingency.

Study Level	Project Definition	Accuracy	Expected Contingency Range
Concept/Scoping	1% to 15% Preliminary economic and technical Investigation. Project screening. Comparison of alternatives, configurations and options	+/-30% to +/-40%	25%-40%
Pre-Feasibility	10% to 40% Economic Feasibility of one or more chosen options.	+/- 20% to +/- 30%	15%-25%
Feasibility	30% to 75% Project Approval and basis of approving project finance.	+/-10% to +/-15%	10%-15%

11 The Carmichael Coal Mine Closure and Rehabilitation Strategy (EMGA Mitchell McLennan March 2014) S1.2 Purpose and Scope page 3

12 Ibid S6.1.2 page 35

To cater for an assumed increase in knowledge and completion of key closure studies during the life of the Carmichael Mine this analysis applied a sliding scale;

40% contingency for the current Plan due to its conceptual level of accuracy and the reality that such a large, complex and long-lived project in and of itself is a high risk proposition when it comes to closure, rehabilitation and relinquishment.

A reduction to 25% at year 30 – not all rehabilitation will have commenced by year 30. For example open pit voids is not commenced until year 40. MAW dams, tailings cells and stream diversions do not commence until year 56 meaning the level of practical knowledge will be insufficient and the required studies unlikely to have been completed by year 30. The level of risk has been reduced somewhat and the accuracy of the cost estimate will have improved to a degree hence the reduction in contingency to 25%.

Potentially acid forming material

We have applied the high range default values from the QLD FA Calculator for both open pit and waste rock dump calculations on 50% of the disturbed area for both these domains based on the amount of potentially acid forming material the Project is likely to produce or expose;

"Therefore, based on the limitations of the mine waste geochemistry assessment, a total of 1.8 billion bcm, or around 8 to 9 per cent of the total volume of mine waste may require the application of dedicated AMD management strategies."[13]

We also note that acidic or toxic tailings will be dried in the tailings drying cells then removed and will be encapsulated in the out of pit dumps requiring covers designed to permanently isolate this material from the surrounding environment. [14]

The rationale for applying the default value of $136,000[15] per hectare for high risk acid forming materials is based on the dispersed nature of this material through the waste rock profile. For example while this material will only potentially constitute around 10% of the waste rock material that will be encapsulated in the waste rock dump, or the tailings or in the in pit dumps, its presence requires that capping be designed over the entire structure to prevent the creation of acid mine drainage. It is plausible that the application of only 50% could be an under estimation depending on the dispersed nature of this hazardous material.

Mine Affected Water (MAW) Dams

According to the Closure and Rehabilitation plan;

The rehabilitation approach for all water storages will consist of:

- *testing of water quality in all dams, and sediment quality in sediment ponds, MAW dams and other dams that may have received mine affected or contaminated water;*
- *disposing of contaminated water to final voids if appropriate, if this is not possible then contaminated water will be treated to an acceptable level prior to discharge or disposal;*[16]

No information regarding predicted water quality is available in the documents. However we do know there is an estimated 1.8 billion bcms of 8 to 9 percent of mine waste that is potentially acid forming which implies that mine affected water will require some management and treatment.

Treatment costs of mine affected water vary between $1500 and $3600 per ML[17] depending on levels of salinity and other pollutants. For the sake of this analysis it is assumed that 50% of the mine affected water will be allocated to each – the low and the high - of the default values.

Year 5 calculations. Based on the mine plan we assume that at this point in the mine's life, 75% of the total MAW dams have been constructed. All dams are assumed to have a working volume of 50% of required volume. 100% MAW required volume is calculated to be 43,060,000 m3[18]. 75% equates to 32,295 ML. Assumed 50% working volume equals 16,147ML.

Year 30 calculations. Assumed that all MAW dams will be in place at year 30 as all open cut pit development is complete. MAW dam calculations include Central MAW dams North and South, all MAW transfer dams and all overburden MAW dams. All dams are assumed to have a working volume of 50% of required volume. Total MAW required volume is calculated to be 43,060,000 m^3 [19] translating to 21,530 ML at 50% of required volume.

13 Carmichael Coal Mine and Rail Project 41/25215/442155 Volume 2 Section 13 Environmental Management Plan (Mine) p.13-134

14 The Carmichael Coal Mine Closure and Rehabilitation Strategy (EMGA Mitchell McLennan March 2014)

15 Queensland Financial Assurance Calculator - https://www.business.qld.gov.au/running-business/environment/licences-permits/rehabilitation/security-deposit

16 The Carmichael Coal Mine Closure and Rehabilitation Strategy (EMGA Mitchell McLennan March 2014) page 18

17 Queensland Financial Assurance Calculator - https://www.business.qld.gov.au/running-business/environment/licences-permits/rehabilitation/security-deposit

18 Carmichael Coal Mine and Rail Project SEIS Report for Updated Mine Project Description 18 October 2013 Section 8.6.5

19 Carmichael Coal Mine and Rail Project SEIS Report for Updated Mine Project Description 18 October 2013 Section 8.6.5

Stream diversions

Completion criteria in the Closure and Rehabilitation Plan requires;

"Evidence in the Rehabilitation Report that required contour banks, channel linings, surface armour, engineered drop structures and other required measures are in place and functioning. Minimum of 70% groundcover is present (or 50% if rocks, logs or other features are present). No bare surfaces >20m^2 in area or > 10m in length down slope."

The QLD FA calculator default values are $2500/metre for repair and $750/metre[20] for long-term maintenance. For the purposes of this analysis we are assuming that a conservative 50% of diversion channels will require this level of intense treatment to achieve the completion criteria. We would stress that stabilizing diversion channels can be expensive and has proven to be difficult in climatic zones that experience a combination of extended drought followed by intense and sustained rainfall events.

GHD's *Appendix K4 Flood Mitigation and Creek Diversion Design* shows watercourse diversions for the northern section of the mine to be in place by 2019 and all watercourse diversions to be completed by 2024. By 2019 the total length of diversions will be approximately 56km and by 2024 88km[21].

Carmichael Mine's Impacts

The Adani Carmichael Mine will have the largest footprint of any coal mine in Australia, some 28,000 hectares (see table below). Progressive rehabilitation will start very late in the mines life cycle for several high risk domains including the open pits which along with the waste rock dumps are the major post closure landforms.

Reference to the provided final landform includes 6 final voids[23] with a total final void area of around 3,346 hectares.[24] Open pit void design is still conceptual and may change over the life of the mine. The suitability of the pit voids for grazing is yet to be determined[25].

There will be 5 very large, and 12 smaller out-of-pit spoil dumps covering a total of 8309 hectares[26]. The suitability of these landforms for grazing is yet to be determined.[27]

Table 3.1 Summary of rehabilitation schedule

Mine	Disturbance area (ha)	Year disturbance starts	Year progressive rehabilitation starts	Year progressive rehabilitation ends	Total area rehabilitated (ha)
Open-cut voids and slopes.[1]	8331.55	2015	2054	2074	8331.55
Underground mining areas (including subsidence).	7786.76	2018	2030	2065	7786.76
Mine infrastructure.	2032.77	2014	2071	2074	2032.77
Out-of-pit spoil dumps.	8308.69	2014	2024	2074	8308.69
Water storage areas (including MAW dams, raw water dams and sediment ponds).	817.53	2014	2071	2074	817.53
Stream diversions.	472.68	2014	2071	2074	472.68
Tailings drying cells.	216.17	2014	2071	2074	216.17
Carmichael River corridor.	50.78	2014	2071	2074	50.78

20 Queensland Financial Assurance Calculator - https://www.business.qld.gov.au/running-business/environment/licences-permits/rehabilitation/security-deposit

21 The Carmichael Coal Mine Closure and Rehabilitation Strategy (EMGA Mitchell McLennan March 2014 Fig. A-6

22 Ibid, Page 11

23 Carmichael Coal SEIS, Appendix K1, Section 5.7.1, p108

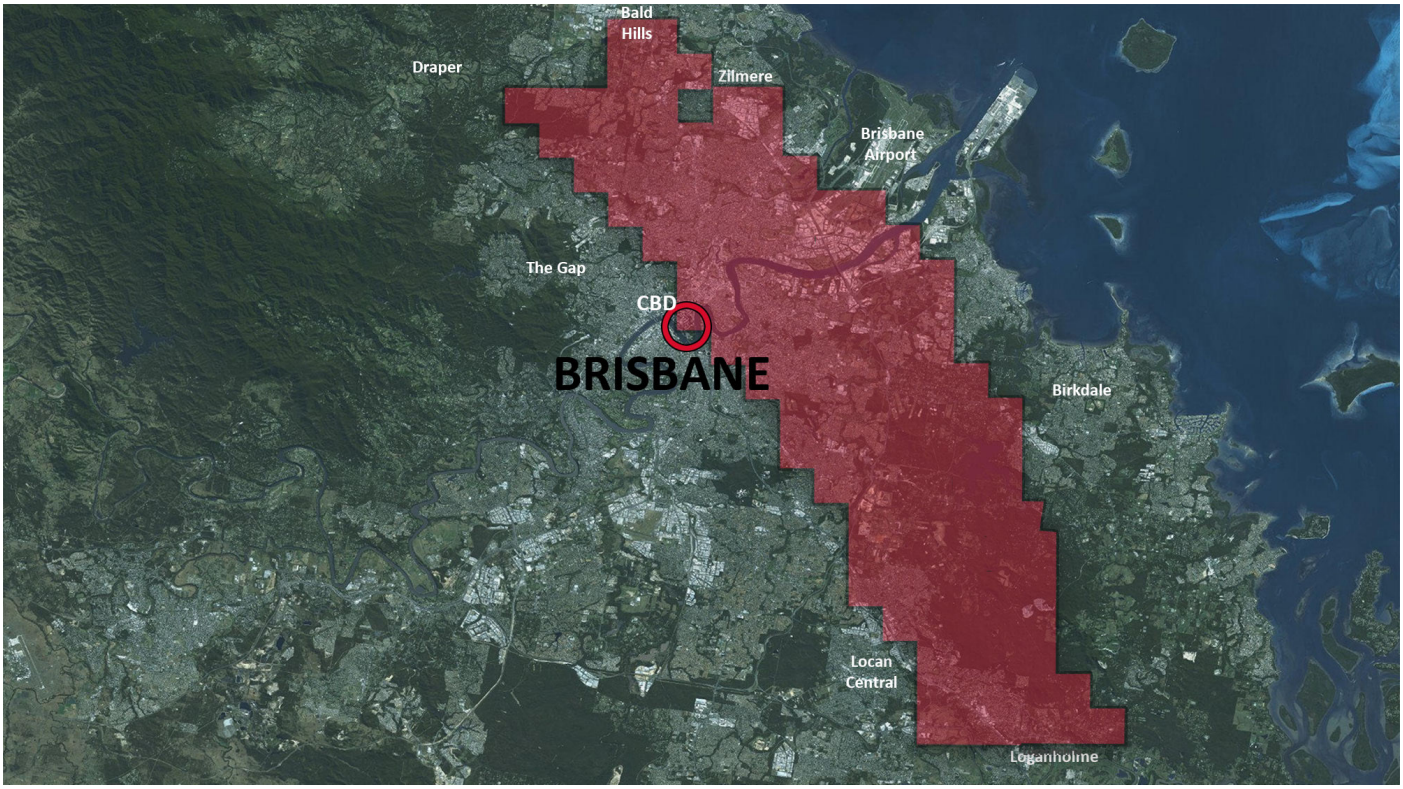
24 Carmichael Coal Mine and Rail Project SEIS (Nov 2013) Mine Hydrogeology Report, Appendix K1.Page 108

25 The Carmichael Coal Mine Closure and Rehabilitation Strategy (EMGA Mitchell McLennan March 2014) 4.1 page 23 rehab plan

26 Ibid, Figure A-4

27 Ibid, Table 4.1 page 23

Total area of the Carmichael Mine lease superimposed of the Brisbane metropolitan area



Total area of the Carmichael Mine's post closure impacts superimposed over the Brisbane CBD

Water Impacts

The mine will draw water from groundwater sources with take peaking at 9.5 GL (billion litres) in mine plan year 2029[28], and recent statements from the Queensland Government put modelled ground water extraction at 4.55 GL on average for the 60 year life of the mine[29]. As a result the water table is expected to drop by up to 300m within the mine site, and between 20m and 50m further from the mine. Even ten kilometres away, water tables are expected to drop by over one metre[30].

The Mellaluka Spring is a rare natural spring complex found close to the mine site. According to the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Developments;

The proposal has predicted adverse impacts at the Mellaluka Spring Complex, including loss of all ecological function due to a maximum predicted drawdown of up to 8.22m during the mine's operational phase and up to 25.6m post-closure. Proposed mitigation measures include the manual pumping of groundwater to the surface to offset the loss of flows to spring-fed wetlands. The proponent also proposes to prepare a wetland remediation and management plan when drawdown commences. The Committee considers that detailed consideration of mitigation and management measures at the Mellaluka Springs Complex should be carried out prior to the commencement of mine operations and include comprehensive ecological and water quality studies. It would be important to determine and characterise the source aquifer for the Mellaluka Springs Complex to determine the effectiveness of mitigation measures. [31]

Following mine closure, Adani are not proposing to entirely back fill the pits. Instead, they plan to leave voids up to 200 metres deep[32] that will act as permanent sinks as groundwater leaks into the voids;

"This shortfall (in mine spoil) will prevent all groundwater aquifers from being covered by backfilling operations. The Mine Hydrology report (Carmichael Coal SEIS, Appendix K1, Section 5.7.1, p108) identifies that the voids will remain mostly dry except during periods of high rainfall. This is the result of the modelled groundwater intrusion, into the final constructed landform in the voids, being less than the daily evaporation rate.[33]*"*

In other words, groundwater will permanently flow into the pits and evaporate, acting as drain of this vital resource in perpetuity. Post closure model results indicate that groundwater inflow to final void areas via the modelled drain cells will fall gradually from 6.5 ML/d at the end of the operational period to 2.4 ML/d in the long term[34] . However these figures are yet to be verified;

Table 4.2 Conceptual post-mine land use summary

Domain	Pre-mining GQAL(ha)	Post-mining GQAL(ha)	Description/reason for loss/gain of GQAL
open-cut voids and slopes	C – 8,331.54	C/D – 8,331.54	No net gain of class A or class BGQAL. Aim is to return land to low ranking class C or class D land.
underground mining areas	B – 3.37 C – 7,508.7	C/D – 7,512.07	No net gain of class A or class B GQAL. Aim is to return land to low ranking class C or class D land.
Mine infrastructure	C - 1,161.50	C/D – 1,161.50	No net gain of class A or class B GQAL. Aim is to return land to low ranking class C or class D land.
out-of-pit spoil dumps	C – 8,308.69	C/D – 8,308.69	No net gain of class A or class B GQAL. Aim is to return land to low ranking class C or class D land.
water storage areas	C – 817.53	C/D – 817.53	No net gain of class B GQAL. Aim is to return land to low ranking class C or class D land.
stream diversions	C/D – 472.68	C/D – 472.68	to be advised
tailings drying cells	B – 203.40 C – 12.77	C/D – 216.17	to be advised
Carmichael River corridor	C – 1,799.02	C/D – 1,799.02	No net gain of class C GQAL. Aim is to return land to low ranking class C or class D land.

28 Calculated based on 26ML/day inflows into open cut and underground mines in year 2029. Carmichael Coal Mine and Rail Project SEIS (Nov 2013) Mine Hydrogeology Report, Appendix K1.

29 http://statements.qld.gov.au/Statement/2017/4/6/carmichael-licences-safeguard-water

30 Carmichael Coal Mine and Rail Project SEIS (Nov 2013) Mine Hydrogeology Report, Appendix K1

31 http://www.iesc.environment.gov.au/system/files/resources/224fbb59-e5e6-4154-9dd0-8d60d7c87a75/files/iesc-advice-carmichael-2013-034.pdf

32 The Carmichael Coal Mine Closure and Rehabilitation Strategy (EMGA Mitchell McLennan March 2014) Figure 4.2 Conceptual Final Landuse Plan

33 Carmichael Coal Mine and Rail Project SEIS (Nov 2013) Mine Hydrogeology Report, Appendix K1

34 Carmichael Coal Mine and Rail Project SEIS (Nov 2013) Mine Hydrogeology Report, Appendix K1

"A groundwater monitoring program for the operational phase of the Project will be developed and will be described in detail in the groundwater monitoring plan (GWMP). The GWMP will be updated on a regular basis throughout the operational phase of the Project. [35]

At this stage there is no groundwater rehabilitation plan other than to leave a series of open voids that will act as sinks for a perpetual flow of groundwater drawing some 876,000,000 litres into the open pits annually (based on the 2.4ML/day figure referenced above).

Loss of land use values.

As illustrated in the table below there will be a loss of landscape functionality and land use utility across all land classes- even if the proposed rehabilitation is successful. The financial cost of this loss of utility has not been calculated.

The Calculations

The following tables summarise the rehabilitation cost estimates for a subset of closure cost elements for the Carmichael Mine. These cost estimates have applied the default values contained in the Queensland Government's financial assurance calculator. It is important to note that these calculations draw heavily on estimates of domain areas produced by analysis of mine plan diagrams with a likely accuracy of approximately +/- 15%.

Disturbance at first 5 years of operation

The first five years of operation represents the most likely timeframe for the first Plan of Operations which is required to be submitted to EHP as the basis for the first tranche of financial assurance. The assurance is based on the maximum estimated disturbance area during the life of that Plan of Operations. For the purposes of this exercise we have estimated the disturbance areas by analysing the Mine Stage - Year 2019 diagram presented in the updated mine project description, which formed part of the Carmichael Mine and Rail Project SEIS.[36] This document assumed a starting date of 2014/15. 2015-2019 is likely to be the first plan of operations period.

Domain	Area (*estimated from analysis of Adani mine stage diagram)	Cost per hectare[1]	Total cost
Open cut voids and slopes	2000*	$136,000 (50%) $108,000 (50%)	$136,000,000 $108,000,000 Total $244,000,000
Out of pit dumps	4400*	$136,000 (50%) $108,000 (50%)	$299,000,000 $237,000,000 Total $536,000,000
Mine affected water dams	16,147 ML[2]	$3600 ML (50%) $1500 ML (50%)	$29,000,000 $12,000,000 Total $41,000,000
Stream diversions	56km *	$2,500/m (50%) $750/m (50%)	$70,000,000 $21,000,000 Total $91,000,000
Sub-total (rounded)			$912,000,000
Contingency	40%		$365,000,000
Total (rounded)			$1,277,000,000

35 Page 33 rehab plan

36 Carmichael Coal Mine and Rail Project SEIS Report for Updated Mine Project Description
18 October 2013, Figure 12 Mine Stage Year 2019

Disturbance at 30 years of operation (2017 $ - includes assumed progressive rehabilitation)

Thirty years was chosen as a mid-point in the mine's projected life of 60 years. The areas assume some level of rehabilitation as committed to in the Closure and Rehabilitation Strategy. Therefore, it assumes all of the progressive rehabilitation foreshadowed over that period has been conducted.

For the purposes of this exercise, we have estimated the disturbance areas by analysing the Mine Stage - Year 2040-2044 diagram presented in the updated mine project description, which formed part of the Carmichael Mine and Rail Project SEIS.[37] That document assumed a starting date of 2014/15. Given most coal mines in Queensland have dramatically over promised and under delivered on progressive rehabilitation commitments, in the absence of reform there is every likelihood that the estimate below will underestimate the actual cost. It should be noted that if the level of progressive rehabilitation is not achieved then the deficit accrues to the next Plan of Operations.

Conclusion

It is the responsibility of the Queensland EHP to set the level of financial assurance for the Carmichael Mine. The size of the mine's disturbance footprint is enormous. The risk to the taxpayers of Queensland with regards to the likelihood that the mine will not last its projected 60 year life is real due mainly to the long-term structural decline in the use of thermal coal, is real. Setting the right level of financial assurance is, in this context, one of the most important risk management tools the Government possesses to protect the interests of the Queensland taxpayer and ensure the environmental risks of this huge mine are effectively mitigated.

This baseline analysis puts the likely cost of rehabilitating the disturbed area of the mine after the first 5 years of operation at in excess of $1.5 billion. This is more than double the largest previous financial assurance estimate for a coal mine in Queensland (Idemitsu's Ensham Mine at $719m[38]). The imposition of such a significant level of financial assurance is likely to be a political as well as a technical challenge for the Department given the political pressure to approve the mine and the Department's limited technical capacity to challenge Adani's own calculations.

However, in light of the Report of Targeted Compliance Program's finding that the current level of financial assurance held by the Government against the rehabilitation liabilities by over $3.2bn[39], it is incumbent on the Department not to repeat the mistakes of the past and impose an adequate and realistic financial assurance requirement on the Adani Carmichael Project so as to protect the interest of the Queensland taxpayers and the State's environment.

Domain	Area (Ha)/Volume (ML) (*estimated from analysis of Adani mine stage diagram)	Cost per hectare[3]	Total cost
Open cut voids and slopes	7,748 Ha*	$136,000 (50%) $108,000 (50%)	$527,000,000 $418,000,000 Total $945,000,000
Out of pit dumps	5,648 Ha*	$136,000 (50%) $108,000 (50%)	$384,000,000 $305,000,000 Total $689,000,000
Mine affected water dams	21,530 ML[4]	$3600 ML (50%) $1500 ML (50%)	$39,000,000 $16,000,000 Total $55,000,000
Stream diversions	88 kms (*)	$2,500/m (50%) $750/m (50%)	$110,000,000 $33,000,000 Total $143,000,000
Sub-total (rounded)			1,832,000,000
Contingency	25%		$458,000,000
Total			$2,290,000,000 (2017 $)

37 Carmichael Coal Mine and Rail Project SEIS Report for Updated Mine Project Description 18 October 2013, Mine Stage 2040-20144, Figure 17

38 Report of Targeted Compliance program – Financial assurance for Queensland Coal Mines (TCP15-009) 29 January 2016

39 Ibid.

Appendix A

Benchmark for closure cost estimation

Below is a table containing all the basic elements of what should be included in a detailed closure cost estimation. In regard to this estimation of the Carmichael Mine, we have chosen to focus on a subset of domains and to include other key elements in the cost as straight percentages based on industry expertise. As such this estimation does NOT include all the elements of closure cost estimation detailed below and as such can be considered a conservative estimate.

Tier 1	Tier 2	Tier 3	Tier 4
Direct	Social commitments	Community Heritage HR management	Trust funds Community programmes Cultural heritage Employment and skills programmes Redundancies Redeployment Relocation Retention
	Mining infrastructure	Pit Underground shafts Waste rock dumps ROM pads Stockpiles Haul roads	Decommission plant and equipment Demolition and disposal Remediation of contaminated sites Mine site rehabilitation: • Pit • Underground shafts • Waste rock dumps • ROM pads • Stockpiles • Haul roads • Tailings storage
	Process infrastructure	Crushers Minerals processing (floatation, etc) Tailings storage Materials handling	Rehabilitation: • Crushers • Minerals processing (floatation, etc) • Tailings storage dam
	Administration infrastructure	Administration buildings Accommodation	Rehabilitation: • Administration buildings • Accommodation village
	Services infrastructure	Power grid Sewage Bores	Rehabilitation: • Power generation plant • Distribution grid • Sewage treatment plant • Bores
	Other infrastructure	Train loadout Rail lines Port facilities Industrial facilities Airstrips Off site roads	Rehabilitation: • Train loadout • Rail lines • Port facilities • Industrial facilities • Airstrips • Off site roads
Indirect	Common distributable costs	Recurring costs Temporary costs Mobilisation Demobilisation	Camp costs Flights Services Light vehicles
	Owners costs	General Pre-closure Active closure Passive closure	Management team Property costs and rates Royalties, assurances and bonds Insurance Additional studies QA/QC verification Monitoring Maintenance
	Closure execution costs	Consultant costs	EPCM costs
Contingency			
	Project contingency Escalation and adjustments		
Additional costs	Salvage costs Risk costs		

Footnotes

1 Queensland Financial Assurance Calculator - https://www.business.qld.gov.au/running-business/environment/licences-permits/rehabilitation/security-deposit

2 Carmichael Coal Mine and Rail Project SEIS Report for Updated Mine Project Description 18 October 2013 Section 8.6.5

3 Queensland Financial Assurance Calculator - https://www.business.qld.gov.au/running-business/environment/licences-permits/rehabilitation/security-deposit

4 Carmichael Coal Mine and Rail Project SEIS Report for Updated Mine Project Description 18 October 2013 Section 8.6.5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THE GATE