IN THE LAND COURT OF QUEENSLAND

REGISTRY: BRISBANE
NUMBERS: MRA428-14 & EPA429-14 (MLA 70441)
MRA430-14 & EPA431-14 (MLA 70505)
MRA432-14 & EPA433-14 (MLA 70506)

Applicant:	**ADANI MINING PTY LTD (ACN 145 455 205)**
	AND
First Respondent:	**LAND SERVICES OF COAST AND COUNTRY INC.**
	AND
Second Respondent:	**CONSERVATION ACTION TRUST**
	AND
Statutory Party:	**CHIEF EXECUTIVE, DEPARTMENT OF ENVIRONMENT AND HERITAGE PROTECTION**

CLOSING SUBMISSIONS ON BEHALF OF THE FIRST RESPONDENT

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LIST OF ACROYNMS

AHD	Australian Height Datum [elevation above sea level]
BOS	Biodiversity Offset Strategy
BTF	Black-throated Finch
BTF SMP	Black-throated Finch Species Management Plan
CBA	Cost Benefit Analysis
CGE	Computable General Equilibrium Model
CHM	Conceptual Hydrological Model
CO_2	carbon dioxide
DEHP	Queensland Government Department of Environment & Heritage Protection / the statutory party
DoE	Australian Government Department of the Environment
EA	environmental authority
EIS	Carmichael Coal Project Environmental Impact Statement
EPA	*Environmental Protection Act* 1994 (Qld)
EPBC Act	*Environment Protection and Biodiversity Conservation Act* 1999 (Cth)
ESD	Ecologically Sustainable Development
fte	full time equivalent (job)
GABSRP	Great Artesian Basin Springs Research Plan
GAB TEC	Great Artesian Basin Threatened Ecological Community
GBRMPA	Great Barrier Reef Marine Park Authority
GHD	GHD Australia [environmental consultancy company]
GHG	greenhouse gas
GRP	Gross Regional Product
GSP	Gross State Product
HD02	Adani groundwater monitoring bore No. HD02
IDP	Carmichael Coal Project Initial Development Plan
IESC	Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development
IGAE	Intergovernmental Agreement on the Environment
I/O	Input/Output [Analysis]
IPCC	Intergovernmental Panel on Climate Change
JER	joint expert report
LSCC	Land Services of Coast and Country Inc / The First Respondent
ML / MLA	Mining lease / Mining lease application
MRA	*Mineral Resources Act* 1989 (Qld)
NGER Act	*National Greenhouse and Energy Reporting Act* 2007 (Cth)
P&E	Planning and Environment Court
s / ss	section / sections
SDPWOA	*State Development and Public Works Organisation Act* 1971 (Qld)
SEIS	Carmichael Coal Project Supplementary Environmental Impact Statement
SFA	Springs flow assessment [by Dr Merrick]
UNFCCC	*United Nations Framework Convention on Climate Change*

INTRODUCTION

1. The Applicant has applied under the *Mineral Resources Act* 1989 (Qld) (**MRA**) for three separate mining leases (**MLs**) – ML70441, ML70505 and ML70506 – and under the *Environmental Protection Act* 1994 (Qld) (**EPA**) for a site-specific environmental authority (mining activities relating to a mining lease) (**EA**), each of which is necessary to construct and operate the proposed Carmichael Coal Mine (**the mine**). The mine and associated rail project (**the Project**) was declared a coordinated project and underwent the environmental impact statement process under the under the *State Development and Public Works Organisation Act 1971* (Qld) (**SDPWOA**).

2. The First Respondent objected to the proposed mine on a number of grounds, in summary including:

   (a) the impacts of the mine on groundwater and groundwater-dependent ecosystems, particularly the Doongmabulla Springs Complex;

   (b) the impacts of the mine on biodiversity, particularly an endangered bird species, the Black-throated finch (Poephila cincta), and a vulnerable plant species, the Waxy Cabbage Palm (*Livistona lanuginosa*);

   (c) the contribution that the burning of the coal from the mine will make to climate change, thereby contributing to environmental harm to the Great Barrier Reef World Heritage Area due to climate change;

   (d) that the mine is not economically viable; and

   (e) that approval of the mine is contrary to the public interest.

3. The First Respondent's submission on the evidence heard by the Court in the objections hearing to the mine and the recommendation that the First Respondent submits ought to be made based on this evidence and the relevant statutory criteria are summarised in separate, short submission. These submissions will analyse the statutory tests to be applied by the Court and the evidence relevant to the grounds of objection in more detail than the summary submissions.

THE STATUTORY TESTS TO BE APPLIED BY THE COURT

Overview

4. The Court has considered the application of the EPA and MRA to proposed mines, and their relationships with the SDPWOA and the *Water Act* 2000 (Qld) (***Water Act***), in previous judgments.[1] However, there have been amendments to the EPA in several regards since the Court's earlier decisions changing the structure, section numbering

[1] Noting particularly, *De Lacey v Kagara Pty Ltd* (2009) 30 QLCR 57; [2009] QLC 77 (Smith M); *Donovan v Struber* (2011) 32 QLRC 226; [2011] QLC 45 (Smith M); *Xstrata Coal Queensland Pty Ltd & Ors v Friends of the Earth – Brisbane Co-Op and DERM* [2012] QLC 013; (2012) 33 QLCR 79 (MacDonald P) concerning the proposed Wandoan Coal Mine (**the *Xstrata* case**); and *Hancock Coal Pty Ltd v Kelly & Ors & DEHP (No. 4)* [2014] QLC 12 (Smith M), concerning the proposed Alpha Coal Mine (**the *Alpha* Case**).

and relevant considerations for the grant of environmental authorities.[2] The new structure of the Act applies to the revised application for the environmental authority as it was lodged on 14 April 2014,[3] after the amendments commenced.[4] These submissions refer to the current reprints of the EPA and MRA, which, in the First Respondent's view, are materially the same as the legislation in force when the applications for the environmental authority and mining leases were lodged.[5]

5. The judgment of the Court in the *Alpha* case is currently the subject of judicial review proceedings before the Supreme Court and a decision in that case was reserved by Douglas J on 23 April 2015 (**the *Alpha* judicial review proceedings**).[6] The First Respondent will inform the Court if the decision in the *Alpha* judicial review proceedings is delivered prior to the Court's judgment in the present case being delivered.

6. The analysis presented here builds upon the Court's previous judgments and notes aspects that the First Respondent submits, with respect, require reconsideration, particularly in light of the evidence that has emerged in this case.

7. The criteria for the Court's decision in the objections hearing are now set out in ss 191 of the EPA and s 269(4) of the MRA; however, these criteria must be understood within their statutory context and interpreted consistently with the objects, nature, scope and terms of their respective Act.[7] It is trite law that the relevant considerations for an administrative decision-maker are found not only in factors that a statute has expressly laid down as matters which the decision-maker is bound to consider. There are also considerations to be found from a reading of the subject-matter, scope and purpose of the Act.[8] We, therefore, begin with a general overview of the EPA and MRA. Further reference to specific aspects of the EPA and MRA are made in later sections, where relevant.

8. As the contribution of a mine to climate change has been a vexed issue in past decisions of the Court, these submissions will first address the statutory tests for the consideration of environmental issues other than climate change, before turning to the consideration of climate change largely as a discrete topic (commencing at [111]). It is hoped that this will assist the Court by separating what are expected to be largely uncontroversial aspects of the legal framework from the more contentious examination of climate change.

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[2] The EPA was substantially amended on 31 March 2013 by the commencement of the *Environmental Protection (Greentape Reduction) and Other Legislation Amendment Act 2012*, including renumbering of relevant chapters and sections and amending the standard criteria.

[3] See Exhibit 3; AA004 (Mr Manzi's First Affidavit), para 29.

[4] In the absence of anything to the contrary, the Court would ordinarily be required to make its recommendation on the basis of the law in force at the time of its recommendation: see, e.g., *Kentlee Pty Ltd v Prince Consort Pty Ltd* [1998] 1 Qd R 162, 173.

[5] The first of the three mining lease applications were applied for in 2010 and the revised environmental authority was applied for in 2014: see Exhibit 3; AA004 (Mr Manzi's First Affidavit), paras 27-29.

[6] Supreme Court proceedings Nos 4249/14 and 9505/14.

[7] Applying the ordinary principles of interpretation stated in *Project Blue Sky v Australian Broadcasting Authority* (1998) 194 CLR 355 at 381-384, [69]-[70] and [78] (McHugh, Gummow, Kirby and Hayne JJ).

[8] *Minister for Aboriginal Affairs v Peko-Wallsend Ltd* (1986) 162 CLR 24 at 39-40 (Mason J).

Onus of proof

9. A preliminary issue to clarify is which party, if any, carries the onus of proof in the objections hearing. This issue has not been resolved in previous decisions of the Court.[9]

10. There may be a tendency for Queensland practitioners familiar with the Planning and Environment (P&E) Court to assume that the Applicant for the mine bears the onus of proving that the mine should be approved, as is the case for applicants for development approval in appeals in the P&E Court. However, the onus for appeals in the P&E Court is expressly provided by s 493 the *Sustainable Planning Act 2009* (Qld). There is no equivalent provision in the *Land Court Act 2000* (Qld), the EPA or the MRA for objections hearings in the Land Court.

11. The principles used in courts of law regarding the onus of proof should be approached with great caution in administrative decisions and administrative appeals, particularly where a decision-maker is not bound by the rules of evidence and may inform itself on any matter in such manner as it thinks appropriate,[10] as is the case for the Land Court.[11]

12. The complications and questions raised regarding the Court's powers in objections hearings under the MRA and EPA by the recent judgment of Philip McMurdo J in *BHP Billiton Mitsui Coal Pty Ltd v Isdale & Ors* [2015] QSC 107 (***BHP Billiton***) do not appear to apply to the Court's general power stated in s 7 of the *Land Court Act 2000* (Qld). His Honour held in that case that the Court did not have power under r 13 of the *Land Court Rules 2000* to order disclosure in an objections hearing under the MRA and EPA as such a hearing was administrative in nature and, therefore, not a "proceeding" in the Land Court that enlivened the power in r 13. However, the Court's general power stated in s 7 of the *Land Court Act 2000* (Qld) refers to "In the exercise of its jurisdiction …"[12] and contains no reference to "a proceeding" before the Court. This general power, therefore, does not appear to be affected by the decision in *BHP Billiton.*

13. His Honour's reasoning in *BHP Billiton* supports the conclusion that there is no onus of proof on any party in an objections hearing under the MRA and EPA because the Land Court must have regard to considerations which extend beyond the respective interests of the applicant and the objectors. After discussing how disclosure is normally limited to the issues in dispute between parties, his Honour stated:

> But in referrals to the Land Court of the present kind [under the MRA and EPA], the scope of the court's factual inquiry is not defined by the parties. Their respective arguments and the evidence which they present are to be considered. But the Land Court must have regard to considerations which extend beyond the respective interests of the applicant and the objectors. In particular, it must consider the public interest.[13]

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[9] In the *Xstrata* case [2012] QLC 013; (2012) 33 QLCR 79 at [572] the Court noted that the Applicant miner submitted in that case in relation to assessing the public interest that "the onus lies with the party contending that there should be a refusal to satisfy the Court that there is prejudice to that interest" without deciding that point specifically. No other cases appear to have considered this issue in relation to objections hearings under the MRA and EPA.

[10] *McDonald v Director-General of Social Security* (1984) 1 FCR 354 at 356 (Woodward J).

[11] *Land Court Act 2000* (Qld), s 7.

[12] This is clearly to be read by reference to the Court's jurisdiction stated in s 5 of the *Land Court Act* as "the jurisdiction given to it under this Act or another Act".

[13] *BHP Billiton Mitsui Coal Pty Ltd v Isdale & Ors* [2015] QSC 107 at [42].

14. The First Respondent submits that, consistently with the approach to administrative decisions generally,[14] the general powers of the Court "to inform itself in the way it considers appropriate",[15] and the recent decision in *BHP Billiton*, no party bears a legal or evidential onus of proof in relation to any issue.

Environmental Protection Act

Statutory context of objections decision under the EPA

15. The nature of an objections decision for an environmental authority is set out in s 190 of the EPA. In short, it is a choice between the alternatives of recommending approval based on the Draft Environmental Authority, recommending approval based on conditions different to those in the Draft Environmental Authority or recommending refusal.

16. The objections decision must be understood within the statutory context provided by the EPA.

17. An objections decision must, as a matter of first importance, comply with the statutory command in s 5 of the EPA that decision-makers under the EPA must exercise their functions and powers in the way that **best achieves** the object of the EPA in s 3:

> To protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends (ecologically sustainable development).

18. Sections 8-17 of the EPA provide definitions for key concepts under the Act, which are supplemented by a dictionary of terms in schedule 4. Although "environment" is defined widely in s 8, the EPA does not use this term directly in its provisions but incorporates it into the terms "environmental value" and "environmental harm". It is the latter concept that forms a common thread running through much of the EPA.

19. Section 9 of the EPA defines "environmental value" in the following way:

> (a) a quality or physical characteristic of the environment that is conducive to ecological health or public amenity or safety; or
>
> (b) another quality of the environment identified and declared to be an environmental value under an environmental protection policy or regulation.

20. As relevant to this objection hearing, the following are all components of "the environment" and "environmental values" as defined in ss 8 and 9:

    (a) the biological integrity of an aquatic ecosystem that is effectively unmodified or highly valued[16] (in relation to groundwater supply to the Doongmabulla Springs Complex, which are high ecological value waters, particularly the Moses Springs[17]);

[14] *McDonald v Director-General of Social Security* (1984) 1 FCR 354 at 356-359 (Woodward J).
[15] *Land Court Act 2000* (Qld), s 7.
[16] *Environmental Protection (Water) Policy 2009* (Qld), s 6(2)(a).
[17] See Exhibit 21; JR005 (Springs Ecology Joint Experts Report).

(b) biodiversity (such as represented by the Black-Throated Finch and Waxy Cabbage Palm);

(c) the social, economic, aesthetic and cultural conditions that affect, or are affected by the environment, such as jobs, royalities and taxes;

(d) the concentration of carbon dioxide (**CO_2**) in the atmosphere and its associated greenhouse effect; and

(e) the climate.

21. Section 14 of the EPA defines "environmental harm" widely as, in effect, "any adverse effect … on an environmental value". Subs 14(2) states that:

> Environmental harm may be caused by an activity—
>
> (a) whether the harm is a direct or indirect result of the activity; or
>
> (b) whether the harm results from the activity alone or from the combined effects of the activity and other activities or factors.

22. Consequently, as relevant to this objection hearing, an act that adversely affects the biological integrity of the Moses Springs, loss of biodiversity, the concentration of CO_2 in the atmosphere, or the climate, constitutes environmental harm.

23. The body of the Act then creates a toolbox of mechanisms to meet the objects of the Act of protecting Queensland's environment while allowing for ecological sustainable development (ESD).

24. These tools include, importantly, licensing systems for a range of activities that may harm the environment, of which mining is one. The process of applying for an environmental authority for mining activities is contained in Ch 5 of the EPA.

25. Section 110 defines a "mining activity" for Ch 5 of the EPA as "an activity that is an authorised activity for a mining tenement under the Mineral Resources Act." This definition includes the mining and rehabilitation activities but does not include activities such as the burning of the product coal. That much is a given, however, to say that the application process for an environmental authority is limited to only considering the mining activity is to ignore the context of the application process, which is to regulate the environmental harm caused by the mining activity.

26. In this way, the Applicant has relied on, for Approval under the EPA economic consequences of the mining activity which occur through related related but separate activities such as indirect jobs and benefits accruing to the coal fired power stations in India and elsewhere.[18]

27. At the time relevant to the application for the environmental authority for this mine, Ch 5 provided different processes for different types of applications.[19] The mine was applied for as a "site specific application" and has been referred to the Court as part of

[18] Exhibit 43; AA006 (Dr Fahrer's First Economic Assessment Expert Report) soft page 31, paras 95 and 96; Transcript 16-89, lines 38-41.
[19] EPA, s 112.

the Decision Stage under Part 5 of Ch 5. The process for the objection hearing before the Court, and the considerations in s 191, are included in that part.

28. Section 191 of the EPA (in its current form and as relevant to the application for an environmental authority), sets out an express list of mandatory criteria for the objections decision under the EPA for the mine, including the "standard criteria".

29. The "standard criteria" are defined in Schedule 3 (Dictionary) to the EPA to include the following principles of environmental policy as set out in the *Intergovernmental Agreement on the Environment* of 1992 (**IGAE**):[20]

    (a) The precautionary principle;

    (b) Intergenerational equity;

    (c) Conservation of biological diversity and ecological integrity.

30. The IGAE defines these principles as follows:

> **3.5.1 Precautionary principle**
>
> Where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.
>
> In the application of the precautionary principle, public and private decisions should be guided by:
>
> (i) careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment; and
>
> (ii) an assessment of the risk-weighted consequences of various options.
>
> **3.5.2 Intergenerational equity**
>
> The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.
>
> **3.5.3 Conservation of biological diversity and ecological integrity**
>
> Conservation of biological diversity and ecological integrity should be a fundamental consideration.

31. The inclusion of the principles of environmental policy set out in the IGAE differs from the statutory scheme considered by earlier decisions of the Court and, consequently, this is the first occasion when the Court has considered the EPA in its current form.

32. The "standard criteria" also include other matters that were included in previous versions of the EPA and have been considered by the Court in previous decisions, relevantly:

    (a) the character, resilience and values of the receiving environment; and

    (b) the public interest.

[20] The definition of the IGAE in the EPA notes that "A copy of the Intergovernmental Agreement on the Environment is in the *National Environment Protection Council (Queensland) Act 1994*, schedule."

Precautionary principle

33. The Court has considered the application of the precautionary principle on a number of occasions in the past.[21] The reference document by which the EPA defines the precautionary principle has changed since those earlier cases, however, there is no material difference in the definition.[22]

34. The precautionary principle is engaged when two conditions are satisfied:

    (a) there is a risk of serious or irreversible environmental harm; and

    (b) uncertainty about the likelihood, nature or scope of that harm.[23]

35. Here, these three conditions are plainly satisfied regarding the Doongmabulla Springs Complex, the Black-throated Finch and the Waxy Cabbage Palm, which will be discussed further below.

Intergenerational equity

36. The concept of intergenerational equity was discussed by Pain J in *Gray v Minister for Planning* [2006] NSWLEC 720; (2006) 152 LGERA 258 at [118]-[126].[24] The central principles of intergenerational equity include that each generation must maintain the quality of the earth so that it is passed on in no worse condition than it was received.[25]

Conservation of biological diversity and ecological integrity

37. The conservation of biological diversity and ecological integrity has also been discussed in NSW cases, particularly by Preston CJ in *Bentley v BGP Properties Pty Ltd* [2006] NSWLEC 34; (2006) 145 LGERA 234, [58]–[63]. Preston CJ stated at [61] and [63]:

> Maintaining ecological integrity involves maintaining ecosystem health. Ecosystems become unhealthy if their community structure (species richness, species composition or food web architecture) or ecosystem functioning (productivity, nutrient dynamics, decomposition) has been fundamentally upset by human pressures. …
>
> The conservation of threatened species is an essential action in the conservation of species diversity, and hence of biological diversity, and of ecological integrity.

38. These principles are clearly relevant, particularly in relation to the potential severe impacts of the mine on Doongmabulla Springs Complex, Waxy Cabbage Palms and the Black-throated Finch.

The character, resilience and values of the receiving environment

39. The requirement in the standard criteria to consider "the character, resilience and values of the receiving environment" complements the requirements to consider matters such

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[21] Particularly, *DeLacey v Kagara Pty Ltd* [2009] QLC 77, [172]–[177]; and the *Xstrata* case [2012] QLC 013; (2012) 33 QLCR 79 at [253], [256] & [347].
[22] Prior to 2013, the precautionary principle was defined by reference to the *National Strategy for Ecologically Sustainable Development*. Now it is defined by reference to the IGAE.
[23] *Telstra Corporation Ltd v Hornsby Shire Council* (2006) 67 NSWLR 256, [128].
[24] See also, *Taralga Landscape Guardians Inc v Minister for Planning and RES Southern Cross Pty Ltd* [2007] NSWLEC 59; (2007) 161 LGERA 1 at [74] (Preston CJ).
[25] *Gray v Minister for Planning* [2006] NSWLEC 720; (2006) 152 LGERA 258 at [119].

as maintaining ecological integrity and is raised by each of the environmental grounds of objection raised by the First Respondent.

40. For instance, the agreed "exceptional ecological value" of the Doongmabulla Springs Complex[26] and low resilience to changes in groundwater supply are clearly matters requiring careful consideration.

41. Similarly, the potential loss of the core habitat of the most important population of the threatened Black-Throated Finch species, and the very low resilience of the species to further impacts are clearly matters requiring careful consideration.

The public interest

42. The public interest involves a discretionary balancing exercise of the widest import confined only so far as the subject matter and the scope and purpose of the statute may enable.[27]

43. While the public interest is a relevant consideration under both the EPA and the MRA, it should be noted again that they are two very different Acts with two very different objects. This means there are different frameworks for considering the public interest under the two Acts. The MRA provides a system aimed at promoting the development of the mineral resources of the State while the EPA is very much focused on the protection of the environment. These objects overlap to some extent, but they are quite different and it would be wrong to assume that the consideration of the public interest aspect of the mining lease application under the MRA and the consideration of public interest in the application for the environmental authority under the EPA are the same.

The central relevance of environmental harm for the objections decision

44. The above considerations are all expressly listed in s 191 and the standard criteria; however, this list is not necessarily a comprehensive list of relevant considerations for the environmental authority.[28]

45. While s 191 of the EPA and the standard criteria do not refer to "environmental harm" specifically, it is clear from the structure and objects of the EPA that the risk and extent of likely environmental harm is central to assessing any application for an environmental authority and, therefore, any objections decision.

46. The EPA directly links the concept of environmental harm to an environmental authority granted under it in the following way:

    (a) Sections 437 and 438 of the EPA provide criminal offences for unlawfully causing serious or material environmental harm.[29]

[26] Exhibit 21; JR005 (Springs Ecology Joint Experts Report), line 97.
[27] *Sinclair v Mining Warden at Maryborough* (1975) 132 CLR 473 at 487 (Taylor J); *McKinnon v Secretary, Department of Treasury* (2005) 145 FCR 70 at [8]-[12] (Tamberlin J); *McKinnon v Secretary, Department of Treasury* (2006) 228 CLR 423 at [55]-[56] (Hayne J).
[28] *Minister for Aboriginal Affairs v Peko-Wallsend Ltd* (1986) 162 CLR 24 at 39 (Mason J).
[29] Material and serious environmental harm are defined in ss 16 and 17 of the EPA.

(b) In the context of the ss 437 and 438, causation of environmental harm must be construed by reference to s 14.[30]

(c) Section 493A provides that serious or material environmental harm is lawful if, amongst other things, it is authorised under an environmental authority.[31]

47. Therefore, the environmental harm that the mining activity will cause (which, absent the environmental authority, is unlawful) must be considered in granting an environmental authority for it. Were this not the case, the decision to grant the authority would authorise something that was not considered in making the decision. Therefore, having regard to the subject matter, scope and purpose of the EPA and the central function of the grant of an environmental authority, it is apparent that the enumerated factors in s 191 do not constitute an exhaustive list. It follows that the environmental harm that any activity may cause is a *relevant consideration* that the Court is bound to consider in respect of the grant of an environmental authority to authorise that activity (or, rather, the environmental harm which flows therefrom).[32] A failure to have regard to relevant matters may lead a decision-maker to wrongly deny the existence of its jurisdiction or to mistakenly place limits on its functions or powers.[33] Considering something irrelevant might disclose a constructive failure to exercise jurisdiction.[34]

Is the Court obliged to recommend refusal of an unsustainable activity?

48. Having reviewed the relevant provisions of the EPA, an important issue arises in the context of this objections hearing, namely: is the Land Court obliged to recommend refusal of an unsustainable mining activity to meet the obligation imposed by s 5?

49. The relevant question to ask is whether the purpose of the EPA means that a recommendation by the Court to approve an unsustainable activity is invalid having regard to the language, scope and object of the Act.[35] The legislation must be constructed on the prima facie basis that its provisions are intended to give effect to harmonious goals and, where conflict is found, the Land Court may be required to determine a hierarchy of provisions.[36]

50. On its face, s 5 of the EPA states a clear legislative intent that, in exercising its functions under the Act of hearing the objections and making its recommendation to the Minister, the Land Court "must perform the function or exercise the power in the way that best achieves the object of this Act" of ecologically sustainable development. In contrast, ss 190 and 191 provide a list of matters that the Land Court is only required to "consider" but leave it to the Court to determine the appropriate balance and weight to be given to each consideration. The Act creates a hierarchy in which the obligation in s 5, linked directly to the object of the Act stated in s 3, provides an overriding duty

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[30] When causation is made relevant to the operation of a statute, notions of "cause" are to be understood by reference to the statutory subject, scope and purpose: *Allianz Australia Insurance Ltd v GSF Australia Pty Ltd* (2005) 221 CLR 568 at 581-587 [41]-[55] (McHugh J) & 596-598 [95]-[101] (Gummow, Hayne & Heydon JJ).
[31] EPA, s 493A(2)(d).
[32] *Minister for Aboriginal Affairs v Peko-Wallsend Ltd* (1986) 162 CLR 24 at 39-40 (Mason J).
[33] *Abebe v Commonwealth* (1999) 197 CLR 510 at 552 (Gaudron J).
[34] *Minister for Immigration & Multicultural Affairs v Yusuf* (2001) 206 CLR 323 at 339-340 (Gaudron J).
[35] *Project Blue Sky v Australian Broadcasting Authority* (1998) 194 CLR 355 at 390 [93] (McHugh, Gummow, Kirby and Hayne JJ).
[36] *Project Blue Sky v Australian Broadcasting Authority* (1998) 194 CLR 355 at 381-382 [70] (McHugh, Gummow, Kirby and Hayne JJ).

when exercising any function under the Act, including the functions of the Court. This construction is confirmed by the *Environmental Protection Bill 1994 Explanatory Notes* given that the reasons for the Bill stated, "Protection of the environment is ensured by requiring economic development to be ecologically sustainable." (emphasis added).

51. If the Court concludes that a proposed mining activity is unsustainable, it is difficult to see how the Court could "best achieve the objects of the Act" in any way other than to recommend the activity be refused.

52. Consequently, having regard to the scope and object of the whole Act, including the explanatory notes, it is submitted that, if the Court concludes that an activity is unsustainable (in the sense defined in s 3), the Court is obliged to recommend that the activity be refused. The effects of the mine on the exceptional ecological values of the Doongmabulla Springs Complex, the Black-throated finch and the contribution of the mine to climate change raise first order questions of unsustainability.

Mineral Resources Act

53. The MRA has different objects to the EPA. While the two Acts are interrelated to an extent, it is trite that they must each be applied by reference to their own terms.

54. The object and statutory framework of the MRA are very different from the EPA. The object of the MRA, stated in s 2, is to encourage mining and financial returns to the State through royalties, while also encouraging environmental responsibility.

55. The major considerations for the Court to have regard to under the MRA in assessing the mining lease application are the objects of the Act stated in s 2 and the considerations listed in s 269(4). These include whether:

    (a) there will be an acceptable level of development and utilisation of the mineral resources within the area applied for (s 269(4)(c));

    (b) the applicant has the necessary financial and technical capabilities to carry on mining operations under the proposed mining lease (s 269(4)(f));

    (c) there will be any adverse environmental impact caused by those operations (s 269(4)(j));

    (d) the public right and interest will be prejudiced (s 269(4)(k)); and

    (e) any good reason has been shown for a refusal to grant the mining lease (s 269(4)(l)).

56. The Land Court's decision on the objection hearing for a mining lease does not finally determine the application for it. The Land Court makes a recommendation to the Minister administering the MRA and the Minister is not bound to follow the recommendation.[37]

[37] MRA, ss 271 and 271A.

Section 269(4)(c) and (f) – "acceptable level of development" and "necessary financial and technical capabilities"

57. In relation to s 269(c) and (f) the Court of Appeal has held that "whilst there is no specific reference in s 269(4) to the 'economic viability' of a project, it is relevant to interpreting the information about mineralisation and to at least the matters set out in s 269(4)(c)."[38]

Section 269(4)(j) – "any adverse environmental impact"

58. Section 269(4)(j) of the MRA provides that the Land Court "when making a recommendation to the Minister that an application for a mining lease be granted in whole or in part, shall take into account and consider whether there will be any adverse environmental impact caused by those operations and, if so, the extent thereof". It is clear from the terms of the preceding paragraph, paragraph 269(4)(i), that "operations" means the "operations to be carried on under the authority of the proposed mining lease". Thus, the consideration required by paragraph 269(4)(j) of the MRA is the consideration of "adverse environmental impact caused by [the operations to be carried on under the authority of the proposed mining lease]".[39] In the context of the present case, "operations" in paragraphs 269(4)(i) and (j) means the physical activities associated with winning and extracting the coal product.[40] To this limited extent, the First Respondent respectfully agrees with the decision in *Xstrata*.[41]

59. The First Respondent submits, however, that the Court erred in *Xstrata* by excluding the impacts of the transport and burning of the coal from the mine from the matters that fell within "any adverse environmental impact caused by those operations" under s 269(4)(j) of the MRA.[42] This issue will be addressed in more detail below, commencing at [115], in relation to the consideration of climate change.

Section 269(4)(k) – "the public right and interest will be prejudiced"

60. As noted earlier, at [42], the requirement to consider whether the public right and interest will be prejudiced[43] involves a discretionary balancing exercise of the widest import confined only so far as the subject matter and the scope and purpose of the statute may enable.[44]

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[38] *Armstrong v Brown* [2004] 2 Qd R 345 at 348-8 [15] (per McMurdo J with whom McPherson JA and Jerrard JA agreed).

[39] The definition of "mine" in s 6A and the purposes for which a mining lease may be granted under s 234 of the MRA indicate what operations may be carried on under the authority of a mining lease.

[40] Applying "adverse environmental impact caused by those operations" in its most narrow and direct sense, it includes the impacts on groundwater and due to carbon dioxide and other greenhouse gases released by carrying out those physical activities (i.e. scope 1 emissions).

[41] *Xstrata* case [2012] QLC 013; (2012) 22 QLCR 79 at [528]-[529].

[42] *Xstrata* case [2012] QLC 013; (2012) 22 QLCR 79 at [530].

[43] There is no material distinction between a public right or the public interest for the purposes of this hearing but these submissions will focus on the public interest as the more relevant term. There are public rights to a healthy and pleasant environment, protected through the tort of public nuisance, as well as a public interest in a healthy and pleasant environment.

[44] *Sinclair v Mining Warden at Maryborough* (1975) 132 CLR 473 at 487 (Taylor J); *McKinnon v Secretary, Department of Treasury* (2005) 145 FCR 70 at [8]-[12] (Tamberlin J); *McKinnon v Secretary, Department of Treasury* (2006) 228 CLR 423 at [55]-[56] (Hayne J).

61. Even though the MRA is not focused on environmental protection, it is submitted that the reference to "encourage environmental responsibility in prospecting, exploring and mining" as one of the objects of the MRA in paragraph 2(a) of the MRA militates in favour of not restricting "public right and interest" in paragraph 269(4)(k) from extending to a consideration of the relationship between the resource sought to be exploited and very significant global problems to which the removal and use of the resource will contribute and ways in which that contribution can be mitigated.[45] Equally, the more narrow context of paragraph 269(4)(k) of the MRA includes paragraph 269(4)(j), with its express comprehension of "any adverse environmental impact". This also suggests that the phrase, which is of widest import should not be construed restrictively, in the context of environmental impacts.

Section 269(4)(l) – "any good reason has been shown for a refusal"

62. Section 269(4)(l) of the MRA is extremely wide and limited only by the subject matter, scope and purposes of the Act.[46] Clearly, there must be a *good* reason, as opposed to a reason that is extraneous to the purposes of the Act.[47] The question of whether good reason has been shown must depend on all the circumstances of the particular case.[48]

63. As discussed in the context of s 269(4)(k), paragraph 2(d) of the MRA includes, as an objective of the MRA: to "encourage environmental responsibility in prospecting, exploring and mining". For the reasons stated in respect of paragraph 269(4)(k) and its reference to prejudice of "the public right and interest", "good reason … for a refusal to grant" comprehends the matters raised by the Applicant's objection. There is nothing in the statutory context which suggests that the phrase should be read down to exclude those matters.

64. It is submitted, however, that the inclusion of two very broad criteria, namely, those in paragraphs 269(4)(k) and (l) involves a mutual reinforcement of the breadth of each criterion. It would be easier to conclude that, if only one "catch all" criterion had been included, it should be read down by reference to parts of the statutory context. The inclusion of two such criteria is a very strong indication that each criterion should be construed according to its generous terms.

Relationship between the EPA and MRA

65. The legislative history of both Acts is of assistance in understanding the relationship between the EPA and the MRA. As originally enacted in 1989, the MRA was intended to provide the principal regime for the approval and regulation of mining in Queensland. The enactment of the EPA in 1994 provided another layer of regulation of mining as an environmentally relevant activity. In 2000, the Acts were amended[49] to separate the promotion of mining and tenure issues from the regulation of the environmental impacts

[45] In *Telstra v Hornsby* [2006] NSWLEC 133; (2006) 146 LGERA 10, at [121]-[124], Preston CJ used the subject matter, scope and purpose of the environmental assessment legislation being applied by him to conclude that "public interest" included consideration of the principles of ESD.
[46] See *Minister for Aboriginal Affairs v Peko-Wallsend Ltd* (1986) 162 CLR 24 at 39-40 (Mason J).
[47] *Water Conservation and Irrigation Commission (NSW) v Browning* (1947) 74 CLR 492 at 505 (Dixon J).
[48] See *Campbell v United Pacific Transport* [1966] Qd R 465, at 472 (Gibbs J) in the context of considering whether "good reason" had been shown by an applicant plaintiff for leave to proceed after six years without a step in the proceedings.
[49] By the *Environmental Protection and Other Legislation Amendment Act 2000* (Qld).

of mining.[50] While the 2000 amendments focused the MRA on the tenure aspects of mining, environmental impacts of mining remain relevant to the objects of the MRA and s 269(4) considerations for the grant of a mining lease.

66. The EPA and the MRA are two very different Acts with two very different objects.[51] The EPA focuses on the protection of the environment while the MRA provides a system aimed at promoting the development of the mineral resources of the State. These objects overlap to some extent, but they are quite different and it would be wrong to assume that the consideration of the application for the environmental authority under the EPA and the consideration mining lease application under the MRA are the same. A particular feature that distinguishes the two Acts is that the duty under s 5 of the EPA is to perform a function and exercise the powers conferred by the Act "in the way that best achieved the object of the Act" of ecologically sustainable development. There is no such duty under the MRA.

Relationship between the EPA, MRA and Water Act

67. The Court has analysed the need for an applicant for a mine to obtain a water licence under the *Water Act 2000* (Qld) (*Water Act*) in previous decisions in circumstances similar to the present case where the mine has been declared a coordinated project under the SDPWOA. The Court has held that it is necessary to consider the impacts of a mine on ground and surface water when assessing the applications for the mining lease under the MRA and the environmental authority under the EPA, but there are limits to which the Court can recommend further conditions addressing water issues.[52]

68. As in previous cases, the Applicant has not yet, to the knowledge of the First Respondent, applied for a water licence but when it does so, an appeal will lie against the grant of a water licence to the Land Court.[53] In effect, while there is considerable overlap in the issues that must be considered regarding the impacts of the mine on water under the MRA, EPA and *Water Act*, the application for a water licence is a separate, future approvals process for the mine.

Relationship between the EPA, MRA and SDPWOA

69. As with the interaction with the *Water Act*, the Court has previously considered the relationship between the EPA, MRA and the SDPWOA for applications involving mines that have been declared to be coordinated projects (prior to 2012 referred to as "significant projects"), particularly the requirement that the Court may not recommend a condition that is "inconsistent" with a condition imposed by the Coordinator-General.[54] The Court has held that:

> … the Court has power under the EPA to recommend conditions for the draft EA dealing with the same subject matter as conditions imposed by the Coordinator-

[50] *Environmental Protection and Other Legislation Amendment Bill 2000 – Explanatory Notes*, p 2.
[51] As recognised in the *Alpha* case [2014] QLC 12 at [63] citing the earlier decision in *Donovan v Struber & Ors* (2011) 32 QLCR 226; [2011] QLC 45.
[52] *Xstrata* case [2012] QLC 013; (2012) 22 QLCR 79 at [205]-[215] and [606]-[610]; *Alpha* case [2014] QLC 12 at [81]-[130].
[53] *Alpha* case [2014] QLC 12 at [103].
[54] *Xstrata* case [2012] QLC 013; (2012) 22 QLCR 79 at [24]-[50] and [606]-[610]; *Alpha* case [2014] QLC 12 at [71]-[80].

> General, provided that the Court's recommended conditions do not contradict or lack harmony with the Coordinator-General's conditions.[55]

70. With respect, the First Respondent agrees with this conclusion.

71. However it does the Court in a difficult position if it is that satisfied conditions imposed by the Coordinator-General are inadequate to address a significant harm, an unable to be remedied by consistent conditions, as it leaves the Court with little option but to recommend refusal.

Over-arching test to be applied under the EPA and MRA

72. The EPA and MRA do not expressly state an overarching test to be applied by the Court in assessing an environmental authority or a mining lease. However, it is submitted that on the proper construction of the EPA and MRA the Court must be affirmatively satisfied that the grant of the mining lease and the environmental authority meet all statutory requirements, including that the proposed mining activity would produce a net benefit taking all relevant criteria into account.[56] The need for the Court to be affirmatively satisfied arises from the nature and subject matter of the decisions it is required to make and the legislative framework it is required to apply.

73. The Land Appeals Court and Supreme Court have held that in making a recommendation on a mining lease under the MRA the Court is acting in an administrative capacity.[57] As an administrative decision-maker, the Court is required to make the "correct or preferable" decision on the material before it.[58]

74. In applications of this kind, the Court must resolve a tension between, on the one hand, the possible economic benefits of allowing a private company to exploit public resources, in the form of coal owned by the Crown in right of Queensland,[59] and, on the other hand, the costs of allowing that exploitation, particularly in the form of environmental harm. Given the public nature of the resource to be exploited and the public nature of the costs to be incurred, the Court should only recommend approval if it feels positively persuaded that the grant of the approvals will result in a net benefit taking all relevant criteria into account. Or, to use the words of the EPA, 'improve the total quality of life'.

75. The function of the Land Court is similar to the function of the Mining Wardens Court the subject of *Sinclair v Mining Warden at Maryborough* (1975) 132 CLR 473 (***Sinclair***). Barwick CJ emphasised in *Sinclair*, in relation to an objections hearing for a mining lease application, that the hearing is not a mere formality but, rather, has an important function to examine the matters which would justify the objections raised to

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[55] *Xstrata* case [2012] QLC 013; (2012) 22 QLCR 79 at [47].

[56] As noted earlier, the sections do not spell out an overall test. However, the requirement for some form of affirmative satisfaction is apparent from the case law both in Queensland and elsewhere. This case law is discussed below. This phrase is a convenient paraphrase of the case law which, it is submitted, captures the essence of both the case law and the statutory requirements.

[57] *Dunn v Burtenshaw* [2010] QLAC 5, [47]; *BHP Billiton Mitsui Coal Pty Ltd v Isdale & Ors* [2015] QSC 107 (Philip McMurdo J).

[58] See, e.g., *Drake v Minister for Immigration and Ethnic Affairs* (1979) 24 ALR 577, at 589. *Drake* was concerned with merits review proceedings, but the same test has been said to apply to first instance decision-makers: see *Bushell v Repatriation Commission* (1992) 175 CLR 408, at 425 per Brennan J.

[59] Section 8(2) of the MRA provides that coal is property of the Crown.

the grant of the mining lease.[60] His Honour stated that, to justify a recommendation that a mining lease be granted, there must be material before the warden "which would warrant an affirmative conclusion on the substance of the applications that the recommendations should be made."[61]

76. In *Armstrong v Brown* [2004] 2 Qd. R. 345 at 348 [15], McMurdo J (with whom McPherson and Jerrard JJA agreed) observed that *Sinclair* still has application under the MRA and that a recommendation should not be made for the grant of a mining lease under the MRA "unless the circumstances warrant that recommendation, having regard to the purposes for which the Crown should give a right to mine its minerals."

77. In *Queensland Conservation Council Inc v Xstrata Coal Queensland Pty Ltd* [2007] QCA 338; 155 LGERA 322 at [53], McMurdo P (with whom Holmes JA and Mackenzie J agreed) emphasised that, irrespective of the content of any particular objection, the task of the Court, under both the EPA and the MRA, was to consider all relevant matters and to decide what recommendation it should make to the Ministers. In doing so, her Honour referred to both *Sinclair* and *Armstrong*.[62]

78. The requirement of the Land Court to be positively satisfied that the mine will produce a net benefit taking all relevant criteria into account is consistent with the approach to mining legislation in NSW where the Land and Environmental Court and Court of Appeal have recently stated that the final task of a court in a merits appeal against approval of a mine after fact finding and assigning weight to the relevant matters, "is to balance the matters to determine whether the preferable decision is to approve or disapprove of the carrying out of the Project."[63] In essence, this requires the trial court "to balance the public interest in approving or disapproving the project, having regard to the competing economic and other benefits and the potential negative impacts the project would have if approved".[64] This is the final task in deciding a mining application following a decision-making process involving the resolution of a polycentric problem. That is, the decision-making process requires "the consideration, weighting and balancing of the environmental, social and economic impacts" of a proposed mine in circumstances where a range of interests are affected, and there are complex and interdependent issues involving a complex network of relationships with interacting points of influence.[65]

79. It is submitted that the reasoning of the NSW Land and Environment Court and the NSW Court of Appeal in explaining the polycentric nature of decisions to approve a mine is applicable to the questions of proof and satisfaction arising under the Queensland legislation. It is also submitted that the final question to be asked by a trial court in a merits hearing against approval of a mine in NSW is, not surprisingly, very

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[60] *Sinclair v Mining Warden at Maryborough* (1975) 132 CLR 473 at 481.
[61] *Sinclair v Mining Warden at Maryborough* (1975) 132 CLR 473 at 481.
[62] *QCC v Xstrata Coal Queensland Pty Ltd* [2007] QCA 338; 155 LGERA 322 at [53].
[63] *Bulga Milbrodale Progress Association Inc v Minister for Planning and Infrastructure* [2013] NSWLEC 48; (2013) 194 LGERA 347 at [347] (Preston CJ), approved in *Warkworth Mining Ltd v Bulga Milbrodale Progress Association Inc* [2014] NSWCA 105; (2014) 307 ALR 262 at [172] (Bathurst CJ, Beazley P and Tobias AJA).
[64] *Warkworth Mining Ltd v Bulga Milbrodale Progress Association Inc* [2014] NSWCA 105; (2014) 307 ALR 262 at [172] (Bathurst CJ, Beazley P and Tobias AJA).
[65] *Bulga Milbrodale Progress Association Inc v Minister for Planning and Infrastructure* [2013] NSWLEC 48; (2013) 194 LGERA 347 at [31] and [347] (Preston CJ), approved in *Warkworth Mining Ltd v Bulga Milbrodale Progress Association Inc* [2014] NSWCA 105; (2014) 307 ALR 262 at [147]-[152] and [172] (Bathurst CJ, Beazley P and Tobias AJA).

similar to the nature of an objections hearing in the Land Court under the EPA and MRA.

80. The need for affirmative satisfaction is particularly great in making a recommendation under the EPA considering the object of the EPA stated in s 3 and the duty of the Land Court stated in s 5 to exercise its powers under that Act "in the way that best achieves the object of [the] Act". It would not be consistent with this duty to allow development where the Land Court could not positively conclude that the development would be ecologically sustainable and in the public interest.

81. The need for adequate information is also particularly important under the EPA given the prominence of ESD in the object of the Act as stated in s 3, and the duty of the Land Court stated in s 5. In *Gray v Minister for Planning* [2006] NSWLEC 720; (2006) 152 LGERA 258 at [118], Pain J of the NSW Land and Environment Court observed:

> The key purpose of environmental assessment is to provide information about the impact of a particular activity on the environment to a decision maker to enable him or her to make an informed decision based on adequate information about the environmental consequences of a particular development. This is important in the context of enabling decisions about environmental impact to take into account the various principles of ESD…[66]

82. In that case, her Honour found that the absence of information regarding the impacts of a proposed coal mine on climate change meant that it was not possible for the decision-maker to have taken into account the ESD principles.[67]

83. It is submitted that, given the uncertainty regarding the impacts of the mine on groundwater and potential to offset the Black-throated finch, it was not appropriate for the Court to address this matter through conditions. The power to impose conditions serves as an aid to good decision making. However, the imposition of conditions by itself is not a substitute for a decision made on the basis of reliable information. The purpose of conditions on a permit is to avoid or manage impacts once they have been identified. This requires the Court to have suitable confidence that it knows what the impacts of granting approval will be.

The role and limits of conditions

84. Conditions fill an important role under both the EPA and MRA in managing the harm caused by an activity for which an environmental authority or mining lease is granted; however, conditions have important limits.

85. There are two issues in relation to conditions:

    (a) The first is the scope of the Court's power to impose conditions, particularly in relation to groundwater.

    (b) The second is the appropriateness of imposing conditions in situations where there is inadequate information available.

[66] See also *Bentley v BGP Properties Pty Ltd* (2006) 145 LGERA 234, [67]–[70] per Preston CJ.
[67] *Gray v Minister for Planning* [2006] NSWLEC 720; (2006) 152 LGERA 258, [126] and [135].

The Court's power to recommend conditions in relation to groundwater

86. The Court has considered previously whether it can recommend conditions on the mining lease or the environmental authority which might otherwise be contained in a water licence issued under the *Water Act 2000* (Qld) separately to the applications currently before the Court.

87. In *Xstrata*, the Court held that it could not recommend conditions relating to the diversion or appropriation of water on a mining lease or an environmental authority.[68] The Court reached this conclusion on the basis of s 235(3) of the MRA, which provides:

> Where any Act provides that water may be diverted or appropriated only under authority granted under that Act, the holder of a mining lease shall not divert or appropriate water unless the holder holds that authority.

88. In *Xstrata*, the Court held that, because a further approval was required under the *Water Act*, the diversion or appropriation of water were not matters authorised under either the mining lease or the environmental authority and, hence, no conditions in relation to those matters could be recommended.[69]

89. The First Respondent submits that, contrary to the decision in *Xstrata*, the Court may recommend conditions be imposed relating to groundwater on a mining lease or an environmental authority. This is based on two premises:

(a) First, that the Court has a broad power, under both the MRA and the EPA, to recommend conditions that fairly and reasonably relate to development being approved; and

(b) Second, the fact that a further approval is required before an action is taken does not prevent the powers conferred on the Court under the MRA and EPA from being exercised.

90. The Court has a broad power to recommend conditions on a mining lease. Section 269(3) of the MRA confers on the Court the power to recommend approval of a mining lease subject to conditions which it "considers appropriate". Although the phrase "considers appropriate" has not been the subject of significant judicial consideration,[70] in substance, it is equivalent to impose such conditions as a decision-maker "thinks fit". That phrase has been considered on many occasions.[71] Such a power is not absolute, as it must be exercised for the purposes for which it is conferred, but, within that, it is very broad.[72] As Gillard J observed in *Protean (Holdings) Ltd v Environmental Protection Authority*, such a test provides limited practical assistance in determining whether a particular condition is within power.[73] In that case, his Honour consider the more useful test was that advocated by Lord Denning in *Pyx Granite Co Ltd v Ministry of Housing and Local Government*, which asks whether the condition imposed "fairly and

[68] *Xstrata* case [2012] QLC 013; (2012) 33 QLCR 79 at [205]–[215].
[69] *Xstrata* case [2012] QLC 013; (2012) 33 QLCR 79 at [205]–[215].
[70] *The Appellants v Council of the Law Society of the ACT and the Legal Practitioner* [2011] ACTSC 133, [77].
[71] See, e.g., *Shrimpton v The Commonwealth* (1945) 69 CLR 613, at 619-620.
[72] *Shrimpton v The Commonwealth* (1945) 69 CLR 613, at 619-620.
[73] [1977] VR 51, at 59.

reasonably relates" to the proposed development.[74] If it did, then the condition was within power.

91. The Court has a similarly broad power under the EPA. The power to recommend conditions under the EPA depends on whether a draft environmental authority has been issued for a project. Where, as here, a draft environmental authority has been issued, the Court may recommend approval either subject to any draft conditions contained in the environmental authority or subject to "stated conditions".[75] The only express constraint on this Court's power to recommend conditions is that the conditions stated must not contradict those imposed by the Coordinator-General.[76] In the absence of any further limitations on the kind of conditions that might be imposed, The First Respondent submits that a broad approach should be taken to the power to recommend conditions. Such an approach is consistent with the text of the EPA and more likely to promote the purposes of the Act than a narrow conception.

92. In light of the above, the First Respondent's position is that the Court has a broad power to recommend conditions on a mining lease or environmental authority provided those conditions "fairly and reasonably relate" to what is being authorised by the relevant instrument.

93. The requirement to obtain an approval under the *Water Act* does not exclude the Court recommending conditions relating to groundwater take as part of other approvals processes:

    (a) The Court's reasoning in *Xstrata* appears to be premised on the view that, because the taking of groundwater specifically requires authorisation under the *Water Act* in order to be lawful, then the taking of groundwater is not authorised under either a mining lease or an environmental authority.

    (b) The First Respondent respectfully disagrees with this view. It submits that the better view is that the EPA, the MRA and the *Water Act* form a series of "multiple controls", all of which must be complied with in order for the taking of groundwater to lawfully occur. Such controls operate in parallel, rather than to the exclusion of one another.

94. The concept of "multiple controls" has been endorsed by the Privy Council, in *Associated Minerals Consolidated Ltd v Wyong Shire Council*,[77] and the High Court in *South Australia v Tanner*.[78] In *Wyong*, the Privy Council considered whether planning permission was required for mining where a mining lease had been granted under the *Mining Act 1906* (NSW). Their Lordships concluded that planning permission was required:

> Both Acts apply, or are capable of being applied, with complete generality to land in the State of New South Wales. Can they, in relation to a given piece of land, coexist?

[74] [1958] 1 QB 554, at 572.
[75] EPA, s 222(1)(b).
[76] EPA, s 222(2)(b).
[77] [1974] 2 NSWLR 681. *Wyong* was recently referred to with approval by Crennan, Kiefel and Bell JJ in the decision of *Commissioner of Police (NSW) v Eaton* (2013) 252 CLR 1 at 18-19, [45]-[46], regarding the need to construe the legislative intent when determining the relationship between two statutes.
[78] (1989) 166 CLR 161.

> In their Lordships' opinion they clearly can, and do. The Acts have different purposes, each of which is capable of being fulfilled.[79]

95. Similarly, in *Tanner*, the High Court rejected an argument that a prohibition on zoos contained in regulations under the *Waterworks Act* 1932 (SA) was inconsistent with the provisions of the *Planning Act* 1982 (SA), which, it was said, provided a complete code for development. In rejecting this argument, the High Court accepted a submission by the Attorney-General for South Australia that:

> Both pieces of legislation can stand together and operate cumulatively. They can do this because each Act has a distinct purpose, different from the other.[80]

96. Here, as in *Wyong* and *Tanner*, each of the EPA, the MRA and the *Water Act* has a separate and distinct purpose and those Acts can and should be treated as operating cumulatively. No single Act has precedence over the other two. Rather, it is necessary to obtain permission under each of those Acts in order to lawfully conduct mining operations which involve the diversion or appropriation of water.

97. Understood in this light, s 235(3) of the MRA does no more than confirm what would otherwise be true: namely, that the mere conferral of a mining lease does not, without more, authorising the taking of groundwater for which permission is required under the *Water Act*.

98. It follows that s 235(3) does not operate to exclude the taking of groundwater from consideration under the EPA and MRA. By extension, if taking of groundwater is a relevant consideration under those Acts, then the power to recommend conditions on instruments under those Acts extends to a power to recommend conditions in relation to the taking of groundwater.

The appropriateness of imposing conditions

99. Leaving aside the issue of power, however, it is the First Respondent's position that the purpose of conditions on a permit is to avoid or manage impacts once they have been identified.

100. This requires the Court to have some confidence that it knows what the impacts of granting approval will be and, further, to have confidence that the conditions imposed will be able to manage those impacts. In all the circumstances of this case, the Court cannot have that confidence. To try to manage impacts for fundamental components of the mining operation such as interference with groundwater without knowing what they are would violate the "principle of finality" endorsed by the Court of Appeal in *McBain v Clifton Shire Council*,[81] as it would potentially result in the approval of something quite different from what was originally considered.

101. Accordingly, rather than seek to regulate unknown impacts through stringent conditions, it is appropriate to simply recommend refusal of the applications.

102. These propositions are consistent with recent academic and professional commentary and analysis of groundwater conditions imposed in Australia purporting to apply

[79] [1974] 2 NSWLR 686, 686.
[80] (1989) 166 CLR 161, at 170.
[81] [1995] 2 Qd R 493. See also cases cited there at pp 496–497.

"adaptive management" principles,[82] including specific criticism of the EPBC Act conditions imposed on the Kevins Corner Coal Mine in the Galilee Basin.[83] This analysis indicates that:

(a) "Good adaptive management requires thorough front-end EIA in order to determine ecosystem baselines, identify uncertainties and make informed decisions on planning and management. It also requires transparency in both its upfront design and its implementation."[84]

(b) "Adaptive management should not be used as a tool to defer tough planning and management decisions and upfront EIA to opaque post-approval processes. Good adaptive management requires thorough front-end EIA and transparency in both its upfront design and its implementation."[85]

(c) "Without substantive limits to guide and constrain it, adaptive management can become nothing more than mere process that fails to deliver substantive environmental outcomes."[86]

(d) "Prior to the grant of a project approval, there should be, at least, a clear definition of the management problem and baseline conditions, and an effective numerical model to predict the impacts of the project and identify areas of uncertainty."[87]

103. This academic and professional analysis emphasise the need to set substantive limits and triggers in the conditions of approval when using adaptive management, something that is conspicuously absent from the conditions imposed on the Carmichael Coal Mine.

104. These points are consistent with many of the criticisms the First Respondent makes of the conditions of proposed approval for the Carmichael Coal Mine relating to groundwater, the Black-throated Finch and the Waxy Cabbage Palm. These matters are addressed in more detail below.

Relevance of general government support for coal industry

105. The Court ought not to accept the policy argument advanced by the Applicant. The Applicant's contention here is that, because governments, State and Federal, favour the coal industry, the Court should not do anything to discourage investment in that industry, such as making private companies bring to account emissions caused by burning of the coal they sell, whether in Australia or overseas. This is apparent in Mr Stanford's observation, with reference to a recent agreement between the Australian and Indian governments to develop a strategic partnership in energy, that:

[82] Lee J, "Theory to practice: Adaptive management of the groundwater impacts of Australian mining projects" (2014) 31 *Environmental and Planning Law Journal* 251-287.
[83] Lee J and Gardner A, "A peek around Kevin's Corner: adapting away substantive limits? (2014) 31 *Environmental and Planning Law Journal* 247-250.
[84] Lee, above n 82, p 257.
[85] Lee, above n 82, p 282
[86] Lee and Gardner, above n 83, p 247.
[87] Lee and Gardner, above n 83, p 247.

> Jon Stanford notes that from a public policy perspective, Australian governments generally welcome foreign investors.[88]

106. This should be categorically rejected. As this Court has previously observed, the Court is not a "rubber stamp" and should not be viewed as such by anyone.[89]

107. It is unsurprising that governments may favour projects with the potential to deliver short-term economic benefits to their constituents, but the function of this Court, under both the EPA and the MRA, is to act independently, to provide a forum for the ventilation of argument and the rigorous testing of evidence and, after that, to make full and frank reports to the EPA Administering Authority and the Minister administering the MRA regarding the likely impacts, positive and negative, of the proposals before it.

108. The importance of this function, and proper approach to it, was recognised by Barwick CJ, with whom Murphy J agreed, in *Sinclair v Maryborough Mining Warden*. His Honour said:

> It is to my mind very important that hearing of an application and of objections thereto by a mining warden take place according to law. The purpose of notifying the making of the applications, indicating the time for objections and of the date of hearing, is to afford the applicant on the one hand an opportunity to justify in a public hearing the grant of a mining lease, both in point of area and point of term, and also to give the public an opportunity of opposition supported by evidence to the grant of a mining lease. I cannot accept the proposition that the hearing of the application and of the objections is a mere formality…[90]

109. In particular, the Court serves a unique function in the assessment of the environmental authority and mining lease applications by providing for the public testing of evidence. While the Carmichael Coal Mine was approved by the Commonwealth Minister under the EPBC Act and the Queensland Coordinator-General has recommended approval, the reality is that this approval and support was provided with little opportunity for concerned parties to challenge the merits of assertions made by the Applicant. The importance of this testing is underlined by the fact that the Applicant has made a number of significant concessions regarding its evidence that might well have been material to those earlier decisions, but were only exposed through this process.

110. Ultimately, this Court has to discharge the vital functions conferred on it by statute. No policy of general government support for the coal industry has the effect of changing the legislative regime to be applied by this Court and this Court should not shy away from fully and vigorously examining the evidence simply because of a perception of what 'Governments' want.

Consideration of the mine's contribution to climate change

111. The consideration of climate change impacts has been a vexed issue in past decisions of the Court and for this reason will be addressed as a final topic in relation to the legal tests to be applied by the Court.

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[88] Exhibit 36; JR007 (Energy Markets & Financial Analysis Joint Experts Report) soft page 16.
[89] *Hancock Coal Pty Ltd v Kelly & Ors* [2013] QLC 9 at [4].
[90] (1975) 132 CLR 473, at 481.

Relevance of climate change to statutory criteria to be considered by the Court

112. The Court held in the *Alpha* case, based on the reasoning in *Xstrata*, that scope 3 emissions from the mine were relevant to the consideration of the public interest in s 269(4)(k) of the MRA and therefore within the jurisdiction of the Court to consider on this basis but not otherwise.[91]

113. The First Respondent submits that the contribution that the mine will make to climate change through direct emissions of greenhouse gases during the mining process and indirectly from the transport and use of the coal from the mine are relevant to consider under other mandatory considerations in the both the EPA and MRA. In particular:

(a) **Intergenerational equity**: Pain J held in *Gray v Minister for Planning* [2006] NSWLEC 720; (2006) 152 LGERA 258 at [122] that an important consideration in intergenerational equity must be the assessment of cumulative impacts of an activity with others. Her Honour found at [126] that failing to take into account the major component of greenhouse gases generated from a coal mine by the burning of the coal from the mine (scope 3 emissions) contravened the concept of intergenerational equity.

(b) **Character, resilience and values of the receiving environment**: The character and exceptional values of the Great Barrier Reef World Heritage Area, and its very low resilience to further emissions of greenhouse gases from the combustion of fossil fuels such as coal[92] are also matters requiring careful consideration in approving a major new source of such emissions.

(c) **Environmental values**: As noted above, at [20], "the environment" and "environmental values" in ss 8 and 9 of the EPA include:

(i) the concentration of CO_2 in the atmosphere and its associated greenhouse effect; and

(ii) the climate.

(d) **Environmental harm**: As noted above, at [22], an act that adversely effects the concentration of CO_2 in the atmosphere or the climate constitutes environmental harm.

(e) **Public interest under EPA**: The statutory context of "the public interest" under the EPA suggests it must be construed to allow and require consideration of all of the effects of the mine on the environment, both positive and negative, including the scope 3 emissions from the transport and burning of the coal from it.

(f) **Environmental harm**: The centrality of the consideration of environmental harm to the assessment of the mine under the EPA was discussed above at [44]-[47]. The environmental harm likely to be caused by the greenhouse gases produced by the mining, transport and use of the coal obtained from the mine is clearly harm which is a "direct or indirect" result of the mining activities as comprehended by s 14 of

[91] *Alpha* case [2014] QLC 12 at [218] and [232], citing, at [218], the reasoning in the *Xstrata* case [2012] QLC 013; (2012) 22 QLCR 79 at [576].
[92] Exhibit 12; OL014 (Prof. Hoegh-Guldberg's Climate Change & GBR Expert Report).

the EPA. It follows, therefore, that the fact that a decision to approve an environmental authority for the mine would authorise that "environmental harm" requires the Court to consider the contribution that the mine would make to climate change due to scope 1, 2 and 3 emissions from the mining, transport and use of the coal from the mine.

(g) **Any adverse environmental impact caused by the mine:** While the Court held in *Xstrata* that the consideration under s 269(4)(j) did not include the contribution that the burning of coal from the mine makes to climate change, the relevance of these matters under s 269(4)(j) is considered further below, commencing at [115].

(h) **Any good reason:** The general requirement to consider whether "any good reason" has been shown to refuse a mining lease under s 269(4)(l) is a very wide consideration, as discussed above at [62]. It is within the scope of the MRA to consider the contribution the mine makes to climate change through the burning of the coal from it.

114. In particular, the First Respondent submits that the Court's jurisdiction in assessing the application for an environmental authority for the mine under the EPA includes the jurisdiction to consider the scope 3 emissions as direct and indirect harm caused by the transport and burning of the coal produced from the mine. The First Respondent submits, with respect, that the Court was wrong to conclude otherwise in *Xstrata*.[93]

Reasoning in the Xstrata and Alpha cases

115. The First Respondent respectfully submits that the Court erred in *Xstrata* by excluding the impacts of the transport and burning of the coal from the mine from the matters that fell within "any adverse environmental impact caused by those operations" under s 269(4)(j) of the MRA.[94]

116. The First Respondent submits that "any adverse environmental impact caused by those operations", in greenhouse gas terms, is not restricted only to the effects of the greenhouse gases emitted by activities such as driving vehicles on the mine site or using electricity to power mine site activity. It is submitted that the statutory context of paragraph 269(4)(j) requires a construction of "any adverse environmental impact caused by those operations" that includes indirect downstream impacts.[95] Because the operations are for the purpose of winning coal for sale and export for ultimate use in power generation, impacts of those operations include the winning of the coal (to which the operations are directed) and the impacts of transporting and using that coal. The emissions from the transport and burning of the coal are inevitable consequences of the mining of it.

117. "Impact" is not defined in the MRA. The ordinary meaning of "impact", in the context of paragraph 269(4)(j) of the MRA, is "influence or effect [exerted by a new idea,

[93] *Xstrata* case [2012] QLC 013; (2012) 22 QLCR 79 at [597]-[603].
[94] *Xstrata* case [2012] QLC 013; (2012) 22 QLCR 79 at [530].
[95] As stated in *Environmental Defence Society Inc v South Pacific Aluminium Ltd (No 4)* [1981] 1 NZLR 531 at 534, the mine must not be divorced from other activities (in this case the sale and intended use of the coal from the mine) that "alone could give it industrial meaning and with which it clearly would be inextricably involved." However, in New Zealand amendments to the *Resource Management Act* 1991 (NZ) mean that the contribution a coal mine will make to climate change is not relevant in assessing it under that Act: see *West Coast ENT Inc v Buller Coal Ltd* [2014] 1 NZLR 32.

concept, ideology, etc.]".[96] The question for the Court posed by the paragraph becomes "whether there will be any adverse environmental influences or effects caused by the mining operations conducted pursuant to the mining lease".

118. While the Court took a contrary approach in *Xstrata*,[97] the meaning of "impact" was considered specifically in the context of environmental impact assessment in *Minister for the Environment and Heritage v Queensland Conservation Council Inc* (2004) 139 FCR 24 at [53]-[57] (**the *Nathan Dam Case***). The Full Court of the Federal Court held in relation to the meaning of the phrase "all adverse impacts" in s 75 of the *Environment Protection and Biodiversity Conservation Act* 1999 (Cth) (**EPBC Act**) that impact in its ordinary meaning can readily include the "indirect" consequences of an action and may include the results of acts done by persons other than the principal actor. Impact is not confined to direct physical effects of the action. It includes effects which are sufficiently close to the action to allow it to be said, without straining the language, that they are, or would be, the consequences of the action on the protected matter.[98]

119. In the Nathan Dam Case, the "action" being considered was a dam intended to allow, *inter alia*, the growing of cotton in areas not previously able to be used for agriculture through using water stored by the dam. The impacts which the Minister had excluded from his consideration were potential impacts of the run off from cotton farms on the Great Barrier Reef hundreds of kilometres downstream. The effect of the decision, at first instance and confirmed on appeal, was that those indirect, downstream impacts on the Reef were impacts of the action for the purpose of the EPBC Act.

120. While there are differences in the precise terms of the relevant statutes, the reasoning in the Nathan Dam Case is applicable to the present construction question. The construction of a dam is, essentially, a physical activity whose direct impacts on the environment are localised and, relatively, restricted. The dam, like a coal mine, produces a product intended for use elsewhere. That product, by being available for use, makes possible activities for which it would not, otherwise, be used. These activities are, in each case, contemplated by the proponent of the action. These subsequent activities have, potentially, broader and more far reaching effects. That is, if the coal stays in the ground (the operations do not occur), it cannot be used for power generation. Similarly, if the water is not stored, it cannot be used for cotton growing. In both cases, the subsequent (facilitated) activities involve the actions of other people but without breaking, as a matter of ordinary usage, the causal relationship between the original physical activities and the effects of the subsequent activities. In both cases, "impact" is used in the phrase being construed and is used in the context of legislation providing for environmental impact assessment and, in both cases, decisions may be made (or recommended) that the proposal be approved, approved with conditions, or not approved. The analogy between the provision in Nathan Dam and paragraph 269(4)(j) is very close, in our submission.

121. In *Xstrata*, the Court distinguished the decision in the Nathan Dam Case "because of the differences in the definitions of the words "action" [in the EPBC Act] and

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[96] *The Macquarie Concise Dictionary* (Revised 3rd ed, The Macquarie Library, 1999), p 564. This definition was accepted in the *Xstrata* case [2012] QLC 013; (2012) 22 QLCR 79 at [533].
[97] *Xstrata* case [2012] QLC 013; (2012) 22 QLCR 79 at [535]-[549].
[98] *Nathan Dam Case* (2004) 139 FCR 24 at [53].

"operations" [in the MRA]."[99] The Court held that the word "operations" is limited to the activities of mining and extracting coal while the word "action" is not so constrained.[100] It is submitted that this reasoning is erroneous as the key term in both pieces of legislation is "impact", which can include both direct and indirect effects of the action or operation.[101] The transport and burning of the coal from the mine is an *indirect* impact of the mine under both the EPBC Act and the MRA.

122. In *Xstrata*, the Court did not refer to NSW and Victorian cases that relied upon the Nathan Dam Case in support of findings under legislation in those States that the emissions of the burning of coal in a power station must be considered when assessing a proposed coal mine.[102] The Court did refer to *Wildlife Preservation Society of Queensland Proserpine/Whitsunday Branch Inc v Minister for the Environment and Heritage* [2006] FCA 736; (2006) 232 ALR 510 as supporting its conclusions to exclude scope 3 emissions from consideration.[103] It is again submitted that the Court erred in relying on that decision. In that case, Dowsett J found that the decision-maker under the EPBC Act had correctly considered the greenhouse gas emissions from the mining, transport and use of coal (scope 1, 2 and 3 emissions) from two coal mines in deciding that the mines were not controlled actions under s 75 of the EPBC Act. However, Dowsett J doubted, in *obiter dicta*, the need to consider greenhouse gas emissions from the use of coal from coal mines under the principles in the Nathan Dam Case.[104] It is submitted that that *obiter dicta* reasoning was erroneous as the reasoning of the Full Court regarding the downstream impacts of using water from a dam was directly analogous to the downstream impacts of burning of coal from a coal mine.

123. The construction that indirect, off-site impacts of a mine must be considered is also supported by the use of "any", in paragraph 269(4)(j) of the MRA as a determiner or pronoun to qualify "adverse environmental impact". The obligation to consider whether "there will be <u>any</u> adverse environmental effect …" in paragraph 269(4)(j) is analogous to the express requirement to consider "<u>all</u> adverse effects, if any" in subs 75(2) of the EPBC Act. It is submitted that the legislature has acknowledged that impacts of the mining operation may be many and varied, direct and indirect.[105] Read in context and in light of the objects of the Act, "any" means in whatever quantity or number, great or small.[106]

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[99] *Xstrata* case [2012] QLC 013; (2012) 22 QLCR 79 at [548].
[100] *Xstrata* case [2012] QLC 013; (2012) 22 QLCR 79 at [548].
[101] As accepted in the *Xstrata* case [2012] QLC 013; (2012) 22 QLCR 79 at [533].
[102] *Gray v Minister for Planning* [2006] NSWLEC 720; (2006) 152 LGERA 258, particularly at [98]-[100] (Pain J); *Australian Conservation Foundation v Minister for Planning* [2004] VCAT 2029; (2004) 140 LGERA 100, particularly [42]-[47] (Morris J). This approach has also been adopted in the United States under the *National Environmental Protection Act 1969* (US): *High Country Conservation Advocates & Ors v United States Forestry Service & Ors* (2014) No. 13-cv-01723, USDC Colorado, 06/27/2014 (Jackson J). A different approach is taken in New Zealand due to specific amendments to the *Resource Management Act* 1991 (NZ): see *West Coast ENT Inc v Buller Coal Ltd* [2014] 1 NZLR 32.
[103] *Xstrata* case [2012] QLC 013; (2012) 22 QLCR 79 at [538]-[542] and [559].
[104] *Wildlife Preservation Society of Queensland Proserpine/Whitsunday Branch Inc v Minister for the Environment and Heritage* [2006] FCA 736; (2006) 232 ALR 510 at [72].
[105] See generally, *Parramatta City Council v Hale* (1982) 47 LGRA 319 at 342 per Moffitt P.
[106] "Any" is defined in the *The Macquarie Concise Dictionary* (Revised 3rd ed, The Macquarie Library, 1999), p 43, as, "**any** / *determiner* / 1. one, a, an, or (with plural noun) some, whatever or whichever it may be: *if you have any witnesses, produce them*. **2.** in whatever quantity or number, great or small: *have you any butter?* **3.** every: *any schoolchild would know that*. **4.** (with a negative) none at all. **5.** a great or unlimited (amount): *any number of things*. – *pronoun* **6.** (*construed as singular*) any person; anybody, or (*construed as plural*) any persons:

124. In the context of a coal mine, producing coal for electricity production will inevitably result in the emission of significant amounts of greenhouse gases when the coal is burnt. There is no suggestion on the evidence before the Court that any other result is contemplated or likely. The Applicant and draft conditions of the environmental authority do not propose to limit such emissions in any way and none of the experts suggested a different result was likely. In such circumstances, the "adverse environmental impact" of the mining operations required to be considered by s 269(4)(j) of the MRA includes the contribution of those greenhouse gases to climate change as a result of the downstream activities of transporting and using the coal which has been won by the mining activities.

125. Such an approach is entirely consistent with the normal approach of considering environmental impacts in legislation that provides for an environmental impact statement (EIS) to be prepared, as was provided here through the EIS process in the SDPWOA for assessing the applications under the MRA and EPA. As a practical tool for decision-making, environmental impact assessment (of which the main type is an EIS) need not be perfect or cover every topic, but it is well recognised that it must at least attempt to broadly alert the decision-maker and members of the public to the true effect of the activity and the consequences to the community inherent in the carrying out or not carrying out of the activity.[107]

126. Obviously there must be a real and sufficient link between the less direct effects likely to flow from the mine if they are to be regarded as relevant. But it is unlikely that it could be Parliament's intention that, in every case, the consideration of the adverse impacts are limited to site-specific and direct impacts of the mining operation in isolation. Assessment of the adverse impacts of the mine should not be artificially separated from activities that give the mine commercial meaning and with which it is inextricably involved.[108] The transport and burning of the coal from the mine are such activities given that the production and sale of the coal is the commercial purpose of the mine.

Consideration of harm caused by others if the mine does not proceed

127. The Court held in the *Alpha* case, based on the reasoning in *Xstrata*, that scope 3 emissions from the mine were relevant to the consideration of the public interest in s 269(4)(k) of the MRA and therefore within the jurisdiction of the Court to consider on this basis but not otherwise.[109]

128. The Court in both the *Xstrata* case and the *Alpha* case excluded or gave zero weight to the environmental harm that would be caused by the transport and use of the coal produced by the mining activities that would be authorised by the environmental authority the subject of the objections decision in part on the basis of evidence before

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he does better than any before him; *unknown to any*. **7.** any single one or any one's; any thing or things; any quantity or number: *I haven't any*. *– adverb* **8.** in any degree; to any extent; at all: *do you feel any better?*; *will this route take any longer?*

[107] *Prineas v Forestry Commission of NSW* (1983) 49 LGRA 402, 417 per Cripps J.

[108] Adopting similar reasoning to *Environmental Defence Society Inc v South Pacific Aluminium Ltd (No 4)* [1981] 1 NZLR 531 at 534 (Woodhouse P, Cooke, Richardson and McMullen JJ).

[109] *Alpha* case [2014] QLC 12 at [218] and [232], citing, at [218], the reasoning in the *Xstrata* case [2012] QLC 013; (2012) 22 QLCR 79 at [576].

the Court on both occasions that other coal mining operations would cause equivalent harm.[110]

129. The factual evidence is quite different in this case, but sticking to the law it is submitted, with respect, such evidence and the conclusions drawn from such evidence of equivalent harm are irrelevant matters that ought not to have been considered by the Land Court or given any weight. Inter alia, by considering and giving weight to those matters, the Land Court, in the *Xstrata* case and the *Alpha* case, removed from consideration the environmental harm caused by the mining activities that would be approved and made lawful by the grant of the environmental authority, a matter that the Land Court was bound to consider by the combined effect of ss 14, 190, 191 and 493A of the EPA.

130. In addition, by considering and giving weight to the impacts that would arise from notional other mining activities, the Court in *Xstrata* case and the *Alpha* cases misdirected itself in that the objections decision required the court to assess the likely environmental harm of the mine the subject of the application and not the likely impacts that might be caused by other activities.

131. This appears, in many respects, to be the central consideration that drew the Court away from considering those impacts, so exhaustively expressed in s 14 of the EPA, and, necessarily, matters to be considered when the statutory scheme is considered and applied. The attraction of the miner's argument appears to arise when causation of environmental harm is considered in the abstract, in neglect of the principles in *Allianz Australia Insurance Ltd v GSF Australia Pty Ltd* (2005) 221 CLR 568 (***Allianz***) and in neglect of the statutory scheme. It is no doubt attractive, in the abstract, to assume that, 'if I don't do it, someone else might do so'.

132. The notion that a certain person's unlawful activity (causing environmental harm) should be ignored because some other actor in the market may cause similar harm is, at best, unconventional. No other unlawful actor could argue that the impact of her actions should be ignored because another actor might or will have stepped in to cause the same harm.

133. There is an issue of general importance that arises here, namely: whether liability for a positive contribution to harm can be avoided on the basis of a party establishing that if the party did not act, someone else would cause equivalent harm in circumstances where the harm is not negligible and the party is one of many contributors to the harm (put simply, the defence is, "I should not be held liable for the harm because if I don't do it, someone else will")?

134. In relation to this issue, Professor Stapleton recently considered the principles of causation in the USA, the UK and Australia, and issues for which liability may be attributed for a positive contribution, albeit unnecessary, to the relevant step in the mechanism by which an indivisible injury occurred.[111] She discussed the following example:

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[110] *Xstrata* case [2012] QLC 013; (2012) 22 QLCR 79 at [599]; and *Alpha* case [2014] QLC 12 at [221]-[232] and [248].

[111] Stapleton J, "Unnecessary causes" (2013) 129 *The Law Quarterly Review* 39. See also, Edelman J, "Unnecessary causation" (2015) 89 *Australian Law Journal* 20-30.

Suppose:

> A, B and C, acting independently but simultaneously, each negligently lean on Paul's car, which is parked at a lookout at the top of a mountain. Their combined force results in the car rolling over a diminutive curbstone and plummeting down the mountain to its destruction. The force exerted by the push of any one actor would have been insufficient to propel Paul's car past the curbstone, but the combined force of any two of them is sufficient. No individual was necessary for the destruction of the car, yet it seems plausible that the law would want to identify their role.

If the law required a factor to satisfy the but-for test before it would be recognised as a factual "cause", the striking result would be that, while it would be known exactly what happened and by what agency, the law would not identify any of these three individuals as a "cause" of the car's destruction.[112]

135. Professor Stapleton continued with another example regarding pollution:

> Another area in which unnecessary factors are important is pollution. Consider this scenario:
>
> > A number of factories each independently and in breach of duty discharge oil into a bay. Under a regulatory standard, fishing in the bay is forbidden if the concentration of oil is greater than a particular level. By the time the pollution is detected the concentration far exceeds this level. The ban is triggered and results in grave economic injury to local commercial fishermen. Suppose the discharge from no one factory would alone have been sufficient to result in the regulatory threshold being exceeded and that, given the other contributions, no one contribution was necessary for the threshold to be reached.
>
> Again if we require a factor to be necessary for an outcome before we are prepared to recognise it as "causal", we would have the striking situation of knowing exactly what happened and by what agency but the law would not identify any of the polluters as a "cause" of the economic injury to the fishermen.[113]

136. Professor Stapleton concluded, relevantly:

> … in cases where the relevant step in the injurious mechanism is known to involve a threshold the only causal question should be whether or not, on the evidence, the factor made the alleged positive contribution to that mechanism. Often this question can uncontroversially be answered in the affirmative, as in all the earlier illustrations: about the car being pushed off the mountain … and about the pollution of the bay.
>
> It is important to note that the conclusion that a factor was a "cause" can be reached in such cases even where the extent of its positive contribution is disputed or unknown. We can conclude, for example, that one of the car pushers in the first illustration made a causal contribution to the car's destruction even if we do not know how much force he exerted. Similarly we can conclude, for example, that one of the polluters made a causal contribution to the triggering of the ban without knowing the volume of pollution it contributed. Such evidentiary gaps do not prevent the relation being identified as "causal".[114]

137. Applying Professor Stapleton's analysis to the statutory language of the EPA, particularly s 14(2) and the object of the Act stated in s 3 to protect the environment while allowing for ESD, it is submitted that under the EPA liability for a positive contribution to harm cannot be avoided on the basis of a party establishing that if the party did not act, someone else would cause equivalent harm in circumstances where

[112] Stapleton, above n 111, 43 (footnote omitted).
[113] Stapleton, above n 111, 44 (footnote omitted).
[114] Stapleton, above n 111, 47 (footnote omitted).

the harm is not negligible and the party is one of many contributors to the harm. The language of s 14 of the EPA that every kind of impact, big or little; long term or short term; certain or potential; direct or indirect; caused solely or cumulatively, must be considered embraces and reflects Professor Stapleton's analysis of legal liability attaching to a factor making a positive, though unnecessary, contribution to a harm.

138. To allow liability for a positive contribution to environmental harm to be avoided by reference to the potential actions of others would defeat the object of the Act of protecting the environment while allowing for ESD.

139. Given this statutory context, the defence that, "I should not be held liable for the harm because if I don't do it, someone else will", is not open under the EPA.

140. This has the consequence that the Court must consider in assessing the application for the environmental authority for the mine the contribution that the mining, transport and burning of the coal from the mine will make to climate change, irrespective of the actions of other mines.

141. Further, it is no defence to the harm that the mine will cause to threatened species, such as the Black-throated Finch, to say that "the species will go extinct anyway, so the mine makes no difference". Again, the positive contribution that the mine makes to the threats to the species must be considered without assuming an outcome in which the mine makes no ultimate difference.

Relevance of NGER Act accounting framework and UNFCCC

142. The Applicant contends that, because it is only required to account for its Scope 1 and 2 emissions under the *National Greenhouse and Energy Reporting Act 2007* (Cth) (**NGER Act**) and because Australia is only required to report its national (Scope 1) emissions under the *United Nations Framework Convention on Climate Change 1992* (**UNFCCC**), then this Court should not consider Scope 3 emissions embedded in coal produced by the mine in assessing the mine under the EPA and MRA. Put another way, the argument is "Australia does not have to report (Scope 3) greenhouse gas emissions in coal exports, therefore the Court does not have to consider it". The correctness of this submission ultimately depends on the proper construction of the EPA and the MRA.

143. Properly construed, neither the NGER Act nor the UNFCCC has the effect the Applicant contends of excluding consideration of Scope 3 emissions from coal produced by a mine when assessing applications under the EPA and MRA.

144. In relation to the UNFCCC:

(a) In construing the EPA and MRA, as far as the language permits it is appropriate to construe any ambiguity so as to conform to Australia's international obligations, at least in those cases in which the legislation is enacted after, or in contemplation of, entry into, or ratification of the relevant international instrument.[115]

[115] *Minister for Immigration and Ethnic Affairs v Teoh* (1995) 183 CLR 273, at 287. The First Respondent notes for the Court that the UNFCCC (ATS 1994 No 2) was signed by Australia on 4 June 1992, ratified by Australia on 30 December 1992 and entered into force for Australia and generally on 21 March 1994. The subsequent

(b) Subject to any contrary intention revealed by the domestic statute making an international instrument part of domestic law, the ascertainment of the meaning of, and obligations within, an international instrument that is made part of domestic law is to be ascertained by giving primacy to the ordinary meaning of the text of the international instrument, but also by considering the context, objects and purposes of the instrument.[116]

(c) The ultimate objective of the UNFCCC, as stated in Article 2, is:

> … to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.

(d) As a party to the UNFCCC, Australia committed under Article 4(1)(f) to:

> Take climate change considerations into account, to the extent feasible, in their relevant social, economic and environmental policies and actions, and employ appropriate methods, for example impact assessments, formulated and determined nationally, with a view to minimizing adverse effects on the economy, on public health and on the quality of the environment, of projects or measures undertaken by them to mitigate or adapt to climate change.

(e) As a developed (Annex I) party to the UNFCCC, Australia committed under Article 4(2)(a) to:

> … adopt national policies and take corresponding measures on the mitigation of climate change, by limiting its anthropogenic emissions of greenhouse gases and protecting and enhancing its greenhouse gas sinks and reservoirs.[117]

(f) Consistent with these provisions, there is nothing in the UNFCCC which, subject to other international obligations, would prevent any nation from taking action to address climate change, especially where that action consists merely of taking climate change impacts into account in domestic decision-making or protecting greenhouse gas reservoirs such as large coal deposits;

(g) Indeed, given the ultimate objective of the UNFCCC is not merely to establish a reporting regime, but to actually avoid dangerous climate change, it would be inconsistent with that objectiveif it prevented parties from taking steps to address emissions from fossil fuels exported by it or protecting its greenhouse gas reservoirs such as large coal deposits.

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reporting framework under the *Kyoto Protocol to the UNFCCC* (**Kyoto Protocol**) ([2008] ATS 2) was done in Kyoto on 11 December 1997 and signed for Australia on 24 April 1998. It entered into force generally on 16 February 2005 but was not ratified by Australia until 12 December 2007 and entered into force for Australia on 11 March 2008. The MRA was assented to 25 October 1989 and the EPA was assented to on 1 December 1994. The First Respondent takes no issue as a consequence of these dates.

[116] *Applicant A v Minister for Immigration and Ethnic Affairs* (1997) 190 CLR 225 (***Applicant A***) at 240 (per Dawson J) and 251-56 (per McHugh J, with whom Brenna CJ and Gummow J agreed).

[117] Footnote omitted. "Reservoir" is defined in Art 1(7) as "'Reservoir' means a component or components of the climate system where a greenhouse gas or a precursor of a greenhouse gas is stored."

145. The Applicant's submission in relation to the impact of the NGER Act on this Court's consideration is erroneous. The normal situation is that State and Commonwealth environmental laws operate concurrently and Commonwealth laws do not override State laws other than in situations of Constitutional conflict.[118] The environmental authority and the mining lease are to be assessed under the EPA and MRA, respectively, not the NGER Act. The EPA and MRA are, relevantly, concerned with the proper environmental impact assessment of proposed mines. The consideration of the greenhouse gas emissions from those mines arises only as an aspect of the overall assessments under the EPA and MRA.

146. It is clear that the Commonwealth Parliament did not intend the NGER Act to override State environmental impact assessment and environmental approval laws such as the MRA and EPA. The situation is analogous to *Commercial Radio Coffs Harbour Ltd v Fuller*[119] where State planning laws were held to not be overridden by Commonwealth laws requiring commercial radio stations to be licenced.

147. Section 5 of the NGER Act expressly addresses the issue of inconsistency with State laws and excludes any State legislation identified under the regulations to the Act that provides, in substance, for carbon reporting by constitutional corporations. Neither the EPA nor the MRA are identified under the regulations to the NGER Act. Further, neither the EPA nor the MRA create a reporting framework for greenhouse gases. Instead, they require assessment of the impacts, including the environmental impacts, of the relevant proposal. Put simply, there is nothing in the NGER Act that would suggest any intention to exclude Scope 3 emissions, if otherwise relevant, from consideration as part of the operation of normal environment protection and project approval legislation such as the EPA and MRA.

148. The reality is that the NGER Act and the UNFCCC simply have no bearing on the operation of the EPA and the MRA. They are directed to different purposes.

149. The remainder of these submissions will apply the evidence presented in this case based on the analysis of the statutory tests to be applied by the Court set out above.

[118] See, e.g., *Commercial Radio Coffs Harbour Ltd v Fuller* (1986) 161 CLR 47 at 56-59 per Wilson, Deane and Dawson JJ.
[119] (1986) 161 CLR 47.

GROUNDWATER

150. As in the *Alpha* case,[120] in a geographically and geologically related area, the Applicant does not properly understand the geology and hydrogeology of the region. For that reason – as well as problems with its numerical modeling – the Applicant's material on groundwater impacts is critically deficient. This is very significant for the potential impacts on the exceptional ecological values of the Doongmabulla Springs.

151. The focus and key area of dispute in the groundwater evidence was on the potential impact of the mine on groundwater supply to the Doongmabulla Springs Complex and, to a lesser extent, the Carmichael River. Given this focus, it is important to place the potential impacts on the Doongmabulla Springs at the forefront of consideration of the groundwater evidence.

Exceptional ecological value of the Doongmabulla Springs

Springs ecology

152. The Doongmabulla Springs Complex (**Doongmabulla Springs**) is comprised of:

(a) Joshua spring;

(b) the Moses springs group; and

(c) Little Moses spring.

153. The Moses group is a very large group of springs. Mr Bradley noted in his evidence in chief that there are in excess of 60 individual springs in the group.[121]

154. The importance of the Springs in the otherwise dry landscape was perhaps captured best in the photographs taken by A/Prof Webb during a helicopter flight in November 2014 (Figures 14 and 16).

155. It is listed as a Great Artesian Basin threatened ecological community (**GAB TEC**) under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (**EPBC Act**), but it is clear from A/Prof Fensham's[122] and Mr Wilson's[123] evidence that the exceptional ecological values of the springs are principally associated with their high level of endemic and threatened species. The exceptional ecological values of the springs are, therefore, independent of the listing GAB TEC listing.

[120] *Alpha* case [2014] QLC 12 (Smith M).
[121] Transcript 2-36, line 24-25.
[122] Transcript 10-79, lines 37-39.
[123] Transcript 10-20, lines 32-42.

Figure 14 (Moses East Spring) in Exhibit 18; OL012 (A/Prof. Webb's Groundwater Expert Report) p 27.

Figure 16 (Main Moses Spring) in Exhibit 18; OL012 (A/Prof. Webb's Groundwater Expert Report) p 29.

156. The experts in springs ecology agreed in the Joint Experts Report: Springs Ecology (**Springs Ecology JER**) that the Doongmabulla Springs are of "exceptional ecological value".[124] Further evidence was heard on the ecological values:

(a) It is host to 6 different endemic species.[125]

(b) It is very large in area, comprising about 13-14% of the GAB TEC in

[124] Exhibit 21; JR005 (Springs Ecology Joint Expert Report), soft page 3, line 97.
[125] Transcript 10-20, lines 40-41.

Queensland.[126]

(c) It is in very good condition relative to other springs of its kind – Mr Wilson described Doongmabulla Springs as being "in very good condition, from all the springs I've seen".[127]

(d) It has international significance. As A/Prof Fensham described:

> And we've done some work in North Africa recently where we went to – probably the most famous desert springs in the world… And perhaps not surprisingly, they have been extensively transformed by human civilisations over the years so that they now, essentially, consist of, you know, a series of ponds and – and drains – manmade drains. And all remnants of the biological values that might have been there have been lost… And this pattern is repeated all over the world, you know, the springs in – in Chad or Iran, in Turkey, in the – you know, dry places part of the world. And even in the Southern US where there's some really large and – and important springs that really do have some remnants of the exotic – of the endemic species including specialised fish, the spring there have – have had this, you know, substantial transformation for human use that <u>really exemplify the value of the Australian desert springs as the last remnants on the planet of springs that essentially retain their natural condition.</u>[128]

157. A/Prof Fensham also gave evidence about the ecological value of discharge springs more generally:

> And you know, if you turn that into, you know, a score for things that you can only preserve in these places anywhere on the planet, then the discharge springs would win hands down. So whichever way you look at them … whether it's from a global perspective, or in relation to other desert wetlands, or in relation to where we need to look after threatened species that are in an imminent threat of extension, the discharge springs are highlighted as just exceptionally important.[129]

158. The impact of water use in the development and operation of this mine will be significant by virtue of its sheer scale. As the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (**IESC**) put it:

> Although a number of management strategies are proposed to minimise the impacts of the proposal, due to the scale of this project, there will be both unavoidable and permanent impacts that are unlikely to be adequately mitigated.[130]

159. A key area where the First Respondent says that this is so is the impact on the Doongmabulla Springs, particularly the Moses group. In relation to the impact of the mine on the Doongmabulla Springs Complex, the Applicant conceded in its opening regarding the source of groundwater to the springs that:

> If, however, the source is below the Rewan, like the aquifer that feeds the Mellaluka, then the impacts will be significant. The … springs will not merely have a drawdown but will be lost.[131]

160. The First Respondent submits that, despite this significant concession, the Applicant has, in effect, closed its eyes to the risk of the complete destruction of these springs. As

[126] Transcript 10-22, lines 7-8.
[127] Transcript 10-14, lines 31-32.
[128] Transcript 10-40, lines 6-31. [*Emphasis added*]
[129] Transcript 10-41, lines 26-32.
[130] Exhibit 59; OL032 (IESC Advice to decision maker on coal mining project) p 7.
[131] Transcript 1-10, lines 39-42.

a result it has no mitigation plan, nor any offsets plan. The latter is not surprising given the impossibility of offsetting the environmental values of the complete loss of this ecological community.

161. The First Respondent submits that this issue is an obvious place requiring the application of the precautionary principle.

Potential impacts on the Doongmabulla Springs

162. The groundwater evidence permits analysis of a number of scenarios in relation to the potential impacts on the Doongmabulla Springs.

163. The first set of scenarios all **put to one side** A/Prof Webb's opinion that it is likely that the Doongmabulla Springs are fed – at least in part – from the Colinlea Sandstone.

(a) If the Court takes at face value the drawdown impacts predicted in the modelling done by GHD on behalf of the Applicant, Dr Merrick's evidence demonstrates that even those drawdown impacts will be sufficient to cause an unknown but significant number of the Doongmabulla Springs to dry up.

(b) If the Court accepts that the model predictions of drawdown are inappropriately constrained by the unjustifiably low conductivity values (particularly in the Rewan formation and the units underlying it) the inevitable consequence is that drawdown has been underestimated. If so, the likelihood of the whole complex drying up is dramatically increased.

(c) If the Court accepts Prof Werner's evidence that the numerical modelling cannot be relied on as a basis for assessing the likely impacts of the mine then the Court has no basis at all to assess the risk of the mine to the Doongmabulla Springs.

164. **Finally**, if the Court accepts A/Prof Webb's evidence about the Colinlea Sandstone as a likely contributing aquifer to the Doongmabulla Springs then the Applicant conceded in its opening to this Court that the springs and their exceptional ecological value will be lost.

On the Applicant's own numbers springs will be lost

165. The following section considers the first of the scenarios noted above i.e. an acceptance that the only source aquifer for the Doongmabulla Springs is the Clematis Sandstone and that the GHD model accurately predicts the drawdown range for that unit.

166. In the interest of absolute clarity, the First Respondent does not concede the accuracy of this scenario. On the evidence, both assumptions that underlie it should be rejected. It is, however, the appropriate starting point given that – even on this scenario – there is a high likelihood that many of the springs in this complex will run dry.

Issues with spring flow assessment

167. Mr Wilson and A/Prof Fensham identified in the Springs Ecology JER that they required an assessment of the predicted change in flow rates to fully assess the impact on ecological values of the Doongmabulla Springs.[132]

168. Dr Merrick's spring flow assessment (**SFA**) was prepared in response to this request and is included in his individual expert report.[133]

169. The key findings in the SFA include the anticipated spring flow reductions set out in Table 1 from the SFA (**SFA Table 1**), as a percentage of current flow, and the following conclusions:

(a) Flow reductions are most unlikely to exceed 10 percent at the Doongmabulla Springs; and

(b) Flow reductions are more likely to be in the 3-5 percent range at the Doongmabulla Springs.[134]

170. Mr Wilson subsequently prepared Appendix B to his expert report based on data from the Queensland Herbarium[135] and the rates of spring flow calculated in the SFA.[136]

SFA Table 1 (Anticipated Spring Flow Impacts at Joshua Spring)[137]

DRIVING HEAD	Drawdown 0.16 m	Drawdown 0.19 m	Drawdown 0.3 m
5 m	3.2%	3.8%	6%
6 m	2.7%	3.2%	5%

171. Mr Wilson, in Appendix B to his expert report, has calculated an approximate reduction in the area of the springs that comprise Doongmabulla Springs by applying 10%, 5% and 3% reduction in flow rate uniformly across each of the individual springs[138] and used this as a basis to assess the commensurate loss of ecological value.

172. While these figures applied by Mr Wilson are obviously different from those calculated by Dr Merrick and presented in the SFA, Mr Wilson appears to have relied on the following assumptions:

(a) That the flow reduction will not exceed 10%; and

(b) That the calculated reductions at Joshua Spring can be extrapolated and applied

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[132] Exhibit 21; JR005 (Springs Ecology Joint Experts Report) soft page 5, lines 200-201.
[133] Exhibit NPM-3 to Exhibit 19; AA010.1 (Dr Merrick's Groundwater Modelling Expert Report) soft page 65, section 4.1.
[134] Exhibit NPM-3 to Exhibit 19; AA010.1 (Dr Merrick's Groundwater Modelling Expert Report) soft pages 66-67, section 4.1.
[135] Exhibit 22; AA011 (Mr Wilson's Springs Ecology & WCP Expert Report) soft page 43.
[136] Transcript 9-84, line 46 to 9-85, line 7.
[137] Exhibit NPM-3 to Exhibit 19; AA010.1 (Dr Merrick's Groundwater Modelling Expert Report) soft page 65.
[138] Exhibit 22; AA011 (Mr Wilson's Springs Ecology & WCP Expert Report) soft page 13.

uniformly to every spring in the Doongmabulla Springs.

173. As is set out below, in light of the detailed evidence heard at trial neither of these assumptions is valid.

Disagreement about the equation: what is the driving head difference? (ΔHB)

174. Prof Werner set out in his individual report what he considered to be the flaws in Dr Merrick's calculations,[139] and in his oral evidence he was very explicit in his disagreement with SFA Table 1 – "One of two things is wrong in the table: the heading or the numbers."[140]

175. Prof Werner does not disagree in any way with the equation Dr Merrick used to calculate the reduction in spring flow. The basis of this disagreement is a difference of opinion about what is the relevant driving head difference (ΔH_B) for any given spring.

(a) Dr Merrick considers ΔH_B is "the head difference between the water table and the artesian head, which drives the spring flow".[141]

(b) Prof Werner considers ΔH_B is the difference between the artesian head that is driving flow at a particular spring and the geomorphic threshold of that spring.[142] As a consequence, ΔH_B (and the percent reduction in flow as a consequence of a particular drawdown magnitude) will be specific to each spring.[143]

176. Notwithstanding the disagreement in the detailed application of the equation used to calculate the reduction in spring flow Dr Merrick and Prof Werner are in complete agreement about the **practical outcome** of the spring flow assessment.

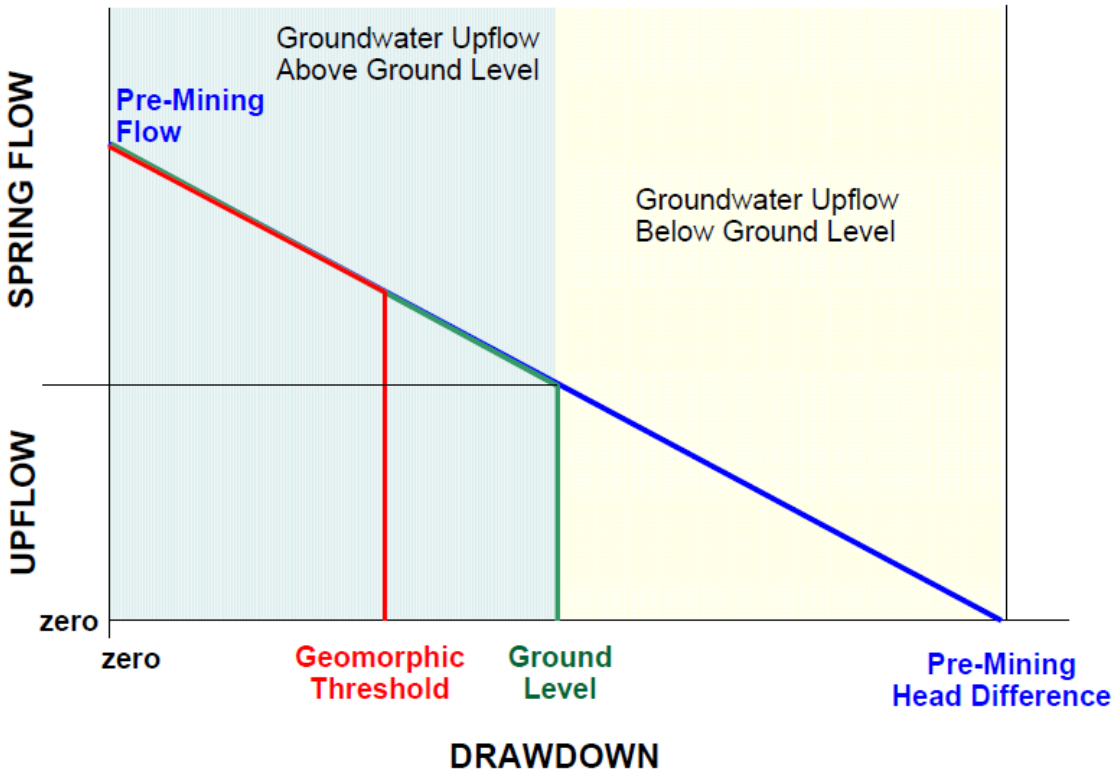
Figure 2 and the importance of the geomorphic threshold

177. The following is a key passage in Dr Merrick's spring flow assessment:

> This expression shows that the flow reduction is proportional to drawdown. If drawdown were one percent of the driving head difference, then the flow rate would be expected to reduce by one percent also. The relationship would be linear until the artesian head declined to a threshold elevation, at which point flow would cease abruptly.[144]

178. Figure 2 from the SFA (**SFA Figure 2**) was referred to extensively in the oral evidence to demonstrate the relationship between drawdown and the cessation of flow when the artesian head reaches the geomorphic threshold.

[139] Exhibit 20; OL011 (Prof. Werner's Groundwater Modelling Expert Report) soft pages 28-29.
[140] Transcript 9-31, lines 46-47.
[141] Exhibit NPM-3 to Exhibit 19; AA010.1 (Dr Merrick's Groundwater Modelling Expert Report) soft page 65, section 4.1.
[142] Transcript 9-34, lines 11-15.
[143] Transcript 9-34, line 42 to 9-35, line 6.
[144] Exhibit NPM-3 to Exhibit 19; AA010.1 (Dr Merrick's Groundwater Modelling Expert Report) soft page 66, section 4.1.



SFA Figure 2: Schematic Illustration of Spring Flow Reduction with Increased Drawdown

179. Dr Merrick and A/Prof Werner are in complete agreement that spring flow will stop when the artesian head at a spring drops to the level of the geomorphic threshold.[145]

180. It follows that the two necessary pieces of information required to determine what amount of drawdown will cause each of the springs to stop flowing are:

(a) the level of the geomorphic threshold for each spring; and

(b) the artesian head at each spring.[146]

181. These are considered in turn below.

Geomorphic thresholds

182. The geomorphic threshold can be compared to:

(a) The point at which water stops flowing over the rim of a bathtub;[147]

(b) The top of a container.[148]

183. In the context of the range of different kinds of springs that comprise the Doongmabulla Springs, the following points are the relevant geomorphic thresholds:

[145] Transcript 8-55, lines 13-21; Transcript 8-55, lines 31-35; Transcript 10-33, lines 9-45.
[146] Transcript 8-59, lines 18-20.
[147] Transcript 8-53, lines 34-35.
[148] Transcript 8-54, line 7.

(a) At Joshua Spring, the geomorphic threshold is the discharge pipe;

(i) If the discharge pipe was not there, the geomorphic threshold would be the top of the turkey's nest;[149]

(ii) The discharge pipe could be moved down to lower the geomorphic threshold and maintain flow from the turkey's nest despite a larger drawdown.[150]

(b) For a mound spring, the geomorphic threshold is the top of the mound;[151]

(i) A/Prof Fensham gave evidence that he has measured the heights of the mounds in the Moses complex to sub-centimetre accuracy, and the highest mound spring in the Doongmabulla Springs is the main Moses spring, which is 50 cm high.[152]

(ii) This is contrary to the assertion made by Dr Merrick and set out in GHD's Carmichael Coal Mine and Rail Project SEIS - Report for Mine Hydrogeology Report, dated 13 November 2013 (**SEIS Report**), that the mound springs at Moses "range in height from around 0.4 to 1.5 m"[153], which appears not to be based on any measurement.

(c) For seeps coming out at ground level, the geomorphic threshold is ground level.[154]

Artesian heads

184. The potentiometric head at the individual springs is not known, except to the extent that they are at least at ground surface.[155] If they were not at least at ground surface then there would be no spring.

185. The artesian head at each spring will be different, and A/Prof Fensham gave evidence that measuring the heads at the different springs is difficult.[156]

186. It does not appear that the Applicant or its contractors have attempted to measure the artesian head at each or any of the springs.[157]

187. A number of witnesses, including Dr Merrick, have made estimates of the likely head at Joshua Spring, but Dr Merrick acknowledged in cross-examination that these are only

[149] Transcript 8-53, lines 35-36. Dr Merrick noted that this is the case if you define the loss of spring flow as the cessation of water spilling out of the turkey's nest dam. If there was drawdown beyond this point there would be still be a pool in the dam and the water surface level would represent the reduced artesian head level. See Transcript 8-56, lines 8-15; Transcript 8-56, lines 24-38; Transcript 8-60, lines 18-37.
[150] Transcript 8-60, lines 36-44.
[151] Transcript 8-53, lines 38-44.
[152] Transcript 10-64, line 43 to 10-65, line 4.
[153] Transcript 8-62, line 46; MR167 (SEIS, Volume 4, Appendix K1 - Mine Hydrogeology Report GHD (2013)) soft page 145.
[154] Transcript 8-54, lines 13-18.
[155] Transcript 4-51, lines 32-33.
[156] Transcript 10-12, line 46 to 10-13, line 4.
[157] MR167 (SEIS, Volume 4, Appendix K1 - Mine Hydrogeology Report (GHD 2013)) soft page 135.

estimates and that "[t]here's really no basis for estimating the strength of the head above the elevation of the outflow pipes."[158]

188. Dr Merrick gave evidence that he believes the head at the seep springs at Doongmabulla is only a matter of centimetres from the ground.

> Q: And given [Little Moses is] a seep, would you assume that to be pretty – not far above the ground surface?
>
> A: Very close to ground level.
>
> Q: By "very close", a matter of centimetres?
>
> A: Centimetres for the geomorphic threshold.
>
> Q: Yeah. So, in that case, again, the number that we need to figure out when Little Moses would stop – would stop, is the difference between that head [in] the Clematis, a few centimetres above ground level, and ground level?
>
> A: Yes.
>
> Q: Logically, that's a few centimetres?
>
> A: It probably is.
>
> Q: And just to be absolutely clear, that's the – that's one for one drawdown. So if drawdown is more than that few centimetres number, then Little Moses stops flowing?
>
> A: Yes….
>
> Q: In any event, if it just so happens that that number, the drawdown – five centimetres, 10 centimetres, 12 centimetres, whatever it is – if it so happens that that number is bigger than the few centimetres that would be needed to make Little Moses run dry, then Little Moses runs dry?
>
> A: Yes. If the drawdown were to be of the order of five centimetres, then you would expect seeps would dry up.
>
> Q: And that's on the basis of the outputs of this model in their current state, accepting them on face value?
>
> A: Correct. That's, yes, for the base case model.[159]

189. This is of central importance given the drawdown at the Doongmabulla Springs predicted by GHD.

190. It also makes absolutely clear that the percentages in Dr Merrick's spring flow assessment are not percentages of the draw down necessary to make the springs stop flowing. Instead, they are percentages of the reduction necessary to stop water moving upwards from the Clematis Sandstone to the overlying unit.[160] All of the springs will have stopped flowing well before that point is reached.

Drawdown predictions

191. GHD's predictions of post-closure drawdown are shown in Table 23 of the SEIS Report (**SEIS Table 23**).

[158] Transcript 8-59, lines 40-41.
[159] Transcript 8-64, lines 9-41.
[160] Transcript 8-54, line 38 to 8-55, line 6; Transcript 8-59, lines 4-7; Transcript 7-50, lines 26-29.

Table 23 Predicted water table impacts at spring locations – post closure

Spring number and name	Spring system	Sub-system	Predicted drawdown in source aquifer (m)
1031_Moses4	Doongmabulla	Moses	<0.05*
1032_Moses3	Doongmabulla	Moses	0.05*
1033_Moses2	Doongmabulla	Moses	0.08*
1034_Littmose	Doongmabulla	Little Moses	<0.05*
1035_Moses1	Doongmabulla	Moses	0.06*
1036_75E	Doongmabulla	Moses	0.09*
1037_75A	Doongmabulla	Moses	0.07*
1038_75D	Doongmabulla	Moses	0.07*
1039_75B	Doongmabulla	Moses	0.11*
1040_75C	Doongmabulla	Moses	0.11*
1041_Doongma	Doongmabulla	Joshua	0.16*
41_(no name recorded)	Mellaluka	Mellaluka	1.6 -8.39**
42_(no name recorded)	Mellaluka	Mellaluka	2.9 -9.07**
Storie's	Mellaluka	Storie's	8.2 – 13.4**
Lignum	Mellaluka	Lignum	14.8 – 25.6**

* predicted drawdown in the Clematis Sandstone

** predicted drawdowns in the uppermost aquifer and Older Permian units since source aquifer has yet to confirmed

SEIS Table 23: Predicted post closure drawdown at Doongmabulla Springs from GHD (2013) Carmichael Coal Mine and Rail Project SEIS: Mine Hydrogeology Report[161]

192. It is clear from SEIS Table 23 that the predicted drawdown at almost all of the springs is "of the order of five centimetres", which Dr Merrick considers likely to cause complete cessation of spring flow at springs like Little Moses.[162]

193. More importantly, as shown in SFA Table 1, Dr Merrick was content to adopt a range of drawdown impacts of up to 30 cm for the purposes of his assessment based on the sensitivity analysis conducted by GHD.[163]

194. In light of Mr Bradley's evidence that the Moses group is comprised of around 60 individual springs, SEIS Table 23 clearly does not predict drawdown in the majority of the springs. However, Dr Merrick gave evidence that only a few cells in the model would cover the Moses Springs and the drawdown figure would apply to all of these.[164]

195. While there was a lot of evidence about Joshua Spring, it is in many ways the least important of the 60 springs that make up the complex because it is already heavily modified, could be modified further and has no endemic species.

196. Adopting the drawdown predictions from GHD's modelling, on Dr Merrick's evidence, at least some – and likely very many – of the Doongmabulla Springs will dry up.

197. The reality is as stated in Prof Werner's report:

> a) The use of the nearby watertable head (i.e. 2-3 m below ground surface) in the

[161] MR167 (SEIS, Volume 4, Appendix K1 – Mine Hydrogeology Report (GHD 2013)) soft page 120.
[162] Transcript 8-64, lines 37-38.
[163] Transcript 8-31, lines 5-6.
[164] Transcript 8-16, lines 15-17.

> estimation of the head difference is incorrect. The head difference (source aquifer head minus spring water level head) is probably much smaller than that suggested by Dr Merrick, because the heads at the springs are higher than 2-3 m below ground surface. Hence, the springs are much more susceptible to drawdown impacts (i.e. ΔHB in Dr Merrick's equation is much smaller and therefore the relative reduction in flow is much larger) ...
>
> c) I expect that any springs with points of discharge that are low (near the land surface), and/or that are presently slow flowing (i.e. suggesting that they perhaps have a small driving head difference), will cease to flow with small changes in the source aquifer head …
>
> f) Ultimately, given that there are springs with discharge points that are almost at the land surface, the change in flow will be up to 100% of spring flow, and not the small values of a few % suggested by Dr Merrick.[165]

198. There is considerable uncertainty as to which springs are most likely to dry up, given that the artesian head for each spring is not known and therefore the drawdown required to entirely stop an individual spring flowing cannot be known.

199. This stands in stark contrast to the confidence expressed in GHD's SEIS Report, which suggested that:

> The predicted impacts of between 0.06 and 0.12 m will not therefore lead to any of these mound springs drying up but could act to reduce current pressures and therefore flows by between 4 and 30 percent ...
>
> Non-mound springs are likely to be more sensitive to any groundwater level drawdowns since the current pressures may be at or close to ground surface. However, even at these springs some natural fluctuation in levels and flows is expected. Hence, if we assume that actual pressures in non-mound springs vary seasonally between 0 and 0.5 m above ground then a drawdown of 0.12 m equates to a 24 percent increase in the cease to flow period rather than a permanent drying up of the spring.[166]

200. This above passage from the SEIS Report demonstrates that, until this point, decision-makers have proceeded on the assumption that there would be no significant impact on the Doongmabulla Springs. The evidence in this trial proves that this is not the case.

Disconnect between calculated flow reductions and actual impacts

201. Dr Merrick confirmed, by way of an example put to him, the apparent disconnect between the claimed very small percentage reductions in flow rate and the likely actual impacts at any given spring.[167]

(a) If we start with the assumption of a 75% reduction in flow rate, this would be indicated in SFA Table 1 as 75%, which might be taken to indicate that 25% flow remains.

(b) In the context of SFA Figure 2, this represents a reduction in flow to the point three-quarters of the way along the horizontal axis.

(c) At this level of drawdown, the head of every spring is below the ground, so there

[165] Exhibit 20; OL011 (Prof. Werner's Groundwater Modelling Expert Report) soft page 29.
[166] MR167 (SEIS, Volume 4, Appendix K1 – Mine Hydrogeology Report (GHD 2013)) soft page 145-146. [*Emphasis Added*].
[167] Transcript 8-58, lines 23-36.

is in fact 100% loss of spring flow, rather than the 75% reduction that was taken as the starting point.

202. If we start the same process with 100% drawdown (i.e. all the way along the horizontal axis) this is the point at which there will be no flow from the underlying aquifer (on GHD's interpretation, the Clematis Sandstone) to the water table (on GHD's interpretation, the Moolayember Formation).[168]

203. Prof Werner's disagreement with Dr Merrick is that he believes that the appropriate expression of the reduction in flow is a percentage of the difference between the initial potentiometric head to the level of the geomorphic threshold.[169]

204. Using the above example, this would have the effect that a 75% reduction in flow rate for any given spring would be observed when the potentiometric head has dropped 75% of the distance between the initial head and the geomorphic threshold.

Mr Wilson's assumptions

205. As discussed above, Mr Wilson's calculations of reduction in area of the Doongmabulla Springs and the loss of ecological value are based on the following assumptions:

(a) That the flow reduction will not exceed 10%; and

(b) That the calculated reductions at Joshua Spring can be extrapolated and applied uniformly to every spring in the Doongmabulla Springs.

206. Mr Wilson made clear that his assessment of impacts on the spring were based "purely on the changes in flow that Dr Merrick had provided" and he was relying on Dr Merrick's assumptions.[170]

207. Clearly Mr Wilson did not appreciate that there would be a complete loss of spring flow once drawdown reaches the geomorphic threshold, and he has not considered at all the possibility of loss of any of the individual springs at Doongmabulla Springs.

208. On this basis alone, the conclusions in Mr Wilson's report about the likely impact on the springs cannot be given any weight.

Modelling choices have led to an under-estimation of drawdown at the springs

209. The impacts at the Doongmabulla Springs discussed above assume that the drawdown impacts are as presented in GHD's reports. This is at best a fragile assumption.

210. The discussion that follows deals with the second scenario identified above; namely that GHD's numerical modelling can be relied upon to some extent but, because of input choices made by the modellers, underestimates drawdown at the Doongmabulla Springs.

[168] Transcript 8-54, line 38 to 8-55, line 6; Transcript 8-59, lines 4-7; Transcript 7-50, lines 26-29.
[169] Transcript 9-61, lines 6-36; Transcript 9-34, lines 32-40.
[170] Transcript 10-13, lines 17-18; Transcript 10-13, line 24.

211. There was a substantial body of evidence called by the Applicant and by the First Respondent that calls into question the reliability of GHD's predictions because of the choices that it made about conductivity, recharge, discharge and storage values.

212. The discussion of this issue that follows **continues to assume** that only the Clematis Sandstone is the source aquifer for the Doongmabulla Springs. Again, for the avoidance of doubt, the First Respondent does not agree with that assumption.

Key Modelling Features

213. There is general acceptance that the key features in a numerical groundwater model are:

(a) Conductivity, both vertical (k_v) and horizontal (k_h);

(b) Recharge;

(c) Discharge; and

(d) Storage parameters.

214. Calibration is the process of assessing the "goodness of fit" of the model outputs to the measured groundwater heads in the model area, and is an important process in determining the most suitable values for the above parameters (except discharge, which is generally a model output).[171]

215. The experts agree that there are an infinite number of different parameter sets that could generate the observed heads, so uncertainty analysis is important in resolving this uncertainty and giving a sense of the reliability of model predictions.[172]

Conductivity

216. It is not contentious that conductivity values are key to the prediction of impacts.[173] They are the most important factor in determining impacts during the mining phase.[174]

217. Conductivity is a measure of the flow of water through a geological unit, with aquifers exhibiting a higher conductivity and aquitards exhibiting a lower conductivity.

218. Each geological unit will have characteristic horizontal conductivity (k_h) and vertical conductivity (k_v) values, and in each of the units considered in this model the horizontal conductivity is higher than the vertical conductivity. It is assumed for the purpose of allocating these values in the model that vertical conductivity is one-tenth of horizontal conductivity, so where only a k_h value is shown it can be inferred that the vertical conductivity is one order of magnitude lower.

219. Mr Bradley gave evidence in relation to vertical conductivity values:

(a) a vertical conductivity value of 0.01 m/day (that is, 1×10^{-2} m/day) is typical of an

[171] Transcript 7-53, lines 34-37.
[172] Transcript 7-55, lines 1-9.
[173] Transcript 8-18, lines 30-36.
[174] Transcript 8-22, lines 20-32.

aquitard and is an "extremely low permeability";

(b) a vertical conductivity value of 1.1 to 1.2 m/day is typical of an aquifer and is a comparatively high level of vertical conductivity;[175]

Relevance and effect of conductivity values in the model

220. Of particular importance in this case are the conductivity values of the Rewan formation, particularly vertical conductivity,[176] given that it is presumed to be the aquitard that provides the Doongmabulla Springs protection from drawdown impacts of the mine.[177]

221. Dr Merrick also considers that the conductivity values of the Colinlea Sandstone, the Bandanna Formation and every other unit above are also important in that the predicted drawdown impacts to the Doongmabulla Springs will necessarily propagate through these units.[178]

222. Lower vertical conductivity values, particularly for the Rewan Formation, will result in the model predicting lesser impacts on the Doongmabulla Springs, because they protect the overlying aquifers from the effect of mining.[179]

223. Dr Merrick also accepted that lower conductivity values for the target aquifers, in particular the Colinlea Sandstone, would result in the impacts at the Doongmabulla Springs being "muted", because this also limits the propagation of dewatering effects.[180]

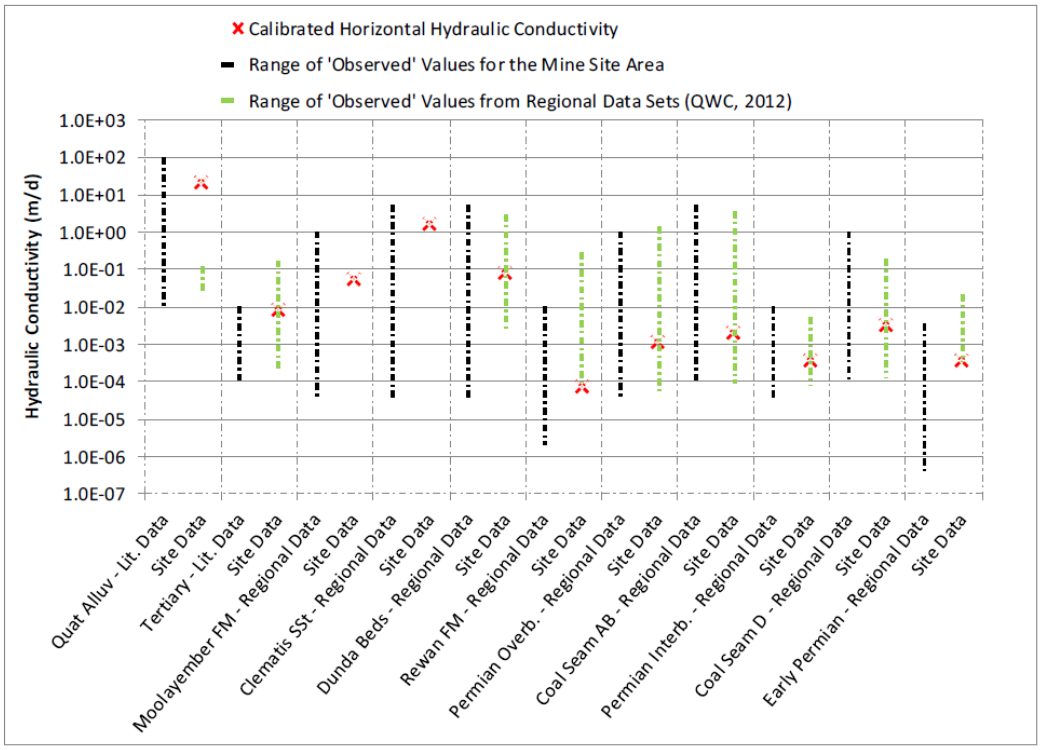
Values in the model

224. The range of conductivity values considered in the modelling process and the calibrated values used in the modelling were presented in different forms throughout the evidence.

225. Figure 32 from the SEIS Report (**SEIS Figure 32**) shows the range of horizontal conductivity values considered by the modellers from site specific testing (green line) and regionally relevant literature (black line), and the calibrated value (red cross) for each of the units modelled.[181]

[175] Transcript 4-25, lines 21-41.
[176] Transcript 8-25, lines 28-29.
[177] Transcript 8-19, lines 38-39.
[178] Transcript 8-21, line 25 to 8-22, line 1.
[179] Transcript 8-22, lines 34-44; Transcript 8-23, lines 4-6.
[180] Transcript 8-23, line 8 to 8-23, line 14.
[181] There was some confusion during the trial over the correct interpretation of SEIS Figure 32, given the mismatch between the labelling of the green and black lines in the key and on the horizontal axis. Further interrogation of the document makes it clear, at least in the context of the range of values shown for the Rewan Formation, that the key is incorrect and the labelling on the horizontal axis should be relied on.

Figure 32 Steady state historic calibration model –calibrated parameters



SEIS

Figure 32: Table of Calibrated parameters from GHD (2013) Carmichael Coal Mine and Rail Project SEIS: Mine Hydrogeology Report.[182]

Table 8 Adopted hydraulic conductivity values – Lake Galilee catchment

Model Layer	Formation	k_h (m/d)
2	Tertiary-age deposits	1.00×10^{-02}
3	Moolayember Formation	5.18×10^{-02}
4	Clematis Sandstone	1.55×10^{-00}
5	Dunda Beds	7.90×10^{-02}
6	Rewan Formation	7.38×10^{-05}
7	Rewan Formation	7.38×10^{-05}
8	Permian units overlying AB seam	4.00×10^{-05}
9	AB Seam Coal (Bandanna Formation)	1.00×10^{-04}
10	Permian overburden	4.00×10^{-05}
11	D Seams and Permian interburden (Colinlea Sandstone)	1.00×10^{-04}
12	Permian underburden	Variable (constant T of 1.50×10^{-02} m^2/d)

Notes:

Model regions are based on the zonation shown in Figure 10

k_h is the horizontal hydraulic conductivity, vertical hydraulic conductivity (k_z) is a factor of 10 less than k_h.

Table 8: Adopted hydraulic conductivity values form the Response to Federal Approval Conditions - Groundwater Flow Model - November 2014[183]

[182] MR167 (SEIS, Volume 4, Appendix K1 – Mine Hydrogeology Report (GHD 2013)) soft page 103.

[183] Exhibit 68; AA036 (GHD Report - Response to Federal Approval Conditions - Groundwater Flow Model – November 2014) soft page 53.

226. Table 8 (**Table 8**) from the Carmichael Coal Project: Response to Federal Approval Conditions- Groundwater Flow Model November 2014 (**EPBC Response Report**) lists the adopted horizontal conductivity values for the final model.[184]

227. Notwithstanding that the modelling process necessarily arrives at a single value for the conductivity of a unit, largely through the process of calibration, Dr Merrick accepts that there are reasonable ranges of conductivity values for a given unit that can cross over orders of magnitude.[185]

Rewan Formation

228. The Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (**IESC**) in its December 2013 *Advice to decision maker on coal mining project*[186] (**IESC Advice**) made clear its concern about the variability in conductivity values for the Rewan Formation and potential for impacts on the Doongmabulla Springs:

> The current groundwater model assumes the Rewan Formation will respond uniformly as an aquitard. However, the Committee questions this assumption based on variability in the hydraulic conductivity field data. Further data collection and assessment of the Rewan Formation is necessary. …
>
> The proponent's field data needs to be further integrated into the groundwater model to establish an appropriate set of values and ranges for model layers, in particular, hydraulic conductivity parameters for the Rewan Formation. Sensitivity analysis of the groundwater model confirms that the integrity of the Rewan Formation plays a critical role in controlling impacts to the GAB and the Doongmabulla Springs Complex. …
>
> Rewan Formation: On-site measurements of hydraulic conductivity values for the Rewan Formation ranged across several orders of magnitude, consistent with the variable lithology presented from drilling logs. These variations in local geology, including the potential for faulting, deep weathering or lateral gradation into the Warang Sandstone, may increase the permeability of the Rewan Formation. The implications of this contrasting behaviour for regional groundwater processes need to be further explored.[187]

229. Dr Merrick was scathing of the IESC and its understanding of the basic groundwater principles. Such criticism is difficult to reconcile with the IESC membership, which includes the Director of the National Centre for Groundwater Research and Training, and the Branch Head of Groundwater at Geoscience Australia.[188]

230. Mr Bradley accepted that testing carried out in relation to the Alpha and Kevin's Corner projects showed vertical conductivity values in the Rewan Formation of up to 1.18

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[184] While Table 8 specifically refers to conductivity values adopted for the Lake Galilee Catchment, which was required to be included in the model as a condition of the EPBC Act Approval, the text makes clear that these were applied throughout the model:

> *The hydrostratigraphy within the expanded model region (Lake Galilee area) is consistent with that of the adjoining area of the SEIS model, and consequently the hydraulic conductivity values adopted within the SEIS model have been applied to this region. The adopted hydraulic conductivity values are summarised in Table 8, which are consistent with those developed from the calibration process in the SEIS model.*

[185] Transcript 8-39, lines 30-33.

[186] Exhibit 59; OL032 (IESC Advice to decision maker on coal mining project).

[187] Exhibit 59; OL032 (IESC Advice to decision maker on coal mining project) pp 2-3.

[188] Transcript 8-49, line 6 to 8-49, line 18; See also Staff profile for Jane Coram (http://www.ga.gov.au/about/who-we-are/organisational-structure/jane-coram) and Prof Craig Simmons (http://www.flinders.edu.au/people/craig.simmons)

m/day and 1.2 m/day, and that these measurements are consistent with aquifer properties, rather than properties of an aquitard.[189] This data highlights the variability of conductivity values in the Rewan Formation and reinforces the concerns raised by the IESC.

231. GHD acknowledges, and the Applicant's groundwater experts accept, that there is no on-site vertical conductivity data at Carmichael[190] and that "[r]eliable estimates of vertical hydraulic conductivity… are few and far between."[191]

232. As a consequence, the vertical conductivity values for the Rewan Formation have been adopted essentially on the basis of horizontal conductivity values and regional data, notwithstanding that this is one of the most important factors in determining whether the Rewan Formation will protect the overlying units and the Doongmabulla Springs from the effects of dewatering.[192]

233. Additionally, the horizontal conductivity value adopted in the modelling (7.38×10^{-5} m/day) is below the minimum estimated site value, as shown above in SEIS Figure 32.[193]

234. There is conflicting reporting as to the sensitivity of the Doongmabulla Springs to the Rewan Formation conductivity, which led Dr Merrick to comment that he was "a little concerned":

(a) The SEIS Report states that "predicted impacts at the Doongmabulla Springs are relatively insensitive to this parameter."[194]

(b) In contrast, the Carmichael Coal Mine and Rail Project SEIS - Mine Hydrogeology Report Addendum, dated 24 October 2013 (**SEIS Addendum Report**), states that "predicted drawdown impacts are relatively sensitive to the modelled hydraulic conductivity of the Clematis Sandstone and Rewan Group".[195]

(c) Notwithstanding the concern regarding the inconsistent reporting, it appears the latter is in fact more accurate, given that the drawdown impact at the Doongmabulla Springs almost doubled from 0.16m to 0.3m as a consequence of a 1 order of magnitude increase in the Rewan Formation conductivity.[196]

[189] Transcript 4-26, line 1 to 4-27, line 3.
[190] Transcript 4-24, line 10-19; Transcript 8-27, line 39 to 8-28, line 42; MR170.2 (SEIS, Volume 4, Appendix K6 – Mine Hydrogeology Report Addendum) soft page 17.
[191] Transcript 4-24, lines 21-23; MR170.2 (SEIS, Volume 4, Appendix K6 – Mine Hydrogeology Report Addendum) soft page 14.
[192] Transcript 8-27, line 39 to 8-28, line 2; Transcript 8-35, lines 15-35; MR170.2 (SEIS, Volume 4, Appendix K6 – Mine Hydrogeology Report Addendum) soft page 46.
[193] MR167 (SEIS, Volume 4, Appendix K1 – Mine Hydrogeology Report (GHD 2013)) soft page 133.
[194] MR167 (SEIS, Volume 4, Appendix K1 – Mine Hydrogeology Report (GHD 2013)) soft page 133.
[195] MR170.2 (SEIS, Volume 4, Appendix K6 - Mine Hydrogeology Report Addendum) soft page 40.
[196] Transcript 8-32, lines 3-17; Transcript 8-22, lines 42-44; MR170.2 (SEIS, Volume 4, Appendix K6 – Mine Hydrogeology Report Addendum) soft page 40.

Colinlea Sandstone

235. Table 8 shows that the Colinlea Sandstone is in model layer 11 and is combined with the coal in the D seam.

236. The Colinlea has been assigned a horizontal conductivity of 1.0 x 10^{-4} m/day (and therefore a vertical conductivity of 1.0 x 10^{-5} m/day).

237. This horizontal conductivity (0.00010 m/day) is almost as low as the Rewan Formation (0.000074) – to make the comparison directly, the Colinlea Sandstone has been modelled as only 35% or 1.35 times more conductive than the Rewan Formation.

238. Importantly, this value is significantly lower than the calibrated value indicated by the red cross on Figure 32, which looks to be in the order of 4 x 10-3 m/day. It is unclear why the conductivity values in the EPBC Response Report are at least an order of magnitude lower than the calibrated conductivity values shown in the SEIS Report.

239. In light of Dr Merrick's view that the conductivity of one unit can vary by orders of magnitude,[197] it seems entirely unrealistic that an aquifer and an aquitard would have conductivity values only 35% different.

240. By way of comparison, Dr Merrick accepted that the appropriate value taken from the horizontal conductivity table in the Galilee Coal Project Groundwater Assessment extract, which Dr Merrick authored, is 1.3 x 10^{-1} m/day.[198] Again, to make the direct comparison, this value (0.13 m/day) would make the Colinlea Sandstone 1300 times more conductive in Dr Merrick's model than in GHD's work.

241. Dr Merrick commented that the conductivity for the Colinlea Sandstone appears low and that this would reduce the modelled impacts:

> Q: Now, that's an incredibly low permeability for the Colinlea, isn't it?
>
> A: I think it's on the low side.
>
> Q: Yes. And the effect, I think, as we discussed before, is that if there's a value that's on - that's lower in relation to the Colinlea then that is likely to have the effect of reducing the projected impacts on the Doongmabulla Springs?
>
> A: Yes, it should because it should allow less water to flow into the mine. [199]

242. Dr Merrick commented that it is not preferable to have the Colinlea combined with the D Seam:

> It is lumped in with the coal and I normally wouldn't do that. And I don't recall what I used in the Galilee model … for the Colinlea Sandstone, which was a separate layer in my model which is the better way to do it. And, actually, everybody has said of the GHD model that the Colinlea Sandstone should be pulled out - not pulled out but should be inserted as its own layer because the problem with lumping with - a hard rock layer with a coal seam is you're combining two very different [lithologies], very different

[197] Transcript 8-39, lines 30-33.
[198] Exhibit 80; OL046 (*Extract from the Galilee Coal Project Groundwater Assessment - Galilee Coal Project Supplementary Environmental Impact Statement - March 2013*) soft page 2, para 26.
[199] Transcript 8-48, lines 22-28.

permeabilities and so it's hard to settle on what is an appropriate one for the aggregation.[200]

243. It is telling that Dr Merrick had not brought any of these issues to the Court's attention previously.

Other Permian Units

244. As per Table 8, the other Permian units that overlie the Colinlea Sandstone are:

(a) Model layer 8 – the Permian units overlying AB seam;

(b) Model layer 9 – the AB Seam Coal (Bandanna Formation); and

(c) Model layer 10 – the Permian overburden.

245. The Bandanna Formation (layer 9) is also an aggregation of coal seams and the host unit, and has been assigned conductivity values the same as the Colinlea Sandstone of 1.0×10^{-4}.

246. However, the Permian overburden (layers 8 and 10) has been assigned a conductivity value of 4.0×10^{-5} – this is a **lower conductivity than the Rewan Formation.**

247. As with the Colinlea Sandstone, these values are lower than those represented by the red cross in Figure 32 by an order of magnitude or more. Again, it is unclear why the conductivity values in the EPBC Response Report are at least an order of magnitude lower than the calibrated values reported in the SEIS Report.

248. Each of these unexplained decisions by GHD has the effect of reducing the predicted impacts on the Doongmabulla Springs. Given that stopping the springs flowing requires a drawdown in the order of centimetres, these decisions are of central relevance.

<u>Conductivity is underestimated</u>

249. Dr Merrick claims the adoption of a 1:10 vertical to horizontal conductivity ratio is a conservative assumption.[201] However, this claim logically rests on the assumption that the horizontal conductivity values themselves are sufficiently accurate.

250. It seems untenable that the impact assessment can be considered reliable given that the Rewan Formation has been assigned a permeability lower than the lowest observed on-site value and when there are two other layers in the model that have lower conductivity values than the Rewan Formation.

251. Prof Werner highlighted a clear example of this incongruity in his expert report.[202] Table 6 of the EPBC Response Report describes the Dunda Beds as "moderately permeable", whereas the Colinlea Sandstone and the Bandanna Formation are both described as

[200] Transcript 8-49, lines 11-20.
[201] Exhibit NPM-1 to Exhibit 19; AA010.1 (Dr Merrick's Groundwater Modelling Expert Report) soft page 12, section 4.3(b).
[202] Exhibit 20; OL011 (Prof. Werner's Groundwater Modelling Expert Report) soft page 20.

"permeable", yet they both have a conductivity value 800 times lower than the Dunda Beds.[203]

252. The above analysis supports a comment made by Prof Werner in his evidence in chief, with respect to conductivity and recharge values, that "it's hard to imagine putting in other parameters that would give you lesser of an impact and you could still defend them."[204]

253. Dr Merrick acknowledged that some of the conductivity values are low and that lower conductivity will lead to an underestimate of impacts.[205] As such, any assertion of conservatism in the assigned conductivity values cannot be sensibly maintained.

254. Based only on the choice of very low conductivity values for the Rewan Formation, Prof Werner considered that a drawdown in the Clematis Sandstone of up to 1m was plausible.[206] For the reasons discussed above, a drawdown at that level would cause at least most of the Doongmabulla Springs to run dry.

Recharge

255. Dr Merrick and Prof Werner both expressed a view in their exert reports that the recharge values adopted in the model are too low.

(a) Dr Merrick states:

> The adopted rates are 0.1 to 1.1 mm/year. These values are at the low end of values reported in the literature review. Personally, I would have expected the rates to be higher, based on modelling done by me elsewhere In the Galilee Basin, where I used values ranging from 0.1 to 30 mm/year.[207]

(b) Prof Werner notes in his report that this is important because:

> iii) low recharge values will lead to low calibrated hydraulic conductivity values, which leads to prediction of lesser impacts;
>
> iv) low recharge values may lead to underestimation of modelled inflows to final void; and
>
> v) errors in recharge will translate to errors in the simulation of groundwater discharge to and impacts on the Carmichael River.[208]

256. Dr Merrick accepts that the consequence of increasing recharge would be to require higher conductivity values:

(a) Dr Merrick gave evidence that this is of limited relevance since only the top layers

[203] Exhibit 68; AA036 (GHD Report - Response to Federal Approval Conditions - Groundwater Flow Model – November 2014) soft page 36.
[204] Transcript 9-44, lines 30-34.
[205] Transcript 8-22, lines 34-44; Transcript 8-23, lines 4-6; Transcript 8-23.8 to 8-23.14; Transcript 8-48, lines 22-28.
[206] Transcript 9-20, line 27 to 9-21, line 2; Exhibit 20; OL011 (Prof. Werner's Groundwater Modelling Expert Report) soft page 16.
[207] Exhibit NPM-1 to Exhibit 19; AA010.1 (Dr Merrick's Groundwater Modelling Expert Report) soft page 20, section 4.1.
[208] Exhibit 20; OL011 (Prof. Werner's Groundwater Modelling Expert Report) soft page 7.

of the model would be affected by higher recharge.[209]

(b) Prof Werner noted that each of the model layers comes to the surface at some point, and as such they would all be affected by an increase in recharge to some degree.[210]

Dr Merrick's change of opinion

257. Dr Merrick gave evidence of a late change of opinion on the appropriateness of the recharge values, based apparently on tender documents put out by Geoscience Australia,[211] rather than any published or peer reviewed literature. He noted his understanding that this reflects a change of opinion by Jim Kellett, who has done work "not specifically at the same location but similar geology."[212]

258. Prof Werner notes that similar geology is not necessarily of great relevance to recharge rates, and that determinant number of factors including rainfall, vegetation and soil cover will effect recharge.[213]

259. Notwithstanding that this change of opinion is based merely a tender document, Dr Merrick accepted again that the recharge rate applied by GHD is at the "very low end" but then stated "It is – it is very low, but I have to accept the findings of Geoscience Australia who are the experts in this field."[214]

260. At the time GHD chose the recharge values, they could have had no knowledge of the Geoscience Australia tender document, even if it is in fact relevant.[215]

Discharge

261. Recharge and discharge are intimately related, since any water that comes into the model must leave the model.

262. Discharge in a model is predominantly an output, based on recharge, conductivity and storage parameters and elevation.[216] Alternatively, pumping bores can be simulated by way of forced extraction from the relevant location.[217]

263. Dr Merrick stated he based his original assessment of the model on an assumed discharge of 1.35 megalitres (ML) per day, taken from GHD's 2012 assessment, but he accepts the discharge estimates provided by Mr Wilson of 2.68 ML/day (note that 1ML is equal to $1000m^3$).[218]

264. This apparently new information indicates that GHD's estimate of discharge was about half the actual discharge from Doongmabulla Springs, and Dr Merrick accepts that this

[209] Transcript 8-14, lines 36-42.
[210] Transcript 9-15, lines 23-37.
[211] Transcript 8-12, lines 9-21.
[212] Transcript 8-12, lines 27-31; Transcript 8-12, line 47.
[213] Transcript 9-16, lines 3-18.
[214] Transcript 8-13, lines 17-28.
[215] Transcript 8-14, lines 13-15.
[216] Transcript 8-15, lines 7-9.
[217] Transcript 7-53, lines 34-45.
[218] Transcript 7-2, line 45 to 7-3, line 7.

would impact the choice of conductivity and recharge values in order to keep the model calibrated.[219]

265. Additionally, GHD has modelled 152 m^3/day of extraction from bores:

(a) Dr Merrick conceded that this is "not much" and is subject to a "huge, huge error band".[220]

(b) GHD assumed that only 30% of the entitlement was being used, whereas he would assume the full entitlement was being used unless he knew otherwise.[221]

(c) Dr Merrick was not sure, but had the impression this amount of extraction was attributable to only licenced bores and did not include registered bores, and his opinion is that these should have been considered.[222]

266. The failure to properly consider discharge from bores adds further uncertainty to the calibrated conductivity and recharge values.

Storage

267. It is not contentious that storage properties play an important role in the timing of impacts, in that higher storage values will lead to slower aquifer responses to mine induced drawdowns.[223] Dr Merrick considers that they are particularly important in the timing of recovery of water levels after mining.[224]

268. In the absence of transient calibration (i.e. where only steady state calibration has been undertaken, as is the case here), storage parameters must be assumed.[225]

269. Prof Werner's opinion is that the storage values applied in the model are not adequately justified and are lower than the value suggested by Todd and Mays (2005).[226]

270. Dr Merrick criticised Prof Werner's reliance on storage values from Todd and Mays (2005).[227] However, Dr Merrick also made clear that he places "no credence" in textbooks and that "they are the refuge of academics".[228]

The effect of the model under-estimating draw down in the Springs

271. Even if the model is otherwise appropriately constructed, run and calibrated, the model outputs are inappropriately constrained by the unjustifiably low conductivity values, particularly in each of the units underlying the Rewan Formation.

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[219] Transcript 8-16, lines 1-11.
[220] Transcript 8-17, lines 18-20; Transcript 8-18, line 7.
[221] Transcript 8-17, lines 7-13.
[222] Transcript 8-17, line 1 to 8-18, line 2.
[223] Transcript 8-18, lines 43-45.
[224] Transcript 7-62, lines 30-33.
[225] Transcript 7-52, lines 31-32; Transcript 8-18, lines 24-28.
[226] Exhibit 20; OL011 (Prof. Werner's Groundwater Modelling Expert Report) soft page 9.
[227] Transcript 8-19, lines 15-24.
[228] Transcript 8-27, lines 14-19.

272. The inevitable outcome of low conductivity values is that the model will have underestimated drawdown impacts at the Doongmabulla Springs.

273. The modellers also made unexplained choices about recharge, discharge and storage parameters all of which tend to reduce the modelled impacts i.e. to result in a lower drawdown predicted at the springs.

274. As noted, Prof Werner considers that a 1m drawdown in the Clematis is "plausible". A drawdown at that level is likely to see most of the Doongmabulla Springs dry up given Dr Merrick's agreement that the difference between the potentiometric head and the geomorphic threshold is likely to be in the order of centimetres. Once that gap is bridged a spring will run dry.

The model cannot be relied upon to predict impacts

275. The GHD modelling has a range of problems associated with it beyond the choices of conductivity and other values discussed above.

276. These problems have led Prof Werner to conclude that the model cannot be confidently used to predict impacts on the springs. This is the third scenario discussed above.

277. If so, then the Court has no reliable evidence upon which to found any conclusion on whether the dewatering process will cause the Doongmabulla Springs to run dry or not.

278. Again, this discussion proceeds on the assumption that the only source aquifer for the Doongmabulla Springs is above the Rewan Formation.

Features not included in the model

<u>Springs were not modelled</u>

279. Dr Merrick accepted in cross-examination that no attempt had been made by GHD to model the springs.[229] This had not been made clear in either the EIS documents or in any of the material supplied by the Applicant's experts in these proceedings.

280. Dr Merrick subsequently gave evidence that:

(a) The springs could have been modelled.[230]

(b) If this was done then the model could have generated information on spring flows.[231]

(c) The approach taken by GHD is "a blunt tool" in comparison to modelling the springs.[232]

281. Dr Merrick agreed that the springs should have been modelled:

> Q: But it would be much better, much more precise if the springs themselves, the very

[229] Transcript 7-60, lines 29-42.
[230] Transcript 7-60, line 42.
[231] Transcript 7-61, lines 31-40.
[232] Transcript 7-62, line 4 to 7-62, line 5.

thing we're concerned about, had actually been modelled?

A: Look, I, I agree that some attempt should've been made.[233]

282. Dr Merrick later accepted that:

(a) Discharge from the springs could have been simulated by modelling a bore, but this hadn't been done;[234] and

(b) The springs would have been modelled if those impacts were specifically sought:

Q: So if you really wanted to know what the impact on the springs would be, if you really wanted to know, you would model them; you would model if you were asked to?

A: I – I – I would, and then I would be able to partition that flow between baseflow and spring discharge.

283. Prof Werner made the point that modelling the springs provides an additional test of the conceptualisation:

Q: Thinking particularly about HD02, if you were a modeller in this case, you were someone involved in this case, what would that piece of evidence tell you about whether you needed to re-think your conceptualisations?

A: If you matched HD02 with the model so you got a perfect calibration, you couldn't simulate any springs with the model, because your water levels would be below the ground and your model of the spring needs to be above the ground, so there'd be no spring in the model. So from a modelling point of view, you're in trouble, because someone says hey, you know, model the spring, because we really care about that thing going dry, so stick something in there. Well, if you've put it in there, then there'd be no water coming out of it, which is a sign that there's something wrong with the conceptualisation. You'd have to modify the model so that it produces some spring flow and you are now able to answer at least some questions about it. [235]

<u>Faulting or fracturing not modelled</u>

284. Dr Merrick gave evidence that:

(a) "it would be wrong to model a fault without any evidence for one",[236] notwithstanding that there is significant evidence of faulting where data has been collected on the area of the mining lease application (**MLA**);

(b) The condictivity of any fault "would have to be consistent with that, of the Rewan formation, and because that is so thick it means that the – the fault would – would be hydraulically invisible and therefore pointless to attempt a model."[237]

(i) This assertion is directly contradicted by Mr Bradley's evidence that primary conductivity assumptions don't apply where faulting is concerned because "[y]ou're not dealing with the primary properties of the material", but rather,

[233] Transcript 7-62, lines 16-18.
[234] Transcript 8-15, lines 15-35.
[235] Transcript 9-80, lines 22-34.
[236] Transcript 7-20, lines 25-26.
[237] Transcript 7-20, lines 35-38.

something akin to space.[238]

Not adequately addressed through sensitivity analysis

285. The Applicant asserts that, while they have not directly modelled any faults and this is entirely appropriate since they believe that there are none,[239] the potential for faulting and the IESC's concerns in this regard have been addressed by way of a sensitivity analysis:

> On this basis, no direct simulations of hypothetical faulting of the Rewan Group or other strata have been undertaken. However, as discussed in Section 1.2.2, a detailed sensitivity analysis has been undertaken to quantify groundwater impacts based on a wide range of possible hydraulic conductivity values for the Rewan Group. The results of this sensitivity analysis are reported in Section 3.6.1 of the SEIS Mine Hydrogeology Report Addendum (SEIS Appendix K6). Hydraulic conductivity values for the Rewan Group of as high as $1x10^{-2}$ m/d horizontally and $1x10^{-3}$ m/d vertically were considered for the Rewan Group, increasing post mining to $1x10^{-2}$ m/d horizontally and vertically in the area immediately overlying the underground mine workings. Hence under the 'worst case' Rewan Group hydraulic conductivity scenario considered for the sensitivity analysis, the groundwater modelling assumes that the Rewan Group will respond uniformly as a fractured sandstone **aquifer**. This is akin to assuming that the Rewan Group is heavily faulted and fractured throughout the area, such that it ceases to function as an aquitard.[240]

286. Dr Merrick gave similar evidence that this conductivity is equivalent to that of sandstone.[241]

287. Importantly, as is set out below in more detail, Mr Bradley gave evidence that:

(a) The highest vertical conductivity values applied to the Rewan Formation (that is, 1×10^{-2} m/day) are typical of an aquitard, not an aquifer as is asserted in the above passage;[242]

(b) Aquifer conductivity values are typically metres per day.[243]

288. On this basis alone, the Applicant's sensitivity analysis cannot be considered a substitute for modelling faulting.[244]

Analysis of model uncertainty

289. Uncertainty analysis is about understanding how certain (or uncertain) a model's predictions might be. There is agreement that it is very important to know how good or otherwise a model is at predicting outcomes.[245]

[238] Transcript 4-24, lines 36-45.
[239] Transcript 4-70, lines 3-16.
[240] MR2014 (GHD (2014) Letter GHD to Hamish Manzi entitled *Carmichael Coal Project - Response to IESC Advice*) soft page 14. [*Emphasis Added*].
[241] Transcript 7-22, lines 36-40.
[242] Transcript 4-26, line 1 to 4-27, line 3.
[243] Transcript 4-25, lines 21-41; Transcript 5-38, lines 37-40.
[244] Transcript 4-70, lines 14-19.
[245] Transcript 7-67, lines 42-47.

290. The following guiding principles from the 2012 Australian groundwater modelling guidelines (**2012 Guidelines**) give useful insight into the purpose of uncertainty analysis:

> **Guiding Principle 7.1**: Because a single 'true' model cannot be constructed, modelling results presented to decision-makers should include estimates of uncertainty.
>
> **Guiding Principle 7.2**: Models should be constructed to address specific objectives, often well-defined predictions of interest. Uncertainty associated with a model is directly related to these objectives.[246]

291. The IESC made the following comments about the uncertainty analysis in this case in its meeting minutes of 13-14 May 2014 (**IESC Minutes**):

> In this case, the proponent did not provide a model uncertainty analysis to substantiate the robustness of its groundwater flow conceptualisation and model results. … An uncertainty analysis of the groundwater model would allow a better understanding of the impacts on the Mellaluka and Doongmabulla Springs Complexes, and Carmichael River. [247]

292. The 2012 Guidelines clearly distinguish between sensitivity analysis and uncertainty analysis:

> …uncertainty analysis builds upon, but is distinct from, sensitivity analysis. Whereas sensitivity simply evaluates how model outputs change in response to changes in model input, uncertainty analysis is a more encompassing assessment of quality of model predictions. In uncertainty analysis, sensitivities of predictions to model parameters are combined with a statistical description of model error and parameter uncertainty. Thus, the uncertainty associated with a prediction depends on both the sensitivity of the prediction to changes in the model input, and on the uncertainty of the inputs, parameters, observations and conceptual model itself.[248]

293. Dr Merrick conceded that GHD has not done anything that permits a statistical description of model error, and what has been done with respect to parameter uncertainty "is at the most basic and rudimentary level."[249]

294. Prof Werner's key concerns on this issue, as set out in section 4.4 of his individual expert report,[250] align with the concerns of the IESC:

(a) The analysis and understanding of the uncertainty in model predictions is weak; and

(b) Sensitivity analysis is not an adequate assessment of uncertainty in the model.

Single parameter peturbation

295. The sensitivity analysis undertaken by GHD was a simple perturbation of individual model parameters one at a time.

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[246] Exhibit 78; AA042 (National Water Commission - Australian Groundwater Modelling Guidelines (June 2012)) p. 93, soft page 105.
[247] Exhibit 60; OL033 (IESC Minutes).
[248] Exhibit 78; AA042 (National Water Commission - Australian Groundwater Modelling Guidelines (June 2012)) soft page 107, para 95. [*Emphasis added*].
[249] Transcript 7-71, lines 13-26; Transcript 8-5, lines 23-24.
[250] Transcript Exhibit 20; OL011 (Prof. Werner's Groundwater Modelling Expert Report) soft pages 10-13.

296. Dr Merrick agreed with Prof Werner that the sensitivity analysis undertaken is a very basic analysis of uncertainty, and described it in cross-examination as "[p]retty close to the [most] basic form."[251]

297. Dr Merrick accepted that sensitivity analysis by perturbation is "an essential base, and there are more sophisticated methods that could be done in addition to that."[252]

Multiple aquitards "mute" impacts

298. This approach to sensitivity analysis must also be considered in light of the discussion above related to "Conductivity".

299. Given that there are a number of model layers with similar or lower conductivity values than the Rewan Formation (layers 6 to 11), an increase in the conductivity of any one of these at a time can have only a limited effect on the impact predictions.

300. Dr Merrick accepted the analogy that the model layers represented "gates" between the target units and the upper aquifers, through which the impact would have to propagate before impacting the springs.[253] The sensitivity analysis opens only one gate at a time to test the extent of the impact on the Doongmabulla Springs.

301. Dr Merrick agreed that the effect of this approach and the very low conductivity of layers 6 to 11 was to "mute" the predicted impacts:

> Q: The Permian unit overlaying the AB seam is modelled with a lower permeability than the Rewan Formation?
>
> A: Yes.
>
> Q: Yes. In other words, to use slang which I think that a couple of you have used so far, it's an even tighter – as it's modelled, an even tighter [aquitard], an even tighter barrier to flow, than the Rewan?
>
> A: Right.
>
> Q: So given that we're talking about the capacity of mine impacts to propagate upwards, having a unit which is less permeable than the Rewan above it effects, doesn't it, the sensitivity analysis; the way in which tweaking the Rewan might give you a bigger or a lower impact?
>
> A: It does. Yes.
>
> Q: And in particular, it would tend to mute the impact of the sensitivity analysis to the Rewan?
>
> A: It – it will mute it. It doesn't stop it because we see that there is a – well, we have seen the – the shape of the curve though there is sensitivity still to the Rewan values in the sensitivity analysis. So it does have a muting effect. That's true.[254]

Perturbing multiple parameters increases impacts

302. Dr Merrick confirmed that in the sensitivity analysis done by GHD no two parameters were perturbed in combination.[255]

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[251] Transcript 7-68, lines 23-24.
[252] Transcript 7-18, line 36 to 7-19, line 1.
[253] Transcript 8-47, lines 5-8.
[254] Transcript 8-68, lines 21-37.
[255] Transcript 8-46, lines 39-43.

303. He also confirmed that perturbation increasing the conductivity of two parameters at the same time would increase the observed impact:

> Q: So, in other words, if you tweak the Rewan Formation numbers but you leave, for example, the Permian units overlying the AB seam the same then you're not going to get as big an impact as if you tweak both of them at the same time, are you?
>
> A: That's true….
>
> Q: So, for example, we, I think, agreed earlier that the Clematis Sandstone and the Rewan Formation were identified by GHD as being relatively sensitive insofar as impacts to the Doongmabulla Springs are concerned?
>
> A: Right.
>
> Q: So, given that, if the tweaking to each of those layers was done at the same time to increase the permeability, you would reasonably expect an increase in the impact to the Doongmabulla Springs?
>
> A: Yes, if you vary the two in the same - well, in a direction, that gives you a higher impact in both cases without trying to second guess which way it should be done. Yes, you will get a greater impact than perturbation of a single one alone.[256]

304. By assigning very low permeability values to the units between the coal seam the Doongmabulla Springs, and then perturbing only one parameter at a time, GHD has taken an approach that cannot be expected to usefully demonstrate the sensitivity of the model outputs and predicted impacts on the Doongmabulla Springs.

Unexplained mistake in sensitivity analysis

305. Figures 12 to 14 in the Carmichael Coal Mine and Rail Project SEIS: Mine Hydrogeology Report Addendum, dated 24 October 2014 (**SEIS Addendum Report**), show the sensitivity analysis.

[256] Transcript 8-47, lines 10-37.

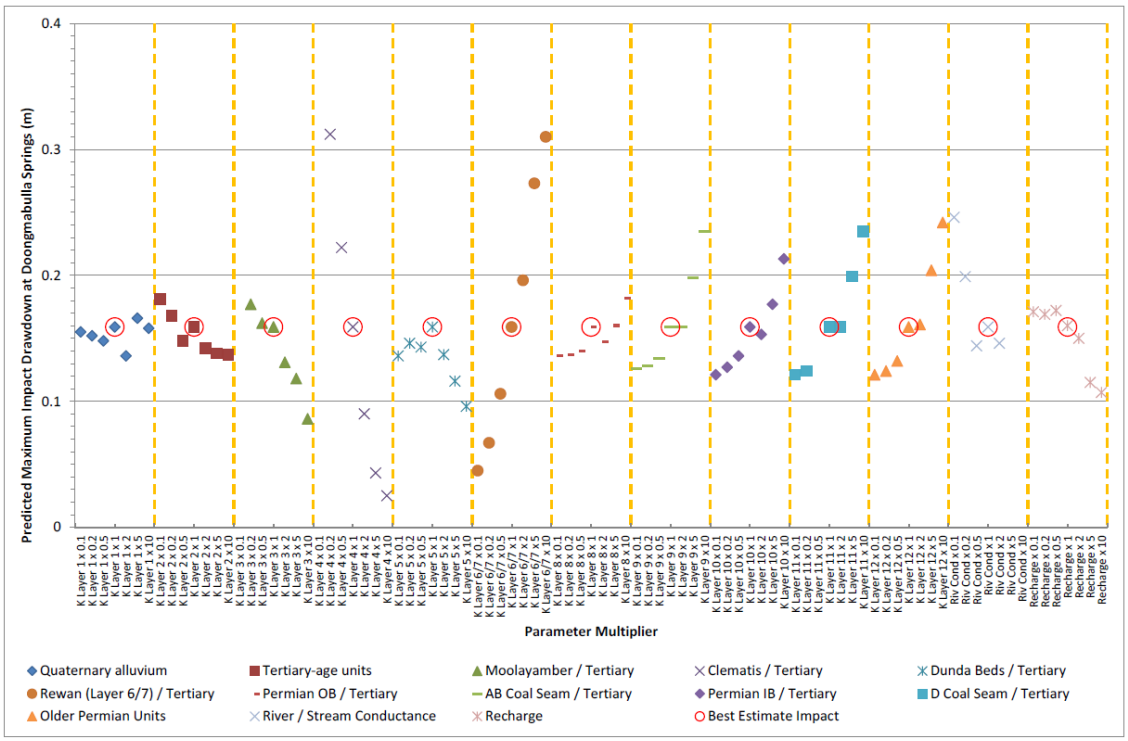

Figure 12 Sensitivity Analysis – Doongmabulla Springs Maximum Impacts

SEIS Addendum Figure 12: Sensitivity analysis outputs from GHD (2013) Carmichael Coal Mine and Rail Project SEIS: Mine Hydrogeology Report Addendum [257]

306. Dr Merrick gave evidence that a plot such as that shown in SEIS Addendum Report Figure 12 (**SEIS Addendum Figure 12**) should show a "monotonic" relationship – that is, a linear or parabolic function – and noted that some of the results shown in SEIS Addendum Figure 12 are off the function line. [258]

307. Dr Merrick's explains the issue and his concern:

> Q: You see there's a middle – a middle result there which is off what you would describe as being the function line?
>
> A: Sure. Yes.
>
> Q: Yes. And when you see patterns like that where one of the values or more than one of the values are off the function line, I understand Prof Werner will say that's a significant cause for concern in terms of the calibration and the sensitivity analysis you're doing?
>
> A: Well it does suggest that there was some other change in the model.
>
> Q: Yes?
>
> A: Other than that perturbation…. It's indicative that they didn't use the exact base model when they perturbed it. There must have been some other variation to the base model sitting there without their realising it.
>
> Q: Okay?
>
> A: Otherwise you would get the continuous curve.
>
> Q: Yes. You'd get the function line we've been talking about?
>
> A: Yes.

[257] MR170.2 (SEIS, Volume 4, Appendix K6 – Mine Hydrogeology Report Addendum) soft page 42.
[258] Transcript 8-3, line 39 to 8-4, line 22.

Q: So, right. So the point of the – the commendable sensitivity analysis done in this case was to test the impact on the results of the model by changing one parameter?

A: Yes.

Q: And what this shows is, that without the modellers knowing it, more than one parameter was changed?

A: It – it does suggest that….

Q: But we don't know what the other change or changes were?

A: No.

Q: We have no idea?

A: No.[259]

308. Such an unexplained error is of fundamental concern, particularly given that it represents a mistake in the only analysis of uncertainty (albeit rudimentary) that has been done on the model.

Non-convergent sensitivity runs

309. Dr Merrick and Prof Werner both expressed concerns about the results shown in a similar diagram to SEIS Addendum Figure 12, but prepared with respect to the sensitivity analysis on the final void.[260]

310. Dr Merrick described this as a water balance error and indicated that the model runs should be thrown away:

> So there are many reasons why a simulation might not converge. They don't all run easily, I can assure you. So that's my best estimate of what's happening there, that some of the runs you would dismiss. And you could probably dismiss them on - I mean, systematically by looking at water balance errors. If they were significant errors then you throw those runs away.[261]

311. Prof Werner expressed concern about this issue in his individual expert report and in oral evidence, and particularly the statement in the EPBC Response Report that instances where water balance errors were returned were subsequently "treated with caution", not discarded.[262]

312. This non-convergence is a serious issue in the eyes of both modelling experts but, again, Dr Merrick did not identify this issue until it was put to him in cross-examination. Neither did Mr Middlemis, the reviewer who described the uncertainty analysis as "commendable".[263]

<u>Type I – IV analysis</u>

313. The modelling experts agreed in the Joint Groundwater Experts Report dated 9 January 2015 (**Groundwater JER**) that:

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[259] Transcript 8-4, line 20 to 8-5, line 15.
[260] MR170.2 (SEIS, Volume 4, Appendix K6 – Mine Hydrogeology Report Addendum) soft p44.
[261] Transcript 8-50, line 47 to 8-51, line 4.
[262] Transcript 9-56, lines 20-25; Transcript 9-68, lines 30-34; Exhibit 20; OL011 (Prof. Werner's Groundwater Modelling Expert Report) soft page 19; Exhibit 68; AA036 (GHD Report - Response to Federal Approval Conditions - Groundwater Flow Model – November 2014) soft page 65.
[263] Exhibit NPM-2 to Exhibit 19; AA010.1 (Dr Merrick's Groundwater Modelling Expert Report) soft page 42.

> In the 2012 groundwater modelling guidelines, the Type I to Type IV sensitivity analysis is no longer recommended and the analysis as presented in the SEIS modelling report is not instructive.[264]

314. Dr Merrick went further in cross-examination and observed that the process undertaken by GHD represented an "abuse"[265] of this kind of analysis:

> Q: I think they misinterpreted it in – they interpreted it as virtually guaranteeing no impacts, and that's not the intention of the process…
>
> So I wasn't aware of the opportunity for abuse until I read this report.
>
> A: I see. And then the opportunity for abuse was made manifest by the reading of this report?
>
> Q: Yes.[266]

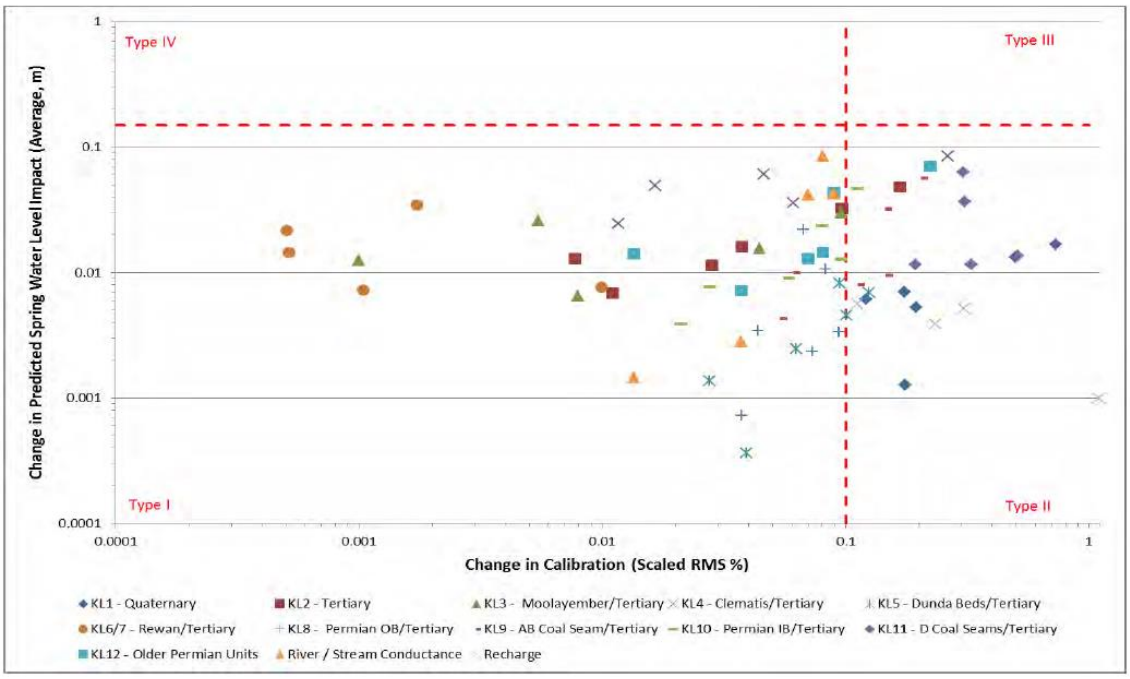
315. The essential premise of this kind of analysis is that outputs of the sensitivity analysis are plotted within 4 quadrants, which assign Type 1 to Type 4 sensitivity. As set out in the 2001 Murray-Darling Basin Commission Groundwater Flow Modelling Guideline (**2001 Guidelines**), Type 4 is of concern because "non-uniqueness in a model input might allow a range of valid calibrations but the choice of value impacts significantly on a prediction."[267]

316. In simple terms, the model will readily calibrate a Type 4 parameter to a range of different values, but the value ultimately used in the predictive model will have a major impact on the accuracy of the impact prediction.

317. Figure 41 from the SEIS Report (**SEIS Figure 41**) is an example of Type 1-4 analysis outputs, and shows the four quadrants or sensitivity "types" divided by the red dotted lines.

[264] Exhibit 14; JR004 (Groundwater Joint Experts Report) p 5, para 19.
[265] Transcript 8-6, lines 42-44.
[266] Transcript 7-69, lines 38-40; Transcript 7-70, lines 9-13.
[267] Exhibit 58; OL031 (Middlemis et al (2001) *Murray-Darling Basin Commission Groundwater Flow Modelling Guideline*) soft page 70.

Figure 41 Sensitivity analysis results – Doongmabulla Springs



SEIS Figure 41: Sensitivity analysis outputs from SEIS Report[268]

318. The following exchange highlights Dr Merrick's primary concern:

> Q: And so you can go through this process, and it can lead you to overconfidence in your model, but based on an analysis which is, as you described, unhelpful, and open to abuse, for that reason?
>
> A: Oh, I don't know that it – there's a link to overconfidence in the model. It could be – well, my objection to its use in this case was that GHD used it to suggest that there would not be any impacts of concern.[269]

319. Prof Werner expressed concern that the placement of the lines that effectively determine the sensitivity type had been set applied in such a way as to avoid demonstrating any Type 4 sensitivity,[270] and Dr Merrick agreed that the division of quadrants is somewhat arbitrary.[271]

320. In light of the unexplained error discussed above, this abuse of sensitivity analysis further erodes any remaining confidence that one might have in the GHD model's predictive capacity.

321. Once again, these issues with the "commendable" sensitivity analysis were not identified in the Middlemis Review.[272]

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[268] MR167 (SEIS, Volume 4, Appendix K1 – Mine Hydrogeology Report (GHD 2013)) soft page 90.
[269] Transcript 8-7, lines 24-28. [*Emphasis added*].
[270] Transcript 9-9, lines 22-41.
[271] Transcript 8-7, lines 16-20.
[272] Exhibit NPM-2 to Exhibit 19; AA010.1 (Dr Merrick's Groundwater Modelling Expert Report) soft page 42.

Inadequate assessment of uncertainty

322. Ultimately, the evidence demonstrates that neither the Court nor any other decision maker can properly understand the likelihood of the modelled predictions being correct, because the analysis simply has not been done.

323. Dr Merrick seeks to justify this on the basis that he has only ever done qualitative risk assessment and claims that no mining development he is aware of has ever done a quantitative uncertainty analysis.[273]

324. However, poor industry practice is not a proper basis to excuse inadequate impact assessment, nor should it be allowed to affect the quality of decision making on a project with such significant potential groundwater impacts as this.

Calibration

Transient calibration not done

325. The Applicant's numerical model has only undergone steady state calibration, which Dr Merrick and Prof Werner agree is a weakness.[274]

326. The absence of transient calibration means:

(a) there is no corroboration of the assumed storage parameters in the model; and

(b) there is no independent assessment of rainfall recharge.[275]

327. Steady state calibration does not deal with any fluctuations over time whereas transient calibration does allow for time-varying stressors[276] and, as a consequence, the 2012 Guidelines articulate that "a model that is calibrated in steady state only will likely produce transient predictions of low confidence."[277]

328. The 2012 Guidelines indicate that:

(a) A model of Class 2 (medium) confidence level should have undergone transient calibration to at least some extent.

(b) A feature of a Class 1 (low) model is that it makes transient predictions when calibration has been done only in steady state.[278]

329. Dr Merrick accepts that for the purpose of evaluation and management of potentially high risk impacts, the model should be "[h]eading towards class 3."[279]

[273] Transcript 7-73, lines 26-32.
[274] Exhibit 14; JR004 (Groundwater Joint Experts Report) p 5, para 13.
[275] Exhibit NPM-1 to AA010.1 (Dr Merrick's Groundwater Modelling Expert Report) soft page 13, section 4.1.
[276] Transcript 7-53, lines 1-15.
[277] Exhibit 78; AA042 (National Water Commission - Australian Groundwater Modelling Guidelines - June 2012) soft page 30, para 18.
[278] Transcript 7-63, lines 21-28; Exhibit 78; AA042 (National Water Commission - Australian Groundwater Modelling Guidelines - June 2012) soft page 33, para 21.
[279] Transcript 7-60, lines 20-23.

330. The modelling experts disagree on the availability of data to form the basis of a transient calibration:

(a) Dr Merrick considers that there was limited data available at the time the earlier modelling was done, but that they could have quite reasonably done transient calibration in respect of one bore.[280]

(b) Prof Werner notes that:

> A few bores with transient records will usually provide useful insights to a transient calibration attempt. The suggestion that water level variations in time are small is also not a valid reason to avoid a transient calibration. In any case, it seems contradictory to state that there is limited time-series information, but that it is possible to discern that the system is temporally stable. The seasonality in spring flow contradicts this and indicates significant transient variations.[281]

331. The Coordinator-General (**CG**), in the Coordinator General's evaluation report (**CG's Report**), requires as a condition of the EA that the Applicant undertake transient calibration within 2 years of the commencement of box cut.[282]

(a) On this basis, Dr Merrick is unconcerned about the lack of transient calibration at this stage, however, he notes that transient calibration will improve the model and that there are some hydrographs that would give useful information for transient calibration.[283]

(b) Prof Werner raised concerns about the timing of this requirement:

> We do a transient calibration to understand the timing of impacts of the mine. Two years after mining starts – I don't know … I have a very large red flag that comes up, that you are going to do what is kind of – other people are saying is necessary – two years after you've already committed a huge amount of money to get something done. I mean, I just – I – it's – there's red flags.[284]

<u>Barely acceptable calibration</u>

332. Prof Werner and Dr Merrick agreed in the Groundwater JER that the "latest SEIS model calibration statistics (12 %RMS on mine lease; 7 %RMS overall) are at the limit of acceptability."

333. Dr Merrick maintained this view in his oral testimony.[285]

<u>Automated Calibration - PEST</u>

334. Prof Werner identified in his expert report that he had concerns over an assertion by GHD that the use of parameter estimation software – PEST – is automated and therefore objective.

> For the SEIS modelling work, rather than return to the premodelling parameter estimates

[280] Transcript 7-64, lines 4-18.
[281] Exhibit 20; OL011 (Prof. Werner's Groundwater Modelling Expert Report) soft page 9.
[282] Exhibit 6a; SP001.12 (Coordinator-General's Report) soft page 380. See Condition E6.
[283] Transcript 8-72, lines 1-29.
[284] Transcript 9-64, line 34 to 9-65, line 11.
[285] Transcript 7-65, lines 23-26.

> used as initial values, the calibrated parameter values from the EIS model were used as initial values for the SEIS re-calibration. These values were then optimised further using PEST to fit the groundwater level calibration data set. It should be stressed that this parameter optimisation (or calibration) process is almost entirely automated and hence objective.[286]

335. Dr Merrick gave the following evidence in response to the above passage taken from the SEIS Report:

> Q: I take it from your earlier answer that you don't agree that it's objective because it's automated?
>
> A: Well, it – it's – it's – it's – it's the opposite. It's – it's objective in the sense that an automated process has what it – is called an objective function that is a – a essentially the RMS. So it's – it's a word that can be used in two different ways; either mathematically or – or, you know, culturally. I think it's an unfortunate use of language by GHD in saying that the process was – was automated and, therefore, it is objective. Now, it would be wrong to rely completely on an automatic process without oversight and intuition and involvement of the modeller.[287]

336. Dr Merrick gave the following evidence in respect of calibration generally:

> It's a – it's a difficult process. It requires a lot of intuition, manually [sic] adjustment, as well as automated methods, that they should be used advisedly. They should not be a replacement for the modeller's intuition.[288]

Deficient data

337. The IESC identified particular concerns with the lack of real world data that underpinned the model:

> The conceptual groundwater model is not adequate nor underpinned by sufficient representative data. There is insufficient hydraulic head information, particularly in the deeper geological units, to justify the groundwater flow predictions made by the groundwater flow model. Further hydraulic head information, especially in the deeper geologic units, and at a regional scale both within and beyond the mine site is required in order to better constrain the groundwater model.[289]

338. Prof Werner raised concerns in his individual expert report about the paucity of data outside the mining lease area in the following terms:

> There is insufficient monitoring data outside of the mined area to infer reliable groundwater flow directions and trends, to determine the impacts of mining once dewatering begins, and to ascertain the relationship between the water levels of springs, streams/ rivers and aquifers.[290]

339. When this was put to Dr Merrick he agreed that, in terms of the data that's so far been incorporated into the model, there is a deficiency in the area of the springs:

> A: I don't agree with that across the entire model extent, no.
>
> Q: No. But off the mine lease?

---

[286] MR167 (SEIS, Volume 4, Appendix K1 – Mine Hydrogeology Report (GHD 2013)) soft page 97. [*Emphasis Added*].
[287] Transcript 7-66, lines 11-39
[288] Transcript 7-64, lines 39-42.
[289] Exhibit 59; OL032 (IESC Advice to decision maker on coal mining project) p 4.
[290] Exhibit 20; OL011 (Prof. Werner's Groundwater Modelling Expert Report) soft page 7.

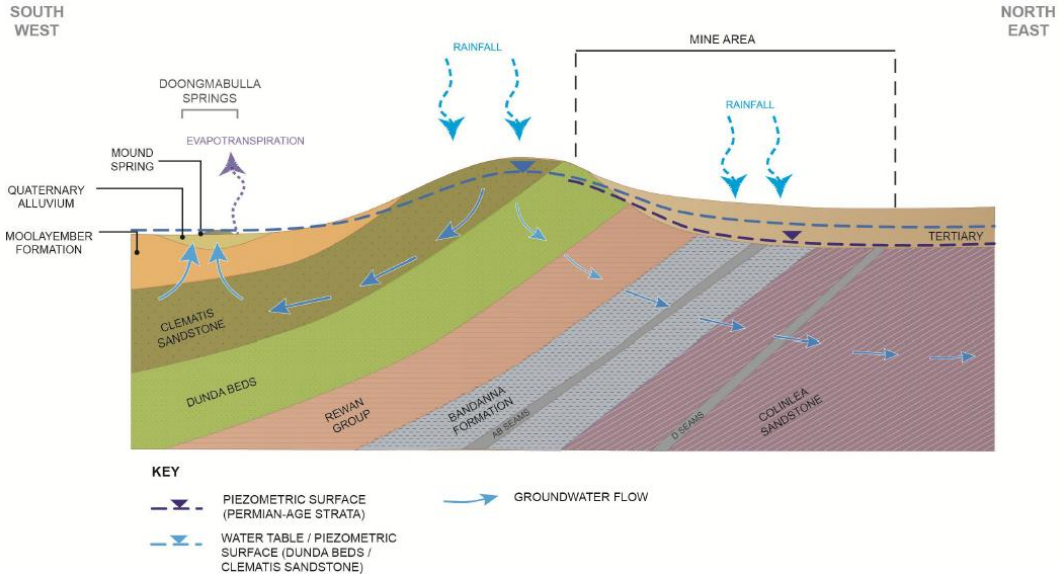
A: Off the mine lease about - there is insufficient data from - I can't recall the distances but certainly to the west of the mine lease. But let's say between - between the mine lease and the springs, I think there is sufficient data now because there has been new drilling done since the SEIS reporting has been done. So I'm aware of extra drilling and extra information that has not had the opportunity of being incorporated in the model.[291]

Conceptual Model

340. As A/Prof Webb explained in his report[292] and his evidence-in-chief,[293] the Applicant's conceptualisation of the regional hydrogeology is based on an outdated understanding of the geology derived from very basic historical mapping, limited data outside of the mine area, and is fundamentally unreliable.

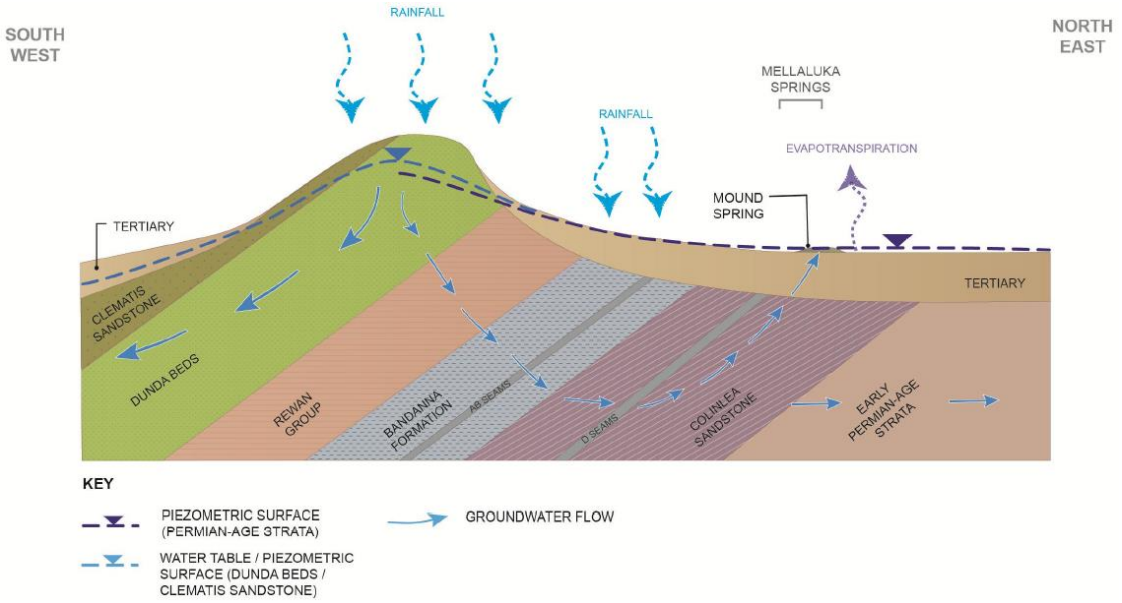
341. A/Prof Webb has used data not previously considered by the Applicant, including airborne radiometric and satellite images, and the Applicant's own seismic and drilling data to conclude that the assumed geology and hydrogeology of the area is in error. In particular, his evidence indicates that the Applicant's conceptualisation and numerical modelling ignores the critical importance of faulting. These issues are discussed in more detail below in relation to the final scenario: whether there is a source for Doongmabulla Springs below the Rewan Formation.

342. All of the groundwater experts agreed "that the conceptual cross sections (e.g. Figures 9 and 10 of the SEIS Addendum, GHD (2013)) are simplistic and that they do not accurately represent the probable flow conditions."[294] This was because, amongst other things, it showed groundwater movement through the Rewan Formation, which GHD assumed to be an aquitard.[295]



SEIS Addendum Figure 9: (Sketch Cross Section (west to east) through Doongmabulla Springs) in SEIS Mine Hydrogeology Report Addendum (Exhibit 6; MR170.2) p 18.

[291] Transcript 8-9, lines 11-18 [*Emphasis Added*].
[292] Exhibit 18; OL012 (A/Prof. Webb's Groundwater Expert Report).
[293] Transcript 5-2, line 12 to 5-50, line 2.
[294] Exhibit 14; JR004 (First Groundwater Joint Experts Report), para 6.
[295] Transcript 3-22, lines 28-47; Transcript 9-14, lines 4-22; Exhibit 14; JR004 (Groundwater Joint Experts Report) p 4, para 6.



SEIS Addendum Figure 10: (Sketch Cross Section (west to east) through Doongmabulla Springs) in SEIS Mine Hydrogeology Report Addendum (Exhibit 6; MR170.2) p 19.

343. Mr Bradley gave evidence about the importance of the Conceptual Hydrogeological Model (**CHM**) as a basis for numerical modelling:

> The conceptual model is everything. I think if you get the conceptual model wrong, then the numerical model cannot hope to be right.[296]

344. Mr Bradley did not prepare the CHM for GHD's numerical model in this case, but he has been engaged to prepare CHM for other mining projects.[297]

345. At one point Mr Bradley described the GHD's conceptual cross section as "slightly cartoonish",[298] and he accepted that the level of detail shown in the CHM cross-section in Figure 2.4.1 of the 2001 Groundwater Modelling Guidelines[299] was sufficient to describe the groundwater system.[300]

346. Mr Bradley, despite the shortcomings of the cross sectional representation, considered the GHD conceptualisation to be adequate on the basis that the modellers' understanding of the conceptualisation would be demonstrated by the in-text discussion.[301]

347. However, Mr Bradley later accepted that the text in GHD's SEIS Addendum Report[302] reinforced the conceptual cross sections with which he disagreed.[303]

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[296] Transcript 3-6, lines 5-16.
[297] Transcript 3-19, lines 46-47.
[298] Transcript 3-20, line 44.
[299] Exhibit 58; OL031 (Middlemis et al (2001) *Murray-Darling Basin Commission Groundwater Flow Modelling Guideline*) soft page 35, para 19.
[300] Transcript 3-9, lines 29-33.
[301] Transcript 3-21, line 43 to 3-22, line 13.
[302] MR170.2 (SEIS, Volume 4, Appendix K6 – Mine Hydrogeology Report Addendum) soft pages 31-32.
[303] Transcript 4-19, lines 3-13.

348. Notwithstanding Dr Merrick's agreement in the Groundwater JER that the CHM in SEIS Addendum Figures 9 and 10 "are simplistic and that they do not accurately represent the probable flow conditions", he gave evidence that:

> "I had no issue with GHDs sketch of the conceptual model… They're meant to say water starts at A and ends up at B… So I would draw it exactly the same way."[304]

349. This statement is not only inconsistent with Dr Merrick's earlier agreement in the JER, but also with the following statement in his individual report, which sets out his view that the recharge area is in fact different from that shown in Figure 9:

> "The issue here is that the originally drawn conceptual model diagram has proved to be overly schematic. The main source of water inputs has proved to be higher ground distant from the mine rather than the Great Dividing Range adjacent to the mine."

Middlemis review

350. The Applicant has sought to rely heavily on the peer review carried out by Mr Hugh Middlemis (**the Middlemis Review**)[305] in support of Dr Merrick's appraisal of the GHD model's adequacy.

351. The Middlemis review should be given very little weight for a number of reasons, not least of which is that Mr Middlemis was not involved in the conclave process and his opinions were not scrutinised under cross-examination.

352. Furthermore, Mr Middlemis appears to have overlooked or failed to recognise all the issues brought to the Court's attention by Dr Merrick and Prof Werner.

353. Of particular concern is the characterisation of uncertainty analysis in the Middlemis review. Prof Werner and Dr Merrick agree that there has been no uncertainty analysis beyond the sensitivity analysis that Prof Werner considers "rudimentary" and Dr Merrick has described "[p]retty close to the [most] basic form",[306] whereas the Middlemis Review describes it in the following terms:

> The exploration of model uncertainty in conceptual and parameter value terms is commendable and the results indicate low sensitivity/uncertainty.[307]

354. It was put to Prof Werner a number of times and in various ways that he was not in a position to disagree with the conclusions in the Middlemis Review because only Mr Middlemis had accessed the model data files, however:

(a) Prof Werner addressed this in his individual report:

> Access to the modelling files will improve only a small sub-set of the opinions expressed in this report. For example, the application of the STR package and the method of simulating the springs are unclear in the reporting, and an evaluation of the modelling files would clarify the methods used. However, the short-comings in the report in explaining these aspects of the methods are themselves an issue, given (a) above, and hence, the same issues would need to raised regardless of any clarification obtained through assessing the

[304] Transcript 7-56, lines 28-42.
[305] Exhibit NPM-2 to AA010.1 (Dr Merrick's Groundwater Modelling Expert Report) soft page 40.
[306] Transcript 7-68, lines 23-24.
[307] Exhibit NPM-2 to AA010.1 (Dr Merrick's Groundwater Modelling Expert Report) soft page 42 [*Emphasis added*].

modelling files.[308]

(b) Prof Werner responded this cross-examination in the following terms:

> Q: But you haven't investigated the model itself; only what's been reported?
>
> A: I have not investigated the model itself.
>
> Q: How can you say the model itself is deficient?
>
> A: Because there is enough indication that there are problems with the model with what I read in the report. It's like standing on the side of a river and seeing dead fish floating in it and saying there's nothing wrong with the water because I haven't been in it. I'm sorry, but I can see enough evidence through the reporting that there are issues and not just with the model recalling that hydrogeology is a collection of evidence; there are also fundamental concepts that are missing and that are wrong.[309]

(c) The Middlemis Review makes it clear that the author only reviewed the data files on one day in what was described as a "brief audit investigation".[310]

(d) It is also noteworthy that the Applicant seeks to rely on Dr Merrick's opinion in support of the conclusions reached in the Middlemis Review, yet Dr Merrick has not himself reviewed the model data files.[311]

Reliance on standard industry practice

355. Dr Merrick noted that it is rare to use more sophisticated uncertainty analysis in impact assessment for mining projects.[312]

356. Later in his evidence, he stated that "full blown uncertainty analysis… just doesn't happen" and that:

> [Uncertainty analysis] would always be beneficial. There has to be some degree of pragmatism in groundwater assessments for EISs. And in my view, it is too computationally demanding to get to a point of describing probabilities that have any meaning.[313]

357. Low standards among modellers for the mining industry cannot justify the approval of a mine of this scale without a proper understanding and assessment of the impacts. If industry practice does not permit the Court to adequately answer the relevant statutory questions then a claim of compliance with industry practice takes the matter no further.

Modelling guidelines

358. Dr Merrick notionally accepts that improvements to modelling should be expected as technology advances, and made the following comment particularly in relation to uncertainty analysis.

> With the evolution of groundwater modelling capability, it is reasonable to put more effort

[308] Exhibit 20; OL011 (Prof. Werner's Groundwater Modelling Expert Report) soft page 5.
[309] Transcript 9-68, lines 36-45.
[310] Exhibit NPM-2 to AA010.1 (Dr Merrick's Groundwater Modelling Expert Report) soft page 44.
[311] Transcript 8-9, line 46 to 8-10, line 3.
[312] Transcript 7-19, lines 13-15.
[313] Transcript 7-72, lines 19-32.

> into this activity although it is computationally demanding.[314]

359. However, Dr Merrick on a number of occasions disagreed with both the 2001 Guidelines and the 2012 Guidelines and indicated his preparedness to disregard them:

(a) When shown an example conceptual model in the 2001 guidelines,[315] Dr Merrick stated that he "would never present" such a cross section and that he "would never use that as an example."[316]

(b) With respect to the 2012 Guidelines and the classification system they use, Dr Merrick considers that the "classification system has not worked well in practice" and that he prefers "to go back to the old system".[317]

(c) Dr Merrick is critical of the overall standard expected under the 2012 Guidelines, and took aim at the "academic" authors:

> And I should point out that the new guidelines were written mostly by non-practicing modelists, right? Mostly academic modelists. And that's – and I think there is an element of academia in the guidelines where certain things are put in as expectations which really are not achievable under normal practical business conditions.[318]

(i) Dr Merrick gave no indication of what is meant by "normal practical business conditions" but apparently assumes this is some kind of relevant benchmark;

(ii) Dr Merrick's criticism of the authors appears to neglect that the 2 lead authors and at least 2 others are practicing consultants.[319]

The modelling cannot be relied upon to predict impacts

360. The breadth and depth of problems with the Applicant's numerical modelling caused Prof Werner to conclude that it could not be safely relied on to predict the impacts of dewatering. The evidence at trial confirms that this is so.

361. The above analysis has focused on problems with the analysis that do not rely on Prof Werner's list of "fundamental errors" in the reporting that have caused him to lose confidence in the modellers.[320] If those are added into the equation then the modelling becomes an even more fragile proposition.

362. If the Court concludes that it cannot rely on the GHD model to predict impacts then it is left with a risk of complete loss of the Doongmabulla Springs, which have "exceptional ecological value", with no sound basis to assess what the level or probability of the impact will be. The mine cannot proceed on such a footing, at least not consistently with the precautionary principle.

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[314] Exhibit NPM-1 to AA010.1 (Dr Merrick's Groundwater Modelling Expert Report) soft page 16, section 4.3(n).
[315] Exhibit 58; OL031 (Middlemis et al (2001) *Murray-Darling Basin Commission Groundwater Flow Modelling Guideline*) soft page 35, para 19.
[316] Transcript 7-57, lines 15-26.
[317] Transcript 7-58, lines 42-46; Transcript 7-59, line 45.
[318] Transcript 7-76, lines 41-45.
[319] Transcript 8-2, lines 24-42; Transcript 8-84, line 36 to 8-85, line 9.
[320] Transcript 9-12, lines 8-23; Exhibit 20; OL011 (Prof. Werner's Groundwater Modelling Expert Report) soft page 16.

Doongmabulla Springs are likely to be lost if mine proceeds – source aquifer below the Rewan

363. The final scenario for the Court to consider is A/Prof Webb's evidence that the Doongmabulla Springs is sourced, at least in part, from an aquifer below the Rewan Formation, namely the Colinlea Sandstone.

364. Much of the argument about the likely extent of the mine's impact on the springs centred on the source aquifer for the Doongmabulla Springs and in particular whether the springs were fed at least in part by an aquifer below the Rewan Formation.

365. In opening submissions the Applicant acknowledged the likelihood that the Doongmabulla Springs would be lost if the source aquifer is below the Rewan in the aquifers that will be dewatered for the mining:

> If, however, the source is below the Rewan, like the aquifer that feeds the Mellaluka, then the impacts will be significant. The [Doongmabulla] springs will not merely have a drawdown but will be lost.[321]

366. Mr Bradley also accepted that the Doongmabulla Springs will run dry if A/Prof Webb is correct.[322]

Agreement about uncertainty

367. The Groundwater JER includes the following statement of agreement:

> **Source aquifer for Doongmabulla Springs Complex**
>
> 7. We agree that the source of the Doongmabulla Springs is inconclusive and that there are two potential sources that need to be considered; one a source below the Rewan Formation, the other a source from above the Rewan Formation. Methods such as isotope sampling, in conjunction with analysis of existing data (water chemistry, water level, geology) would potentially assist in resolving the question.[323]

368. This is understood by A/Prof Webb and Prof Werner to be an agreement of all the groundwater experts.[324] Although Mr Bradley attempted to re-characterise the agreement in his evidence,[325] its meaning was plain when it was written and remains so.

Evidence of A/Prof Webb and Mr Bradley

369. The evidence of A/Prof Webb and Mr Bradley is central to identifying whether the Doongmabulla Springs is fed from a source aquifer above or below the Rewan Formation (or both), and was focussed on the following key issues:

(a) What evidence is there of **faulting through the Rewan Formation** that could provide a preferred flow path from the Colinlea Sandstone to the surface at the Doongmabulla Springs?

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[321] Transcript 1-10, lines 39-42.
[322] Transcript 3-10, lines 44-47; Transcript 4-54, lines 30-31.
[323] Exhibit 14; JR004 (Groundwater Joint Experts Report) p 4, para 7.
[324] Transcript 5-35, lines 40-43; Transcript 9-30, lines 44-45.
[325] Transcript 2-22, lines 2-40; Transcript 4-16, line 33 to 4-17, line 20.

(b) What does the available regional data tell us about **regional groundwater flow** within, and likely discharge from, the aquifers above and below the Rewan Formation?

(c) What evidence is there that either of the potential source aquifers above and below the Rewan Formation has the **necessary potentiometric head to drive artesian spring flow** at the Doongmabulla Springs?

(d) What does the available information on **regional geology** and from relevant **bore log data** tell us about the competing conceptualisations to explain the source aquifer/s of the Doongmabulla Springs?

(e) Is there any other data that assists or could assist in addressing the uncertainty about the source aquifer/s of the Doongmabulla Springs?

A/Prof Webb

370. A/Prof Webb, as set out in his individual report, undertook a comprehensive investigation and remapping process to better understand the regional geology, which had not been mapped in the last 45 years.

371. A/Prof Webb then collated all the data available to him and developed a number of lines of evidence to attempt to conclusively identify the source aquifer of the Doongmabulla Springs.

Mr Bradley

372. Mr Bradley said that he considered his task as an expert witness in this case was to address only the question of whether the Doongmabulla Springs is fed from above or below the Rewan Formation.[326]

373. Mr Bradley essentially employed only two lines of argument in support of his position that the Doongmabulla Springs are fed from an aquifer above the Rewan Formation:

(a) He dismissed out of hand the possibility of substantial flow through the Rewan, either in the form of recharge or discharge; and

(b) He proffered an alternative conceptualisation of how the Doongmabulla Springs might be fed from above the Rewan Formation, notwithstanding the fact that HD02 (the nearest groundwater monitoring bore to the Doongmabulla Springs) is not artesian.

374. Mr Bradley's conceptualisation regarding the source of the Doongmabulla Springs was presented in Figure 4 in his first individual report[327] (**Figure 4**), which essentially relied on:

(a) Existing regional geological mapping;[328] and

[326] Transcript 3-28, lines 22-25.
[327] See "Figure 4: Conceptual Hydrogeological Cross Section" in Exhibit JWB-1 to Exhibit 16; AA008 (Mr Bradley's First Groundwater Expert Report) soft page 18, para 14.
[328] Transcript 2-22, lines 42-44.

(b) Bore log data, primarily from the Shoemaker 1 bore.[329]

each of which is considered in detail below.

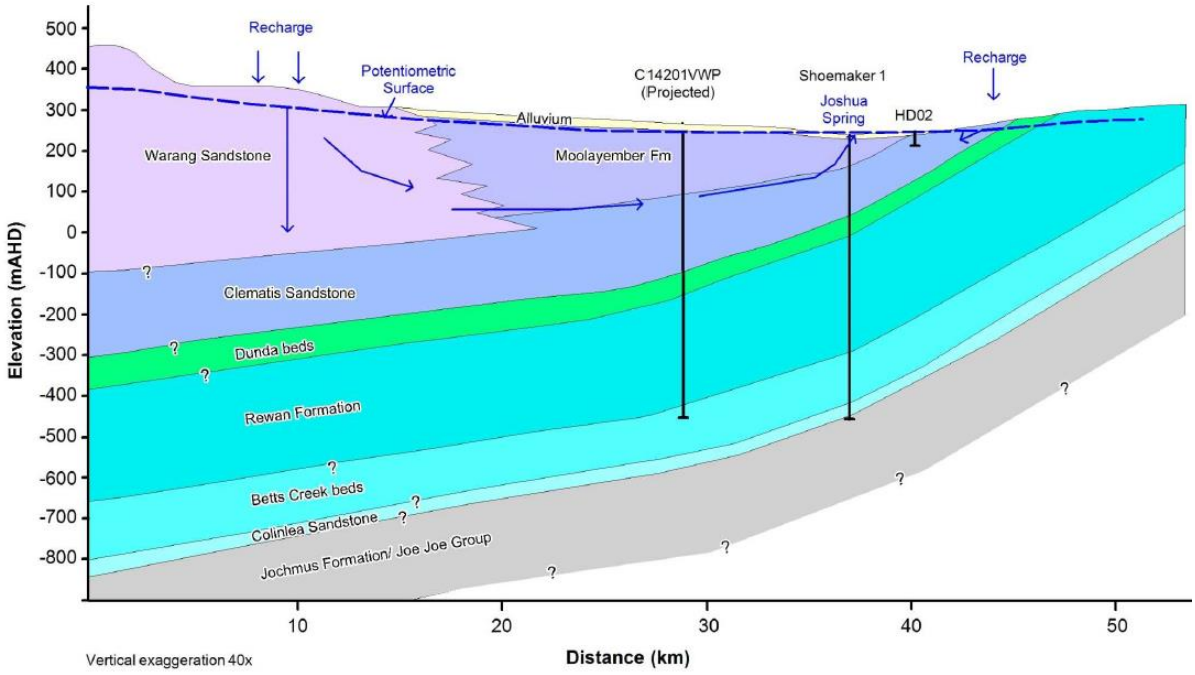


Figure 4: (Conceptual Hydrogeological Cross Section) from the First affidavit of Mr Bradley[330]

Faulting through the Rewan Formation

375. Dr Webb's evidence is that, while the Rewan Formation is generally a low permeability unit and acts as an aquitard, that it is "leaky" – that is, it has areas of high vertical conductivity and is capable of transmitting significant volumes of groundwater in places.[331]

(a) Dr Webb presents a number of lines of evidence in paragraph 54 of his individual report that support the conclusion that the Colinlea Sandstone is feeding the Doongmabulla Springs by way of a fault or fracture.

(b) It was put to Dr Webb that none of these lines of evidence are in themselves conclusive evidence that the springs are being fed from below the Rewan Formation,[332] but Dr Webb was clear that these lines of evidence need to be taken together and that any single line of evidence is not by itself convincing.[333]

376. Mr Bradley persistently referred to the absence of evidence for faulting with sufficient throw to "completely disrupt" the Rewan Formation,[334] and gave inconsistent evidence

[329] Transcript 3-48, lines 9-12; Transcript 3-48, lines 26-28; Transcript 3-60, lines 36-39.
[330] Exhibit 16; AA008 (Mr Bradley's First Groundwater Expert Report) p 14.
[331] Transcript 5-29, line 38 to 5-30, line 8.
[332] Transcript 6-22, lines 1-6.
[333] Transcript 5-61, lines 15-16; Transcript 5-62, lines 14-16.
[334] Transcript 2-31, line 46 to 2-32, line 2; see also Transcript 2-34, line 45 to 2-35, line 2; Transcript 3-32, lines 11-14; Transcript 4-80, lines 12-18.

on whether this was necessary for faulting or fracturing to create a preferred flow pathway:

(a) At some points Mr Bradley asserted that complete disruption of the Rewan was necessary:

> …what you're wanting to do with a fault to allow transmission across it is that you're wanting to totally disrupt the strata so that there are permeable layers that are connected and the Rewan Formation is completely disrupted either side of it…[335]

(b) He further identifies as an additional requirement that the fault remain open:

> …the other requirement you would have if you had a fault that went from the Permian all the way to surface, you'd want that fault to be open the entire distance to serve as a pathway for water…[336]

(c) Yet Mr Bradley subsequently accepted in cross-examination that faults can create a preferential flow path without throw sufficiently large to disrupt the strata,[337] and that this is the possibility contested in this case.[338]

(d) The Applicant, in some of its most recent impact assessment documentation, relies on the same rationale:

> Given that the Rewan Group is around 250 m thick at the western boundary of the proposed Mine Area a throw of 40 m would still result in an effective aquitard thickness of 210 m. There is no evidence in the geological data set of any faults with sufficient throw to, for example, bring the Dunda Beds or the overlying Clematis Sandstone into contact with the underlying Permian-age units on the other side of a faulted contact.[339]

377. A/Prof Webb made clear in his evidence that such a major disruption of aquifers does provide a mechanism for the flow of groundwater between aquifers and across a fault, but that a pathway for groundwater movement along a fault or a fracture can exist without extensive disruption:

> If we have an aquifer, an aquitard and an aquifer with a fault between them, the situation we're talking about where you get a displacement so that one side moves up – so this side moves up, so that the aquifer that was down here is now juxtaposed against the aquifer up there and that will form a continuous pathway. So, Mr Bradley referred to that several times and it's the correct way that faults can move in order to allow transmission of ground water across the fault. The other way is that there's a smaller amount of movement on a fault so that one side moves up a small amount compared to the other side, so you don't get the aquifers matching. But the fault itself can open and leave a space that can provide a pathway for ground water movement....
>
> There are many springs that are believed to be fed by faults that go through aquitards. ... in the central Great Artesian Basin, many of those are believed to be fed by faults that

[335] Transcript 2-35, lines 6-10.
[336] Transcript 2-35, lines 15-17.
[337] Transcript 4-35, lines 33-45; Transcript 3-4, lines 5-6; Transcript 3-13, lines 26-29.
[338] Transcript 4-22, lines 30-32. Note also that A/Prof. Webb confirmed in his evidence in chief that this is the nature of the fault he considers is creating the base flow into the Doongmabulla Springs in this instance - Transcript 5-5, lines 10-12.
[339] MR204 (GHD (2014) Letter GHD to Hamish Manzi entitled *Carmichael Coal Project - Response to IESC Advice*) soft page 14. See also discussion of this at Transcript 4-69, line 32 to 4-70 line 6.

must transmit through aquitards. [340]

378. Mr Bradley has described the likelihood of fracturing or faulting permitting high hydraulic conductivity inconsistently:

(a) He expressed a view at one point that this was "unlikely":

> Q: One of the key views that you hold is that fracturing or faulting through the Rewan, permitting high hydraulic connectivity is unlikely?
>
> A: Yes.
>
> Q: I put that fairly?
>
> A: Yes.

(b) Mr Bradley stated positively at one stage that where a fault results in "Rewan against Rewan, it's going to self-heal"[341], contrary to his earlier more equivocal statements about the effect of faulting.

(c) When asked whether a fault through the Rewan Formation was impossible, Mr Bradley replied "[a]s a scientist, you're never going to say never, so."[342]

379. A number of others involved with the proposed mine have made observations about the possibility of faulting and fracturing in the Rewan Formation:

(a) GHD states in the SEIS Addendum Report, in considering the source of the Mellaluka Springs:

> Potential pathways for groundwater flow from this outcrop area through the underlying Rewan Group aquitard and other units to the springs include:…
>
> - A deeper groundwater flow path characterised by vertical leakage through the Rewan Group and underlying Bandanna Formation with flow returning to the surface in the vicinity of the springs via more permeable units and/or fractures within the Colinlea Sandstone.[343]

(b) GHD states in the SEIS Report, in relation to groundwater flow systems:

> Groundwater flow through the Permian-Triassic rock units is expected to be primarily via fractures and fissures, whereas flow through the overlying Tertiary and Quaternary units will be predominantly via pore spaces in these unconsolidated to poorly-consolidated sedimentary deposits.[344]

(c) The CG's Report refers to the possibility of faulting:

> Potential impacts on the GAB and therefore the Doongmabulla Springs Complex may only arise indirectly from groundwater draining via geological fault structures from the Clematis Sandstone through the Dunda Beds and the Rewan Formation (an aquitard defined as the base of the GAB) into the aquifers of the Bandanna Formation and Colinlea

[340] Transcript to 5-4, line 40 to 5-5, line 2; Transcript 5-5, lines 18-21. See also Exhibit 70; OL041 (*Whiteboard Diagram of Prof. John Webb - Faulting Types - JW1*).
[341] Transcript 4-36, lines 12-13.
[342] Transcript 3-36, lines 44-45.
[343] MR170.2 (SEIS, Volume 4, Appendix K6 – Mine Hydrogeology Report Addendum) soft pages 31-32.
[344] MR167 (SEIS, Volume 4, Appendix K1 – Mine Hydrogeology Report (GHD 2013)) soft page 90.

Sandstone.[345]

(d) The IESC Advice includes the following observations:

> Regional Faults: The conceptual model would benefit from an assessment of regional faults. The proponent's groundwater model does not take into consideration the influence of faulting within the Rewan Formation. The Committee notes that faults have been identified on the eastern boundary of the Galilee Basin within the Rewan Formation in other project proposals, but their potential role on groundwater flow processes has not been considered in this project.[346]

380. Mr Bradley accepts that groundwater conceptualisation requires one to look at all possibilities,[347] and he considers that faults would usually be identified by drilling data and geophysics such as seismic.[348] Yet Mr Bradley appears to have failed to properly consider even the available drilling and seismic data.

381. Dr Merrick holds the view that geophysical seismic evidence is the strongest evidence for locating a fault.[349]

382. Before considering all the available data, it is noteworthy that essentially all the data that might assist in identifying faults has been collected in the proposed mining lease area. The experts were not aware of any conclusive data in the area of the Doongmabulla Springs.

383. In particular, it is important to recognise that the absence of any data that shows faulting in the immediate vicinity of the Doongmabulla Springs can only be taken to indicate an absence of evidence, rather than evidence of an absence of faulting.

Seismic data – Velseis Report

384. In preparing his evidence A/Prof Webb requested from the Applicant and reviewed the report "2011 Adani 2D Seismic Survey - Interpretation & Data Processing Report" prepared by Velseis[350] (**Velseis Report**).

(a) Appendix A to the Velseis Report presents the results of nine seismic lines as cross sectional representations.[351]

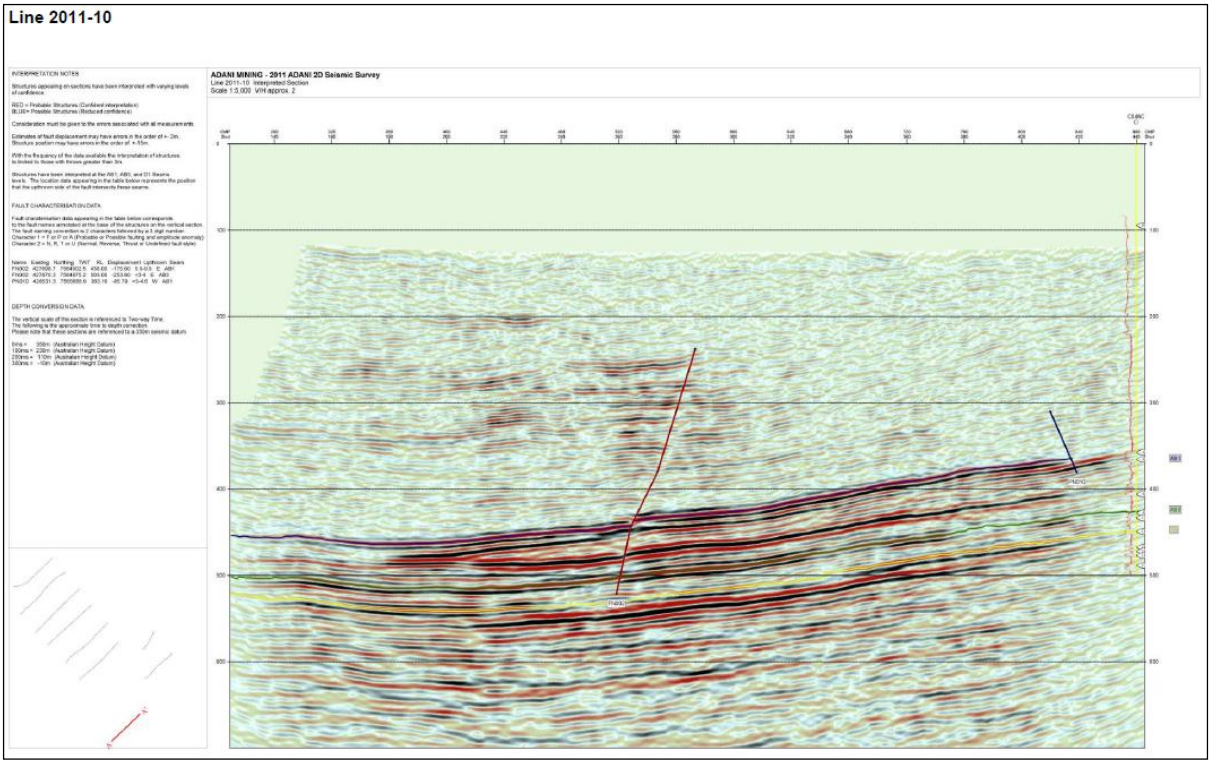
(b) As described in Figure 11 of the Velseis Report, the seismic sections at Appendix A show possible faults as blue lines and probable faults as red lines.[352]

385. The seismic section labelled "Line 2011-10" in the Velseis Report[353] is referred to in A/Prof Webb's individual report shows a fault spanning from a depth of about 230m to

[345] Exhibit 6a; SP001.12 (Coordinator-General's Report) soft page 179.
[346] Exhibit 59; OL032 (IESC Advice to decision maker on coal mining project) p 3.
[347] Transcript 3-12, lines 3-6.
[348] Transcript 2-30, lines 39-41.
[349] Transcript 8-44, lines 14-15.
[350] Exhibit 67; OL040 (Velseis (2011) Adani 2D Seismic Survey – Interpretation and Data Processing Report).
[351] Exhibit 67; OL040 (Velseis (2011) Adani 2D Seismic Survey – Interpretation and Data Processing Report) soft pages 28-36.
[352] Exhibit 67; OL040 (Velseis (2011) Adani 2D Seismic Survey – Interpretation and Data Processing Report) soft page 21.
[353] Exhibit 67; OL040 (Velseis (2011) Adani 2D Seismic Survey – Interpretation and Data Processing Report) soft page 36.

about 520m that extends through the AB1 and AB3 seams (shown in blue and green) and the strata above these.

386. Mr Bradley accepts that the probable fault shown in this cross section extends through 200m of the Rewan Formation.[354]



Line 2011-10 from Appendix A to the Velseis Report

387. Mr Bradley made it clear that he had not considered any seismic data but that it would be helpful:

> I've not assessed any seismic data in putting my opinions together. … I'm not suggesting that there is no seismic data there. I'm just saying that I haven't assessed it. So there may or may not be seismic data there. I haven't looked at it. That's about as much as I can say. I have not looked at seismic data. I don't disagree that seismic data would be instructive through that area. I don't disagree with that at all.…
>
> I don't dispute at all that seismic data would be valuable. All I'm saying is I haven't assessed any.
>
> Q: Did you ask for seismic data from Adani?
>
> A: No. I assessed the information that was available to me.
>
> Q: I think evidence will be given that Dr Webb did ask for seismic data from Adani. I'm just interested as to why, given the dispute here, you didn't?
>
> A: Dr Webb was investigating in his way, and I was investigating in my way.[355]

388. Mr Bradley did not seek out this seismic data, despite A/Prof Webb having referred in his expert report to "regional seismic data for the area (Canso Resources Ltd 1983) and

[354] Transcript 4-33, lines 23-30.
[355] Transcript 3-32, line 37 to 3-33, line 44; Transcript 3-33, lines 13-21.

detailed seismic data for the northern part of the Carmichael lease (Velseis Processing Pty Ltd 2012)".[356]

389. Later in his evidence, Mr Bradley made clear that he was aware of the Velseis seismic testing[357], but that he had not referred to this at all in his first or second reports, despite it being one of two bodies of work done to investigate for faulting on the MLA.[358]

390. Notwithstanding this, Mr Bradley gave evidence that he had seen "no evidence of faulting though the Rewan Formation or in the area of the Doongmabulla Springs.[359]

391. Mr Bradley's evidence on the existence of any seismic testing at the Doongmabulla Springs demonstrated a disinterest in considering potentially relevant data:

(a) Initially, Mr Bradley said he was not aware of any seismic testing of the area around Doongmabulla Springs.[360]

(b) Mr Bradley subsequently revealed, somewhat reluctantly, that he had been made aware of some seismic data by the Applicant:

> I'm aware of – I suppose I should mention a couple of days before court, I became aware of a document that Adani geologists had put together, which mentioned some seismic data, but I never looked at that in great detail, and I haven't used it in my evidence. So I certainly haven't looked at seismic data in the area.[361]

(c) Mr Bradley later accepted that this was the 1983 seismic data referred to in A/Prof Webb's report and that, despite having been provided a copy by this information by the Applicant, he still did not use that data in forming his opinion.[362]

392. In summary, the Applicant has seismic data that shows faulting through most of the thickness of the Rewan Formation. It has never conducted seismic testing in the area of the Doongmabulla Springs even though that would provide an important data set to help to determine the source of the springs.

393. Mr Bradley has failed to properly consider or bring to the Court's attention the relevant seismic data, despite acknowledging its relevance to the issues in dispute.

Drilling data

394. There is substantial evidence of faulting in the general area that came out throughout the course of the trial based on drilling data. The April 2013 report by Xenith consulting – *Adani Mining Pty Ltd JORC Coal Resource Estimate – Carmichael Coal Project* (**Xenith 2013**)[363] identifies a number of faults on the MLA:

> At this time four faults have been interpreted, all with vertical throws of between 20 m

[356] Exhibit 18; OL012 (A/Prof. Webb's Groundwater Expert Report) p 8, para 14.
[357] See Exhibit 67; OL040 (Velseis (2011) Adani 2D Seismic Survey – Interpretation and Data Processing Report).
[358] Transcript 3-62, line 39 to 3-63, line 2; Transcript 3-63, lines 10-12.
[359] Transcript 2-34, lines 45-46; Transcript 2-51, lines 10-13; Transcript 3-35, lines 9-11.
[360] Transcript 3-12, lines 27-33.
[361] Transcript 4-27, lines 36-39.
[362] Transcript 4-29, lines 3-6.
[363] Exhibit 54; AA031 (Xenith (2013) Adani Mining Pty Ltd JORC Coal Resource Estimate – Carmichael Coal Project).

> and 40 m with a strike in a general east west direction. This trend is concurrent with other faulting seen in the basement strata in other areas of the Galilee Basin. All faults are interpreted to be vertical, however, in practice this is unlikely to be the case and more drilling focused around the faulted zones will be needed to better pin point the location, throw and angle of the fault plane.[364]

395. The Applicant appears to have sought to use the location of these faults to indicate an absence of faulting in the immediate area of the Doongmabulla Springs,[365] yet Figure 5.1 in Xenith 2013 clearly demonstrates that the drilling relied on in that report was all conducted on-lease and in no way serves to demonstrate an absence of faulting at the Doongmabulla Springs.[366]

396. Mr Bradley agreed that, while the Xenith reports demonstrate faulting within the MLA, they do not deal with the area of the Doongmabulla Springs "for obvious reasons".[367]

397. Mr Bradley gave evidence about the potential to identify faulting using drill data and misalignment of the strata between drill logs, some of which was concerned with the work done by Xenith in 2009 and 2013 as part of the resource assessment work that would have included identification of faults.[368]

398. Figures 10 and 11 below are taken the *Adani Mining Pty Ltd Carmichael Coal Project Initial Development Plan* (**IDP**), which appears to be based on earlier work by Xenith[369] and shows faults present on the MLA.

[364] Exhibit 54; AA031 (Xenith (2013) Adani Mining Pty Ltd JORC Coal Resource Estimate – Carmichael Coal Project) soft page 24.
[365] Transcript 2-34, lines 40-43.
[366] Exhibit 54; AA031 (Xenith (2013) Adani Mining Pty Ltd JORC Coal Resource Estimate – Carmichael Coal Project) soft page 24.
[367] Transcript 4-29, lines 22-28.
[368] Transcript 3-62, lines 25-29; Transcript 3-61, lines 1-21; Transcript 2-34, line 46 to 3-35, line 2; Transcript 3-32, line 7 to 3-31, line 14; Transcript 3-33, lines 40-44.
[369] MR024 (Application for Mining Lease - Carmichael Coal Project – Initial Development Plan) – See comment at soft page 20:

> *A JORC Resource report has been completed for Adani in respect of Coal Resource for the Carmichael Coal Project:*
>
> > • *"Adani Mining Pty Ltd – JORC Coal Resource Estimate – Carmichael Coal Project"- by Xenith Consulting*
>
> *All resource information for this IDP has been sourced from the above report.*

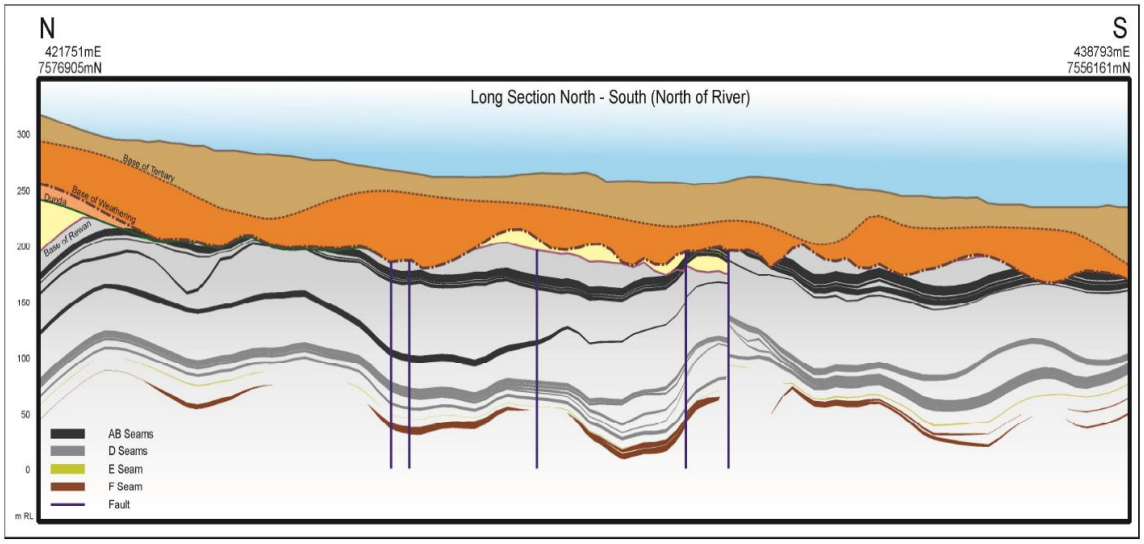


Figure 10 Longitudinal Section- North of the Carmichael River - Showing Coal Seams and Overburden

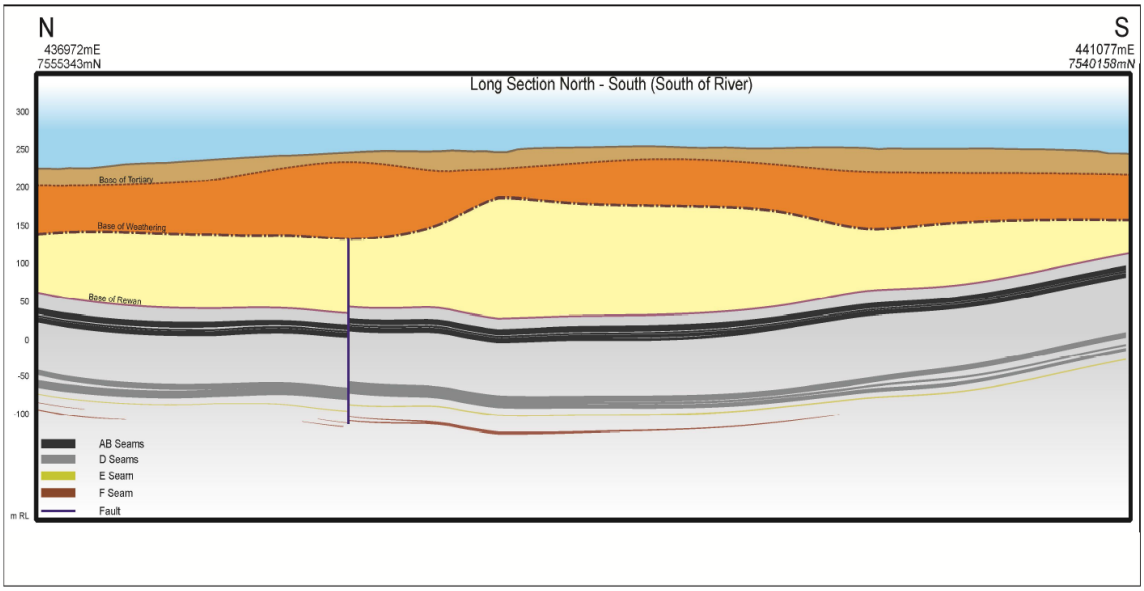


Figure 11 Longitudinal Section – South of the Carmichael River - Showing Coal Seams and Overburden

Figures 10 and 11 from the IDP showing identified faults

399. Mr Bradley said he had looked at the IDP but appeared uncertain whether these figures showed faulting. Nonetheless, he ultimately accepted that they show faulting through the Rewan Formation.[370]

400. Mr Bradley made clear that he was aware of the drilling investigations done by Xenith that had identified faulting on the MLA, but that he had not referred to this at all in his

[370] Transcript 4-34, line 8 to 4-35, line 31.

first or second reports, despite this being one of only two bodies of work done to investigate for faulting on the MLA.[371]

401. A/Prof Webb was criticised[372] for the reference in his expert report to "evidence for a fault through the middle of the Carmichael lease, as interpreted by Xenith Consulting (2009)", yet the Applicant appears to have failed to recognise that this statement was in fact paraphrased from its own EIS Hydrogeology Report (**EIS Report**):

> It has been reported that a fault has been interpreted through the middle of the lease but requires further drilling to confirm (Xenith Consulting, 2009).[373]

402. Mr Bradley also gave apparently conflicting evidence on whether the analysis of the bore logs provided any support for the absence of faulting:

(a) Mr Bradley claimed that the Shoemaker 1 and the Carmichael 1 bore log draw the coal seams "in direct connection with each other based on the [dip]" and that the cross section drawn between these two points suggests that there is no evidence of a fault between the two bores.[374]

(b) Yet when it was pointed out to Mr Bradley that the coal seams were located 120m higher than predicted before drilling (i.e. at depth of 529 m compared to 650 m predicted), he indicated this was of no concern.[375]

(c) Mr Bradley later conceded that the cross section he had earlier referred in the Shoemaker 1 Well Completion Report[376] was of **no assistance** in ruling out the possibility of faults.[377]

(d) A/Prof Webb also gave evidence to this effect in relation to both the Shoemaker 1[378] and the Montani 1[379] well completion reports.

(e) Notwithstanding this admission, later in his cross-examination Mr Bradley:

(i) incorrectly reasserted that consistent dip between bore logs allowed him to infer there was no faulting, and

(ii) reaffirmed that the appearance of strata at depths different from the predicted depth does indicate faulting, despite having earlier dismissed as inconsequential a 120m discrepancy between predicted and observed depth of the coal beds.

> Q: The best evidence of the existence of a fault at Doongmabulla Springs would have been seismic testing?

[371] Transcript 3-63, lines 4-12.
[372] Transcript 2-31, line 10 to 2-32, line 18; Transcript 5-62, line 42 to 5-63, line 17.
[373] MR122 (EIS, Volume 4, Appendix R - Mine Technical Report - Hydrogeology Report) soft page 18.
[374] Transcript 3-13, lines 35-39; Transcript 3-14, lines 37-42.
[375] See Exhibit 57; AA034 (Shoemaker 1 Well Completion Report) soft page 8; Transcript 3-16, line 31 to 3-17, line 26.
[376] Exhibit 57; AA034 (Shoemaker 1 Well Completion Report) see Figure 10, soft page 32.
[377] Transcript 3-32, lines 16-26.
[378] Transcript 5-26, line 34 to 5-27, line 3.
[379] Transcript 5-28, lines 25-30.

> A: That's not necessarily the case. If you, as I said yesterday, if you – or as I've said in my evidence, if you have drill data that shows that strata is occurring at the depth that you would expect it to, based on the dip, then it's reasonable to infer that there is not a fault between them. If the strata exists at a significantly lower dip it's reasonable to infer that there is a fault. But, if in assessing this data, the dip of, let's say the surface of the Rewan Formation is what you would expect it to be, then, in my assessment, that's not showing significant – indication of a significant fault. You might find, from a seismic section that there is faulting along there, because they find that from the seismic sections in the mine area.[380]

403. Questions were put to Mr Bradley in cross-examination about the potential identification of faults through on-site measurement of high permeability areas in the Rewan Formation:

    (a) Mr Bradley asserted that the high permeability zones within the Rewan Formation provide "no evidence … of high permeability zones that continue from the base to the surface."[381]

    (b) When it was put to Mr Bradley that drilling data through a fault would only be likely to pick up a relatively short area of high conductivity, Mr Bradley again acknowledged that drill testing is not necessarily going to pick up a fault.[382]

404. In re-examination, Mr Bradley was given the Montani 1 Well Completion Report:[383]

    (a) Mr Bradley referred to a cross section[384] similar to one in the Shoemaker 1 well completion report, which he once again used to suggest there was no evidence of faulting,[385] despite having earlier accepted that the Shoemaker 1 cross section couldn't assist in demonstrating that there was no faulting.[386]

    (b) A/Prof Webb reinforced in his evidence in chief that the cross section could not tell you whether there was any faulting in this area.[387]

405. In summary, the resource drilling data collected on the MLA provides clear evidence of faulting through the Rewan Formation. The limited on-site drilling data does not and cannot provide conclusive evidence of the presence or absence of faulting at the Doongmabulla Springs.

406. The Applicant has chosen not to properly investigate in the area of springs and then to use that very failure – and the lack of data that flows from it – to conclude that there is "no evidence of faulting".

[380] Transcript 3-33, line 46 to 3-34, line 9.
[381] Transcript 4-22, lines 19-28.
[382] Transcript 4-22, line 45 to 4-23, line 3.
[383] Exhibit 69; AA037 (Montani 1 Well Completion Report).
[384] Exhibit 69; AA037 (Montani 1 Well Completion Report) see soft page 30, Figure 10.
[385] Transcript 4-73, lines 24-36.
[386] Transcript 3-32, lines 16-26.
[387] Transcript 5-28, lines 27-28.

Healing of faults

407. As indicated above, Mr Bradley relied very heavily on "self-healing" – that is, the suggestion that any faults through the Rewan Formation that did not have "throw" sufficiently large to disrupt the strata completely would "self-heal" and close any preferred flow path.

408. Mr Bradley's evidence in respect of the likelihood of any faults through the Rewan Formation "self-healing" comprised nothing more than what he has described as "anecdotal evidence" from Mr Mark Stewart of URS,[388] and was stated in the following terms in his first individual report:

> This attests to the properties of clays within the Rewan Formation that would tend to "heal" any faults, rather than allowing the presence of hydraulically continuous faults through the entire thickness of the formation.[389]

409. A/Prof Webb in his evidence-in-chief dispelled the notion that "self-healing" of faults or fractures is inevitable:

> Faults may heal due to clay blocking them up, or they may be open. Faults vary enormously in their capacity to transmit or block ground water flow. Many faults do block ground water flow, but likewise there are many faults that allow ground water flow through aquitards....
>
> So there's a widespread belief that clay rich aquitards will always heal faults. But more recent work that's been done, and recent papers that have been published, indicate clearly that in some cases faults can transmit water through aquitards.[390]

410. Also in evidence is a recent paper by Cherry et al that relevantly states:

> Historically, hydrogeologists believed fractures in relatively unweathered clayey aquitards were unimportant because of the expectation that natural plasticity would cause fractures to "heal" (e.g., close naturally). Today, open fractures are recognized as abundant in unweathered zones in many aquitards.[391]

(a) Dr Merrick disputed the relevance of this quote on the basis of its context, which he claimed, having recalled it off the top of his head, was "of a shallow system, and of an aquitard that is not [lithified]."[392] A detailed reading of the passage and its context reveals no such constraint – the quote is in the chapter on "Groundwater Flow Through Aquitards", in a section called "Occurrence of Fractures in Aquitards".

(b) Prof Werner subsequently affirmed the relevance of this passage in his evidence-in-chief.[393]

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[388] Transcript 2-30, line 29; Transcript 5-37, lines 5-11.
[389] Exhibit JWB-1 to Exhibit 16; AA008 (Mr Bradley's First Groundwater Expert Report) soft page 21, para 20. [*Emphasis added*].
[390] Transcript 5-5, lines 36-47. See similar comments from A/Prof Webb at Transcript 5-38, lines 1-12.
Exhibit 83; OL048 (Role of Aquitards in the Protection of Aquifers from Contamination: A "State of the Science" Report (2004)) soft page 69. [*Emphasis added*].
[392] Transcript 8-42, lines 26-37. Note there is a clear transcription error in this section: *lithophyte*, as recorded in the transcript, is a pant that grown on rocks; *lithified* is the past tense of the verb lithify, to change (sediment) to stone or rock.
[393] Transcript 9-29, lines 19-35.

411. A/Prof Webb's evidence also explained the difficulty in determining whether a fault is open or healed using either seismic testing or drilling data.[394]

412. Prof Werner noted that he is familiar with a number of texts that discuss faults as pathways through aquitards, and other literature that refers to faults and springs in the Great Artesian Basin (**GAB**), many of which were through aquitards.[395]

413. Prof Werner also noted that he had recently referred to some literature coming out of the petroleum industry that referred to substantial uncertainty around the potential for faults to heal and prevent vertical transmission.[396]

414. Dr Merrick was explicit in his individual expert report that he had "nothing further to add" on the question of the source aquifer of the Doongmabulla Springs, and that this issue is outside his primary field of expertise.[397] As such, Dr Merrick's views on this issue should be given little weight by the Court.

415. In general terms, Dr Merrick appears to accept the proposition that faults can create conduits or barriers to flow.[398]

416. Notwithstanding this, Dr Merrick made a variety of comments about the likely source aquifer of the Doongmabulla Springs, and in the course of his evidence he became increasingly intractable in his view:

(a) Dr Merrick gave evidence initially, in relation to the subsidence fractures underestimated by GHD, that he considered "the Rewan Formation would **tend to**, I believe, close up those fractures substantially."[399]

(b) Dr Merrick stated the view that it is "most unlikely" that the Colinlea Sandstone is the source aquifer for the Doongmabulla Springs.[400]

(i) Dr Merrick's opinion here is based on the head measurement in the Shoemaker 1 bore, which is unreliable and is considered in detail below (see Colinlea Sandstone – Shoemaker Bore), and which Dr Merrick said he had accepted unquestioningly.[401]

(c) When asked later whether a fault through the Rewan Formation could remain open to the surface, he stated "I don't think it's possible… I can't see any mechanism for a – a fault remaining open through aquitard material."[402]

(d) Dr Merrick stated at one point that "[t]here is no possibility of that fault not sealing." He subsequently appeared to retreat with the statement "So there's very –

[394] Transcript 5-6, line 30 to 5-7, line 3.
[395] Transcript 9-29, lines 9-15; Transcript 9-26, lines 9-21.
[396] Transcript 9-27, lines 5-16.
[397] Exhibit NPM-1 to AA010.1 (Dr Merrick's Groundwater Modelling Expert Report) soft page 10, section 4.1.
[398] Transcript 8-41, lines 45-47.
[399] Transcript 7-13, lines 44-45. [*Emphasis added*].
[400] Transcript 7-10, lines 41-42.
[401] Transcript 7-42, line 45 to 7-43, line 2.
[402] Transcript 7-20, line 44 to 7-21, line 2.

very little doubt about the – the sealing properties of a hypothetical fault."[403]

417. In considering the Thompson River Fault, which forms a conduit of about 1000m to the surface and is close to the Galilee Basin, Dr Merrick conceded that before it was discovered there would have been an assumption that there were no significant faults in the area.[404]

418. A/Prof Fensham gave evidence on the occurrence of springs in the GAB as a consequence of faulting through aquitards:

> …of course, you can get them through faults, and that's not uncommon in the Great Artesian Basin – to have faults that drive springs, and the way – the reason we know that there are faults there is that the seismic record shows that there's a displacement of the rocks, and also that the aquitard is just too thick to be conceivably penetrated by the groundwater without a fault, without a pathway… in Queensland, maybe about, yeah, 35 per cent of the discharge springs would be associated with fault structures.[405]

419. Mr Wilson also noted in his evidence that "[i]t's quite common that GAB springs are sourced from faults".[406]

420. In summary, the supposed evidence of self-healing is unconvincing and stands in contrast to the numerous information sources and examples of extant open faults through aquitards.

Regional groundwater flow

Agreed flow patterns

421. The groundwater experts agree that:

(a) The groundwater flow patterns shown in Figure 1 in the Groundwater JER (**Figure JER 1**) are a reasonable best estimate of the actual groundwater flow patterns in the Colinlea Sandstone;[407] and

(b) These are reasonably consistent with the flow patterns in the Clematis Sandstone, as shown in Figure 2 in the Groundwater JER (**Figure JER 2**).[408]

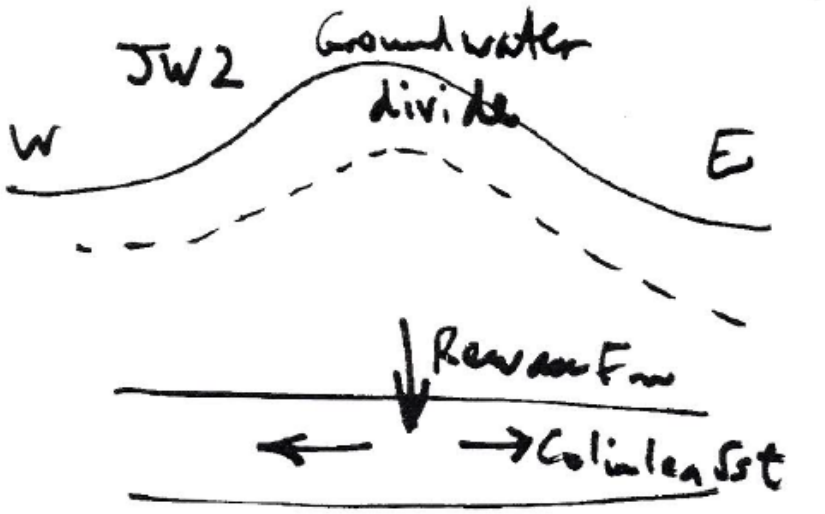
422. A/Prof Webb and Prof Werner hold the view that the regional groundwater flow patterns shown in Figure JER 1 demonstrate that groundwater recharge must be occurring through the Rewan Formation at a groundwater divide west of the mine. This is significant because it provides further evidence that the Rewan Formation is permeable through its thickness, and supports the possibility that the Doongmabulla Springs are fed from flow below the Rewan Formation.[409]

423. As A/Prof Webb explained, with the assistance of the whiteboard diagram JW2 in evidence in chief, recharge must be occurring to the Colinlea Sandstone at the

[403] Transcript 8-45, line 42 to 8-46, line 5.
[404] Transcript 8-43, lines 21-22.
[405] Transcript 10-66, lines 1-11.
[406] Transcript 10-8, line 25.
[407] Exhibit 14; JR004 (Groundwater Joint Experts Report) p 4, para 2.
[408] Exhibit 14; JR004 (Groundwater Joint Experts Report) p 4, para 4.
[409] Transcript 5-35, lines 15-20.

groundwater divide, at depth, for the higher potentiometric surface (i.e. the groundwater divide) to be maintained in the long term.[410]

> So the groundwater is flowing that way from high hydraulic head to low hydraulic head, and it's flowing this way from high hydraulic head to low hydraulic head. And in order for that groundwater flow to keep going – so this piezometric surface showing the hump there is a long-standing feature. It's not something temporary. As far as we can tell it's been there for a very long time. But it means that groundwater is flowing in opposite directions in the aquifer. And the only way you can keep that is to have water coming down into the aquifer to replace the groundwater that's continually flowing away. There is no other way to do it. And in this case, of course, overlying it is the Rewan Formation. So, therefore, water has to be flowing through the Rewan Formation into the Colinlea Sandstone to keep that groundwater flow pattern persistent.[411]



JW2: Whiteboard Diagram of Prof. John Webb - West-East Cross Section of Groundwater Divide - JW2 [OL042], Exhibit 71.

424. The agreed groundwater flow shown in Figure JER 1 is in the Colinlea Sandstone (below the Rewan Formation) and shows west-to-east and south-to-north groundwater flow towards the area of the Doongmabulla Springs and the mine, perpendicular to the groundwater contours.

425. A/Prof Webb considers that, while you wouldn't necessarily expect the kind of similarity seen Figure JER 1 and Figure JER 2 in aquifers separated by an aquitard, if both aquifers are subject to similar recharge and discharge, then they will show similar flow patterns.[412] In this case, both aquifers appear to converge on the Doongmabulla Springs which indicates that they are both feeding the springs.[413]

[410] Transcript 6-20, line 13 to 6-21, line 33.
[411] Transcript 5-30, line 45 to 5-31, line 8.
[412] Transcript 5-45, line 45 to 5-46, line 2.
[413] Transcript 5-46, lines 7-17.

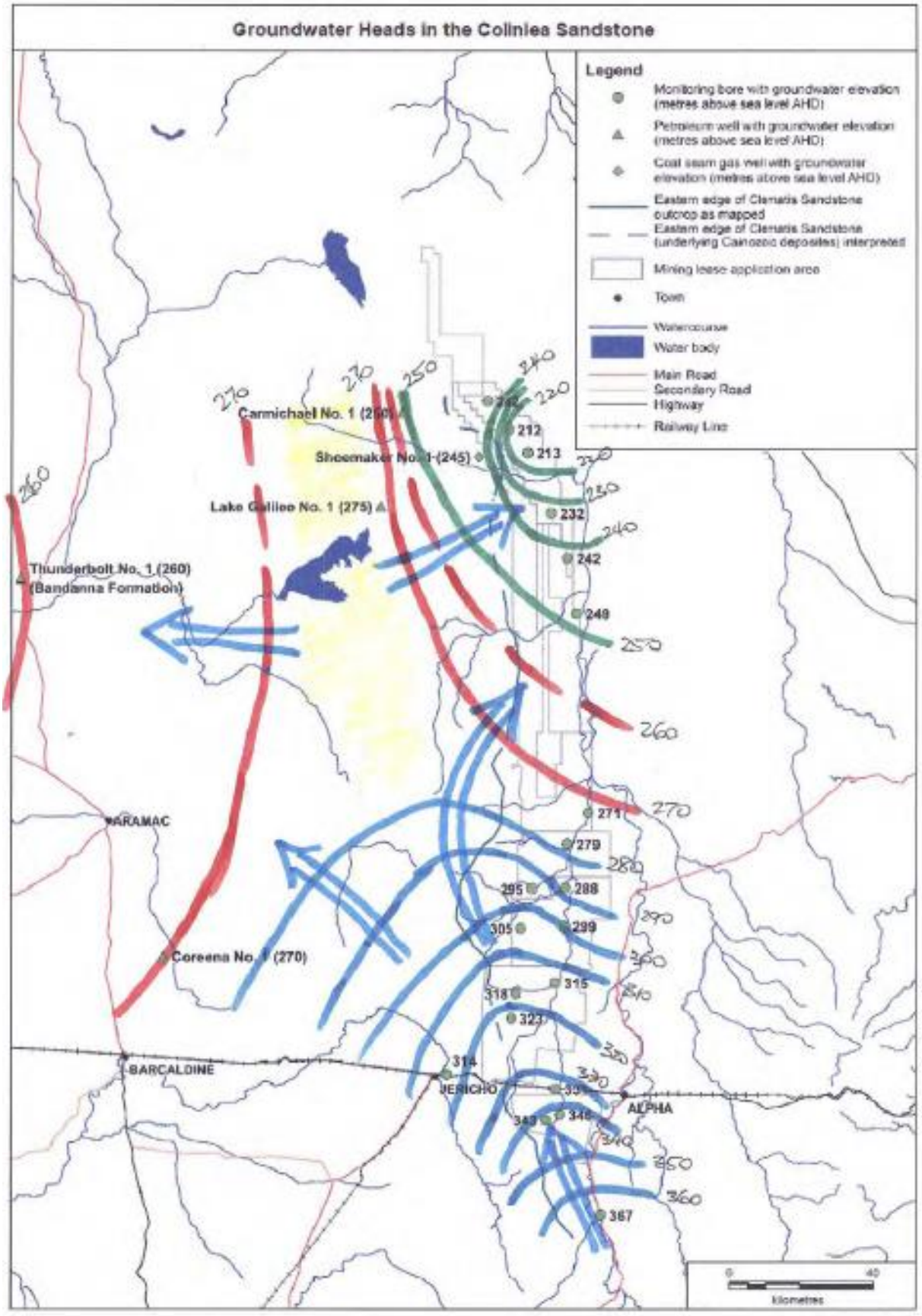


Figure 1 (Groundwater Heads and Flow Directions in the Colinlea Sandstone) from Exhibit 14; JR004 (Groundwater Joint Experts Report), soft page 6.

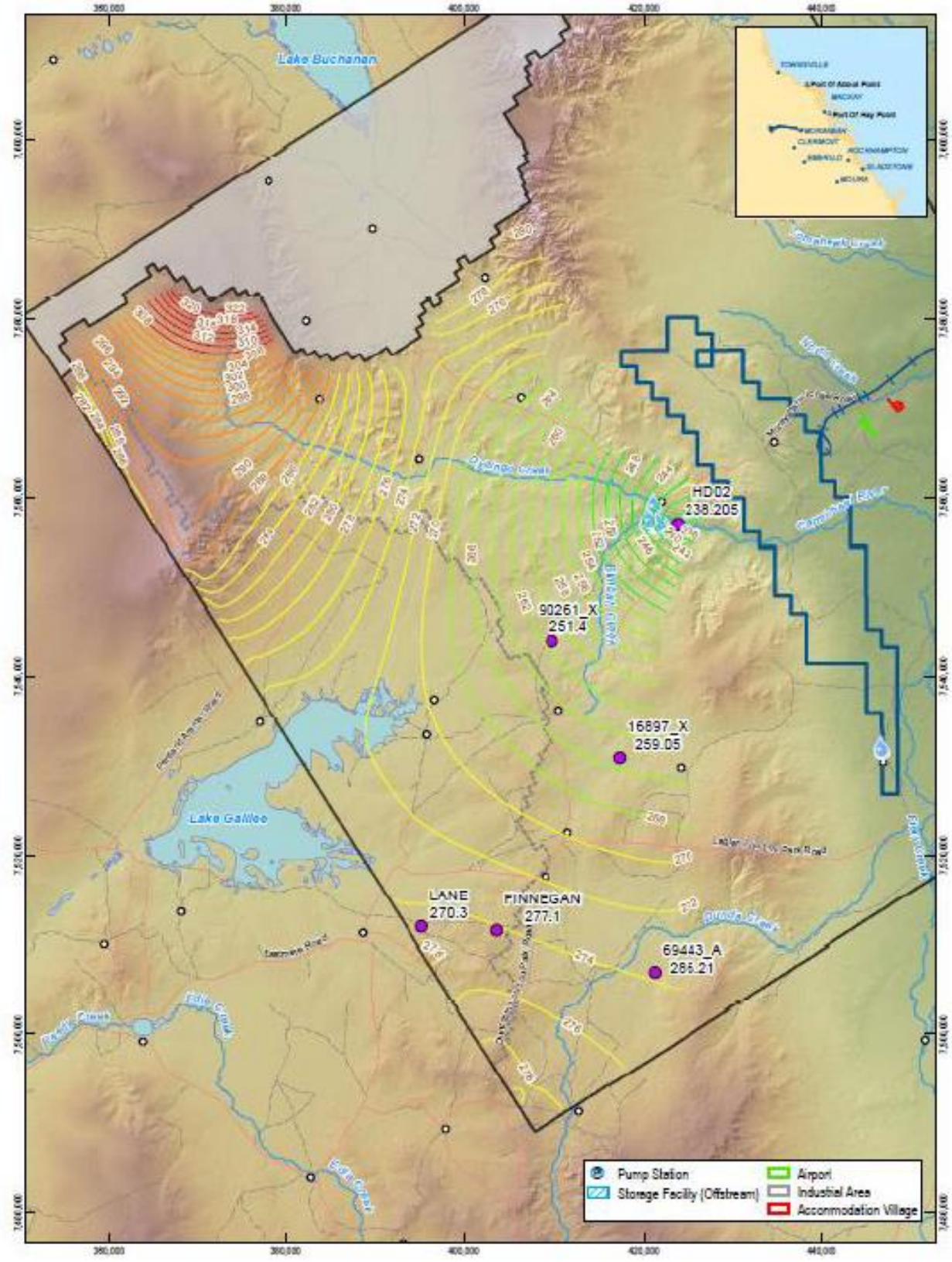


Figure 2: Simulated Groundwater Heads (mAHD) for the Clematis Sandstone - Option 1 Scenario[414]

[414] Exhibit 14; JR004 (Groundwater Joint Experts Report) p 7 [after Figure 31 in GHD 2014].

426. Mr Bradley and Dr Merrick's view is put in the second JER as follows:

> 14. Further, JB and NM are of the opinion that the observed groundwater flow in the underlying Bandanna/Colinlea aquifer could be provided by a lateral source.[415]

427. Mr Bradley confirmed in cross-examination that this is as high as he could put the possibility of only lateral flow as a source for flow in the Colinlea Sandstone,[416] and he considers both possibilities (i.e. flow through the Rewan Formation or only flow from the south) would explain the agreed flow patterns in the Colinlea Sandstone.[417]

428. Mr Bradley's second expert report was in response to A/Prof Webb's individual report, and was primarily intended to address the question of whether groundwater flow could exist without recharge through the Rewan Formation at that point.[418]

(a) Mr Bradley's second report included what he described as "a simple 2-dimensional groundwater model" that "is not intended to be an accurate representation of the geology/hydrogeology of the Project area, but rather has been constructed to demonstrate a concept", however it was "loosely based on the actual hydrogeology" of the Carmichael area.[419]

(b) Mr Bradley gave evidence in cross-examination on the limitations of his simple 2D model:

(i) It could not give any understanding of the rate of movement of groundwater between the units,[420] and particularly within the Colinlea Sandstone,[421] notwithstanding that this is the primary feature with which A/Prof Webb is concerned in this location (i.e. recharge through the Rewan Formation to the Colinlea Sandstone).

(ii) The conclusions that could be drawn from the model would necessarily be conceptual, rather than representing the real world on the ground.[422]

(c) Notwithstanding these limitations, Mr Bradley concludes in his second report that the simple 2D model output "serves to demonstrate that groundwater flow to the springs can be derived from shallow groundwater units and that the springs in this case are occurring as rejected recharge springs". Mr Bradley reluctantly conceded in cross-examination that this was an inappropriately site-specific conclusion to draw, such that "can" should be replaced with "could".[423]

(d) A/Prof Webb gave evidence that the outputs of Mr Bradley's model are correct, but Mr Bradley's interpretation of these outputs is incorrect.[424]

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[415] Exhibit 15; JR010 (Supplementary Groundwater Joint Experts Report) p 4, para 14. [*Emphasis added*].
[416] Transcript 4-7, lines 10-11.
[417] Transcript 4-6, lines 20-33.
[418] Transcript 3-80, lines 35-38.
[419] Exhibit JWB-2 to Exhibit 17; AA020 (Mr Bradley's Second Groundwater Expert Report) soft page 11, paras 18-19.
[420] Transcript 3-80, line 10 to 3-81, line 14.
[421] Transcript 4-4, lines 33-36.
[422] Transcript 3-83, lines 1-7.
[423] Transcript 3-83, lines 14-23; Transcript 3-84, lines 33-38.
[424] Transcript 6-28, lines 43-47.

429. Mr Bradley conceded in cross-examination that the conclusion he drew in his second expert report was incorrect – i.e. the conclusion that "[b]ased on output from the model discussed in this report, the Colinlea Sandstone is not recharged in areas where the Rewan Formation overlies the Colinlea Sandstone."[425]

(a) Mr Bradley sought to limit this correction to only suggest that the Rewan Formation was transmitting water at the groundwater divide only to an extent consistent with the permeability of the Rewan Formation generally.[426]

(b) Mr Bradley later agreed that this concession was specifically that groundwater movement must occur through the Rewan Formation at the point of the groundwater divide shown in Figure JER 1.[427]

Unexplained discharge

430. A/Prof Webb's evidence is that the groundwater flow diagrams, including Figure JER 1 and others in the Applicant's assessment documentation, show a marked trough in the potentiometric surface in the Colinlea Sandstone, which "is most easily explained if the springs represent a discharge point for the aquifer."[428]

(a) It was repetitively put to A/Prof Webb in cross-examination for that some of the contours he referred to as indicating a trough do not sit exactly over the springs, and the suggestion was that the trough should be directly at the springs if the Colinlea was discharging to the springs.[429]

(i) A/Prof Webb observed that the contours are necessarily interpretive and supported by very minimal data.[430]

(ii) The innermost contour in Figure 4-10 of the EIS Report is based on only one data point so it's impossible to draw the contours with any degree of certainty,[431] and there is no reason for it to be drawn as a circle, (i.e. to indicate unequivocally that it is a discharge point).[432]

(iii) A/Prof Webb's opinion about the location of the trough is based on the data points and the similar patterns of these data points across Figures 4.8 to 4.12 of the EIS Report.[433]

(b) Mr Bradley accepts, in line with A/Prof Webb's views, that:

(i) the modelled contours are simply artefacts of the model and that the head

[425] Exhibit JWB-2 to Exhibit 17; AA020 (Mr Bradley's Second Groundwater Expert Report) soft page 14, para 24.
[426] Transcript 3-86, lines 1-16.
[427] Transcript 3-86, lines 2-9.
[428] See Exhibit 18; OL012 (A/Prof. Webb's Groundwater Expert Report) para 54(a).
[429] Transcript 6-10, line 15 to 6-12, line 39.
[430] Transcript 6-11, lines 1-18; Transcript 6-57, lines 39-43; Transcript 6-58, lines 15-20; Transcript 6-59, lines 8-15.
[431] Transcript 6-11, lines 35-39; MR122 (EIS, Volume 4, Appendix R - Mine Technical Report - Hydrogeology Report) soft page 48.
[432] Transcript 6-59, lines 3-6.
[433] Transcript 6-11, line 41 to 6-12, line 5; Transcript 6-57, lines 14-19; MR122 (EIS, Volume 4, Appendix R - Mine Technical Report - Hydrogeology Report) soft pages 46-50.

measurements are the actual data against which the groundwater flow (i.e. including any groundwater trough) can be assessed.[434]

(ii) the representations of flow are limited by the number of data points on which they are based and that improved data would provide more accurate indications of the actual discharge point.[435]

(c) Dr Merrick also gave evidence consistent with A/Prof Webb that contours can be drawn in different ways and that it is the underlying data points that matter.[436]

431. Figure JER 2 shows **modelled** contours in the Clematis Sandstone:

(a) Mr Bradley relies on these flow patterns to conclude that flow in the Clematis Sandstone converges on the Doongmabulla Springs, whereas flow in the Colinlea Sandstone does not.[437]

(b) However, he also accepts that this convergence is evident only because the model is designed to match to the head in HD02 during calibration.[438]

(c) In essence, the modelled contours in Figure JER 2 lend no support to Mr Bradley's view that the Doongmabulla Springs are a discharge point for only the Clematis Sandstone and not the Colinlea Sandstone.

432. With the exception of the Doongmabulla Springs, there is no satisfying explanation as to where the Colinlea Sandstone is discharging:

(a) Mr Bradley accepts that the "massive amounts of water" flowing east in the Colinlea Sandstone and the Clematis Sandstone must discharge at some point before the Colinlea Sandstone sub-crops in the mining lease area.[439]

(b) It was suggested to A/Prof Webb in cross-examination that the Mellaluka Springs were a possible explanation for the necessary discharge from the Colinlea Sandstone. A/Prof Webb's evidence is that:

(i) Based on the agreed contours in Figure JER 1, the Melleluka Springs cannot be the primary discharge point for the Colinlea Sandstone;

(ii) There's only a small amount of groundwater coming out at Mellaluka Spring compared with the system as a whole, which must be discharging somewhere; and

(iii) The artesian bores at Melleluka are capped and only release water on demand.[440]

(c) Mr Bradley accepts that the contours in the Colinlea Sandstone (Figure JER 1) and the Clematis Sandstone (Figure JER 2) come together (i.e. discharge) in the same

[434] Transcript 4-64, lines 22-35; Transcript 5-44, lines 16-35.
[435] Transcript 4-8, lines 11-28.
[436] Transcript 7-46, lines 18-21.
[437] Transcript 4-63, lines 23-30.
[438] Transcript 4-63, lines 9-15.
[439] Transcript 4-65, lines 23-27; Transcript 4-38, lines 24-25; Transcript 4-7, line 40 to 4-8, line 8.
[440] Transcript 6-16, line 39 to 6-17, line 19; Transcript 6-51, lines 34-43.

general area, and that the flow patterns are broadly similar.[441]

(d) With reference to Figure JER 1, Mr Bradley gave evidence that the green contour lines in the north of the Figure indicate that there is some discharge from the Colinlea Sandstone in that area.[442]

(e) Notwithstanding that Mr Bradley accepts the inevitable imprecision in the contours represented in Figure JER 1, he does not accept that the groundwater flow converges in the area of the Doongmabulla Springs. Rather, he considers that the contours indicate discharge from the Colinlea Sandstone on the lease area.[443]

(f) The only explanation proffered by Mr Bradley for the necessary discharge from the Colinlea Sandstone is the explanation provided in the EIS documentation – groundwater extraction at La Bona Homestead.[444]

    (i) A/Prof Webb gave evidence that there's no evidence of water use for irrigation at La Bona of the scale that would be necessary to account for this amount of water.[445]

    (ii) Mr Bradley said he doesn't know what this amount of water would be used for on La Bona, and could not point to any evidence he considered in support of the supposition that it is being used there - rather, he was only able to refer to GHD's conclusions.[446]

    (iii) It is noteworthy in this context that GHD has constructed the groundwater model on the basis that La Bona Homestead is further east than the easternmost extent of where the Clematis Sandstone crops i.e. comes to the surface[447] - see below in Figure 7 from the SEIS Addendum Report.

    (iv) A/Prof Webb also makes the point that the contours in Figure JER 1 have been drawn past the actual point of the Colinlea Sandstone outcrop, vividly illustrating the imprecision of contours.[448]

[441] Transcript 4-64, line 43 to 4-65, line 5.
[442] Transcript 3-6, lines 21-24.
[443] Transcript 4-38, lines 11-17; Transcript 4-38, lines 31-32.
[444] Transcript 4-38, lines 33-34.
[445] Transcript 5-45, lines 11-22.
[446] Transcript 4-65, lines 31-42.
[447] Transcript 6-61, lines 11-27.
[448] Transcript 5-44, lines 40-47.

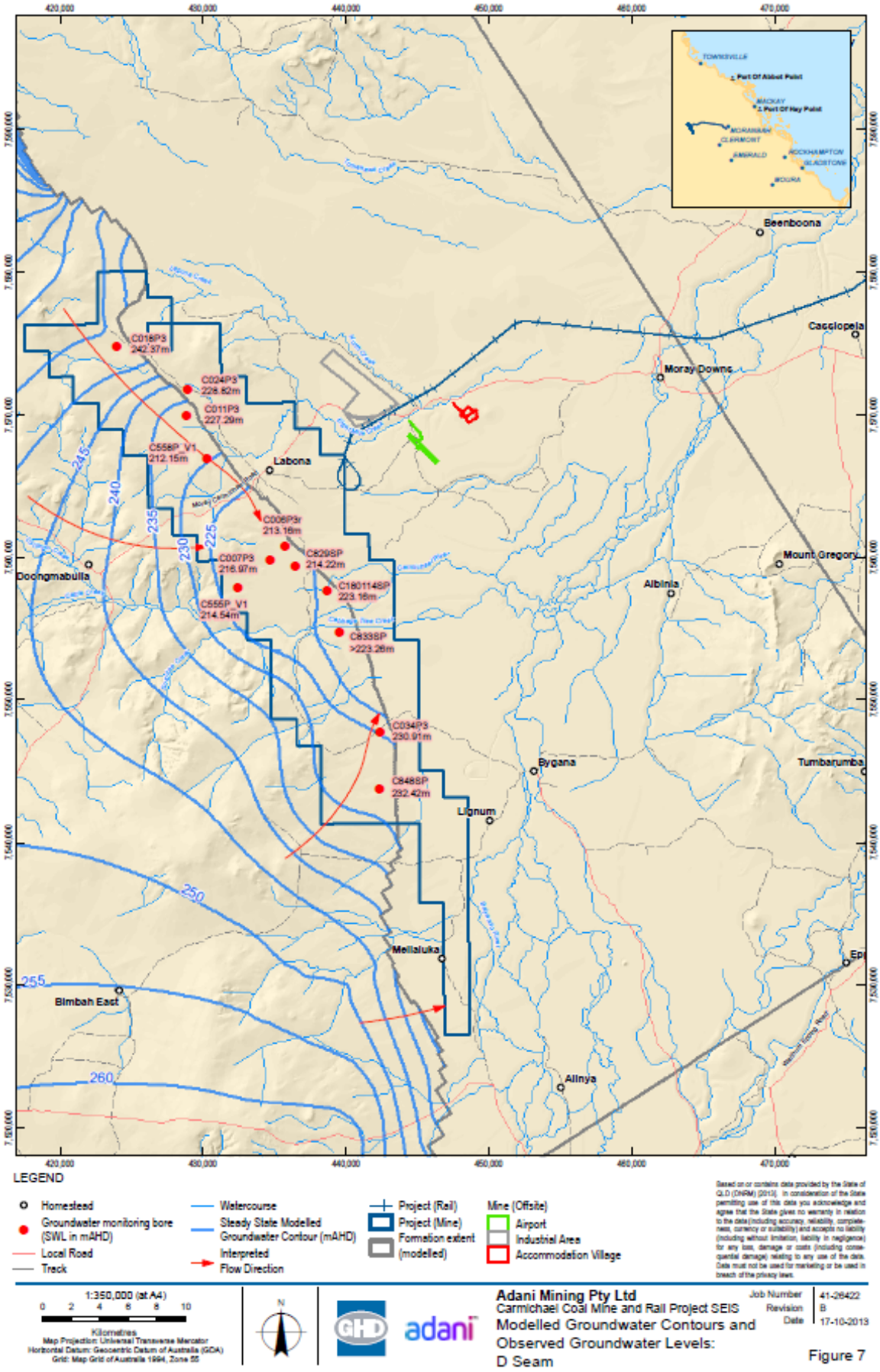

Figure 7: SEIS Groundwater Modelling Addendum Report Figure 7, showing modelled extent of the Clematis Sandstone.

433. On the basis of the above evidence, no adequate explanation exists for the necessary discharge of water from the Colinlea Sandstone, other than the Doongmabulla Springs.

434. On this basis, the Court should accept A/Prof Webb's opinion that the groundwater flow patterns support the view that the Colinlea Sandstone discharges to the Doongmabulla Springs.

Necessary potentiometric head and confinement to drive artesian spring flow

435. There is no dispute that the Doongmabulla Springs are artesian and the groundwater experts agree in general terms that the head at the Joshua Spring is in the order of 3m above the surface.[449]

(a) Mr Bradley put the view in his second individual expert report that the Doongmabulla Springs are "rejected recharge springs".[450]

(b) A/Prof Fensham gave evidence that these are not rejected recharge springs, or "gravity springs" as he otherwise described them.[451]

436. The potentiometric head at the individual springs is not known, except to the extent that they are at least at ground surface as is necessary to drive artesian flow.[452]

437. Mr Bradley's view is that the most important information in determining the source aquifer for the Doongmabulla Springs is whether a given source aquifer is artesian at the springs.[453]

438. This issue is complicated by the fact that the Applicant appears to have no reliable data on:

(a) the elevation (i.e. ground level) at the different springs or the HD02 monitoring bore;[454] or

(b) the potentiometric heads at any of the springs.

439. In the course of the trial data from the Queensland Herbarium was tendered.[455] A/Prof Fensham gave evidence that, although the elevation measurements are only accurate to within 5 metres, the elevations are reliable in a relative sense and can be used to assess whether one location is higher or lower than another.[456]

440. Dr Merrick accepted that, despite any uncertainty about the absolute heights, the relative heights should be reasonable.

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[449] Transcript 4-40, lines 4-11.
[450] Exhibit JWB-2 to Exhibit 17; AA020 (Mr Bradley's Second Groundwater Expert Report) soft page 13, para 20(v)(c).
[451] Transcript 10-43, lines 39-44.
[452] Transcript 4-51, lines 32-33.
[453] Transcript 4-38, lines 36-42.
[454] Transcript 6-47, lines 6-23.
[455] Exhibit 89; [OL052] (Data Spreadsheet from Herbarium Re: Doongmabulla Springs).
[456] Transcript 10-51, lines 10-23.

441. In any case, this is the only relatively complete data set to assist as evidence of the relative heights of the Doongmabulla Springs and HD02.

442. The experts' competing views require that either the Clematis Sandstone or the Colinlea Sandstone (or both) have sufficient potentiometric head at the Doongmabulla Springs to drive spring flow. Dr Merrick's views appeared contradictory on this point:

(a) In his evidence-in-chief Dr Merrick was questioned about head levels in the Colinlea Sandstone based on Figure 1 of the groundwater JER,[457] shown above at p 94, particularly regarding Shoemaker Bore.[458]

(b) He replied to the question, "Putting that in a summary form, what do you say then to the possibility, the suggestion, that the Colinlea is the source of Joshua Springs?---Most unlikely."[459]

(c) In reaching this conclusion, Dr Merrick appears to have not realised the significance for his reasoning of the comparison with Figures 1 and 2 of the Groundwater Joint Expert Report, shown above at pages 94 and 95, namely:

(i) Groundwater head level in the Colinlea Sandstone was estimated at [245] AHD in Shoemaker Bore (Figure 1 of the JER).[460]

(ii) Groundwater head level in the Clematis Sandstone was modelled at 242 AHD (according to the contour in Figure 2 of the JER).

(iii) Joshua Spring is an artesian spring (i.e. groundwater is flowing freely to the surface under pressure, so the source aquifer must have a head pressure above the ground level and turkey's nest dam).

(iv) Ground level at Joshua Spring is approximately the same as at Shoemaker Bore, 248 AHD.[461]

(v) Based on the estimated and modelled groundwater heads in the Colinlea Sandstone **and the Clematis Sandstone** in Figures 1 and 2 of the JER and assuming the ground level at Joshua Spring is 248 AHD, neither aquifer is the source of Joshua Spring.

(vi) Accepting some margin of error in the estimated and modelled groundwater heads in the Colinlea Sandstone and the Clematis Sandstone in Figures 1 and 2 of the JER, **it is more likely** that the Colinlea Sandstone is the source of Joshua Spring (than the Clematis Sandstone, as the head is estimated to be higher in the Colinlea Sandstone).

(vii) Accepting some margin of error in the estimated and modelled groundwater heads in the Colinlea Sandstone and the Clematis Sandstone, **the figures are consistent with A/Prof Webb's hypothesis** that both are

[457] Exhibit 14; JR004 (Groundwater Joint Experts Report), soft page 6.
[458] Transcript 7-8, line 15, and continued to T 7-10, line 42.
[459] Transcript 7-8, line 15, and continued to T 7-10, line 42
[460] Transcript 7-8, lines 13-36.
[461] Transcript 7-8, line 39.

sources for the Doongmabulla Springs, in particular the artesian spring at Joshua Spring which the Colinlea Sandstone may at least be partially contributing to.

Source aquifer above the Rewan Formation - HD02 monitoring bore

443. In considering the possible source aquifer above the Rewan Formation the relevant experts' views differ – A/Prof Webb considers the relevant unit is the Dunda Beds whereas Mr Bradley adheres to the geology mapped in Vine et al and assumes that the relevant unit is the Clematis Sandstone.[462]

444. Whether we refer to Clematis Sandstone or Dunda Beds (referred to for present purposes as the Dunda/Clematis), the groundwater head in the groundwater monitoring bore HD02 is a vital piece of information, since it is the closest groundwater monitoring bore to the Doongmabulla Springs and has a sub-artesian head at approximately 2 metres below the ground surface.

445. The Queensland Herbarium elevation data indicates that HD02 is at a lower elevation than all the Doongmabulla Springs, except Moses Spring which is recorded at the same elevation.[463]

446. HD02 is a groundwater monitoring bore that is specifically designed for measuring the head in the particular aquifer it taps.[464]

447. The experts generally agree that if the Dunda/Clematis is the source aquifer for the Doongmabulla Springs, HD02 should be artesian:

(a) Mr Bradley agreed to this in cross-examination[465] and explains it in the following terms in his first expert report:

> The ground elevation at HD02 is given as 240 mAHD … therefore the recorded water level is approximately 2 m below surface (i.e. approximate water level of 238 mAHD). It has been noted that, based on the probable ground elevations at the Doongmabulla Springs, and on the interpreted artesian head (at least 3 m above ground level) it may be expected that the water level would be above the top of HD02 (i.e. that the bore would be artesian).[466]

(b) A/Prof Webb shares the view that HD02 should be artesian if the Clematis Sandstone is the only source aquifer for the Doongmabulla Springs.[467]

(c) Mr Bradley stated in his cross-examination that HD02 is "certainly the most difficult bore to explain… on its data."[468]

(d) Dr Merrick also gave evidence that if HD02 and Little Moses are at the same elevation "you wouldn't expect the Clematis to be discharging at one place and not

[462] Transcript 4-66, lines 9-10.
[463] [OL052] Exhibit 89, Data Spreadsheet from Herbarium Re: Doongmabulla Springs.
[464] Transcript 4-54, lines 42-44; Transcript 5-48, lines 4-10; Transcript 7-33, lines 16-22.
[465] Transcript 4-41, lines 17-21.
[466] Exhibit JWB-1 to Exhibit 16; AA008 (Mr Bradley's First Groundwater Expert Report) soft page 23, para 31(ii)(d).
[467] Transcript 5-48, lines 45-47.
[468] Transcript 4-46, lines 43-44.

– and not at the other."[469]

448. The Applicant sought to call into question the relative heights of HD02 and the surrounding springs, apparently to infer that HD02 may be at a higher elevation than the springs and that these elevation differences are the reason HD02 is not artesian but the springs are.[470]

(a) A/Prof Webb made very clear in his evidence that, while he had no detailed topographic data, the area around HD02 is a very flat area and that Little Moses is definitely not down at the level of the creek bed.[471]

(b) As indicated above, elevation data from the Queensland Herbarium shows that HD02 is at a lower elevation than all the Doongmabulla Springs, except Moses Spring, which is recorded at the same elevation.[472]

(c) A/Prof Fensham gave evidence that Little Moses is above the creek level.

> Well, like you say, Little Moses is downstream of HD02, but it's also on a terrace; so it's not on the stream bank. It's on a raised terrace above the stream.[473]

449. Mr Bradley in cross-examination gave various explanations as to why HD02 is not artesian, and all but one of these were described for the first time in his cross-examination:

(a) Mr Bradley's only explanation for this in his first expert report is that "the bore is potentially in a groundwater recharge area (where artesian heads would not occur)"[474].

(i) When it was put to Mr Bradley in cross-examination that this is his explanation for the non-artesian head in HD02 he responded:

> Well, I'm trying to explain at that time my thoughts at that time as to the groundwater levels in HD02.[475]

(ii) Mr Bradley did not seek to correct his view on this during his evidence–in-chief.[476]

(iii) A/Prof Webb disagrees with this explanation, primarily because of the relative location of HD02 to the springs, which are clearly discharge points.[477]

(b) In answering questions about his original hypothesis:

(i) Mr Bradley appeared to abandon his original explanation for the non-artesian

[469] Transcript 7-36, lines 22-23.
[470] Transcript 6-29, line 11 to 6-31, line 11.
[471] Transcript 6-47, lines 6-23.
[472] [OL052] Exhibit 89, Data Spreadsheet from Herbarium Re: Doongmabulla Springs.
[473] Transcript 10-53, lines 19-20.
[474] Exhibit JWB-1 to Exhibit 16; AA008 (Mr Bradley's First Groundwater Expert Report) soft page 23, para 31(ii)(d).
[475] Transcript 4-42, lines 9-10.
[476] Transcript 4-42, lines 14-20.
[477] Transcript 5-49, lines 5-6.

head in HD02 and proffer two completely new explanations:

> So there are actually two potential explanations for why HD02 isn't artesian: one is that the system has lost its energy, so you've essentially got that trough, and the artesian energy has been lost from that system in Joshua Spring and Moses Spring; the other explanation, potentially, is that HD02 is only 32 metres deep.[478]

(ii) He subsequently maintained his original explanation but qualified by reference to the new explanation:

> Q: Could you just tell me whether you hold to that explanation or not?
>
> A: I'm going to say yes if we can have the opportunity to qualify.
>
> Q: Thank you. Now tell me why?
>
> A: If the groundwater level is below the surface, then it allows the possibility of recharge getting in at that point.
>
> Q: That's the wrong way round logically though, right?...
>
> A: No and that's where my – my new explanation … comes in.[479]

(c) In relation to the first of these explanations (i.e. that the system has lost energy):

(i) A/Prof Webb noted that it was not possible unless Little Moses spring is fed from a different aquifer.[480]

(ii) Dr Merrick, having considered the Queensland Herbarium elevation data, dispensed with this explanation and arrived at the conclusion that the Clematis Sandstone is **an unlikely source for Little Moses spring**:

> A: Well, it would be unlikely that the Clematis would have sufficient pressure at Little Moses to be driving that spring. That's all I can say on the basis of these elevations, if they are correct, because what I believe is happening at HD02 is that the Clematis pressure is being relieved by discharge into all the numerous Moses springs. It – so that's why I believe it's artesian at Joshua. And then you get quite a relief of pressure at all the Little Moses springs, and HD02, as a result, turns out to be non-artesian, I think for that reason, that relief has been taken off the pressure. So I don't have an explanation for Little Moses.
>
> Q: Yes. So the gradient would be supportive of the absence of an explanation for that difference?
>
> A: Yes.
>
> Q: An explanation is that there's a different aquifer involved at some level?
>
> A: That's a possible explanation.[481]

(d) In relation to the second of these explanations (i.e. that HD02 is only 32m deep):

(i) Mr Bradley stated that his evidence in support was "[j]ust the shallow depth",[482] notwithstanding that HD02 was designed as a groundwater monitoring bore.

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[478] Transcript 4-44, lines 39-45.
[479] Transcript 4-48, lines 1-14.
[480] Transcript 5-49, lines 8-13.
[481] Transcript 8-66, lines 31-47.
[482] Transcript 4-47, line 32.

(ii) A/Prof Webb's opinion is that there is no evidence to support it, particularly given that the Shoemaker 1 bore log shows uniform sandstone for the first 80m.[483]

(iii) Dr Merrick's evidence on this issue does not support Mr Bradley:

(A) In cross-examination Dr Merrick stated:

> That part of the Clematis that has been sampled [at HD02] does not have artesian pressure, and I think it would be fair to extrapolate and say that there is a good chance that the Clematis on the whole does not have artesian pressure at that point.[484]

(B) In re-examination Dr Merrick stated:

> So in all likelihood [the Clematis is] probably not artesian at [HD02] even if you had drilled through the entire thickness of the Clematis.[485]

(e) Mr Bradley appeared to ultimately accept that the simplest explanation for the groundwater level in HD02 is that the Dunda/Clematis is not artesian at this point:

> Q: Can we agree that the simplest explanation – the most, sort of, Occam's Razor-ish explanation – for HD02 not being artesian, that is, having a head which is below ground level, given the assumptions about elevation to Joshua, is that the Clematis Sandstone is not artesian at that point, that is, that the potentiometric surface is below the ground level?
>
> A: It's not unreasonable. Yeah. That's - - -[486]

(f) Mr Bradley subsequently described his 2 new explanations only as plausible, noting the difficulty in explaining the HD02 data:

> Q: …on its face – on its simplest most Occam's Razor-like explanation – HD02 stands against the proposition that the Clematis Sandstone is the source aquifer for the Joshua Spring, doesn't it?
>
> A: HD02 is – it's certainly the most difficult bore to explain on its – on its data. So I have to come down to what are <u>plausible</u> reasons. One could be the depth of the bore. It's only 32 metres. And the other could be the loss of energy in the system.[487]

(g) Mr Bradley very late in his evidence produced a new theory:

> One point with HD02 <u>which I hadn't even thought about until</u> just now is that HD02 is drilled up out of – like Little Moses, for example, is within the creek and HD02 is drilled adjacent to the creek. And I'm not sure what the distance is down to the bed of the creek, but it may well be in the order that the groundwater level is just below the bed of the creek at that point. So it could even be the case that you're dealing with a situation at HD02 where you've got a water level in the Clematis Sandstone very close to the base of the creek.[488]

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[483] Transcript 5-49, lines 15-18.
[484] Transcript 7-35, lines 37-39.
[485] Transcript 8-69, line 47 to 8-70, line 2.
[486] Transcript 4-44, lines 12-17.
[487] Transcript 4-46, lines 41-46. [*Emphasis added*].
[488] Transcript 4-52, lines 10-18. [*Emphasis added*].

450. HD02 provides strong evidence that the Clematis Sandstone is not artesian in the vicinity of the Doongmabulla Springs and that it could not be the only source aquifer. The evidence for the Applicant provides no credible alternative explanation as to how the springs could be fed from any aquifer above the Rewan Formation.

451. Mr Bradley effectively abandoned his original explanation and Dr Merrick categorically disagreed with his two new explanations. Further Dr Merrick concluded that it's unlikely that the Clematis would have sufficient head to drive the spring flow at Little Moses, and that a different source aquifer is a possible explanation.

Colinlea Sandstone – Shoemaker Bore

452. Mr Bradley agreed with A/Prof Webb that there is sufficient potentiometric head in the Colinlea Sandstone to drive groundwater flow to the springs,[489] yet he subsequently sought to rely on the head data from the Shoemaker 1 Well completion report (as represented in square brackets on Figure JER 1) to assert that the Colinlea Sandstone is not artesian at the location of the Doongmabulla Springs.[490]

453. The head measurement taken at the Shoemaker 1 bore log is recognised to be unreliable and should be taken only as a guide to the actual groundwater head in the Colinlea Sandstone.

(a) The Shoemaker bore is a petroleum exploration bore and it was not drilled for the purpose of groundwater investigation, but it provides the only available head data for the Colinlea Sandstone in the area of the Doongmabulla Springs. The bore is now sealed and so the only available groundwater data from Shoemaker 1 are the "drill stem tests" done at the time the bore was drilled.[491]

(b) The uncertainty around the head in Shoemaker 1 is best summed up in the "DNRM advice on groundwater flow direction" at Appendix 3 to the CG's Report:

> Some such data was able to be sourced from old drill stem tests carried out in petroleum exploration wells in the area and more recently in a coal seam gas exploration hole.
>
> Drill stem tests can often provide poor quality information and often these poorer quality tests can easily be identified and discounted. However even in the better tests there remain significant measurement uncertainties. Bearing this in mind <u>any data obtained from these tests can be taken as a guide only</u>.[492]

(c) Mr Bradley accepted, in light of the uncertainty of the drill stem test results at Shoemaker 1, that the head in the Colinlea Sandstone may be above the ground at the location of the Shoemaker 1 Bore.[493]

(d) Similarly, Dr Merrick accepted that, although he had relied on the 245m estimated head for the Shoemaker 1 bore log in interpreting the contours in Figure JER 1,[494]

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[489] Transcript 2-50, lines 7-12.
[490] Transcript 4-38, line 36 to 4-39, line 9.
[491] Transcript 4-55, lines 13-24.

[492] Exhibit 6a; SP001.12 (Coordinator-General's Report) Appendix 3 - DNRM advice on groundwater flow direction, soft page 511. [*Emphasis added*]
[493] Transcript 4-58, lines 10-13.
[494] Transcript 7-42, line 45 to 7-43, line 2.

this measurement is subject to a margin of error of 5 m or more,[495] which would bring the head above the ground level of 248m.[496]

Regional geology

454. It is important to be clear about the relevance of the dispute about regional geology with regard to the competing views about the source aquifer/s for the Doongmabulla Springs:

(a) A/Prof Webb's re-conceptualisation of the regional geology is not essential to his view about the source aquifer for the Doongmabulla Springs.[497]

(b) the regional geology is relevant only to the extent that Mr Bradley relies on the Vine et al regional geology in his alternative conceptualisation of the source aquifer for the Doongmabulla Springs.[498]

455. Mr Bradley gave evidence that he agrees with the regional geology as mapped previously, and that his hydrogeological conceptualisation of the Doongmabulla Springs is consistent with that.[499]

456. In contrast, A/Prof Webb described the process he undertakes to verify any existing geological mapping:

> The first thing I do when I – I'm involved in any study of geology of a particular area is to get all the data that's available for the area, and so that includes the existing geology maps, it includes the topography, the radiometrics, the aeromagnetics, the satellite imagery, and I put it all together – which I can on do very quickly – and I use it to check the geology, just to confirm in my own mind that what they've said is right, that everything makes sense. It's standard practice for me.[500]

457. A/Prof Webb also considered the available seismic data[501] and bore log data[502] in developing his conceptualisation, and he gave a detailed explanation of the process by which this suite of data sources assists him in understanding the regional geology.[503]

458. The Applicant sought to characterise A/Prof Webb's remapping process as an unjustified departure from 45 years of understanding, but the fact is that there have not previously been detailed investigations in this area:

(a) This issue was addressed with A/Prof Webb in cross-examination:

> Q: What, in fact, your remapping has done of the regional geology, in fact, it's overturned accepted regional geological mapping of the last 45 years?
>
> A: Given that it's only been mapped twice in the last 45 years, 45 years ago and

[495] Transcript 7-27, lines 29-41; Transcript 7-42, lines 23-34.
[496] See Annexure D to Exhibit JWB-1 to Exhibit 16; AA008 (Mr Bradley's First Groundwater Expert Report) soft page 53.
[497] Transcript 5-47, line 43 to 5-48, line 2; Transcript 5-56, lines 11-16. See also Exhibit 18; OL012 (A/Prof. Webb's Groundwater Expert Report) p 25, para 40.
[498] Exhibit JWB-1 to Exhibit 16; AA008 (Mr Bradley's First Groundwater Expert Report) soft page 13, para 3.
[499] Transcript 2-40, lines 1-7.
[500] Transcript 5-7, lines 12-18.
[501] Transcript 5-11, line 45 to 5-12, line 5.
[502] I.e. the well completion reports from Carmichael 1 and Lake Galilee 1 - see Transcript to 5-12, line 37 to 5-13, line 2.
[503] Transcript 5-10, line 20 to 5-11, line 43; Transcript 5-17, line 17 to 5-18, line 13.

now, what you say is true.[504]

(b) A/Prof Webb's remapping was also discussed with A/Prof Fensham in cross-examination as being "radical", but A/Prof Fensham gave evidence that other experts, including Rein Habermehl whose work is relied on by the Applicant,[505] agree that the existing mapping may be wrong:

> …in relation to the possibility that the mapping was that wrong, I have had the opportunity, subsequently, to talk to another – other colleagues of mine who are very well established hydrogeologists with specific familiarity with the GAB, Jim Kellett and Rien Habermehl, and I raised the possibility that the established mapping could be that far out, and they, kind of, rolled their eyes, and said, well, that mapping was done a long time ago, and that's a corner of the GAB that we don't know a lot about, and it is indeed a possibility that it could be substantially wrong.[506]

Regional geological mapping

459. The geological mapping relied on in the Applicant's assessment documentation is the 1:250,000 scale mapping done in 1969 and 1972 by Vine et al:

(a) The Buchanan sheet[507] covering the northern part of the mine; and

(b) The Galilee sheet[508] covering the northern part of the mine.

460. The only additional mapping was the 1997 map *Hydrogeology of the Great Artesian Basin* by Habermehl and Lau,[509] which the experts agreed was entirely based on the earlier mapping by Vine et al.[510]

461. There was substantial discussion about the limited technologies and resources available to the geologists in preparing these maps and their reliability:[511]

(a) The mappers were limited to the technologies available at the time, which primarily included flyovers and interpretation of air photos.

(b) The mappers themselves categorised the majority of the area mapped in this area as reliability level "C" – Mr Bradley accepts that this makes the maps less reliable.[512]

462. Mr Bradley accepted that in modern remapping projects, a number of new data sources, such as remote sensing images (i.e. radiometrics, Landsat imaging, high-resolution topographic data generated from NASA's Shuttle Radar Topography Mission (SRTM)), would be used.[513]

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[504] Transcript 6-36, lines 30-33.
[505] Transcript 10-78, line 1 to 10-79, line 29.
[506] Transcript 10-67, line 29-36.
[507] Exhibit 61; OL034 (1-250k Buchanan Map).
[508] Exhibit 62; OL035 (1-250k Galilee Map).
[509] Exhibit 52; AA029 (Map titled 'Hydrogeology of the Great Artesian Basin' prepared by Habermehl and Lau dated 1997)).
[510] Transcript 5-8, line 11-14, Transcript 2-24, lines 34-35.
[511] Transcript 3-43, line 10 to 3-44, line 30.
[512] Transcript 3-43, line 25.
[513] Transcript 3-46, lines 12-43.

463. These are all data sources that A/Prof Webb used in producing his geological conceptualisation of the area, and A/Prof Webb gave evidence of his involvement in a recent remapping project that has resulted corrections to earlier mapping done in the era of Vine et al.[514]

464. Mr Bradley indicated that he has little or no experience with some of these techniques.[515]

465. Mr Bradley acknowledged the consistency between A/Prof Webb's approach and the methodology used in recent remapping,[516]and also gave evidence that he did not take issue with any of the techniques used by A/Prof Webb in his remapping.[517]

466. Mr Bradley accepted that remapping using all these new technologies can result in a change in understanding of the geology of a particular area and that he would rely on remapping in preference to the 1:250,000 mapping.[518]

467. Despite this acknowledgement, and the substantial amount of additional data A/Prof Webb brought to bear on the regional geology, when asked about A/Prof Webb's data or remapping Mr Bradley persisted in referring back to the 45 year old regional mapping by Vine et al, rather than engaging with A/Prof Webb's new evidence.[519]

<u>Rewan outcrop</u>

468. The data collected by A/Prof Webb that indicated flaws in the previously mapped geology included radiometric imaging that shows, based on A/Prof Webb's earlier work in this region, that there was outcropping of the Rewan Formation.[520]

469. This outcrop of Rewan Formation is in an area where the overlying unit has been eroded, and is identifiable by the pink radiometric signature seen below in the figure "Digital elevation modelling with radiometric image superimposed".

Bradley's Floodplain deposition theory

470. In Mr Bradley's examination-in-chief, he put for the first time a theory that the radiometric imaging suggestive of Rewan Formation outcropping was simply as a consequence of flood plain deposits.[521]

471. However, as A/Prof Webb subsequently demonstrated, there is no upstream geology that shows the same radiometric signature, so the high-potassium readings could not be caused by flood deposition and are better explained by erosion of surface strata in the surface drainage channels to reveal the underlying Rewan Formation.[522]

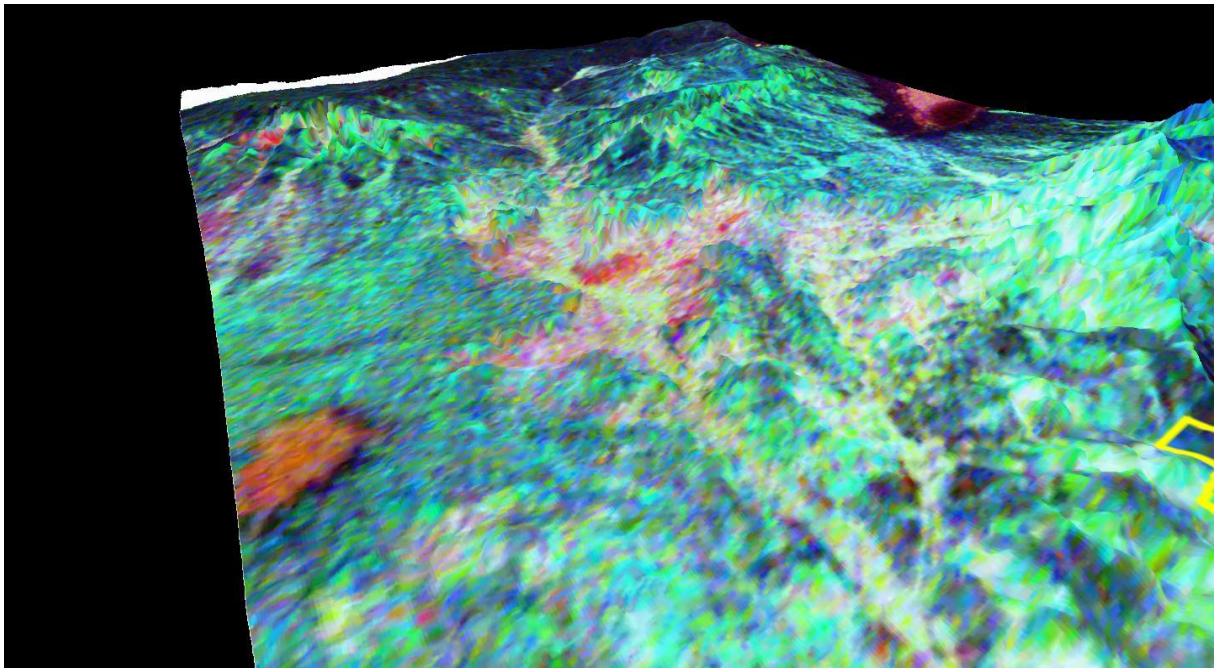
> So what you can see here, if you look further upstream in to the distance, is that there's no extensive area of pink sediments that could be eroded to deposit as the flood plain sediments

[514] Transcript 5-8, line 39 to 5-9, line 9.
[515] Transcript 3-47, lines 20-25; Transcript 3-77, lines 6-10.
[516] Transcript 3-66, lines 32-35.
[517] Transcript 3-67, lines 31-35; Transcript 3-67, lines 43-45.
[518] Transcript 3-47, lines 6-12.
[519] Transcript 3-70, lines 1-3; Transcript 3-70, lines 21-29; Transcript 3-77, lines 18-23; Transcript 3-77, line 43 to 3-78, line 7; Transcript 3-78, lines 17-19.
[520] Transcript 5-9, line 14 to 5-9, line 42.
[521] Transcript 2-48, lines 17-27; Transcript 6-52, lines 22-27.
[522] Transcript 5-14, line 17 to 5-15, line 34; Transcript 6-52, lines 5-20.

> in the area in the centre of the photo. There's just no source area for those potassium rich sediments.[523]

472. A/Prof Webb confirmed in cross-examination that he had mapped right to the headwaters of the Carmichael River and found no source for potassium deposition.[524]

473. When this proposition was put to Mr Bradley, he accepted that the potassium had to come from somewhere, but could not indicate where he considers it came from.[525] Instead, Mr Bradley simply reiterated that the pink area identified by A/Prof Webb as Rewan Formation corresponded with drainage,[526] which is entirely consistent with A/Prof Webb's view that the Rewan Formation has been exposed by erosion in the drainage channels.



Digital elevation modelling with radiometric image superimposed, showing high potassium Rewan outcrop (pink area in centre of image), extracted from Exhibit 65 by A/Prof Webb (Mapping outcrop using digital elevation modelling and radiometric imaging).

Mica and Glauconite

474. It was put to A/Prof Webb in cross-examination that the pink radiometric signature, indicating a potassium rich unit, could simply indicate the presence of Mica or Glauconite. While this had never been suggested to A/Prof Webb as a source of the potassium signature,[527] he had considered this and determined that it does not explain the observed radiometrics.

475. Regarding the suggestion that Mica is the source of the high potassium signature, A/Prof Webb gave the following evidence:

> So to get a high potassium signature like that, we see uniform pink colour. You actually

[523] Transcript 5-15, lines 30-34.
[524] Transcript 5-76, line 41.
[525] Transcript 3-74, lines 24-28.
[526] Transcript 3-75, lines 1-7; Transcript 3-75, line 45 to 3-76, line 12.
[527] Transcript 6-52, lines 39-42.

> require more than just a trace. And, in fact, what I think it's more likely is that it's actually a clay Mica Illite which is a potassium clay Mica that's providing that high potassium signature…
>
> So when it says "traces", it doesn't seem like there's going to be enough potassium to provide the signature. And also, once again, I matched the radiometric signature with the topography which showed that you've got erosion of a surface layer and exposure of a layer underneath.[528]

476. With respect to the suggestion that Glauconite is the cause of the signature:

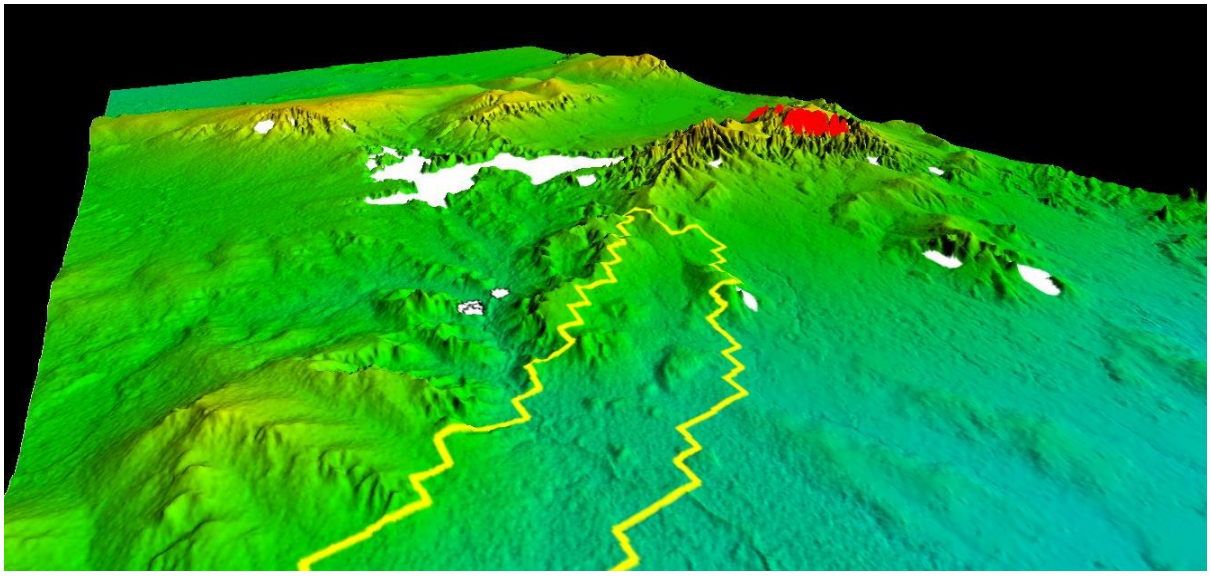
> So I did notice the Glauconite in those units when I read this, and I was a bit surprised because Glauconite is predominantly a mineral formed in shallow marine environments. So Glauconite is by far most common in marine sediments. And nobody is pretending that the Moolayember Formation is marine. The Glauconite is a very distinctive green, dark green colour. And I think, without being certain, that some of the sandstone looks a bit greenish, and on that basis they've said there's a trace of Glauconite. Because given that this is a freshwater deposit, the Moolayember Formation, I'm very surprised to see Glauconite in it.[529]

Clematis outcrop

477. A/Prof Webb identified an outcrop of Clematis Sandstone slightly to the northeast and at a higher elevation to the Doongmabulla Springs Complex. He first identified its distinctive characteristics using radiometric and satellite imagery, then verified his identification of Clematis Sandstone during a helicopter fly past on 21 November 2014.[530] He stated repeatedly how distinctive Clematis Sandstone is and how readily it can be identified (a matter that he was not challenged on in cross-examination):

> … the Clematis Sandstone has a very distinctive outcrop signature, that I can pick up on the satellite images, and so down south, particularly the Clematis Sandstone, I mapped it in exactly the same way that the Jericho sheet was mapped, and that is it's a cliff forming sandstone. So you can see the cliffs, and I can see them on the satellite imagery.[531]
>
> … in this particular case I identified some Clematis Sandstone outcrops to the north, and the outcrops are so distinctive that if you see them visually, in my opinion, you can be certain that's what they are. So the helicopter fly past was to check the Clematis, and then we landed to check outcrops that I had identified as Dunda Beds and to see areas that I'd identified as potentially Rewan Formation.[532]
>
> … the Clematis Sandstone forms high cliffs, steep cliffs that are quite white in colour. It's really distinctive. You see it all over that part of Central Queensland.[533]
>
> … Clematis, in my opinion, is the easiest unit to identify in the whole area because it forms these very prominent cliffs of white sandstone, and the base of the cliffs is mapped to the south, and I followed the mapping in the north, as the boundary between the Clematis and the underlying Dunda Beds. It's – it's crystal clear.[534]

[528] Transcript 6-40, lines 18-28.
[529] Transcript 6-39, line 40 to 6-40, line 1.
[530] See Exhibit 18; OL018 (A/Prof Webb's Groundwater Expert Report), paras [16], [17], [24] and [34]; Transcript 5-9, lines 35-40; Transcript 5-11, lines 25-33; Transcript 5-11, lines 39-41; and Transcript 5-16, lines 28-33.
[531] Transcript 5-9, lines 35-40.
[532] Transcript 5-11, lines 25-33.
[533] Transcript 5-11, lines 39-41.
[534] Transcript 5-16, lines 28-33.



Digital elevation modelling with Rewan and Clematis outcrop, extracted from Exhibit 65 by A/Prof Webb (Mapping outcrop using digital elevation modelling and radiometric imaging).

JW Figure 4: Outcrop of Clematis Sandstone, distinguished by pale coloured sandstone and strongly developed cliffs; photo taken by John Webb, 21/11/2014, at 146.0999695E 21.62299317S) in Exhibit 18; OL012 (A/Prof. Webb Groundwater Expert Report) p 10.

478. A/Prof Webb was taken to the photograph in Figure 4 of his expert report (**JW Figure 4**) during his oral testimony. He explained:

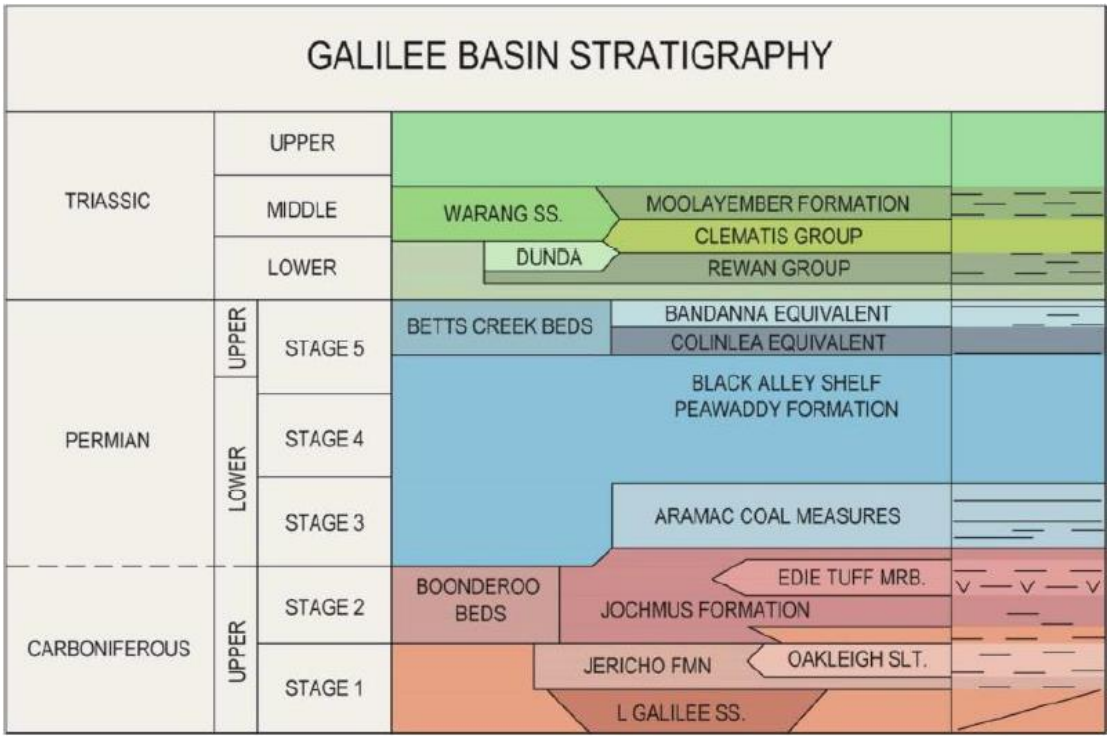
> So that's a classic outcrop of Clematis Sandstone. You see the prominent white cliffs. It

forms these isolated pinnacles, sometimes called pagodas, at the end of the ridges.[535]

479. A/Prof Webb's identification of an outcrop of Clematis Sandstone slightly to the northeast and at a higher elevation than the Doongmabulla Springs Complex is particularly significant as:

(a) Based on the accepted stratigraphy of the Galilee Basin, Clematis Sandstone lies beneath the Moolayember Formation.[536]

(b) If the Court accepts A/Prof Webb's identification of the Clematis Sandstone and the Rewan Formation at this point, it follows that the historic mapping of the Moolayember Formation around Doongmabulla Springs Complex that the Applicant and Mr Bradley rely upon must be incorrect.



Stratigraphy of Galilee Basin[537]

480. Mr Bradley gave evidence that he did not "follow the logic"[538] of how A/Prof Webb identified outcrop of Clematis Sandstone using the Landsat imagery, and noted that he does not do a lot of "this sort of mapping of specific geological features".[539] He gave no alternative identification to that of A/Prof Webb other than to rely on the identification in the 45 year old mapping by Vine et al.[540]

[535] Transcript 5-16, lines 45-47.
[536] Transcript 5-10, line 5 to 5-10, line 13. See Figure 4 (Stratigraphy of Galilee Basin) in MR024 (Application for Mining Lease - Carmichael Coal Project – Initial Development Plan) p 22. There is no suggestion in the evidence of overturning of the stratigraphy of the Galilee Basin.
[537] MR024 (Application for Mining Lease - Carmichael Coal Project – Initial Development Plan) p 22.
[538] Transcript 3-76, lines 40-41.
[539] Transcript 3-77, lines 6-10.
[540] Transcript 3-77, lines 20-23.

Bore Log data – Shoemaker 1[541]

481. Mr Bradley accepted at different points in his evidence that in forming his opinion he had placed a lot of weight on the stratigraphy shown in the Shoemaker 1 bore log,[542] and that he had simply relied on the stratigraphic interpretation presented in the bore log, rather than undertaking his own interpretation of the bore log data - that is, Mr Bradley used the "picks", or boundaries between the strata, identified by the earlier geologists and presented in the Shoemaker 1 bore log.[543]

482. Similarly, Mr Bradley also relied later on the picks in the Montani 1 bore bog to seek to refute A/Prof Webb's interpretation of the regional geology.[544]

483. Mr Bradley accepts, however, that "an awful lot of interpretation and investigation" and a degree of judgement is necessary in determining the stratigraphy of an area,[545] which was later reinforced by his observation that "any of the units in any particular location, [may be] more or less sandy."[546]

484. A number of features in the Shoemaker 1 bore log suggest that it should not have been relied on as it has been by the Applicant's experts.

(a) The target coal in the D Sean is recognised by Mr Bradley and the Applicant to be in the Colinlea Sandstone,[547] yet the Shoemaker 1 bore log shows no coal in the Colinlea Sandstone;[548]

(b) The thickness of the seams identified in the Shoemaker 1 Bore Log is very different from the descriptions of the strata relied on by the Applicant:

(i) What is described as Dunda beds in Shoemaker 1 bore log is only 50m thick, compared with approximately 150-200m in Mr Bradley's and the Applicant's evidence;[549]

(ii) What is described as Clematis Sandstone in the Shoemaker 1 bore log is only 119m thick, compared with approximately 200m "near Doongmabulla" in Mr Bradley's the Applicant's evidence.[550]

(c) Mr Bradley says the Rewan Formation is a "marker unit" with a characteristic thickness,[551] yet he also accepted that sometimes the Dunda Beds are arbitrarily

[541] See Annexure D to Exhibit JWB-1 to Exhibit 16; AA008 (Mr Bradley's First Groundwater Expert Report) soft page 53.
[542] Transcript 3-48, lines 8-12; Transcript 3-48, lines 26-28; Transcript 3-60, lines 37-39.
[543] Transcript 3-48, lines 39-42; Transcript 2-58, lines 5-8.
[544] Transcript 4-74, lines 4-18.
[545] Transcript 2-56, lines 24-29.
[546] Transcript 3-59, lines 32-33.
[547] Transcript 3-54, line 46 to 3-55, line 4.
[548] Transcript 3-56, lines 14-21.
[549] See "Table 4-1 Summary of Hydrogeological Units Identified for the Study Area", Annexure C in Exhibit JWB-1 to Exhibit 16; AA008 (Mr Bradley's First Groundwater Expert Report) soft page 51.
[550] See "Table 4-1 Summary of Hydrogeological Units Identified for the Study Area", Annexure C in Exhibit JWB-1 to Exhibit 16; AA008 (Mr Bradley's First Groundwater Expert Report) soft page 51.
[551] Transcript 2-56, lines 31-34.

included in the Rewan Formation.[552]

485. There is evidence of a number of features in the Shoemaker 1 bore log that support A/Prof Webb's alternative interpretation of the stratigraphy.

(a) The interpretation if stratigraphy in the top 200m of the bore log, which has been picked to include the Moolayember Formation and the Clematis Sandstone, is based entirely on the gamma log, since no chips were collected at this point.[553]

(b) The reading on the gamma log is a measure of clay content in the rock – higher readings (where the EGR line is further to the right) indicate higher clay content.

(c) The gamma log for the top 80m of the bore log shows very low clay content compared to the following 120m,[554] which does not support the pick in the bore log that the top layer is Moolayember Formation.

(i) A/Prof Webb explained that the gamma log for the first 80m of the shoemaker bore indicates that this is clean quartz sandstone, which will typically be a good aquifer.[555]

(ii) The Moolayember Formation is recognised elsewhere in the Applicant's evidence[556] to be an aquitard (sandstone and siltstone).

(iii) Moolayember Formation is described in the Galilee Sheet Explanatory notes as "Mudstone, sandstone, siltstone; sandstone mainly fine, labile to quartzose. Sequence commonly green, red, grey and white. Deeply kaolinized and partly ferruginised and silicified in outcrop."[557]

(d) The gamma log from the underlying 80m to 200m shows more clay content within the sandy sequences,[558] which does not support the pick in the bore log that the portion from 80m to 200m is Clematis Sandstone.

(i) Clematis Sandstone is recognised elsewhere in the Applicant's evidence[559] to be an aquifer (sandstone) rather than interbedded sandstone and clay (i.e. siltstone, mudstone).

(ii) Clematis Sandstone is described in the Galilee Sheet Explanatory notes as "Quartzose sandstone, fine to coarse with conglomerate beds; minor interbedded siltstone and mudstone."[560]

(iii) Mr Bradley accepted that the section picked as Clematis Sandstone (80m to

[552] Transcript 3-53, lines 25-33; Transcript 3-59, lines 19-25.
[553] Transcript 3-51, lines 27-29; Transcript 3-52, lines 1-19; Transcript 3-53, lines 14-16. Note that the gamma log is measured by the "EGR" line in the column second from the right in the Shoemaker 1 bore log.
[554] Transcript 3-54, lines 8-28.
[555] Transcript 5-23, lines 23-33.
[556] See "Table 4-1 Summary of Hydrogeological Units Identified for the Study Area", Annexure C in Exhibit JWB-1 to Exhibit 16; AA008 (Mr Bradley's First Groundwater Expert Report) soft page 51.
[557] Exhibit 64; OL037 (1:250,000 Galilee Map explanatory notes) soft page 9, Table 2.
[558] Transcript 2-57, line 46 to 2-58, line 2.
[559] See "Table 4-1 Summary of Hydrogeological Units Identified for the Study Area", Annexure C in Exhibit JWB-1 to Exhibit 16; AA008 (Mr Bradley's First Groundwater Expert Report) soft page 51.
[560] Exhibit 64; OL037 (1:250,000 Galilee Map explanatory notes) soft page 9, Table 2.

120m) shows more clay sequences than the section picked above as Moolayember Formation.[561]

(e) When questioned in cross-examination about the identification of the Moolayember Formation as the top strata, Mr Bradley conceded that it's more likely to be sandstone:

> Q: Well, there's no indication of this on the basis of the gamma log that there's Moolayember as the top strata layer either, is there?
>
> A: It's far more likely to be sandstone than an identified low permeability unit.[562]

(f) A/Prof Webb's view is that the labelling of units in the Shoemaker 1 bore log are based on the assumption that the Moolayember Formation is the surface unit[563] and the lithology and gamma log are consistent with his conceptualisation of the geology.[564]

(g) Mr Bradley accepted that the strata in the first 200m were labelled based on assumptions about the surface geology (i.e. the regional geological mapping):

> Q: And given those limitations which you've just identified on the gamma log, and given that we have no samples – no samples were taken for that first 200 metres – it's reasonable to assume, isn't it, that the label Moolayember and Colinlea have been put on as a result of the author's pre-existing knowledge on the assumed stratigraphy of the way in which the strata go down?
>
> A: Yes. And you may well find that the – they were more confident about units such as the [Rewan] formation. And that they then went up the hole from there and tried to pick differences.[565]

(h) The gamma log data for the top 200m is far more consistent with A/Prof Webb's interpretation that surficial strata is a sandstone unit, namely the Dunda Beds:

(i) Mr Bradley accepted that the gamma log for the first 200m just shows "a sandier unit followed by a more shale-like unit from 80 metres".[566]

(ii) Mr Bradley conceded that, while the Dunda Beds would be a more sandy unit at the top of the Rewan, the Shoemaker 1 bore log didn't show the Dunda Beds as a sandy unit at the top of the Rewan Formation.[567]

(iii) Dunda Beds is recognised elsewhere in the Applicant's evidence[568] to be a confined local aquifer described as "typically orange-brown and red-brown quartzose sandstone".

(iv) Dunda Beds is described in the Galilee Sheet Explanatory notes as "Labile to quartzose sandstone, mainly fine to very fine; subordinate siltstone and

[561] Transcript 3-54, line 46 to 3-55, line 4.
[562] Transcript 3-58, lines 40-42.
[563] Transcript 5-25, lines 3-4.
[564] Transcript 5-25, lines 11-20.
[565] Transcript 3-58, lines 21-27.
[566] Transcript 3-58, lines 1-2.
[567] Transcript 3-59, lines 20-28.
[568] See "Table 4-1 Summary of Hydrogeological Units Identified for the Study Area", Annexure C in Exhibit JWB-1 to Exhibit 16; AA008 (Mr Bradley's First Groundwater Expert Report) soft page 51.

mudstone, some red."[569]

486. On a proper interrogation of the evidence, the Shoemaker 1 bore log can be seen to have simply been completed to fit within the 45 year old mapping by Vine et al, and shouldn't have been relied on unquestioningly.

487. The Shoemaker 1 bore log is entirely consistent with A/Prof Webb's more thorough interpretation and supports his remapping.

Conclusion on regional geology

488. Ultimately, Mr Bradley failed to properly consider or understand the data he was provided by A/Prof Webb that formed the basis of A/Prof Webb's re-conceptualisation of the regional geology.

489. As noted above, at [479], if the Court accepts A/Prof Webb's identification of the Clematis Sandstone and the Rewan Formation at this point, it follows that the historic mapping of the Moolayember Formation around Doongmabulla Springs Complex that the Applicant and Mr Bradley rely upon must be incorrect.

490. As a consequence, Mr Bradley's conceptualisation cannot stand as an explanation for the source of the Doongmabulla Springs.

Water chemistry

491. Mr Bradley's second report included the following statement, indicating that further water chemistry data would not assist in identifying the source aquifer for the Doongmabulla Springs:

> Further, it is my opinion that further gathering of hydrochemical data would be unlikely to shine further light on the source aquifer to the Doongmabulla Spring Complex - i.e. I am of the opinion that sufficient data is available to date to be able to conclude that the water quality of individual groundwater units in the vicinity of the Carmichael Project site is similar to the likely range of water quality within the Doongmabulla Spring Complex. This is not to say that ongoing sampling is not warranted for environmental compliance reasons; rather that additional water quality data is unlikely to provide definitive proof of the source aquifer for the Doongmabulla Spring Complex. [570]

492. Mr Bradley reaffirmed this view in the Further Joint Groundwater Experts Report dated 25 March 2015 (**Second Groundwater JER**).[571]

493. However, Mr Bradley subsequently gave evidence that strontium isotope data from other aquifers could assist in understanding the source aquifer for the Doongmabulla Springs.[572] A/Prof Webb shares this view.[573]

494. Mr Bradley's evidence on chloride hydrochemical analysis is also unhelpful:

(a) He agrees in the Second Groundwater JER "that the observed chemistry of the

[569] Exhibit 64; OL037 (1:250,000 Galilee Map explanatory notes) soft page 9, Table 2.
[570] Exhibit JWB-2 to Exhibit 17; AA020 (Mr Bradley's Second Groundwater Expert Report) soft page 7, para 8.
[571] Exhibit 15; JR010 (Supplementary Groundwater Joint Experts Report) p 3, para 8.
[572] Transcript 4-60, line 37 to 4-61, line 10; Transcript 4-61, lines 40-42.
[573] Transcript 5-47, lines 13-20.

Doongmabulla Springs complex is more consistent with the chloride chemistry of groundwater in both the Clematis Sandstone and the Colinlea Sandstone than with the hydrochemistry of other groundwater units present in the area."[574]

(i) He later, in his evidence-in-chief, claimed that the chloride data would be unreliable because of contamination by rainwater, such that it couldn't be used to make reliable recharge calculations.[575]

(A) This change in opinion appears to create a new area of disagreement that Mr Bradley did not identify in either of his individual reports, the Groundwater JER or the Second Groundwater JER, and provides yet another example of Mr Bradley's opinion changing in cross-examination without any additional evidence as a basis for the change.

(B) However, as A/Prof Webb made clear in his evidence, the calculations of recharge he made using chloride automatically take rainwater into account,[576] and in fact chloride mass balance is a standard approach to calculating recharge that has been used by the Applicant in its assessment documentation.[577]

(ii) Similarly, Mr Bradley introduced a new line of reasoning in his evidence in chief that the water from the Colinlea would mix with other water on its way through the Rewan, such that the quality would change by the time it reached the surface.

(A) Again, this was not raised in any of the earlier joint expert reports or individual reports.

(B) A/Prof Webb's evidence is that, while there may be mixing occurring, if the water is moving quite rapidly through the Rewan Formation any influence on the chloride concentration would be quite minor.[578]

IESC Advice to Decision Maker

495. The IESC Advice[579] was provided to the Commonwealth Department of the Environment (**DoE**) and the CG on 16 December 2013, and the issues raised in the IESC Advice have been considered extensively in the evidence.

496. The Applicant sought to highlight in Mr Bradley's re-examination the extent to which the IESC's concerns had been addressed in material considered by the CG and referred to in the CG's Report.

497. Mr Ambrose took Mr Bradley to the following passage of the CG's Report:[580]

I consider that the proponent has undertaken sufficient groundwater modelling for the

[574] Exhibit 15; JR010 (Supplementary Groundwater Joint Experts Report) p 3, para 1.
[575] Transcript 2-39, lines 20-22.
[576] Transcript 6-4, line 38 to 6-5, line 32; Transcript 6-54, lines 13-34.
[577] Transcript 6-54, line 44 to 6-55, line 35.
[578] Transcript 5-46, line 43 to 5-47, line 4.
[579] Exhibit 59; OL032 (IESC Advice to decision maker on coal mining project).
[580] Transcript 4-71, line 42 to 4-72, line 4.

> project, as presented in AEIS Appendix K1 and Appendix K6. I am satisfied that the proponent has adequately responded to the IESC's concerns regarding numerical model boundaries and the conceptualisation of groundwater flow. Based on advice received from DNRM and Dr Merrick and all currently known information, I consider that the proponent's groundwater assessment methodology adequately allows for the identification and assessment of potential groundwater impacts.[581]

498. The following exchange came after Mr Bradley had read this passage:

> Q: Those appendices obviously – referred to came into existence after the IESC's 2013 report?
>
> A: Yes.

499. AEIS Appendix K1 and K6, as referred to in that passage and by Mr Ambrose, are in fact: [582]

(a) Appendix K1 Mine Hydrogeology Report,[583] which is dated 13 November 2013; and

(b) Appendix K6 Mine Hydrogeology Addendum,[584] which is dated 24 October 2013.

500. Contrary to both Mr Ambrose's and Mr Bradley's understanding, these documents both pre-date the IESC Advice and as such did not come into existence after the IESC Advice was provided to the CG and DoE on 16 December 2013.

501. It is also noteworthy that subsequent to the advice from DNRM[585] and Dr Merrick[586], received by the CG and referred to in the above passage, the IESC maintained a number of its earlier concerns as set out in the IESC Minutes.[587]

Conditions

502. It is anticipated that the Applicant in its submissions will seek to rely on conditions as a means of remedying the apparent defects in the assessment to date.

503. The conditions of primary relevance are:

(a) the conditions numbers E1 to E16 under the Draft environmental authority EPML01470513 Carmichael Coal Mine[588] (**Draft EA**), which incorporate the conditions required by the CG's Report;

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[581] Exhibit 6a; SP001.12 (Coordinator-General's Report) soft page 178.

[582] The AEIS as referred to in the Coordinator-General's Report is the SEIS as referred to by the Applicant. See in Exhibit 6a; SP001.12 (Coordinator-General's Report):

- the AEIS is described as "additional information to the EIS" at soft page 23; and
- the timeframes set out in Table 3.1 "Overview of EIS Process" at soft page 37 show that the dates related to the AEIS are consistent with what the Applicant has elsewhere described as the SEIS.

[583] MR167 (SEIS, Volume 4, Appendix K1 – Mine Hydrogeology Report (GHD 2013)).

[584] MR170.2 (SEIS, Volume 4, Appendix K6 – Mine Hydrogeology Report Addendum).

[585] Exhibit 6a; SP001.12 (Coordinator-General's Report) Appendix 3 - DNRM advice on groundwater flow direction, soft page 511.

[586] Exhibit 6a; SP001.12 (Coordinator-General's Report) Appendix 4 - Independent peer review, soft page 519.

[587] Exhibit 60; OL033 (IESC Minutes).

[588] Exhibit 6b; SP001.17 (Draft Environmental Authority).

(b) The conditions under the EPBC Act approval.

504. Each of these is considered in turn.

EA Conditions

505. The Draft EA conditions impose a number of fairly standard monitoring and reporting requirements, but the conditions most relevant to the issues raised in this case are:

(a) Condition E4, which requires the preparation of a Groundwater Management and Monitoring Program (**GMMP**); and

(b) Condition E6, which requires a Groundwater Model Review.

Condition E4

506. Condition E4 states:

> A Groundwater Management and Monitoring Program must be developed and certified by an appropriately qualified person which addresses all phases of the mining operation approved under this environmental authority. The groundwater management and monitoring program must be provided to the administering authority for approval with the baseline monitoring program in condition E3. The groundwater management and monitoring program must be developed to ensure that the plan meets the following objectives:
>
> a) Validation of groundwater numerical model (including review of boundary and recharge conditions) to refine and confirm accuracy of groundwater impacts predicted;
>
> b) Groundwater level monitoring in all identified geological units present across and adjacent to the mine site to confirm existing groundwater flow patterns and monitor drawdown impacts;
>
> c) Identification of groundwater drawdown level thresholds for monitoring the impacts to Groundwater Dependant Ecosystems (including spring complexes and Carmichael River alluvium);
>
> d) Monitoring of aquifers in the area to the south of the mining lease that may affect the Mellaluka springs;
>
> e) Identify and refine potential impacts on groundwater levels in the Great Artesian Basin Clematis Sandstone and Dunda Beds geological units;
>
> f) Estimation of groundwater inflow to mine workings and surface water ingress to groundwater from flooding events using the groundwater model;
>
> g) Monitoring in any identified source aquifers for alternative water supplies, relevant to any approval issued under the Water Act 2000 for the project;
>
> h) Monitoring of geological units throughout all phases of project life including for the period post-closure in accordance with Appendix 1;
>
> i) Identifying monitoring bores that will be replaced due to mining activities; and
>
> j) To ensure all potential groundwater impacts from mine dewatering and mine water and waste storage facilities (artificial recharge) are identified, mitigated and monitored.[589]

[589] Exhibit 6b; SP001.17 (Draft Environmental Authority) soft page 12.

507. A number of aspects of this condition undermine any confidence that might be had in its capacity to address substantive issues with the groundwater impact assessment or the impacts themselves:

(a) The GMMP must be provided to the administering authority (**AA**) for approval at least 30 days prior to commencing any mining activities associated with box cut excavation, in line with Condition E3. However, the condition gives no indication of:

(i) when any of the listed objectives proposed to be achieved under the GMMP are supposed to be achieved; or

(ii) when any of the presently undefined action to achieve these objectives will be taken.

(b) The GMMP is supposed to be developed to ensure that some undefined "plan" will achieve the objectives. The lack of clarity around the plan that is supposed to achieve the objectives is concerning.

(c) As the evidence has borne out, a number of the objectives supposed to be achieved under the GMMP are fundamental to understanding the extent of the mine's impacts, particularly on the Doongmabulla Springs, and should have been dealt with in the impact assessment process, in particular:

(i) The requirement at (b) for monitoring to understand groundwater flow patterns;

(ii) The requirement at (c) to identify groundwater drawdown level thresholds for monitoring the impacts to the Doongmabulla Springs; and

(iii) The requirement at (e) to identify and refine potential impacts on groundwater levels in the GAB.

(d) The requirement at (j) to "ensure all potential groundwater impacts ... are identified, mitigated and monitored" is – to put it most generously – aspirational and non-specific:

(i) Potential groundwater impacts should already have been identified, such that they could be considered in the impact assessment and by this Court.

(ii) It includes a baseless assumption that any presently unidentified impacts can be mitigated. There is certainty no evidence before this Court that any substantial drawdown impacts on the Doongmabulla Springs can be mitigated. In fact, there is evidence to the contrary:

(A) Counsel for the Applicant put to A/Prof Webb that:

> Q: Draft condition E4, I suggest to you, therefore ensures Adani's groundwater management and monitoring program will ensure that de-watering of the springs, no matter what their source aquifer, will be monitored and appropriately mitigated?
>
> A: My worry was the word "mitigated", because I'm not sure how that

would actually occur.[590]

(B) Further relevant evidence was given by A/Prof Webb in re-examination:

> My worry is that all the monitoring and additional modelling requirements are very good, but if I'm right and the mine de-waters the Colinlea Sandstone, and that is feeding the springs, and they will dry up and I don't see any way that that can be easily mitigated.[591]

(e) Irrespective of A/Prof Webb's concerns, the mere existence of the condition E4 clearly does not ensure an outcome, as suggested by the Applicant. It requires that the GMMP be developed to ensure that some undefined "plan" achieves certain outcomes. It is questionable whether those objectives are in fact achievable.

(f) More generally, such an ill-defined plan, required to be prepared as a condition of the approval under the Draft EA, should not be considered the appropriate instrument to identify "all potential groundwater impacts". Groundwater impacts must be identified before a proper assessment can be made and an approval granted.

Condition E6

508. Condition E6 states:

> The numerical groundwater model in the reports titled "Carmichael Coal Mine and Rail Project SEIS: Report for Mine Hydrogeology Report (13 November 2013)" and "Carmichael Coal Mine and Rail Project SEIS: Mine Hydrogeology Report Addendum (24 October 2013)" must be reviewed to incorporate groundwater monitoring data and measured mine dewatering volumes from the Groundwater Management and Monitoring Program in condition E4 and E5. The review must be conducted within two years of commencement of any mining activities associated with box cut excavation and at least every 5 years thereafter, or at other intervals specified by the administering authority in writing, if the observed groundwater levels and groundwater flow rates to surface water are not consistent with those predicted by the groundwater model.
>
> The review must provide a revised numerical groundwater model which is based on a transient calibration and includes additional model layers for aquifers below the D seam of the Colinlea Sandstone. The revised model must include:
>
> a) Review of the hydrogeological conceptualisation used in the previous model;
>
> b) An update of the predicted impacts;
>
> c) Revised water balance model;
>
> d) Review of assumptions used in the previous model;
>
> e) Predictions of changes in groundwater levels for a range of scenarios;
>
> f) Information about any changes made since the previous model review, including data changes;
>
> g) A report outlining the justification for the refined model and the outputs of the refined model; ·
>
> h) An evaluation of the accuracy of the predicted changes in groundwater levels, groundwater flow rates to surface water and recommended actions to improve the

[590] Transcript 6-39, lines 1-5.
[591] Transcript 6-66, lines 25-33.

accuracy of the model predictions.[592]

509. Again, the timing of the model review is not confidence building. Reviewing the primary predictive tool for the assessment of groundwater impacts two years after box cut excavation has commenced cannot sensibly be considered a substitute for adequate impact assessment in the first instance.

510. Prof Werner gave the following evidence in respect of the requirement to base future modelling on transient calibration:

> Q: And you accept that the Coordinator-General's conditions do require this?
>
> A: You mean in the future?...
>
> Q: Yes. Is that appropriate, in your view? Two years after mining starts....
>
> A: Two years after mining starts.
>
> Q: Yes?
>
> A: We do a transient calibration to understand the timing of impacts of the mine. Two years after mining starts – I don't know that. You know, like, it's not up to me to say that's right or wrong, necessarily, because I'm not making the decisions based on ecology, economics, social, cultural, and all that. So it's hard for me to say. However, I have a very large red flag that comes up, that you are going to do what is kind of – other people are saying is necessary – two years after you've already committed a huge amount of money to get something done. I mean, I just – I – it's – there's red flags.[593]

511. The same concerns apply to a number of other aspects of the model review, including

(a) the review of conceptualisation;

(b) updated prediction of impacts;

(c) review of water balance model; and

(d) prediction of changes in groundwater levels for a range of scenarios;

512. If Prof Werner's concerns are well founded, which the First Respondent submits they are, the model review may ultimately be a process of demonstrating how much worse the impacts will be after it is too late to address them.

513. Furthermore, Prof Werner and Dr Merrick both consider that the model has too many cells,[594] yet Condition E6 requires additional model layers below the D seam, which could only increase the model size.

EPBC Act Approval conditions

514. The Applicant seeks to rely on conditions that have been imposed under the Federal Government approval issued under the EPBC Act (**EPBC Act Approval**)[595] that require, among other things:

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[592] Exhibit 6b; SP001.17 (Draft Environmental Authority) soft page 13. [*Emphasis added*].
[593] Transcript 9-64, lines 34-11.
[594] Transcript 7-19, lines 4-9; Transcript 8-87, lines 22-25.
[595] Exhibit 22; AA011 (Mr Wilson's Springs Ecology & WCP Expert Report) Attachment 2 – EPBC Act Approval, soft page 54.

(a) the identification of triggers for impacts on groundwater at the Doongmabulla Springs Complex as part of a Matters of National Environmental Significance management plan (Condition 6(f));

(b) provision within the Biodiversity Offsets Strategy (**BOS**) for the potential offsetting of the Doongmabulla Springs (Condition 11(o));

(c) a re-run of the groundwater model (Condition 23);

(d) further research into GAB springs by way of a GAB springs research plan (**GABSRP**) (Conditions 25 and 26); and

(e) further research into the conductivity of the Rewan Formation (Conditions 27 and 28).

Offsetting conditions - 6(f) and 11(o)

515. These conditions, and the BOS as currently drafted, are premised on the impact assessment work done by GHD, which concluded there is no potential for significant impacts to the Doongmabulla Springs.

516. The Applicant's own evidence establishes that at least some of the Doongmabulla Springs will dry up, and there is a real likelihood that the Doongmabulla Springs could dry up completely, in which case the impacts cannot be offset.

517. Mr Wilson made the following observations about the offsetting requirements:

> the offset area management plan actually makes sure they are implemented and they actually do produce what they're required to produce because it sets up objectives and criteria, and if those objectives and criteria aren't met they're aren't actually – if they don't actually accrue - it doesn't actually produce the offsets it's supposed to the offset won't be approved.[596]

518. There is a circularity in Mr Wilson's reasoning. That is, if the objectives and criteria of the offsets plan are not met (i.e. "they don't actually accrue", which cannot be known until after the offsets plan is approved and implemented) then the plan will not be approved.

519. Mr Wilson gave evidence that if the Doongmabulla Springs are fed completely by the Colinlea Sandstone (a Galilee basin aquifer) rather than the Clematis Sandstone (a GAB aquifer) it would no longer be a threatened ecological community (**TEC**) that is a matter of national environmental significance (**MNES**).[597]

520. Mr Wilson's evidence went further to state that, as a consequence, offsetting of wetland values would be less onerous, since any offsets would not be restricted to GAB springs, but nonetheless these springs have exceptional ecological values[598] that could be lost.

[596] Transcript 9-87, lines 33-40.
[597] Transcript 10-4, lines 12-16.
[598] Transcript 10-5, lines 8-11.

521. It is noted again, however, that A/Prof Fensham[599] and Mr Wilson[600] both gave evidence that the exceptional ecological values of the Doongmabulla Springs are principally associated with their high level of endemic, threatened species. The exceptional ecological values of the springs are, therefore, independent of the listing GAB TEC listing.

Groundwater model rerun - Condition 23

522. The Applicant tendered, by consent, late evidence showing that the Commonwealth Department of the Environment (**DoE**) has reviewed the model rerun and found it to have met the requirements of condition 23.[601]

523. Relevantly, the correspondence is dated 17 April 2015, which is the day after Dr Merrick and the other groundwater experts finalised their oral evidence.

524. Condition 23 requires that the groundwater model be rerun to meet, among other things, the following requirements:

(a) review and justify the recharge parameters for the Clematis Sandstone to represent the flux into the recharge beds of the GAB, and modify if required;

(b) document outflow mechanisms used in the model for the Doongmabulla Springs Complex and individual model layers, using maps to show the spatial distribution of model discharges;

(c) document and incorporate known licensed groundwater extractions within the model domain;

(d) as per the IESC information guidelines provide an assessment of the quality of, and risks and uncertainty inherent in, the data used in the background data and modelling, particularly with respect to predicted potential scenarios;

(e) provide adequate data (spatially and geographically representative) to justify the conceptualisation of topographically driven flow from south to north (and west to east) in both shallow and deeper aquifers.

525. The evidence heard by this Court before the date of the correspondence from DoE has demonstrated that significant concerns remain about these very issues, which begs the question how could DoE approve the model given the current state of knowledge.

526. In particular, there is unequivocal evidence that no attempt was made to model the Doongmabulla Spring, yet DoE appears to have been satisfied that the Applicant has documented these non-existent model outflow mechanisms.

[599] Transcript 10-79, lines 37-39.
[600] Transcript 10-20, lines 32-42.
[601] Exhibit 139; Correspondence from Department of Environment to Mr Manzi regarding Condition 23 (Groundwater Model Re-Run) [TBC – Tendered late].

527. Additionally, Dr Merrick raised concerns about the low discharge modelled on account of bore extraction and, in particular, his view that extraction did not include registered but unlicensed bores.[602]

528. It should be of major concern that a further government review and approval has been given without any apparent consideration of the fundamental problems identified by the groundwater expert witnesses in this case.

529. If the Applicant in fact had satisfying answers to all of the issues that Condition 23 required be addressed then it is inconceivable that it would not have provided those answers to its experts to assist the Court with the very issues that were being ventilated in the days before the approval was given.

530. Rather than providing any support for the modelling put forward for the Applicant, this approval gives a further measure of the inadequacy of bureaucratic oversight and assessment of this project – the very oversight that the Applicant relies on so heavily.

Rewan Research Plan (Conditions 27 and 28)

531. Mr Bradley gave evidence that the EPBC Act Approval required "that the properties of the Rewan Formation must be investigated and the Minister must be satisfied that the properties are as – as represented in the model, for example, before the box cut can commence."[603]

532. The conditions relevantly state:

> Rewan Formation Connectivity Research Plan
>
> 27. At least three months prior to commencing excavation of the first box cut, the approval holder must submit for the approval of the Minister a Rewan Formation Connectivity Research Plan ('Rewan Research Plan') that characterises the Rewan Formation within the area impacted by the mine. The Research Plan must include but not be limited to the following:
>
> a) research aims
>
> b) personnel responsible for conducting research and their qualifications
>
> c) timeframes for research and reporting
>
> d) methods, including, but not limited to, seismic surveys to determine the type, extent and location of fracturing, faulting and preferential pathways (including any fracturing induced by longwall mining subsidence) and an examination of the hydraulic properties (including but not limited to petrophysical analysis and facies mapping) of the Rewan Formation, to better characterise the Rewan Formation and the contribution of fracturing, faulting and preferential pathways to connectivity, including a description of how research will be undertaken in a manner that does not cause impacts on Matters of National Environmental Significance (unless the activities will be undertaken in accordance with a plan approved pursuant to conditions of this approval)
>
> e) an explanation of how research will inform the GMMP, any regional groundwater and surface water monitoring and assessment program, or Bioregional Assessment for the Galilee Basin sub-region and the Lake Eyre Basin and any subsequent iterations
>
> f) a peer review of the Rewan Research Plan, by a suitably qualified independent expert, approved by the Minister in writing, and a table of changes made in response to the

[602] Transcript 8-17, lines 18-20; Transcript 8-18, line 7; Transcript 8-17, line 1 to 8-18, line 2.
[603] Transcript 4-71, lines 5-8.

peer review

28. The approval holder must not commence excavation of the first box cut until the Rewan Research Plan has been approved by the Minister in writing. The approved Rewan Formation Connectivity Research Plan must be implemented.[604]

533. Mr Bradley's interpretation of condition 28 is wrong and the conditions do not satisfactorily resolve the demonstrated uncertainty regarding potential impacts on the Doongmabulla Springs:

(a) Condition 28 requires only that the Minister approve the Rewan Research Plan before box cut commences.

(b) Investigation into the type, extent and location of fracturing, faulting, preferential pathways and the hydraulic properties of the Rewan Formation will be required under the Rewan Research Plan, but the conditions give no indication that these investigations will be complete within any particular timeframe.

(c) In fact, the conditions allow for mining to commence after the plan is approved, which implies that the investigations required to be conducted under the Rewan Research Plan will not be complete until some time after mining commences and impacts on the Doongmabulla Springs may already have been realised.

(d) Such an approach is inappropriate and ineffective in the present circumstances, where there is a real likelihood of serious environmental harm before the necessary investigations can be made.

534. The extensive requirements under this condition simply serve to highlight the inadequacy of the assessment done to date.

GAB springs research plan (Conditions 25 and 26)

535. The GABSRP requires, among other things:

(a) analyse potential mitigation activities, such as but not limited to, re-injection to the groundwater source aquifer to maintain pressure head, flows and ecological habitat at the Doongmabulla Springs Complex;

(b) explain how research outcomes will directly inform the monitoring, management, prevention, mitigation and remediation of impacts on the Doongmabulla Springs Complex; and

(c) identify priority actions for potential offsets to protect and manage the GAB springs.

536. With respect to the likely success of this kind of mitigation planning, A/Prof Fensham gave evidence about the limited success in previous attempts to mitigate loss of spring flow or address loss of springs:

Q: But, in any event, you could also return water to the GAB to help GAB springs?

[604] Exhibit 68; AA036 (GHD Report - Response to Federal Approval Conditions - Groundwater Flow Model – November 2014) soft page 149.

A: I don't know that that's so feasible. We've spent $300 million on the Great Artesian Basin Sustainability Initiative, which is about capping these free flowing bores that were put down in the 19th century, and try to restore aquifer pressure, and restore life to the springs. That's been going for 30 years, so we've had a reasonable time to assess its success. It's been very successful in restoring pressure to the GAB, but there's paltry evidence, if any, that I can think of that that's generated any benefits for increased flows to the existing springs, and there's no evidence that any of the inactive springs have been reactivated by that effort.[605]

537. A/Prof Fensham gave further evidence about the utility of research funding:

Q: Mitigation of impacts can also include providing money for research – and that's quite a proper mitigation method, isn't it?

A: I'm not terribly encouraged by it. It's –it's, like, kind of, saying, like, here's something we don't know how to do that's – that's – so here – here's – we don't know how to provide effective offsets for the springs organisms, let's give someone from – some money – possibly me – to try and work out how to do that. You know, it's somewhat of a poisoned chalice. I might not be able to do it. I'm not invincible. It might be very difficult.

Q: That might be so, but it's better than doing nothing, isn't it, surely?

A: It's probably better for me – maybe only marginally better for prospects for the spring organisms, yeah.[606]

538. Again, the condition 26 only requires that the plan be approved by the Minister before mining commences.

Impacts and offsets

539. It is agreed between the parties that the impact on ecological values of the Doongmabulla Springs is necessarily based on an assessment of the predicted change in flow rates.[607]

540. On the basis of the above discussion, it is submitted that even on the Applicant's own assessment of drawdown, there is a high likelihood that many if not most of the Doongmabulla Springs will dry up completely.

541. If any of the further scenarios is accepted by the Court, based on the evidence of Prof Werner or A/Prof Webb, then the position only gets worse for the Applicant.

542. Even so, there was evidence given about the possibility of offsetting any loss of ecological values at the Doongmabulla Springs caused by the mine.

543. However, it is notable that the BOS prepared for the Applicant does not in fact propose any offsets for the Doongmabulla Springs because of its misplaced confidence in the erroneous conclusion that there will be limited if any impact of this mine on the springs.

544. Any requirement for offsetting the impacts on Doongmabulla Springs is conceived in this case as being a consequence of either:

[605] Transcript 10-76, lines 16-24.
[606] Transcript 10-76, lines 33-43.
[607] Exhibit 21; JR005 (Springs Ecology Joint Experts Report), soft page 5, lines 175-176.

(a) A partial loss of spring flow; or

(b) A complete loss of spring flow.

Partial loss of spring flow

545. Dr Merrick gave evidence that the height of the potentiometric head driving flow at springs, and hence the amount of drawdown required to cause the spring to stop flowing:

(a) is different for each spring; and

(b) is not known for the Doongmabulla Springs.[608]

546. In addition to the different and unknown susceptibility of each spring to drawdown impacts, Mr Wilson acknowledged in his evidence in chief that the different springs have different ecological values:

> Well, you'd have to find out which spring was sourced by which, and which spring was going to be impacted, because they all have – they actually have different values.[609]

547. Mr Wilson's opinion, as stated at the time of the Springs Ecology JER, is that:

> … enhancing existing values at another spring site may be able to provide equivalent values that could be used to offset specified impacts at the Doongmabulla Springs."[610]

548. Mr Wilson subsequently gave evidence that the predicted impacts on the springs, in terms of the likely reduction in the area of the springs, is "small, almost not significant", and on that basis that the loss of values at Doongmabulla "could be readily offset".[611] Critically, however, Mr Wilson's calculations of the reduction in spring flow, and the commensurate reduction in spring area and the loss of values, assumes the percentages proffered by Dr Merrick represent a percentage reduction in spring flow which the evidence shows they do not.[612]

549. Mr Wilson noted the likely difficulty in offsetting some of the species endemic to GAB springs that are present at Doongmabulla Springs:

> You'd still have problems offsetting some of those species, particularly the ones – without going into names – some of them are only found at one other location, so there's just very limited opportunity to offset them. Some of the others are found at a few other locations, so you could, at least, partially offset them.[613]

550. Mr Wilson proposes that translocation of some species – that is, the introduction of a species to a location (spring) that is not habitat for that species – would be a necessary component of offsetting for some species:

> And there would – there would have to be – given the limited extent of some of those species, you would have to look at artificial translocation, because, really, there's no

[608] Transcript 10-12, line 46 to 10-13, line 4; Transcript 4-51, lines 32-33.
[609] Transcript 10-5, lines 4-6.
[610] Exhibit 21; JR005 (Springs Ecology Joint Experts Report) soft page 5, lines 190-192. [*Emphasis added*].
[611] Transcript 9-85, lines 20-26.
[612] Transcript 9-85, line 21.
[613] Transcript 10-4, lines 22-26.

other option, even though that's always a last resort.[614]

551. However, A/Prof Fensham gave evidence that:

(a) He would not advise anyone to "waste their time" trying to establish endemic species on springs that don't already host them, like Joshua Spring and Little Moses.[615]

(b) Attempts to reconstruct habitat in the wild have failed.[616]

552. It was put to A/Prof Fensham that it is not impossible that Joshua Spring might provide an offset area for endemic species:

> A: I think I'd have to agree with Mr Wilson that – well, it's not going to be an easy job … And beyond that, even if those things were in – aligned for potentially restoring spring wetland habitats, it is – it's a hypothetical journey because we haven't actually – no one's actually tried to do it or successfully demonstrated any success. Yeah.
>
> Q: That's not saying it can't be done. It's just that it's difficult?
>
> A: Yeah. Well, we don't know if it can be done. Yeah.
>
> Q: There's lots of things we don't know?
>
> A: Mmm.
>
> Q: But **you're always hopeful, aren't you**?
>
> A: Well, yeah.[617]

553. There is nothing in the evidence that can give the court confidence that species translocation or habitat recreation will provide successful offsets.

554. The evidence does make clear that:

(a) There is limited knowledge about both the susceptibility of the individual springs to loss of spring flow and the values of those springs most susceptible;

(b) Mr Wilson's earlier evidence about the potential to offset impacts was based on a substantial misunderstanding and underestimate of the likely impacts; and

(c) A/Prof Fensham has limited confidence in the potential to offset or mitigate the impacts of the mine in the Doongmabulla Springs.

555. It is submitted that the Applicant's "hopeful" approach to offsetting the impacts predicted under its own modelling cannot be accepted by the Court.

[614] Transcript 10-4, lines 41-44.
[615] Transcript 10-73, lines 25-28.
[616] Transcript 10-73, line 38 to 10-73, line 2.
[617] Transcript 10-72, line 47 to 10-73, line 15.

Total Loss of Springflow

556. There is no dispute that if the Doongmabulla Springs run dry, either permanently or temporarily, the endemic species will not survive and will become extinct from the site.[618]

557. The spring ecologists agree that the Doongmabulla Springs cannot be offset in its entirety:

(a) Mr Wilson gave the following evidence in chief:

> Q: And if in fact the whole – the entire Doongmabulla springs complex was drawn down 100 per cent, you say it would be difficult to find an area, but can you – can the impacts be addressed, and do you discuss that at your page 11?
>
> A: Page 11. If the whole area was dewatered, all the values would be lost from the site, and I basically say the ten hectares, there would – in theory, you could offset it if you could find other areas that were equivalent and carry out maintenance, but because the area of Doongmabulla is so large and there's so many – there's six species that just aren't found in great numbers anywhere else, in practical terms, you cannot find an equivalent area…. Because it's such a large proportion of the total area of springs in Queensland.[619]
>
> …I've already said I don't think you can offset the springs – the entire springs.[620]
>
> …there just aren't enough existing populations to offset the size of the Doongmabulla habitat.[621]

(b) A/Prof Fensham's view, as stated in the Springs Ecology JER, is that it is not feasible to offset the complete loss of the Doongmabulla Springs.[622]

Precautionary principle

558. As noted earlier, at [27]-[31], the EPA requires this Court to apply the precautionary principle in making decisions as one of the principles of environmental policy as set out in the IGAE.[623]

559. The precautionary principle applies where:

(a) there is a risk of serious or irreversible environmental harm; and

(b) there is uncertainty regarding the nature or scope of the environmental harm.[624]

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[618] Exhibit 21; JR005 (Springs Ecology Joint Experts Report) soft page 5, lines 166-167.
[619] Transcript 9-85, lines 28-39. [*Emphasis Added*].
[620] Transcript 9-87, lines 20-21.
[621] Transcript 10-4, lines 45-46.
[622] Exhibit 21; JR005 (Springs Ecology Joint Experts Report) soft page 5, line 178-179.
[623] *De Lacey v Kagara Pty Ltd* [2009] QLC 77, [172]–[177].
[624] *Telstra Corp Ltd v Hornsby Shire Council* (2006) 67 NSWLR 256, [128] (**Telstra**). The operation of the precautionary principle, where it applies, has not been expressly considered by the Supreme Court of Queensland. That said, the principle has been taken into account in a number of recent decisions of this Court including *De Lacey v Kagara Pty Ltd* [2009] QLC 77, [172]–[177]; *Dunn v Burtenshaw* [2010] QLC 70, [33]; *Xstrata* case [2012] QLC 13, [253] and [256]; *Gregcarbil Pty Ltd v Backus & Ors (No. 2*) [2013] QLC 46, [192]; *Alpha* case [2014] QLC 12 at [70], [197] & [396].

560. In this case, those criteria are clearly satisfied:

(a) Loss of the Doongmabulla Springs as a consequence of dewatering for the mine is environmental harm which is both serious and irreversible, with potential impacts on people and communities which rely on that water; and

(b) the state of the evidence on groundwater can only leave this Court with uncertainty regarding likely future impacts.

561. The only appropriate precautionary response is to recommend that the application be refused:

(a) Once the precautionary principle is engaged, the decision-maker should take steps to avoid the feared environmental harm.[625]

(b) Whatever steps are taken should be proportionate to the risk feared.[626]

(c) Given the lack of credible information on impacts, refusal is the appropriate response here:

(i) uncertainty is 'part and parcel' of groundwater impact assessment. Nonetheless, there are degrees of uncertainty;[627]

(ii) here, the nature of extent of the inadequacies of the predictive modelling and consequential uncertainties regarding groundwater impacts mean that the Court simply cannot assess what the impacts from Carmichael will be; and

(iii) in those circumstances, the only appropriate response is to recommend refusal.

(d) There is no satisfactory alternative to recommending refusal:

(i) In this case, an adaptive management approach is unsuitable:

(A) In some circumstances, an adaptive management approach can be used to address uncertainty, by providing for monitoring of impacts and responding if problems are detected as part of the conditions attaching to any approval.[628]

(B) That approach is inappropriate in this case:

(1) To be effective, an adaptive management approach must rely on baseline data that allows a decision-maker to have confidence that the desired outcome can be achieved.[629]

(2) Here, there is no adequate baseline assessment of impacts and so

[625] *Telstra*, [128].
[626] *Telstra*, [166] – [167].
[627] *Cox v Southern Rural Water* [2009] VCAT 1001, [39].
[628] *Telstra*, [163].
[629] *Newcastle & Hunter Valley Speleological Society Inc v Upper Hunter Shire Council and Stoneco Pty Limited* [2010] NSWLEC 48, [184].

the Court cannot have the required confidence.[630]

(ii) Nor can the Court simply rely on the possibility of future investigations, management plans and potential offsetting to address the risk of adverse impacts.

(iii) The impacts of Carmichael will effectively last forever, particularly the loss of groundwater through interception by the final void, which will be permanent.

562. Accordingly, the appropriate precautionary response to the lack of certainty over groundwater impacts is to recommend refusal.

WAXY CABBAGE PALM

Contribution of Doongmabulla Springs to Carmichael River base flow

563. As with the issue of the impact of the mine on the Springs Ecology of Doongmabulla Springs, the impact of the mine on the Waxy Cabbage Palm depends in large measure on the groundwater evidence. This is because the permanence of the base flow in the Carmichael River derives from the Doongmabulla Springs. If the Doongmabulla Springs dry up then the flow of the Carmichael River will be (at least) heavily impacted.

564. While there is a lack of data on flow in the Carmichael River, discussed below at [570], the Applicant's regional groundwater expert, Mr Bradley, accepted that the Carmichael River downstream of the point of the Doongmabulla Springs has permanent base flow (it is not just an ephemeral stream) and that is caused by outflow from the Doongmabulla Springs.[631]

Agreement on significance of Carmichael River population

565. The Waxy Cabbage Palm experts, Mr Wilson and Dr Olsen, agreed that:

(a) The Waxy Cabbage Palm is very rare and is found only in the Burdekin River catchment from the Carmichael River to the environs of Charters Towers;[632]

(b) The Carmichael River population is the largest single known population of Waxy Cabbage Palm;[633]

(c) The Carmichael River population is the most significant population in the world.[634] It is an "important population" because:

(i) The Waxy Cabbage Palm is a vulnerable species;

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[630] Compare *SHCAG Pty Ltd v Minister for Planning and Infrastructure and Boral Cement Limited* [2013] NSWLEC 1032. In that case, the NSW Land and Environment Court refused to accept a water management plan (WMP) as creating adaptive management regime 'as there remain significant uncertainties and undefined parameters due to a lack of baseline data on the groundwater and river water quality issues': [86].
[631] Transcript 4-67, lines 5-11.
[632] Exhibit 24; JR001 (WCP Joint Experts Report) lines 174-177.
[633] Exhibit 24; JR001 (WCP Joint Experts Report) lines 179-184.
[634] Exhibit 24; JR001 (WCP Joint Experts Report) line 184.

(ii) The Carmichael River population is considered "necessary for the species long-term survival and recovery, necessary to maintain a genetic diversity, near the limits of the species range and habitat critical to the survival of the species".[635]

Photo: Carmichael River – Waxy Cabbage Palms[636]

Critical uncertainty and lack of information on impact of loss of base flow

566. Both Mr Wilson and Dr Olsen witnesses agreed that if the hydrogeological conditions in the Carmichael River are adversely impacted by the proposed mining activity there is a likelihood of a significant impact on at least parts of the Carmichael River population.[637]

567. Importantly, both witnesses agreed that there is a lack of scientific knowledge about the nature of the relationship between the Waxy Cabbage Palm and hydrogeological conditions.[638]

568. A key difference in the expert evidence from Mr Wilson and Dr Olsen was that Mr Wilson expressed the view that the Waxy Cabbage Palm population on the Carmichael River was unlikely to be "solely reliant on base flows" along the river derived from the Doongmabulla Springs Complex[639] and that "palms located more than a few metres

[635] Exhibit 24; JR001 (WCP Joint Experts Report) lines 184-189.
[636] Exhibit 11, OL018 (Ms William's Affidavit) soft page 13.
[637] Exhibit 24; JR001 (WCP Joint Experts Report) line 313.
[638] Exhibit 24; JR001 (WCP Joint Experts Report) line 332.
[639] Exhibit 22; AA011 (Mr Wilson's Springs Ecology & WCP Expert Report) lines 449-450.

from the river do not have access to base flow".[640] This meant that, in Mr Wilson's opinion, only a small number of palms in the Carmichael River population, would be impacted by the relatively small changes in water table and base flow predicted in the SEIS.[641]

569. Mr Wilson's opinion was crucially flawed, however, due to his misunderstanding of the likely role of base flow from the Doongmabulla Springs in the Carmichael River downstream of the springs, and his failure to appreciate the gaps in information regarding base flow from the springs in this section of the Carmichael River. He expressed an unwarranted certainty in his expert report about the relationship between the palms and base flow in the Carmichael River.[642]

570. While Mr Wilson did not note the limitations on the data he relied upon for determining flows in the Carmichael River in his report, in cross-examination he conceded that:

(a) The only actual data of flow in the Carmichael River was from two surface water monitoring stations which were established as part of the EIS within the study area on the Carmichael River: one close to the upstream boundary of the lease, station number 333301, and one approximately midway between the upstream and downstream boundary of the lease, station number 333302.[643]

(b) These stations provided information on surface water levels and estimated flows, but the upstream gauge only operated for seven months between July 2011 and 4 February 2012.[644]

(c) That seven months of data for the upstream gauge is an incredibly short period for such a highly variable system and more information to verify the flows is definitely required.[645]

(d) The large adult palms that are the "backbone of the population" take 20 years to mature and would have been present during the massive drought that Queensland experienced in 2004 to 2008, but Mr Wilson had no knowledge or data on what the Carmichael River was doing at that time.[646]

(e) From the upstream gauge, average water levels suggest gaining conditions (where the river is "gaining" water from the surrounding area in addition to base flow coming from upstream) but "for large parts of the year indicating periodic losing conditions".[647]

(f) While Mr Wilson's views were based on average flows, the fact that the Carmichael River experiences losing conditions for large parts of the year is potentially very significant. For instance, in dry periods it would mean the water

[640] Exhibit 22; AA011 (Mr Wilson's Springs Ecology & WCP Expert Report) lines 465.
[641] Exhibit 22; AA011 (Mr Wilson's Springs Ecology & WCP Expert Report) lines 523-529.
[642] Exhibit 22; AA011 (Mr Wilson's Springs Ecology & WCP Expert Report) lines 484-501.
[643] Transcript 11-35, lines 10-30.
[644] Transcript 11-35, lines 10-30.
[645] Transcript 11-37, lines 5-8.
[646] Transcript 11-38, line 13.
[647] Transcript 11-40, line 45 to 11-41, line 15.

flow that is coming in from the river is actually feeding into the surrounding watertable.[648]

(g) The Carmichael River around the upstream gauge experiences losing conditions "towards the end of the dry season",[649] which Mr Wilson both accepted was "critical"[650] while maintaining it did not affect his opinion.

(h) Mr Wilson ultimately agreed that the base flow in the Carmichael River was significant for surrounding water table levels (on which he viewed the majority of the Waxy Cabbage Palm population as depending) and that the two were "tightly correlated".[651]

571. Despite the lack of reliable data on base flows from the Doongmabulla Springs in the Carmichael River and the role of these flows in supporting the Waxy Cabbage Palm population on the river, Mr Olsen put it succinctly in answer to a question about the distribution of the palm in re-examination:

> So Given the distribution of the waxy cabbage palm along the Carmichael River, what does that tell you, as an ecologist, about the relationship between that population and the Doongmabulla Springs Complex?---It tells me if you turn – pardon the lay-person analogy – but if you turn the Doongmabulla Springs off, as is suggested by Drs Werner and Dr Webb, you will have a population structured very similar to that between Belyando Crossing and the east – the end of the population just east of the mining lease. In other words, there'll be no palms.[652]

572. The impacts of the mine on the Waxy Cabbage Palm can, therefore, be viewed as joined at the hip to the impacts of the mine on groundwater supply to Doongmabulla Springs. The grave uncertainty regarding these impacts raised in the evidence of A/Prof Webb and Prof Werner applies equally to the potential impacts of the mine on the most globally important population of the Waxy Cabbage Palm on the Carmichael River.

Sufficiency of offsets for impacts on Waxy Cabbage Palm

573. A key difference in the expert evidence also involved the sufficiency of the proposed "offsets".

574. This was one of the three issues in this case that raised the issues of offsets (the others are the Black-throated Finch and Springs Ecology).

575. As the Court is aware, offsets are proposed when environmental harm cannot either be avoided or minimised to an acceptable level.

576. The fundamental problem for the Applicant in relying on offsets in this case is the absence of information. In each area where offsets arise (the Waxy Cabbage Palm, the Black-throated Finch and Springs Ecology) there is a dearth of information about one or more of:

[648] Transcript 11-41, lines 15-20.
[649] Transcript 11-41, line 45.
[650] Transcript 11-42, line 13.
[651] Transcript 11-43, lines 23-24.
[652] Transcript 11-88, lines 34-40.

(a) the environmental values of the impacted environment;

(b) the level and risk of environmental harm; and

(c) the capacity of offsets to meet the predicted harm.

577. Importantly, in each of these areas, this knowledge gap has only become obvious as a result of the joint expert processes in this case. This Court is much better informed about the weaknesses in the Applicant's work in these areas than previous decision-makers have been.

578. In any event, a core requirement of offsets at both a State and Federal level is that offsets must result in an overall conservation outcome that improves or maintains the viability of the aspect of the environment affected by the proposed outcome.

579. As a result of the knowledge gap identified above there is insufficient evidence to permit offsets to be used with anything approaching confidence in an outcome that maintains or improves the affected environmental values.

580. The Applicant has proposed offsetting environmental harm by improving the management of areas along the Carmichael River or its tributaries that are already owned by the Applicant.

581. The improved management is said to involve improving the impacts of "weed infestation, feral pigs, cattle and bush fire".[653]

582. Dr Olsen's opinion is that the proposed offsets are incapable of replacing the environmental values lost if there is a significant impact on the Carmichael River population. This is essentially for two reasons.

583. **First**, the populations of Waxy Cabbage Palms already in the offset areas are not as large, nor do they have the same population structure, as the more significant population. There is nothing to suggest any innate capacity for population growth.

584. **Second,** there is no meaningful evidence that any current population of Waxy Cabbage Palm is negatively affected by any of the factors to which improved management will be addressed. In consequence, the proposed management activities will not improve the values of the habitat proposed to offset the loss.

585. In short, Dr Olsen's evidence is that "there is no evidence to suggest that the populations in the proposed offset area are capable of population increase in any circumstance, altered management or otherwise".[654] If the Court accepts that evidence, then it cannot be satisfied that offsets will replace the values lost.

586. Further, and most obviously, the proposed offset areas are themselves associated with the Carmichael River. Any major change to the hydrogeology of the Carmichael River is just as likely to affect those areas as it will the current population.

[653] Exhibit 6; MR162 (SEIS, Volume 4, Appendix J4 - Report for Population Survey of Waxy Cabbage Palm (16 July 2013)), p iii.
[654] Exhibit 26; OL016 (Dr Olsen's WCP Expert Report) para 21.

587. As importantly, Dr Olsen explained that the lack of knowledge about the unique relationship between the Waxy Cabbage Palm and the hydrogeological regime in the Carmichael River population makes it impossible to proceed with offsets without breaching the precautionary principle.

BLACK-THROATED FINCH (BTF)

Figure 3-2 (BTF records within poorly surveyed parts of the mine site) in Exhibit 31; OL024 (Mr Agnew's expert report) p 14.

Overview

588. The experts agree that the population of Black-throated Finch (southern) (**BTF**) on the MLA, Moray Downs and wider landscape, is the most significant and largest population in the world, and that the area surrounding 10 Mile Bore supports habitat that is critical for the species' survival.

589. If the Court recommends this mine be approved, there is no doubt that this will result in the destruction of key critical habitat.[655] It is this habitat that supports what is now believed to be a core population of BTF, and an area that provides an important function in sustaining that population.

590. The evidence demonstrates that there remain profound uncertainties and insufficient information for the Court to have any confidence in whether granting approval of this mine will not fast track the BTF's trajectory towards extinction. Furthermore, the Court

[655] Transcript 13-22, lines 21-28; Exhibit 27; JR002 (First BTF Joint Experts Report) p 11, para 6.2.6.

cannot have any confidence in aspirational conditions, nor rely on the offsets proposed without a proper understanding of the values being lost.

591. In the absence of knowledge about the BTF itself and the reasons for its reliance on this core habitat, coupled with the inadequacy of the Applicant's survey efforts to date, both on the MLA and in the proposed offset areas, the Court should exercise extreme caution when making its final decision consistent with the precautionary principle.

BTF listing as an endangered species and known range

592. The **BTF** is listed as an endangered species under both the *Environment Protection and Biodiversity Conservation Act* 1999 (Cth) (**EPBC Act**) and the *Nature Conservation Act* 1992 (Qld). Other than being listed as "extinct" or "extinct in the wild", the only higher category of threatened species is "critically endangered". A lower category is "vulnerable" species. The seriousness of listing as an "endangered" species is evident from considering the criteria for listing as a critically endangered, endangered or vulnerable species under the EPBC Act are stated in r 7.01 of the *Environment Protection and Biodiversity Conservation Regulations* 2000 (Cth), which are as follows:

Item	Criterion	Category Critically endangered	Endangered	Vulnerable
1	It has undergone, is suspected to have undergone or is likely to undergo in the immediate future:	a very severe reduction in numbers	a severe reduction in numbers	a substantial reduction in numbers
2	Its geographic distribution is precarious for the survival of the species and is:	very restricted	restricted	limited
3	The estimated total number of mature individuals is: and:	very low	low	limited
	(a) evidence suggests that the number will continue to decline at: or	a very high rate	a high rate	a substantial rate
	(b) the number is likely to continue to decline and its geographic distribution is:	precarious for its survival	precarious for its survival	precarious for its survival
4	The estimated total number of mature individuals is:	extremely low	very low	low
5	The probability of its extinction in the wild is at least:	50% in the immediate future	20% in the near future	10% in the medium-term future

593. The BTF's range once extended from northern NSW through eastern Queensland to Cairns in the north.[656] Its population has reduced by 80% since at least the early 1980s[657] and, as the criteria for its listing as an endangered species reflect, the number of mature

[656] Transcript 13-11, lines 44-45; Exhibit 31; OL024 (Mr Agnew's BTF Expert Report) Attachment C, Vanderduys et al (2015) soft page 50, lines 84-86;
[657] Exhibit 27; JR002 (First BTF Joint Experts Report) p 11, para 6.3; Exhibit 31; OL024 (Mr Agnew's BTF Expert Report) Attachment C, Vanderduys et al (2015) Paper, soft page 50, lines 64-66 and soft page 59, line 227.

adults is likely to continue to decline in its geographic distribution and is "precarious for its survival."[658]

594. The BTF is now extinct south of the Burdekin River and is confined to very few remaining pockets of suitable habitat. The BTF experts, Mr Adrian Caneris for the Applicant, and Mr Lindsay Agnew for the First Respondent (**BTF experts**), have agreed that:

(a) There has been a significant reduction in its known range;[659]

(b) The species is at a high risk of extinction;[660]

(c) The BTF is likely to be extinct in New South Wales;[661] and

(d) There are only two populations of BTF left in the world:

(i) Townsville; and

(ii) in the landscape that encompasses the mining lease area (MLA), particularly the Moray Downs property.[662]

Significance of this population

595. While the Townsville population was until recently considered to be the finch's stronghold,[663] it is now clear that the population on the MLA, Moray Downs and near surrounds, is the most significant and largest population in the world.[664] The area surrounding 10 Mile Bore supports habitat that is "critical for the species survival".[665]

596. It was only as a result of the two BTF experts' involvement in this case that the size and significance of the population on the MLA and near surrounds became clear.[666] All of the claimed work done by GHD on behalf of the Applicant had failed to properly recognise the significance of this population.

597. From the outset, the BTF experts were in agreement that none of the Applicant's reporting provided a sufficient assessment of the site's BTF population or of the BTF habitat values in a regional context.

[658] *Environment Protection and Biodiversity Conservation Regulations* 2000 (Cth), r 7.01.
[659] Exhibit 27; JR002 (First BTF Joint Experts Report) p 11, para 6.3.1.
[660] Transcript 13-12, lines 7-9.
[661] Transcript 14-17, lines 45-46.
[662] Exhibit 28; JR009 (Second BTF Joint Experts Report) Attachment 3 – BTF Recovery Team letter to Lindsay Agnew, soft page 27 and 29.
[663] Transcript 13-14, lines 19-23.
[664] Transcript 13-22, lines 21-32, Transcript 13-23, lines 19-24; Exhibit 27; JR002 (First BTF Joint Experts Report) p 10, para 6.2.6.
[665] Transcript 13-13, lines 23-26; Transcript 13-22, lines21-45; Exhibit 27; JR002 (First BTF Joint Experts Report) p 10, para 6.2.6.
[666] Transcript 13-16, lines 22-24.

598. These criticisms were centred around the failure of the Applicant's reporting to review a variety of publicly available resources or to seek and consider evidence of anecdotal sightings recorded by others.[667]

599. In response to requests from the BTF experts additional material was provided by the Applicant on 13 February 2015.[668] Mr Agnew also sought and obtained further data from the BTF Recovery Team. A summary of this data is presented in the Second BTF Joint Experts Report (**BTF JER2**).[669]

600. The BTF JER2 provides a table of a comparison between the key data provided by the Applicant in the EIS, SEIS and AEIS (**EIS Documents**) and the additional BTF records.[670] This relatively easily accessed data had not been incorporated into any of GHD's analysis. As a result, it had not been considered by any previous decision maker. The table demonstrates starkly just how much information had been previously excluded.

Table 1 (Comparison of key data parameters of existing and additional BTF records) from Exhibit 28; JR009 (BTF JER2) p 7

Key BTF Record Parameters	Applicant's BTF Records (within reporting)	Additional BTF Records (not within reporting)
Number of BTF record observations	**125**	**40**
Cumulative Total of BTF recorded	**1025**	**1019**
Number of flocks >30 BTF recorded	**9**	**7**
Number of flocks >50 BTF recorded	**0**	**5**
Number of flocks >100 BTF recorded	**0**	**At least 3**

601. As a result of this additional material, the BTF experts were able to state with increasing confidence that the population of BTF found in the northern part of the MLA was the most significant population anywhere, in contrast to their previous view that the Townsville population was still considered to be the most significant population.[671]

602. The Applicant's own expert, Mr Caneris, confirms that this additional information helped in making a qualitative assessment of the respective populations. The result is that the population of BTF on Moray Downs is now likely to be the most significant population.[672]

[667] Exhibit 28; JR009 (Second BTF Joint Experts Report) p 14, para 7.1.
[668] Exhibit 28; JR009 (Second BTF Joint Experts Report) p 6, para 4.1.
[669] Exhibit 28; JR009 (Second BTF Joint Experts Report) pp 4-8. The BTFRT maintains a database of BTF records, which contains nearly 3,000 records and spans the period 1800 to present. A Summary of the data provided by the BTFRT is found in Attachment 1 of Exhibit 28, soft page 23.
[670] Exhibit 28; JR009 (Second BTF Joint Experts Report) Table 1, p 7, para 4.10.
[671] Transcript 13-19, lines 36-45.
[672] Transcript 13-26, lines 10-12.

Significance of sighting downplayed in EIS material

603. The effect of the above analysis is that the EIS Documents gave an impression of the significance of this population that is now known to be wrong.

604. The treatment of the sighting of a flock of more than 400 BTF by Stanley Tang (**Tang sighting**) in the EIS is illustrative of the general approach.

605. In September 2013, James Cook University PhD student, Stanley Tang, sighted a flock of 400 BTF at the 10 Mile Bore site on Moray Downs within the MLA.[673]

606. The Applicant's expert, Mr Caneris, agrees that this sighting is believed to be the biggest reported sighting of BTF and is of great significance.[674]

607. However, the Applicant significantly downplays this sighting:

> The absolute abundance declined, though anecdotally a few weeks prior to our survey, a student (Stanley Tang) from James Cook University, trapped and banded 50 birds, and located a flock of about 100 birds, at 10 Mile Bore. Prior to his successful trapping, he spent a number of days searching for birds and was unable to locate any.[675]

Figure 3-1 (Part of a flock of at least 400 BTF) in Exhibit 31; OL024 (Mr Agnew's expert report) p 10.

[673] Transcript 13-13, lines 40-41.
[674] Transcript 13-13, lines 40-44.
[675] MR186 (AEIS – BTF Monitoring Survey 2 Report (GHD 2014)) soft page 30.

608. When pressed about the EIS description of the Tang sighting, the Applicant's own BTF expert, Mr Caneris, agreed that it would not give its intended reader a sense of the significance of this particular sighting.[676]

609. The Tang sighting was described by Mr Agnew as an "extraordinary number of greater than 400 BTF"[677] that was found on the mine site, and that there was "nothing in comparison to the observations of the larger flocks and the frequency of those observations on the Moray Downs site".[678]

610. Mr Agnew described the significance of the abundance of BTF on Moray Downs from his experience in survey work through the southern parts of the Galilee Basin:

> I've stepped through the detail of my reasoning as to why I don't think there's another population of this significance in the area. There has been a considerable amount of work both in terms of the near surrounds to this property. In addition, the broader landscape. That large lease that I worked on – the southern part of the Galilee Basin is part of the desert up lands. It is part of the formal range of BTF. No birds down there. I know on the next site to the north of the China First site – the Hancock mining lease there's a considerable work put in to target BTF. No birds were found there. But as you move further and further north then all of a sudden the lights start showing up. And all of a sudden you get to a very big light on Moray Downs and it's – it's shining brightly in terms of the abundance, and there is nothing else that we know of in the surrounds of this site that compares with what's on this site.[679]

611. It is now agreed between the experts that the population evident on the MLA, Moray Downs and near surrounds, particularly 10 Mile Bore, supports the most significant and important population of BTF, and constitutes habitat which is critical for the species' survival.[680]

Inadequacies of survey methodologies

612. The Applicant's inadequate BTF survey methodologies undermine the reliability of the EIS and subsequent documents. These inadequate surveys have informed the conditions in both the Draft Environmental Authority and the Coordinator-General Evaluation Report. Assessments undertaken prior to the commencement of these proceedings, based on data now shown to be inadequate and incomplete, should be treated with great caution.

613. The Applicant's own BTF expert, Mr Caneris, has been from the outset of this process, highly critical of the survey methodologies used during the EIS process.

614. Key areas of agreement between the BTF experts include the following:

(a) The baseline information provided in the EIS and subsequent documents is not sufficient to adequately understand the existing values of the site commensurate with the significance of the site's BTF population;[681]

[676] Transcript 13-17, lines 5-20; MR186 (AEIS – BTF Monitoring Survey 2 Report (GHD 2014)) soft page 30.
[677] Transcript 14-5, lines 4-5.
[678] Transcript 14-5, lines 33-34.
[679] Transcript 13-93, lines 9-20.
[680] Transcript 13-22, lines 21-32; Exhibit 27; JR002 (First BTF Joint Experts Report) p 10, para 6.2.6.
[681] Transcript 13-38, lines 25-36; Exhibit 27; JR002 (First BTF Joint Experts Report) p 11, para 6.6.1.

(b) The design and application of the field survey program for the EIS documents was inadequate to properly understand the site usage and site values for BTF, especially with regard to breeding;[682] and

(c) The information provided in the EIS documents cannot be relied upon to confidently assess:[683]

(i) the significance of the potential impacts to the BTF;

(ii) the suitability of proposed mitigation measures; or

(iii) the appropriateness of any offsets.

615. Mr Caneris, during cross-examination, has openly agreed that the "reporting to date only seeks to establish that there is potential to meet the offset requirements."[684]

616. Mr Agnew expressed the view that:

> The current monitoring program is based on a previous design which has been identified as deficient. These deficiencies could only result in a significant constraint to understanding BTF site usage.
> …
> If those survey design deficiencies are to be perpetuated through an on-going monitoring program, it follows that such a program could not be relied upon to adequately detect impacts to BTF.[685]

617. Both of the BTF experts agree that the survey methods used to collect the data do not represent a suitable method to investigate BTF site usage.[686]

No Consistency with Commonwealth Assessment Guidelines

618. The BTF experts agreed in the First BTF Joint Experts Report (**BTF JER1**) that:

> Whilst the Applicant's reporting consistently claims that the 20-minute bird survey is a method "based on" the Commonwealth Government's BTF assessment guideline (DEWHA 2009), that method is not referred to in the national guideline (or any nationally threatened bird species; DEWHA 2010).[687]

619. Mr Caneris clarified in evidence that there is no 20-minute bird survey methodology in the guidelines for BTF and the Applicant's survey methodology is not consistent with the guidelines.[688]

[682] Exhibit 27; JR002 (First BTF Joint Experts Report) p 12, para 6.6.5.
[683] Transcript 13-61, lines 43 to 13-62, lines 1-15; Exhibit 27; JR002 (First BTF Joint Experts Report) p 21, para 6.10.25.
[684] Transcript 13-61, lines 46-47 [*Emphasis added*].
[685] Exhibit 27; JR002 (First BTF Joint Experts Report) p 13, para 6.6.9.
[686] Exhibit 27; JR002 (First BTF Joint Experts Report) p 11, para 6.6.2.
[687] Transcript 13-44, lines 3-12; Exhibit 27; JR002 (First BTF Joint Experts Report) p 12, para 6.6.2.3.
[688] Transcript 13-44, lines 17-22.

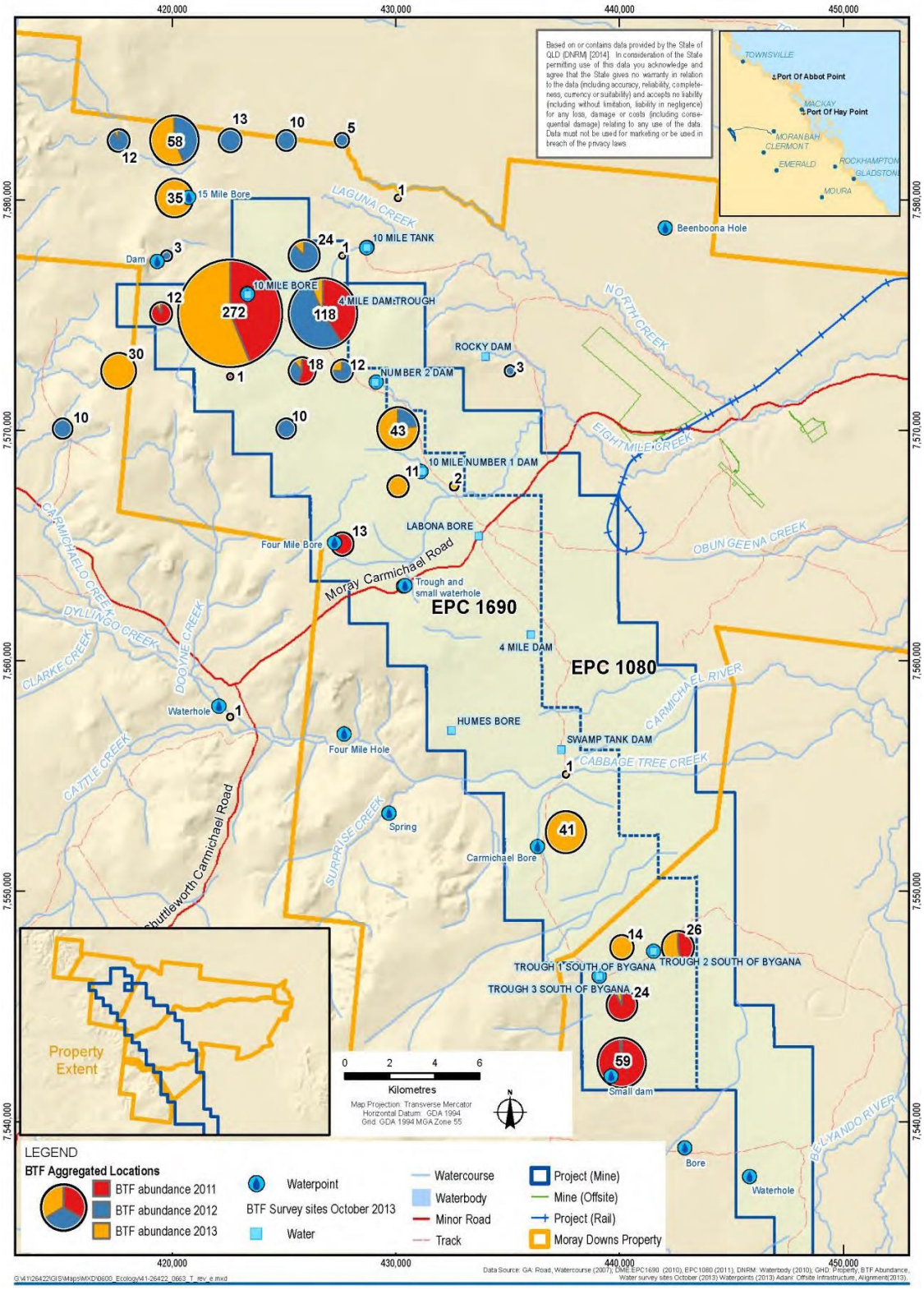

Figure 5.5 (BTF abundance from 2011-2013 BTF surveys)[689]

[689] Exhibit 6a; SP001.12 (Coordinator-General's Report) soft page 84, Figure 5.5 – BTF abundance from 2011-2013 BTF surveys. Note: Locations are mapped as pie charts scaled to the total abundance over time (i.e. the larger the circle the higher the abundance) and split for each year where surveys have occurred.

20 minute/2 hectare rapid surveys are unsuitable

620. The BTF experts agree that the 20-minute/2 ha bird surveys used during site surveys, which are otherwise known as "rapid assessment surveys", whilst having the capacity to provide an overview of the avifauna assemblage using particular habitat area, do not represent a suitable method to investigate BTF site usage.[690]

621. Mr Agnew states that this survey method is only used as a general fauna survey and is not a part of any targeted BTF survey methodology.[691]

622. The abject failure of the survey methodology is made clear in the extent to which the surveys massively underestimated the abundance of the BTF on the MLA. This is true even in the northern part of the MLA where most of the survey effort was directed (see Figure 5.5, above).

Bias towards survey site locations

623. Mr Caneris agrees that there is bias towards survey site locations adjacent to the existing track system, resulting in a noticeable absence of survey coverage across extensive areas of potential BTF habitat through the MLA.[692]

624. In cross-examination, Mr Caneris agreed that this issue represents a significant weakness in the Applicant's assessment of BTF habitat values across the MLA and adjacent areas of the Moray Downs property.[693] He commented that this issue "brings out what's been done to date has been a broad assessment of those values".[694]

625. When pressed, Mr Caneris agreed that, in relation to the Applicant's assessment of BTF habitat values, "it's inadequate to identify the full impact of those habitats."[695]

Water body Survey protocols not followed

626. The BTF experts agree in the BTF JER1 that:

> Whilst the description of [the] survey methodology acknowledges the importance of early-morning surveys and standardised survey protocols, it is apparent that this has not been adhered to in the implementation of this survey approach.[696]

627. This warrants emphasis. GHD described a process for water surveys, failed to follow that process and then failed to acknowledge in its reporting that it had so failed.

628. Mr Caneris and Mr Agnew outlined in the BTF JER1 their concerns about the water body surveys:

> A review of the water body survey data shows 104 surveys have been implemented, with average survey duration (i.e. presence at a water body) of approximately 55 minutes. In

[690] Transcript 13-42, lines 8-12; Exhibit 27; JR002 (First BTF Joint Experts Report) p 11, para 6.6.2.
[691] Transcript 13-84, lines 17-18.
[692] Transcript 13-42, line 46 to 13-43, lines 1-9; Exhibit 27; JR002 (First BTF Joint Experts Report) p 12, para 6.6.2.1.
[693] Transcript 13-43, lines 11-13; Exhibit 27; JR002 (First BTF Joint Experts Report) p 12, para 6.6.2.1.
[694] Transcript 13-43, lines 15-16.
[695] Transcript 13-43, lines 32-33.
[696] Transcript 13-43, lines 35-45; Exhibit 27; JR002 (First BTF Joint Experts Report) p 12, para 6.6.2.2.

> regard to survey effort (survey person hours), the average water body survey effort was approximately 1.8 survey person hours. Neither measure is consistent with the Commonwealth Government's BTF assessment guideline (DEWHA 2009). There is also no evidence of any standardised protocol in regard to survey timing or survey duration. Notably, there appears to be little attention being given to implementing water body surveys during an optimum period which follows dawn.[697]

629. When pressed on whether the water body survey efforts concerned Mr Caneris, he stated:

> It did concern me that the estimates of the birds and the methodologies that were being used could be improved, yes, and certainly should be improved.[698]

630. He further agreed that there appeared to be little attention given to the implementation of water body surveys during the optimum period that follows dawn.[699] Mr Caneris described the importance of the water body surveys in his evidence, particularly in terms of conducting the surveys from dawn and the duration of the surveys:

> These two things are linked. You need to be there from dawn for a good four or five hours type thing. So you're there for the morning from the start of the morning. Just generally, these are granivores; they're eating seed; they need water. Water's important and when they get up in the morning, generally speaking, one of the first things they do is go and have a drink and that's – by monitoring waterholes after dawn, if you get in there too late, there is a chance there has been numbers of birds come to that waterhole, drink and leave before you've actually got there and during the day, birds come back. So they're probably seeing birds come back. Whether they're seeing all of those birds isn't known.[700]

631. It is these criticisms that lead the BTF experts to recommend (as a minimum requirement) more stringent water body survey methodologies.[701] Their joint recommendation included:

> The monitoring of water bodies should be conducted over at least a 6 hour period and commencing from dawn in order to accurately capture utilisation of the watering points. These counts should incorporate a methodology which ensures that all water bodies in close proximity (up to 5km) are all simultaneously counted to provide more accurate capture of BTF populations within an area.[702]

632. The same problems infect the most recent survey conducted by Niche.[703]

633. The BTF experts highlighted their concerns in the BTF JER2:

> In regards to water source surveys, the Niche (2015) report states in Section 2.2.3.2, that the following was implemented at each of the survey sites: 1 x 3-hour early morning and 1 x 1-hour late afternoon surveys. The report's Annexure 8 clearly shows that for the majority of survey sites, the stated methodology was not applied. In the 1st JR, our shared

[697] Exhibit 27; JR002 (First BTF Joint Experts Report) p 12, para 6.6.3; Transcript 13-50, line 32 to Transcript 13-51, line 6.
[698] Transcript 13-51, lines 15-16. [*Emphases added*].
[699] Transcript 13-51, lines 18-20.
[700] Transcript 13-51, lines 18-34.
[701] Exhibit 27; JR002 (First BTF Joint Experts Report) p 28, para 7.8.
[702] Exhibit 27; JR002 (First BTF Joint Experts Report) p 28, para 7.8.1 and p 12, para 6.6.4; Transcript 13-51, lines 36-39.
[703] Transcript 13-56, line 41, to 13-57, line 39.

> view in reviewing previous water body survey methodologies, was that counts needed to be conducted from dawn and for a period of at least 6 hours (Issue No. 19; 1st JR).[704]
>
> In regards to water source surveys, the Niche (2015) report states in Section 2.2.3.2, that all water source surveys were "... conducted between sunrise and 3 hours after sunrise". With reference to the Geoscience Australia database, three hours after sunrise would have been 0822 hours. Annexure 8 of the Niche (2015) report clearly shows none of water watch surveys complied with the methodology stated earlier in the report.[705]

634. Mr Caneris elaborates on his criticisms of the water surveys in his expert report:

> The survey design should ensure that the morning monitoring events commence within 1 hour of sunrise. I accept, as is evidenced within the monitoring reports, that there is inconsistency within the time surveys are being undertaken and the length of time for which water watch monitoring is being conducted.[706]
>
> There is a clear need for more rigor and uniformity in BTF monitoring events and subsequent reporting. The recommended changes provided within the JER 1&2 should be adopted for future monitoring events.[707]

635. Mr Caneris concurs that this is listed as another one of the inadequacies in the Applicant's survey methodology.[708]

Lack of targeted nest searches

636. Mr Agnew states in the BTF JER1 that:

> The lack of apparent effort to detect nest sites, and resultant lack of any appreciation for breeding habitat values for this significant population of BTF presents a major failure of the Applicant's assessment of site values for BTF. Ultimately, the lack of survey effort to assess breeding habitat values significantly constrains and undermines the Applicant's assessment of the relative importance of the habitat to the BTF across the MLA and adjacent parts of the Moray Downs property (and stated impact significance and proposed offsets).[709]

637. When pressed about the lack of targeted survey effort in relation to BTF nests, Mr Caneris stated that "this was a problem" and agreed that "there hasn't been thorough assessment through there [the MLA] to identify the level of nesting",[710] and that due to the number of birds that have been sighted that "it's obvious there is breeding happening in those locations".[711]

638. Mr Caneris provided evidence that as a <u>minimum change</u> to the survey work, specific surveys targeting breeding should be undertaken. He agreed that this had not been done to date.[712]

639. It could only be concluded that, as the First Respondents expert, Mr Agnew voiced in his concluding comments in his expert report:

> There has been a failure to adequately demonstrate a sufficient understanding of the site

[704] Exhibit 28; JR009 (Second BTF Joint Experts Report) soft page 3, para 2.6.2.
[705] Exhibit 28; JR009 (Second BTF Joint Experts Report) soft page 3, para 2.6.3.
[706] Exhibit 29; AA017 (Mr Caneris' BTF Expert Report) soft page 23, para 5.58.
[707] Exhibit 29; AA017 (Mr Caneris' BTF Expert Report) soft page 23, para 5.59.
[708] Transcript 13-43, line 47.
[709] Exhibit 27; JR002 (First BTF Joint Experts Report) pp 12-13, para 6.6.5.
[710] Transcript 13-53, lines 26-28.
[711] Transcript 13-53, lines 38-42.
[712] Transcript 13-56, lines 4-9.

> values for the significant population, and that the subsequent assessment could not be relied upon due to the significant uncertainties within the information it relies upon.[713]

Conclusion of inadequacies of survey methodology

640. The cumulative effect of failing to comply with the Commonwealth guidelines and undertaking "rapid assessment surveys" in limited areas without targeting nests is that the data gathered plainly is inadequate to:

(a) Understand the prevalence and distribution of BTF on the site;

(b) Understand the particular habitat values and requirements; and

(c) Predict the likely effectiveness of mitigation measures or offsets.

641. As Mr Caneris put it with commendable clarity in BTF JER1 at 6.10.25:

> I agree that information provided in the EIS documents cannot be relied upon to confidently assess the significance of the potential impacts to the BTF, the suitability of proposed mitigation measures, or the appropriateness of any offsets it is my view that the reporting to date only seeks to establish that there is potential to meet the offset requirements.[714]

Irreversible damage to the BTF

642. If the Court allows this mine to go ahead it will necessarily result in the destruction of critical habitat.[715] It is this habitat that supports a core population of BTF, which provides an important function in sustaining that population and others throughout the Eastern Desert Uplands Region.

Moray Downs is home to a core BTF population that sustains surrounds

643. Mr Agnew described the importance of the population in the northern area of the Moray Downs property because of its size by comparison to the rest of the population in the Eastern Desert Uplands.

644. He opines that a large population like the one found on the Moray Downs site, means that there must be suitable conditions and resources, and a very high carrying capacity on the site for the BTF.[716]

645. Significantly, Mr Agnew and Mr Caneris agree that the area of Moray Downs is likely to perform a key role as a source population sustaining smaller satellite populations within the metapopulation through the Eastern Desert Uplands area.[717]

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[713] Exhibit 31; OL024 (Mr Agnew's BTF Expert Report), p 18, para 3.5.
[714] Exhibit 27; JR002 (First BTF Joint Experts Report) p 21, para 6.10.25.
[715] Transcript 13-22, lines 21-28; Transcript 12-102, lines 23-26; Exhibit 27; JR002 (First BTF Joint Experts Report) p 11, para 6.2.6.
[716] Transcript 13-92, lines 13-19.
[717] Transcript 13-28, lines 1-4.

646. If such a source population is removed, these smaller populations will not be sustained in the same way.[718] The whole metapopulation will be negatively effected.

647. Mr Agnew stepped out the high potential for serious and irreversible impacts from the mine on this nationally significant population as follows:[719]

(a) If you create a significant disturbance within a population, that will have flow-on negative ramifications for the smaller populations that are in the surrounding landscape;

(b) These smaller populations are in part dependent on the prosperity of the primary population, which is the core population on Moray Downs;

(c) If you extract a significant component of the habitat that they persist in, there will be a major impact on the population and that will have a flow-on effect to the smaller populations;

(d) If you clear the habitat there will be a certain proportion of that population that may well be able to move to and persist and survive in existing habitat in the surrounding area, but this is very much based on the carrying capacity;

(e) Additional birds creates additional pressure on the resources;

(f) Some birds will miss out as they will not have equal share in the resources and as a consequence birds will die;

(g) This is an irreversible negative impact.

648. Mr Caneris agreed. He opined that if the core population was to have a significant decline and became isolated in the landscape, then it would have a considerably lower propensity to act as a source population.[720]

The mine would destroy this critical habitat of BTF

649. Mr Caneris agreed in the BTF JER1 that:

> There is no disputing that the MLA, Moray Downs and wider landscape hold a significant number of black-throated finches and constitute habitat which is critical for the species' survival.[721]

650. He also recognised that the "BTF is in decline and that retention of suitable habitat is critical for the species survival".[722]

[718] Transcript 14-23, lines 15-20.
[719] Transcript 14-6, lines 19-36.
[720] Transcript 13-48, lines 43-46.
[721] Transcript 13-22, lines 21-32; Exhibit 27; JR002 (First BTF Joint Experts Report) p 10, para 6.2.6.
[722] Transcript 13-13, lines 23-24.

651. Both BTF experts agreed that as well as "direct loss of up to 16,500 ha of habitat",[723] the mining and associated activities will cause further fragmentation of habitat and disturbance to existing feeding and breeding pattern.[724]

652. The evidence presented before the Court has made it clear that the most direct risk of harm to the BTF from the mine comes from the process of dispersal.

653. Both BTF experts agree that if the BTF's critical habitat is cleared or disturbed, the BTF are likely to disburse to surrounding areas where they will experience one of the following outcomes:[725]

(a) Not find suitable habitat and die;

(b) Find suitable habitat already occupied by other BTF which cannot support an increased carrying capacity, resulting in further dispersal or death;

(c) Find suitable habitat that is already occupied by BTF and displace the original BTF;

(d) Find suitable habitat not currently occupied by other BTF or occupied by a resident population in habitat which could support a further increase in the local population.

654. Mr Caneris agrees that of the four scenarios, the first three represent high-probability outcomes for BTF displaced by the project. However, he opines that the above statements are only correct if no "nearby offset" is provided.[726] Offsets are discussed in detail below.

655. Both Mr Agnew and Mr Caneris agree that a reduction of the critical habitat for a significant number of BTF is likely to have a corresponding significant impact on the regional population which is of international significance.[727] Which could, in turn, push the BTF closer towards extinction.[728]

Proposed offsets cannot result in a net benefit

Applicant hopes a habitat offset would provide a "better and more secure future for the BTF"

656. The area of offsets is at the heart of the disagreement between both the BTF experts and BTF Habitat experts. The Applicant's expert, Mr Caneris, opines that the proposed offsets may provide a net benefit to the values lost by the destruction of the identified critical habitat.

Offset Policies Overview

657. Principle 1 of the *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy* provides that:

[723] Exhibit 6a; SP001.12 (Coordinator-General's Report) soft page 10.
[724] Transcript 13-59, lines 9-13.
[725] Transcript 13-59, lines 31-42; Exhibit 27; JR002 (First BTF Joint Experts Report) p 23, para 6.14.1.
[726] Transcript 13-60, lines 6-18; Exhibit 27; JR002 (First BTF Joint Experts Report) p 23, para 6.15.1.
[727] Transcript 14-6, lines 19-36; Transcript 12-26, lines 15-16.
[728] Transcript 13-76, line 8; Exhibit 28; JR009 (Second BTF Joint Experts Report) Attachment 3 – BTF Recovery Team letter to Lindsay Agnew, soft page 45.

> Suitable offsets must deliver an overall conservation outcome that improves or maintains the viability of the aspect of the environment that is protected by national environment law and affected by the proposed action.[729]

658. The "aspect of the environment" relevant in this case is the population of BTF resident on the MLA, including its significance as the largest remaining population and as a core population servicing a dispersed metapopulation.

659. In addition, the Queensland Government Biodiversity Offset Policy (QGEOP) establishes the framework for using environmental offsets in Queensland. It is based on seven principles that guide the use of offsets to achieve ecological sustainable development. These principles provide that:

(a) offsets will not replace or undermine existing environmental standards or regulatory requirements, or be used to allow development in areas otherwise prohibited through legislation or policy;

(b) environmental impacts must first be avoided, then minimised, before considering the use of offsets for any remaining impact;

(c) offsets must achieve an equivalent or better outcome;

(d) offsets must provide environmental values as similar as possible to those being lost;

(e) offset provision should minimise lag time between the impact and the offset delivery;

(f) offsets must provide additional protection to environmental values at risk, or additional management actions to improve environmental values; and

(g) offsets must be legally secured for the duration of the offset requirement.

660. Underlying both the Commonwealth and the Queensland Offset Policies is an acceptance that offsets can only be used once it is clear that significant environmental harm cannot be avoided or appropriately mitigated.

661. It is for this reason that offsets represent a balancing of the scales approach; significant harm to an environmental value will occur but either "no net loss" or preferably "net benefit" is created by doing something else positive directed at the same environmental value.[730]

A surrogate vegetation offset alone is not sufficient

662. Mr Wilson for the Applicant described a process by which he calculated habitat offsets based on the loss of habitat for the BTF.

[729] *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy* (October 2012), Principle 1.
[730] Transcript 12-30, lines 11-17.

663. He employed the same essential methodology for BTF as he did for the other MNES and MSES impacted by this mine. This approach is unsurprising given that the EIS documentation had so profoundly failed to identify the significance of this BTF population.

664. As discussed above, a suitable offset must create "no net loss" or preferably "net benefit" in relation to the actual environmental values in issue. What is being impacted here is the most significant population of an endangered species.

665. The offsets package in this case was never directed towards the reality of the environmental harm that was actually in play.

666. The Applicant's response is to make the objectively bizarre claim that building a coal mine on and adjacent to the most significant population of an endangered species is actually good for the survival of that species.

667. The reality is, as Birdlife Australia put it: "this mine will push the BTF closer to extinction". [731]

How the Applicant proposes to achieve a "net benefit"

668. It is Mr Caneris's view that a net benefit may be created through securing habitat, management of the threats of those habitats, the restoration actions that would go on within those habitats, and the long-term security that it gives in that landscape.[732]

669. In essence, Mr Caneris proffers the view that a future for the BTF in an offset area which is legally secured and managed by the Applicant is better than a future in which the mine does not go ahead and their core habitat is therefore not impacted. Mr Caneris considers that if the mine does not go ahead then the BTF onsite will suffer a long and inevitable decline.

670. Mr Caneris expresses such optimism about the proposed offsets notwithstanding that:

(a) He has agreed that the information currently available "cannot be relied upon to confidently assess the significance of the potential impacts to the BTF, the suitability of proposed mitigation measures, or the appropriateness of any offsets";[733] and

(b) He has agreed that the "reporting to date only seeks to establish that there is potential to meet the offset requirements".[734]

671. Before assessing the merits of the claim of a net benefit from the proposed habitat offset, it is important to understand the significant limitations of the work done in identifying the proposed habitat offset as suitable.

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[731] Exhibit 31; OL024 (Mr Agnew's BTF Expert Report) soft page 45.
[732] Transcript 13-63, lines 6-10.
[733] Transcript 13-61, line 40 to 13-62, line 18; Exhibit 27; JR002 (First BTF Joint Experts Report) p 21, para 6.10.25.
[734] Transcript 13-61, line 40 to 13-62, line 18; Exhibit 27; JR002 (First BTF Joint Experts Report) p 21, para 6.10.25.

Information to understand the values of BTF site & offset site is insufficient

672. Offsets cannot be assessed without a proper understanding of the values of which is being lost. The Applicant has not demonstrated any such understanding. This is primarily based on methodology used to assess the suitability of the proposed offset areas, which have been demonstrated to be fundamentally deficient both in terms of an understanding of the flora and of any existing BTF populations.

673. During his evidence, Mr Agnew maintained his firm opinion that the ecological equivalent methodology (EEM) used to assess both the mine site and offsets sites does not provide the sufficient assessment or a detailed understanding given the significance of the population of BTF, which plays a key role as a core population.[735]

674. Mr Agnew sees the EEM as merely a tool that provides only "broad brush", "general" and "indicative data" in terms of habitat assessment.[736]

675. In Mr Agnew's opinion, EEM does not pick up "subtle aspects of critical requirements of BTF" and that it is a "general tool to compare habitats within the clearance footprint to habitats within the offsets areas" and that it "doesn't have the sophistication built into it to give us good information in terms of comparing" habitats.[737]

676. Mr Agnew expands on his opinion by acknowledging that the sort of descriptors that apply to a methodology should be applied to assessing and comparing habitat values for the purposes of determining offsets. For the purpose of assessing the habitat values for this particular significant population of BTF, Mr Agnew does not think it is helpful, and in terms of scientific rigour, Mr Agnew believes that it "doesn't really cut it".[738]

677. When pressed about the EEM being a requirement under the guidelines, Mr Agnew stated that what he understood a guideline to mean is to provide "a set of guidelines on which you make your considerations".[739] Mr Agnew referred to the guidelines as:

> …not [being] of any great assistance in what it's trying to achieve in regards to BTF because it's not a tool to compare habitat values for an endangered species impact site and offset site. It's a general ecological equivalence methodology. It's not a threatened species assessment tool.[740]

678. Surprisingly, the Applicant's BTF Habitat expert, Mr Bruce Wilson agrees. He acknowledged that, in terms of the EEM having the ability to show potential habitat, it "establishes potential or likely habitat for BTF at a broad level".[741] Throughout his evidence, Mr Wilson continued to state that the EEM was "broad" and that "the broad scale identification of habitat at the mine site reported in ELA 2014A is adequate for primary approval of the project".[742]

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[735] Transcript 13-88, lines 34-38
[736] Transcript 13-88, lines 6-7 and 41-46.
[737] Transcript 13-88, lines 4-14.
[738] Transcript 13-88, lines 42-46.
[739] Transcript 14-48, lines 9-11.
[740] Transcript 14-48, lines 13-18.
[741] Transcript 12-55, line 40; Transcript 12-40, line 28.
[742] Transcript 12-40, lines 43-45; Exhibit 30; AA015.1 (Mr Wilson's BTF Habitat Expert Report) soft page 12, lines 153-154; MR205; Carmichael Coal Mine Ecological Equivalence Assessment Stage 2 (ELA 2014a).

679. When pressed on whether he thinks that the sort of broad level analysis, while consistent with the guidelines, is suitable given the significance of the population of BTF, Mr Wilson maintains his opinion that it is "suitable at this level".[743]

680. He agreed that EEM assessment was never intended to be designed as a tool to manage the core population of an endangered species.[744]

681. In contrast to the survey methods undertaken for this project, Mr Agnew outlined the detailed survey work that he had undertaken for the China First EIS, along with the in-depth EEM applied in the assessment.[745]

682. Mr Agnew stated that the EEM assessment, particularly in terms of assessing specific BTF habitat, included assessment on the structural complexity of vegetation, tree density canopy cover, vertical structural complexity, ground cover including diversity of grasses, density of grasses and height grass cover.[746]

683. Of particular importance is that the 14 months of assessment undertaken by Mr Agnew for China First, underpinned a "building base" of information to assess the records, context and values of the site. This information, as Mr Agnew stated during his evidence, was used for an interim report after only one round of survey work on the site.[747] The level of assessment undertaken by Mr Agnew is significantly contrasted to the work that has, to date, been undertaken by the Applicant.

No evidence that the birds will successfully relocate to the offset areas

684. Once the significance of this population is understood, it is clear that the real question is not whether there is similar habitat available elsewhere, but whether this population of BTF – which has a maintenance function for the broader population – will move to an area where they will flourish as they do on the MLA.

685. Mr Caneris conceded that there was no evidence to support what happens to the finches once disturbed:

> A: There is a lot of time in there to get offsets in place, to get them working, to restore the habitat and to conduct a lot more research on these birds.
>
> Q: Well, you know stage 2 is to the north of the Carmichael River, right?
>
> A: Yes.
>
> Q: And that's, essentially, that northern half of the MLA, the top of which we know, at least from the data that we have, has this extensive population?
>
> A: Yes.
>
> Q: Do you know of any studies, any studies at all or any working examples that can help us with what happens to black-throated finch when they are disturbed in the ways proposed?
>
> A: Nothing specifically, no[748]

[743] Transcript 12-52, lines 37-47.
[744] Transcript 12-54, lines 8-10.
[745] Transcript 13-83, line 38 to 13-85, line 21; Transcript 14-64, lines 40 to 14-67, line 28; Exhibit 101; AA052 (Lindsay Agnew's BTF and Habitat Assessment - Preliminary Report for China First (2011)).
[746] Transcript 14-65, lines 35 to 14-66, line 2.
[747] Transcript 14-65, line 28.
[748] Transcript 13-64, lines 31-40.

686. The process of movement is governed by the agreement BTF JER1 that if the BTF's critical habitat is cleared or disturbed, the BTF are likely to disburse to surroundings areas where they will experience one of the following outcomes:[749]

(a) Not find suitable habitat and die;

(b) Find suitable habitat already occupied by other BTF which cannot support an increased carrying capacity, resulting in further dispersal or death;

(c) Find suitable habitat that is already occupied by BTF and displace the original BTF;

(d) Find suitable habitat not currently occupied by other BTF or occupied by a resident population in habitat which could support a further increase in the local population.

687. Importantly, Mr Agnew gave evidence that, to his knowledge, there were no working examples anywhere of a population of BTF being successfully encouraged to relocate to a new area where they were not currently resident. Mr Caneris agreed.[750]

688. When cross-examined on whether the information that had been provided by the Applicant could permit the Court to confidently assess the impacts, the suitability of mitigation measures or the appropriateness of any offsets, and given also the capacity of whether the offset area would have capacity to take all of the birds, Mr Caneris simply stated that "it would not necessarily have the capacity to take all of the birds", but that it did have the "capacity to sustain **a** population".[751]

689. The key problem with this conclusion is that no one knows what the current population of BTF is either within the MLA or within the offset areas.

690. Mr Agnew puts it in simple and understandable terms:

> …if we remove the core of that population, which we don't really understand very well to begin with – there's this layering of uncertainties. We don't really know as much as we should about what's on the mine site. We don't know as much as we should about the offset areas. All we know is that we have a nationally significant population that coincides with the mine footprint and parts of the offset areas.[752]

691. In terms of whether the birds will move to the offset area Mr Agnew states:

> …we're making assumptions about the habitat suitability; we're making assumption that the birds are there and we have no way of telling, with the information that we've got, whether those offsets have capacity for an increase in whatever the population is on there at the moment…
>
> The more birds you add to that habitat, the less resources overall. So we don't have any idea about whether the offsets can support – what sort of level of increase that they can support over and above what's already there now.[753]

692. Of importance is, Mr Caneris', agreement that very little study has been done in relation to the carrying capacity of the offsets, and states that "I certainly don't know that the

[749] Transcript 13-59, lines 31-42; Exhibit 27; JR002 (First BTF Joint Experts Report) p 23, para 6.14.1.
[750] Transcript 13-64, line 38 to 13-65, line 11.
[751] Transcript 13-62, lines 26-31. [*Emphasis added*].
[752] Transcript 14-15, lines 41 to 14-16, lines 1-2.
[753] Transcript 14-22, lines 1-8.

offset areas have now, or in the future, the capacity to maintain the exact number of birds."[754]

693. Due to the inadequate surveys and lack of information regarding the habitat values of the offset areas, little is known about whether that particular landscape, is at its carrying capacity, or even what that carrying capacity is.[755]

Management of the threats to habitats and restoration actions

694. The primary management considerations for the proposed offset areas are outlined in the Biodiversity Offset Strategy. They comprise the provision of water sources, removal and/or reduction of cattle grazing, and the implementation on weed control.

695. Whether these last two will make a significant difference is an area of disagreement between the experts.[756]

696. During cross-examination the Applicant's BTF Habitat expert, Mr Wilson, was asked about whether there were any weed control programs targeting buffel grass that have been successful on this sort of scale, particularly in an area as extensive as the offset area. He replied:

> …weed control of high level infestations, could be done at local areas, …but across the general area, it would have to be more like a grazing control program.[757]

697. Mr Agnew, Mr Caneris and BTF Habitat expert for the First Respondent, Dr Mike Olsen agree on this point.[758]

698. Dr Olsen expands on this in the BTF JER1 and states that "pasture management remains unknown for the study area" and agreed with both Mr Wilson and Mr Caneris that "further information is required to provide a level of confidence in the proposed offset strategy".[759]

699. Mr Agnew states in his expert report that:

> If suitable areas that are currently degraded are proposed to be utilised as offsets (through rehabilitation, management, change, etc) to achieve no net loss, then the proposed offsets can have no guarantee of success because there are currently significant uncertainties in regard to habitat requirements for BTF on the site and that BTF habitat has never successfully been deliberately created from a degraded system.[760]

700. Mr Agnew states that there are no working examples of a significant BTF population being successfully relocated.[761] In terms of whether there are any working examples of

[754] Transcript 13-71, line 45 to 13-72, line 2.
[755] Transcript 13-62, lines 37-45.
[756] Exhibit 84; AA044 (Biodiversity Offset Strategy (CO2 2014)) soft page 25.
[757] Transcript 12-71, lines 22-32.
[758] Transcript 13-72, lines 17-18; Exhibit 28; JR009 (Second BTF Joint Experts Report) p 17, para 7.13; Exhibit 31; OL024 (Mr Agnew's BTF Expert Report) soft page 20.
[759] Exhibit 27; JR002 (First BTF Joint Experts Report) p 26, para 6.20.3.
[760] Exhibit 31; OL024 (Mr Agnew's BTF Expert Report), p 22.
[761] Transcript 14-67, lines 31-34.

BTF habitat being successfully restored, in Mr Agnew's opinion, there were none, particularly on a larger scale such as what is being suggested by the Applicant.[762]

701. Mr Agnew's view is further supported by the Vanderduys et al paper where it states:

> Furthermore to our knowledge restoration has not been attempted for BTF habitats in any context.[763]

702. Mr Caneris agreed that restoration of a BTF habitat has never been attempted.[764] The Applicant essentially seeks to conduct an untried experiment on the finch in the hope that it may work.

703. Even if it can be assumed that "management actions" of the kind proposed can improve the carrying capacity of the offsets area such that it might be able to take and sustain a population the size of that on the MLA, there remains a fundamental timing problem.

704. Vanderduys et al state that:

> If sufficient habitat is to be available continuously and this is essential for the persistence of the species, offsets must be created before the activity they seek to offset is undertaken.[765]

705. Mr Caneris agreed; "offsets should be in place before the action [is] taken".[766]

706. As demonstrated in cross-examination of Mr Wilson, the timeline proposed by the Applicant in its Biodiversity Offset Strategy (**BOS**) would see management actions commence – at best – only months before mining activity commences.[767]

707. A summary of the relationships between the dates, tasks and timeframes for BOS implementation include:

(a) Offset delivery stage 1 commences in 2014 (has not commenced);

(b) October 2015: Commencement of offset areas for offset delivery stage 1 in accordance the Offset Area Management Plans (**OAMP**);

(c) Underground mining stage 1 commences following grant of ML and EA late 2015; and

(d) Mining operations north of the Carmichael River commence in late 2015.

708. When put to Mr Wilson, he agreed that what the Applicant was suggesting, in terms of the management of the offsets and the capability of creating a continuous environment for this population of birds to move into, is presumed to be achieved within, at best, a

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[762] Transcript 14-67, lines 36-37.
[763] Transcript 14-68, lines 12-18; Exhibit 31; OL024 (Mr Agnew's BTF Expert Report) Attachment C – Vanerduys et al (2015) Paper, soft page 61, lines 275-276.
[764] Transcript 13-70, lines 44-46; Exhibit 31; OL024 (Mr Agnew's BTF Expert Report) Attachment C – Vanerduys et al (2015) Paper, soft page 61, lines 275-276. Transcript 13-70, line 44 to 13-71, line 3.
[765] Exhibit 31; OL024 (Mr Agnew's BTF Expert Report) Attachment C – Vanerduys et. al. (2015) Paper, soft page 61, lines 269-271.
[766] Transcript 13-70, lines 12-43.
[767] Transcript 12-66, line 14 to 12-67, line 24.

couple of months; probably only weeks of management prior to the commencement of mining activity north of the Carmichael River.[768]

709. A copy of the tasks and timeframes in stage 1 from Table 16 of the BOS is included below:[769]

Table 16: Tasks and Timeframes for BOS Implementation

Tasks	Completion Date	Responsible Person
Offset delivery stage 1 commences in 2014		
BOS submitted to Office of Coordinator-General for approval	November 2014	Adani
BOS submitted to the Department of the Environment (DoTE) for approval	December 2014	Adani
Undertake field surveys of additional offset area/s including EEM	November/December 2014	Adani's consultant
BOS approved by Queensland Coordinator-General	December 2014	Queensland Coordinator General
BOS approved by Commonwealth Minister for the Environment	March 2015	Commonwealth Minister for the Environment
Finalise identification of additional offset area/s	December 2014/January 2015	Adani's consultant
Commence landholder negotiations with owner/s of additional offset area/s	January 2015	Adani and/or engaged land broker
Prepare OAMPs for Moray Downs West and additional offset area/s	March 2015	Adani's consultant
Finalise landholder negotiations and contractual arrangements	March 2015	Adani and/or engaged land broker
Submit OAMPs for approval within three months of BOS approval	June 2015	Adani
OAMPs approved	July 2015	DoTE and DEHP
Submit applications for legally securing Moray Downs West and additional offset area/s	July 2015	Adani
Construction of rail west and off-lease infrastructure commences	Mid-2015	Adani
Commence management of offset areas for offset delivery stage 1 in accordance with OAMP	October 2015	Adani
Mining lease/EA granted	Mid–Late 2015	DNRM / DEHP
Underground Mining stage 1 commences following grant of ML and EA	Late 2015	Adani
Mining operations north of the Carmichael River commence	Late 2015	Adani
Execute legally binding mechanisms within two years of commencing underground mining stage 1	Mid-2017	Adani
Submit compliance report for the BOS (every five years)	2020	Adani
Revise and update BOS prior to commencement of offset delivery stage 2 and submit to Minister for approval at least three months before commencing offset delivery stage 2	Late 2021	Adani's consultant

710. The BOS has been submitted to the Commonwealth Minister for assessment, and as evidenced by Mr Wilson during his cross-examination, it has not been approved.[770]

[768] Transcript 12-67, lines 17-24.
[769] Exhibit 84; AA044 (Biodiversity Offset Strategy (CO2 2014)) soft pages 55-56, Table 16 – Tasks and Timeframes for BOS Implementation.
[770] Transcript 12-28, lines 5-40.

Legally Securing the Offsets: the emperor is wearing no clothes

711. Condition 8 of the EPBC Act approval requires the Applicant to legally secure the minimum offset area.[771] As the BOS records, the property will be considered "legally secured" once one of the following legally binding mechanisms occur:[772]

(a) Voluntary Declaration under the *Vegetation Management Act 1999*;

(b) Statutory Covenant under the *Land Title Act 1994* or the *Land Act 1994*; or

(c) Nature refuge under the *Nature Conservation Act 1992*.

712. Mr Agnew considers that legally securing the offset area is problematic due to current EPC leases which extend across both Stages 1 and 2 offset areas proposed by the Applicant.[773]

713. These EPC leases are representative of the more basic problem for offsets for BTF in the Galilee Basin, namely that the level of mining development proposed will simply not leave enough land to offset loss of habitat. Even if a quantity of land sufficient to satisfy an offsets calculator could be found, the level of cumulative disruption to the BTF will hasten its path to extinction.

714. In fact, up to 60 per cent of the Desert Uplands area is be covered by both exploration permits or mining applications.[774]

715. Vanderduys et al expanded on this problem:

> Given that the BTF has lost 80% of its historic range, losing over 60% of the remaining habitat would be a serious threat to the species' persistence. It was noted that it is unlikely that all of the extraction or exploration tenure areas will be developed as mines, though data for those sites with detailed mine plans, showed that approximately 41% of the original lease area was planned to be developed. Given that 80% of the BTF stronghold along the eastern edge of the Desert Uplands Bioregion is under resource extraction or exploration tenures, that suggests that if approximately 40% of lease areas are developed, then around 32% of the BTF's stronghold is likely to be lost to mining activities.[775]

716. Figure 3-5 of Mr Agnew's expert report depicts the relationship between proposed BTF offsets and leases of the proposed Alpha North and China Stone Coal Projects.[776]

[771] Exhibit 22; AA011 (Mr Wilson's Springs Ecology & WCP Expert Report) soft pages 58-59.
[772] Exhibit 84; AA044 (Biodiversity Offset Strategy (CO2 2014)) soft page 51, para 6.1.4; Transcript 12-73, line 11 to 12-77, line 27.
[773] Exhibit 31; OL024 (Mr Agnew's BTF Expert Report), soft page 21.
[774] Transcript 13-73, lines 33-35; Exhibit 31; OL024 (Mr Agnew's BTF Expert Report) Attachment C – Vanerduys et al Paper, soft page 59, lines 224-225.
[775] Exhibit 31; OL024 (Mr Agnew's BTF Expert Report) Attachment C – Vanerduys et al (2015) Paper, soft page 59-60, lines 227-234.
[776] Exhibit 31; OL024 (Mr Agnew's BTF Expert Report) soft page 27, Figure 3-5.

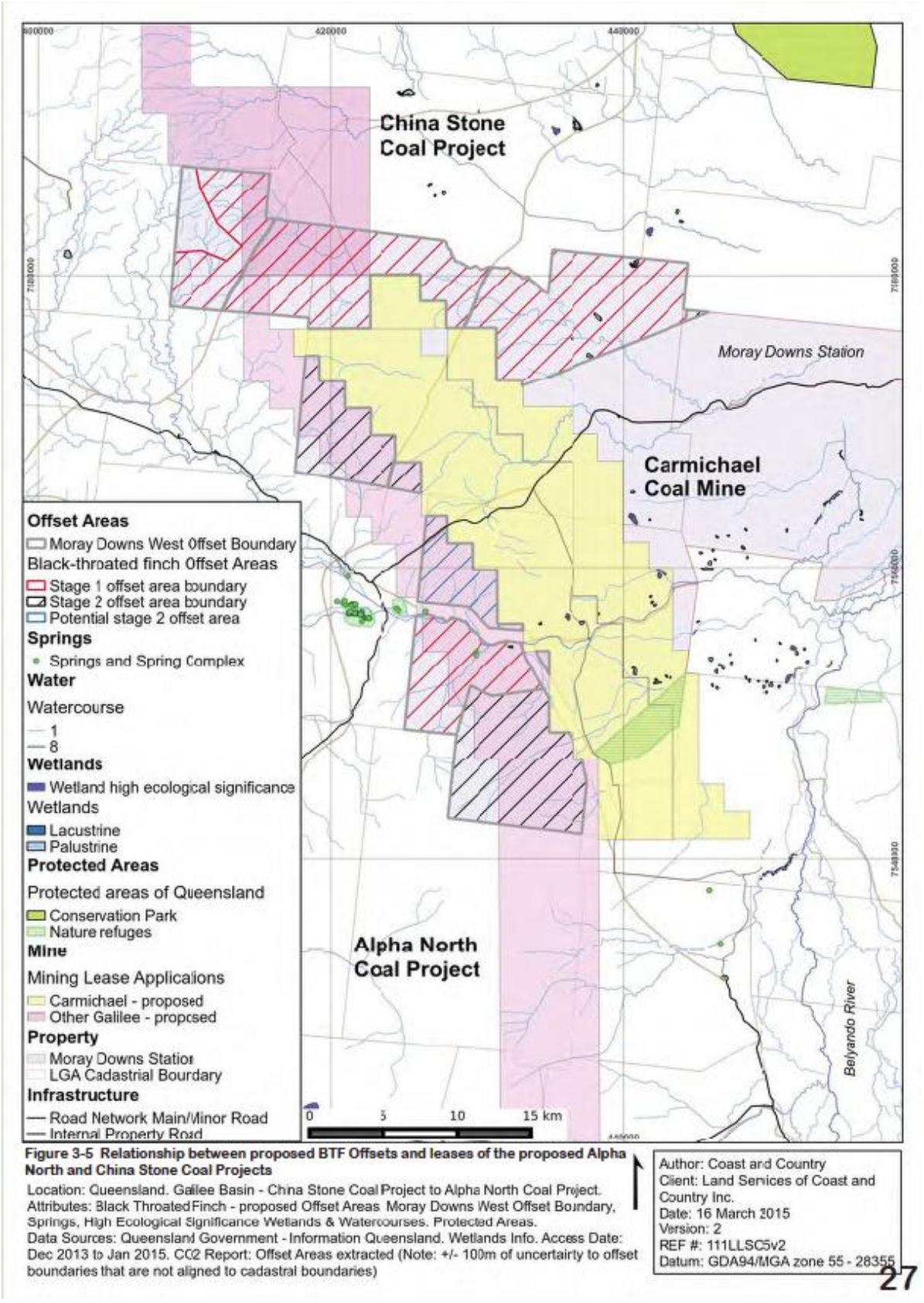

Figure 3-5 (Relationship between proposed BTF Offsets and lease of the proposed Alpha North and China Stone Coal Project) from Exhibit 31; OL924 (Mr Agnew's expert report) p 27.

717. Figure 3 of Mr Caneris' own expert report shows other subject leases where there are applications in place or exploration permits granted.

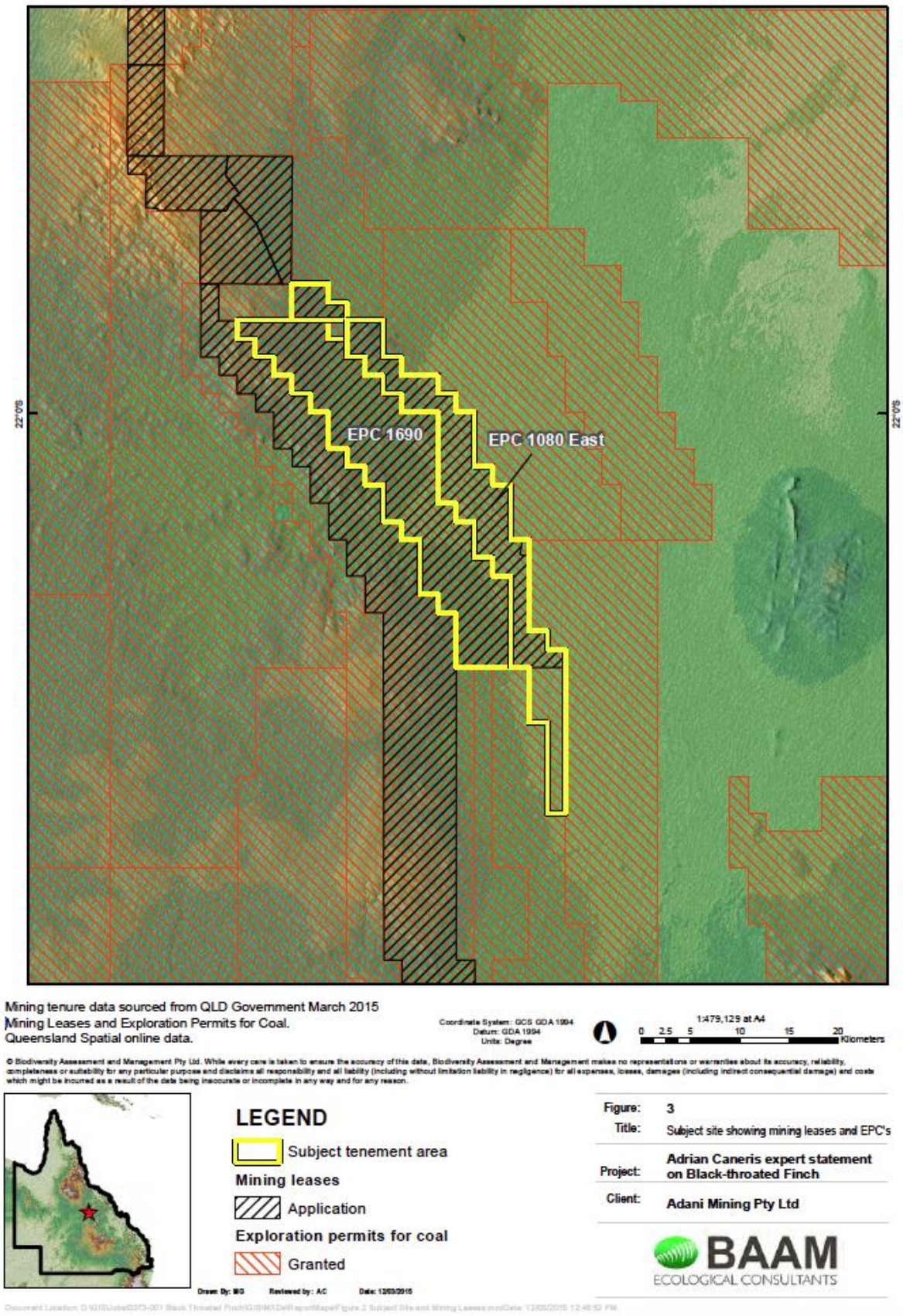

Figure 3 (Subject site showing mining leases and EPC's) from Exhibit 29; AA017 (Mr Caneris' expert report) soft page 16.

718. Mr Caneris agreed that the proposed offset could be mined in the future.[777] However, in a fit of unjustified optimism, Mr Caneris opined that having regard to the land being "legally secured" by the Applicant, the Federal Government would be unlikely to permit mining within those secured habitats.[778]

The future for the BTF is brighter without their core habitat being mined

719. As noted above, Mr Caneris contends that, even with the level of uncertainty about the environmental values at stake, the suitability of the proposed offsets and the likelihood of this core population moving to the offset areas, the future is still brighter for the finch than if its core habitat is not mined.

720. We address below the likelihood of a more secure future for the BTF through enhanced conservation attention in the alternative future where the mine does not proceed.

721. However itis important to emphasise that the prospect of enhanced conservation protection should not be taken as a concession that without it, the BTF will be better off if the mine goes ahead.

722. Such a concession cannot be made because it would be wrong. This population of BTF is much bigger than any others known to exist. For reasons that remain unclear, it flourishes on the MLA notwithstanding that it is a pastoral property and has been for a very long time.

723. Comparing:

(a) a future where the most significant population of BTF retains its core habitat, where it has bucked the trend and flourished; **with**

(b) a future where its core habitat is destroyed and there is every chance that it will not successfully relocate,

permits of only one conclusion: this mine should not proceed if a net loss to the BTF is to be avoided.

724. It is only against this reality that the likelihood of increased conservation protection, if the mine is refused, falls to be considered.

725. While Mr Caneris maintains that the mine will create a more secure future for the finch,[779] Mr Agnew believes that due to the widespread acceptance of the national significance of the BTF population as a result of these proceedings, there are strong grounds to attract Commonwealth, State and non-government attention to partnerships to manage the site.[780]

726. Mr Agnew gave evidence of examples such as BirdLife Australia and the Australian Wildlife Conservancy working together to manage vast areas of former grazing country

[777] Transcript 13-74, lines 6-9.
[778] Transcript 13-74, lines 1-13.
[779] Transcript 13-68, lines 1-5;
[780] Transcript 14-16, lines 39-41.

for the protection of endangered species.[781] While Mr Caneris has voiced his concern about lack of funding,[782] Mr Agnew referred to examples such as Newhaven and Gluepot Reserve; both well-funded, well managed and supported by both paid professionals and volunteers and who are actually, in Mr Agnew's words, "shining a light on how, in terms of conservation management of privately-owned lands – where they're going".[783]

727. When asked about his view in terms of the Moray Downs property being bought for conservation purposes, Mr Agnew responded:

> …it would be a jewel in the crown of protection of BTF in the eastern part of the Desert Uplands and a fantastic contribution to what government agencies are trying to achieve with the likes of the Galilee Basin offset strategy.[784]

728. The Applicant's own BTF expert, Mr Caneris agreed during cross-examination that he could conceive that the Moray Downs property could be purchased for conservation purposes.[785]

Conclusion on offsets

729. As outlined above,[786] Mr Agnew described the population on the Moray Downs as the core population for one of two metapopulations of BTF left. The first stronghold, Townsville, is already in decline. A significant negative impact on this core population will have negative impacts of the meta-population in the second stronghold of the Eastern Desert Uplands Region. To create such a negative impact at the heart of this population, in Mr Agnew's view, would be detrimental to maintaining species viability.[787]

730. The offsets area in this case was chosen based on an inadequate understanding of the significance of this population. It is inadequate to even begin to grapple with the question of how to manage this core population.

731. To permit the offsets to proceed would be to permit an experiment on the BTF – without successful precedent – where the stakes are the hastening of an endangered species to extinction.

732. The Applicant has gone as far as to suggest that we can be "hopeful" that the offsets for the Project will work.[788]

733. This question is emblematic of the approach that the Applicant proposes be taken.

734. Given the underlying profound uncertainties and insufficient information hope may be all that is left.

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[781] Transcript 14-16, lines 42-44; Projects also outlined in Transcript 13-76, lines 1-38.
[782] Transcript 13-9, lines 10-16.
[783] Transcript 14-16, lines 46 to 14-17, lines 1-4.
[784] Transcript 14-57, lines 9-12.
[785] Transcript 13-77, lines 17-18.
[786] See section "Irreversible Damage to Critical Habitat".
[787] Transcript 14-15, lines 9-18.
[788] Transcript 10-73, line 15.

Cumulative impacts on BTF are unknown

735. Cumulative impacts are defined in the EIS Material as:

> …successive and combined impacts of one or more projects upon the society, economy and the environment.
>
> …
>
> Developments may impact upon the environmental values as a result of geographic overlap of projects areas, scheduling overlap or utilization of the same infrastructure, services and resources.[789]

736. The objective of the cumulative assessment is:

> To clearly identify the potential cumulative and consequential impacts upon the existing environment as a result of operating the project and other proposed projects within the Galilee basin.[790]

737. The cumulative assessment in the EIS included the following mines; Alpha Coal, Kevin's Corner, Galilee Coal, South Galilee Coal.[791]

738. The Vanderhuys et al article described BTF habitat loss as rather occurring in "singular events", that it was rather from "small percentage habitat losses, fragmentation and degradation results in cumulative impacts resulting in 'death by a thousand cuts'".[792]

739. Tellingly, the Applicant's cumulative assessment work did not include the very mine proposals that run through the proposed offset site.[793] More tellingly, the conclusion of the cumulative impacts assessment in relation to BTF was that:

> A significant, unmitigated impact to the black-throated finch (southern) is predicted to occur as a consequence of the Project.
>
> …
>
> The black-throated finch has the potential to be cumulatively impacted by other projects in the Study Area. There is potential habitat within the Alpha Coal Project, Galilee Coal (Northern Export Facility) and Kevin's Corner Project to be removed. This increased pressure on black-throated finch habitat in the Study Area is likely to exacerbate the potential significant impact from the Project.
>
> Each proponent will be required to provide offsets in accordance with Commonwealth and State policies for these unavoidable impacts on habitat.[794]

740. When asked to comment on whether cumulative impacts should be taken into account during the assessment process, both Mr Caneris and Mr Wilson responded accurately but tellingly: "I can't comment on other applications"[795] and that "it's not part of this assessment of the Carmichael mine".[796]

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[789] MR057 (EIS, Volume 1, Section 8 - Cumulative Impacts) soft page 1, para 8.1.1.
[790] MR057 (EIS, Volume 1, Section 8 - Cumulative Impacts) soft page 1, para 8.1.2; Transcript 12-78, lines 4-6.
[791] MR057 (EIS, Volume 1, Section 8 - Cumulative Impacts) soft page 1, para 8.2.1.
[792] Exhibit 31; OL024 (Mr Agnew's BTF Expert Report), Attachment C – Vanerduys et al (2015) Paper, soft page 59, lines 217-219.
[793] Transcript 12-78, lines 4-46.
[794] MR057 (EIS, Volume 1, Section 8 - Cumulative Impacts) soft page 22; Transcript 12-79, line 8 to 12-80, line 44.
[795] Transcript 13-73, lines 42-45.
[796] Transcript 12-75, lines 45-46.

Conditions drafted in ignorance of values provide no safeguards

Conditions lack meaningful impact thresholds

741. Both Mr Caneris and Mr Wilson rely heavily on conditions to mitigate against uncertainty and risk of harm.

742. Mr Agnew, in the BTF JER2, observes that there are no impact thresholds nominated by the relevant approval conditions.[797] He describes impact thresholds as:

> …impact thresholds are measures by which you view whether an impact is within the bounds that you have predicted and the bounds that have been agreed are acceptable but moving beyond that threshold obviously is a breach of that measure and evidence of a more significant impact than you had first envisaged and maybe forms part of a condition. So if you don't have impact thresholds, if you don't have measures by which to –to investigate and to monitor ongoing activities and – and their impacts, then you –you – you really don't – you don't have a point of – of saying, well, this has exceed what's acceptable. This has exceeded a particular condition, a measurement. There doesn't appear to be any – any impact thresholds within the conditions. And there's certainly none that have – that I consider to have been nominated, say, in the BTF management plan other than the offset areas won't be reduced or the offset areas won't be cleared, you know.[798]

743. In cross-examination Mr Agnew pointed out that while he is aware that there are impact thresholds in terms of the mine footprint, his statement in the BTF JER2 implied the impact threshold on the BTF specifically.[799] He states that there are no conditions regarding:

> How do you monitor whether birds continue to persist in those offset areas and do they persist in numbers that are similar to before or have they increased? Are birds still breeding? What is their breeding success?[800]

744. The conditions include the following:

(a) A BTF Species Management Plan (**BTF SMP**) to be prepared and certified by "a suitably qualified person" which must include a baseline research program and reviewed annually by an "appropriately qualified person";[801] and

(b) The BTF SMP and research program underpin the BOS which is to be updated as a result of the SMP and research program, and then developed and reviewed by "an appropriately qualified person" every 5 years.[802]

745. The evidence presented before the Court (and as outlined above)[803] has demonstrated that after more than four years of survey effort, the baseline information is inadequate to fully comprehend the impacts to this significant population of BTF and the adequacy of the offset areas.

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[797] Exhibit 28; JR009 (Second Black-throated Finch Joint Experts Report) p 18, para 7.20.
[798] Transcript 14-17, lines 15-27.
[799] Transcript 14-49, lines 40-47.
[800] Transcript 14-50, lines 1-5.
[801] Exhibit 6b; SP001.17 (Draft Environmental Authority) soft page 31, Condition I6 and I7.
[802] Exhibit 6b; SP001.17 (Draft Environmental Authority) soft page 30, Condition I2.
[803] See section "Inadequacies of Survey Methodologies".

746. While the conditions require further monitoring and reporting, it will be done by experts contracted by the Applicant i.e. people in the same category as those who have provided, to date, the insufficient information which has grossly under-estimated the abundance of BTF on the site and has failed to provide anything near adequate baseline information.

747. Mr Caneris notes in his expert report that there are specific processes within the approval conditions to ensure that ongoing assessments "fully capture" the habitat values lost and to ensure commensurate replacement.[804]

748. Again, it would be wrong to have any confidence in these aspirational conditions given that after four years of assessment, there still remains to be, as Mr Agnew quite rightly stated, "a layer of uncertainties"[805] underlying the habitat values of the BTF.

749. Six months after the conditions were provided to the Applicant, there has been minimal change or improvement in the monitoring and survey efforts to assess the habitat values of this significant core population of BTF.[806] Mr Caneris, during his evidence agreed.[807]

Aspirational conditions shift assessment of impacts outside the reach of the Court and community

750. The Applicant places heavy reliance on conditions, which require further monitoring assessment and offset planning to be done in the future.

751. The difficulty for the community concerned about these impacts is that there was no opportunity for independent merits review of the Commonwealth or Coordinator-General conditions and there will be no further opportunities for the merits of the assessment under those conditions to be scrutinised or tested.

752. This is a difficulty for this Court too, which must come to a correct and preferable decision regarding the acceptability of the impacts based on the information it has before it. There will be no further opportunities for the Court to review the adequacy of the conditions, after they are imposed, once all the information is in.

753. To allow a significant part of the assessment of impacts on the BTF to occur subsequent to the approval is to abrogate the function of this Court.

754. The Court is – in essence – being asked to approve the certainty of significant harm where the capacity to offset that harm is based on aspirational conditions which past performance suggests will not yield accurate data. This is unacceptable given the nature of the environmental harm at stake.

755. In the fact of such profound uncertainty about whether the clear harm can be offset, the Court should exercise caution rather than put its trust and faith in the parties who failed to recognise the significance of the site until these proceedings were commenced.

[804] Exhibit 29; AA017 (Mr Caneris' BTF Expert Report) soft page 19, para 5.17.
[805] Transcript 14-15, lines 41 to 14-16, lines 1-2.
[806] Transcript 14-13, line 35 to 14-14, line 8.
[807] Transcript 13-56, line 41 to 13-58, line 21.

Review of draft EA conditions

756. Both Mr Caneris and Mr Wilson rely heavily on draft EA conditions I2 to I7 to "impose milestone achievements to ensure adequate identification and protection of BTF habitats and habitat values",[808] and in particular on draft EA conditions I3 to I5 in regards to ensuring commensurate offset actions are undertaken.[809]

757. Mr Caneris asserts in his expert report that:

> The ongoing monitoring and finer scale assessments, as required by approval conditions, will provide a more thorough measurement of the impact and offset area values and should there be a shortfall, additional offset measures will be required.[810]

758. The first thing to note about these conditions is that they replicate the Coordinator-General conditions and therefore this Court (and consequently the First Respondent) are hamstrung from recommend conditions that are inconsistent with them.[811]

759. Turning to the detail of those conditions:

Condition I6

760. Underpinning the BOS, as mentioned in the section above, is the development of a BTF SMP, which is a requirement under condition I6 of the draft EA and supported by condition 11 of the EPBC Act approval.[812]

761. Mr Wilson in his expert report relies on the BTF SMP to increase the knowledge of the BTF habitat values both at the mine site and offset areas.[813]

762. Condition I6 states:

> The holder of this environmental authority must submit a BTF SMP prepared and certified by a suitably qualified person to the administering authority prior to commencement of project stage 2 for approval. The holder must publish the BTF SMP on its website within 10 business days of receiving the administering authority's approval in writing. The holder must align the SMP with any Bioregional BTF Management Plan and relevant documentation requirements under the Environmental Protection and Biodiversity Conservation Act 1999 including BTF Recovery Plan, conservation advice and the threat abatement plan.
>
> The submitted BTF SMP plan must include:
>
> a) A baseline research program on the specific nesting and feeding requirements of the species that will be undertaken prior to and during project stage 1;
>
> b) A baseline research program to establish whether the BTF at the project site are sedentary, locally migratory or regionally migratory;

[808] Exhibit 29; AA017 (Mr Caneris' BTF Expert Report) soft page 20, para 5.26; Exhibit 30; AA015.1 (Bruce Wilson BTF Expert Habitat Report) soft page 18, line 386-388.
[809] Exhibit 29; AA017 Mr Caneris' BTF Expert Report) soft page 20, para 5.29.
[810] Exhibit 29; AA017 (Mr Caneris' BTF Expert Report) soft page 20, para 5.31.
[811] EPA 1994, s 190(1)(b).
[812] Exhibit 22; AA011 (Mr Wilson's Springs Ecology & WCP Expert Report) Attachment 2 – EPBC Act Approval, soft page 59.
[813] Exhibit 30; AA015.1 (Mr Wilson's BTF Expert Habitat Report) soft page 18, line 384-386.

c) A description of how the results of baseline research are to be used to determine any changes of classification of and/or impact on BTF habitat;

d) Details of proposed impacts to BTF habitat from each project stage including impacts from clearing, subsidence, ecological function changes, hydrological changes and weed and pest infestation changes; and

e) Mitigation measures to be undertaken to avoid, mitigate and manage impact resulting from each stage of the project, including rehabilitation of habitat.

763. It has already been established that no confidence can be placed in the research program implemented to date, nor can there be any reliance on the baseline information collected as part of this future research program.

764. Little has been done since the conditions have been recommended by the Coordinator-General, in terms of changing the approach undertaken by the Applicant in assessing the impacts. The information provided to date, is inadequate to fully comprehend the impacts to this significant population of BTF and the adequacy of the offset areas.

Condition I4

765. Condition I4 of the drat EA, on its face, provides only a general review of the BOS. It states:

> If the review under condition I3 or I4 finds that the actual areas of disturbance to state significant biodiversity values differs from the area of disturbance as detailed in the Biodiversity Offset Strategy, the holder of the environmental authority must amend the Biodiversity Offset Strategy as per condition I5 and deliver the amended offset requirement within 12 months.[814]

766. This condition is focused on "areas of disturbance" not on actual impacts on this core population of BTF. This again reflects the lack of understanding of the significance of the BTF population on the MLA when the conditions were imposed.

767. Furthermore, the environmental authority (**EA**) holder is given 12 months to amend the offset requirement. By this time, significant damage is likely to have already occurred. Birds may have already become displaced, resulting in significant impacts on the core population present at the site. Once this impact on this core habitat begins, it cannot be replaced.

768. While there are conditions that an "appropriate qualified person" will review the material contained in the SMP and in the BOS, this is not a review by the regulating authority and the results of the review are not open to for public scrutiny or review by this Court.

769. The Applicant's own BTF expert, Mr Caneris, stated that "you have to do more offset actions, contribute to more offsetting, provide more understanding of the birds to get a long-term benefit".[815]

[814] Exhibit 6b; SP001.17 (Draft Environmental Authority) soft page 30, Condition I4.
[815] Transcript 13-63, lines 35-37.

770. However, Mr Caneris agreed, during cross-examination, that this would be like "an experiment at the expense of the finch". He agreed:

> We disturb. We check. …if we're wrong, we further offset.[816]

771. It is ironic that the only response to a failure of the offsets would be more offsets.

Precautionary principle

772. There remain profound scientific uncertainties in relation to the impact of this mine on the BTF and the capacity of offsets to nonetheless create a "net benefit":

(a) The abundance of BTF on the MLA, particularly in the areas not surveyed with same intensity as the north of the site;

(b) The current abundance of BTF in the offset areas;

(c) the current carrying capacity of the offset areas;

(d) The movements of BTF, in particular, the extent of their sedentary nature;

(e) The function of the MLA population in relation to the rest of the Eastern Desert Uplands metapopulation;

(f) The ability to improve the carrying capacity of BTF habitat by management actions;

(g) The specific feeding and breeding habits and patterns of the BTF;

(h) Whether a core population of BTF can be relocated such that it maintains its capacity to serve as a core population.

773. Against that uncertainty there is an accepted guarantee of significant harm by way of loss of habitat. Since the BTF experts became involved in this case, it is also apparent that there will be significant harm to this population of BTF, which may well be central to the survival of the species.

774. The offsets and conditions were designed in response to inadequate survey data. They are demonstrably inadequate to deal with the environmental values as they are now properly understood.

775. It is difficult to conceive of a case better designed for the application of the precautionary principle.

[816] Transcript 13-63, lines 34-37.

CLIMATE CHANGE AND THE GREAT BARRIER REEF

776. Turning to the evidence in relation to climate change, there is very little dispute as to the evidence and what it means. This stems from the fact that there is no dispute about "the science of climate change", the fact that climate change is happening and that it is being caused predominantly by human activity.

777. Warming of the climate system driven by human activity is unequivocal and since the 1950s many of the observed changes are unprecedented over decades to millennia.[817] Mean temperatures globally and in Australia have been observed to rise, causing a corresponding rise in extreme hot temperatures. Continued emission of greenhouse gases from human combustion of fossil fuels such as coal will cause further warming and long-lasting changes in all components of the climate system, including a rise in mean global temperatures and corresponding rise in extreme hot temperatures.[818] The importance of understanding the shift the temperature distribution and corresponding increase in extremes was accepted by the Applicant's climate expert, Dr Taylor, with reference to the following figures from reports by the Intergovernmental Panel on Climate Change (**IPCC**) and the Australian Bureau of Meteorology and CSIRO.[819]

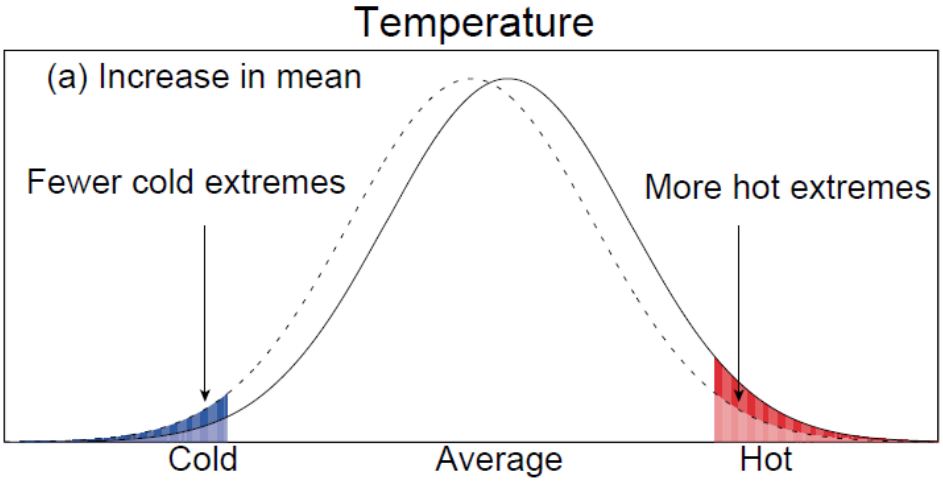
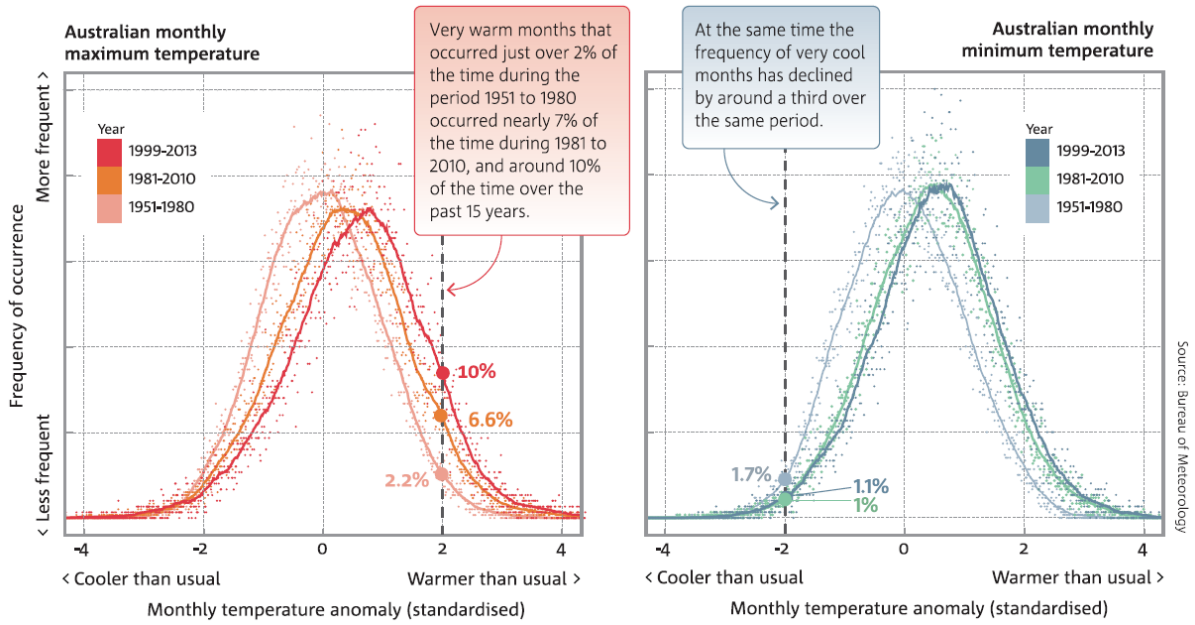


Figure 1.8 (Schematic representation of expected change in the frequencies of extremes affected by changes in the mean) from Exhibit 50 (IPCC WGI Fifth Assessment Report, 2013), p 134.

[817] Exhibit 33; JR006 (Climate Change Joint Experts Report) para 4(a).
[818] Exhibit 33; JR006 (Climate Change Joint Experts Report) para 5.
[819] Transcript 18-10 to 18-14, particularly 18-14, line 21.



Distribution of monthly maximum temperature (left) and monthly minimum temperature (right) across Australia for three periods: 1951–1980 (pink, grey), 1981–2010 (orange, green) and 1999–2013 (red, blue) from exhibit 120 (BOM & CSIRO, *State of the Climate 2014*), p 5.

778. Continued emissions of greenhouse gases will cause further warming increasing the likelihood of severe, pervasive and irreversible impacts for people and ecosystems.[820] Those impacts will occur in Queensland regardless of where in the world the emissions occur.

779. In particular, the emission of greenhouse gases represents the single greatest threat to the Great Barrier Reef,[821] which is already in a damaged and degraded state with low resilience to further emissions of CO_2 from burning fossil fuels. Such emissions cause the twin problems of warming and ocean acidification.

780. The Great Barrier Reef Marine Park Authority concluded in its recent landmark *Great Barrier Reef Strategic Assessment Report* that:

> Climate change remains the most serious long-term risk facing the Reef and is likely to have far reaching consequences for the Region's environment. Future climate change predictions indicate sea level rises and temperature increases will continue, and the ocean will become gradually more acidic. Extreme weather events are predicted to increase in severity. These changes will have dramatic effects on the health and resilience of the Reef. The impacts of climate change will be amplified by the Reef's declining resilience and the accumulation of other impacts. In turn, the effects of climate change will exacerbate the effects of other impacts, potentially accelerating the decline in the condition of the Region's values.
>
> The urgent need to limit global warming to two degrees Celsius above pre-industrial levels has been recognised by almost 200 nations. At present, global emissions are not on track to achieve such a target, and even a two degree Celsius rise would be a very dangerous level of warming for coral reef ecosystems, including the Great Barrier Reef, and the people who derive benefits from them. To ensure the Reef remains a coral-dominated system, the latest

[820] Exhibit 33; JR006 (Climate Change Joint Experts Report) para 5.
[821] Exhibit 12; OL014 (Professor Hoegh-Guldberg's expert report), paras 2 and 47, with reference to Exhibit 51; OL030 (*Great Barrier Reef Region Strategic Assessment*, GBRMPA (2014)) p 11-6.

science indicates global average temperature rise would have to be limited to 1.2 degrees Celsius.[822]

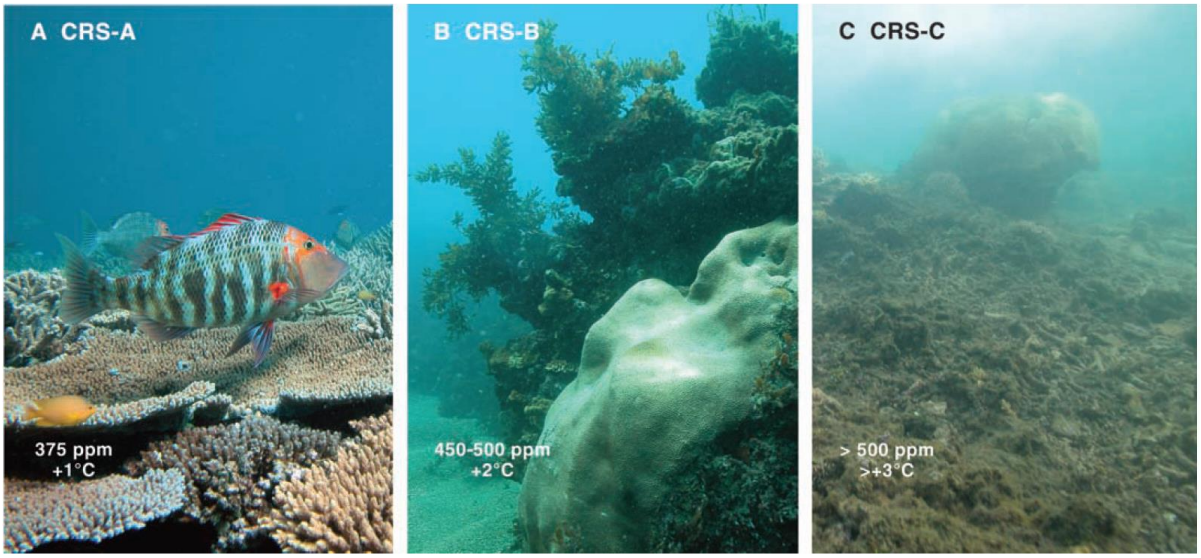


Figure 6 (expected condition of coral reefs under different climate scenarios) from exhibit 12; OL014 (Professor Hoegh-Guldberg expert report) p 18.

781. The global goal to limit global temperature rises beneath 2°C above pre-industrial levels referred to by the GBRMPA was noted by the climate experts.[823] As the GBRMPA had done in the passage set out above, Professor Hoegh-Guldberg's unchallenged evidence was that current levels of atmospheric CO_2 and current warming of approaching 1°C above pre-industrial levels are dangerous for the Great Barrier Reef.[824] Allowing global temperatures to increase to 2°C above pre-industrial levels will lead to inevitable "large-scale changes to coral reefs" and reef ecosystems at this point "would resemble a mixed assemblage of fleshy seaweed, soft corals … with reef-building corals being much less abundant (even rare)".[825] "As a result, the three-dimensional structure of coral reefs would begin to crumble and disappear."[826] Allowing atmospheric CO_2 levels to continue to increase above 500 parts per million and 3°C would mean "any semblance of reefs to the coral reefs of the Great Barrier Reef Marine Park today would vanish".[827]

782. When assessing the impact of greenhouse gases in the context of environmental harm, it is cumulative emissions rather than annual emissions that matter.[828] This is because it takes millennia for the carbon from coal burning to be removed from the atmosphere. This indicates that in assessing the "environmental harm" of the mine under the EPA and the "adverse environmental impact" of the mining operations under the MRA, it is the cumulative emissions of the mine over its 30-year life that should be considered rather than its annual emissions that are to be reported under the NGER Act.

783. The scope 1, 2 and 3 emissions associated with the extraction, transport and combustion of coal from this mine over its proposed life span are assessed by the Applicant's own

[822] Exhibit 51; OL030 (*Great Barrier Reef Region Strategic Assessment*, GBRMPA (2014)) p 11-6.
[823] Exhibit 33; JR006 (Climate Change Joint Experts Report) pages 4-5, paras 7-9.
[824] Exhibit 12; OL014 (Prof. Hoegh-Guldberg's Climate Change & GBR Expert Report) paras 39-42.
[825] Exhibit 12; OL014 (Prof. Hoegh-Guldberg's Climate Change & GBR Expert Report) para 43.
[826] Exhibit 12; OL014 (Prof. Hoegh-Guldberg's Climate Change & GBR Expert Report) para 43.
[827] Exhibit 12; OL014 (Prof. Hoegh-Guldberg's Climate Change & GBR Expert Report) para 46.
[828] Exhibit 33; JR006 (Climate Change Joint Experts Report) p 6, para 10.

expert, Dr Taylor, at 4.73 billion tonnes of CO_2.[829] The scope 3 emissions from burning the coal represent over 98% of this total, at 4.64 billion tonnes of CO_2.[830] This represents one of the highest levels of emissions associated with a single project anywhere in the world.[831] It represents a staggering 0.53–0.56% of the *global* carbon budget that remains after 2015 to have a likely chance of not exceeding 2°C warming.[832] Professor Hoegh-Guldberg considered these emissions represent "a very significant contribution to the impacts being felt on the Great Barrier Reef".[833]

784. All of these emissions will have a climate impact in the physical cause-and-effect sense.[834] That climate impact will damage Queensland's environment generally and the Great Barrier Reef specifically.

785. The Climate Change Joint Experts Report notes that the calculated cumulative emissions associated with the project should be seen as a "worst case" because the "fundamental question" is whether those emissions would occur even if the mine does not go ahead.[835]

786. The climate experts agreed that exploitation of current proven reserves of coal could result in emissions which would vastly exceed 2°C warming, unless carbon capture and storage becomes viable[836] (which none of the experts considered likely in the foreseeable future). A/Prof. Meinshausen built slightly on the agreed propositions in the joint report with reference to recent research that indicates that 93% of the 83 billion tonnes of coal in the OECD Pacific Region, which includes Australia, is unburnable and should remain in the ground to meet the 2°C target even if carbon capture and storage becomes viable.[837] However, while the 2°C target is a major international goal and the carbon budget for it provides a useful reference point to gauge the enormous scale of the emission associated with the proposed Carmichael mine, it is not a point where the impacts of the mine begin or stop. The uncontested evidence of Professor Hoegh-Guldberg is that even current levels of atmospheric CO_2 are highly damaging to the Great Barrier Reef and continued emissions will contribute to a continuum of damage that is expected to be punctuated by currently unknown "tipping points" or "breakpoints" where sudden and catastrophic decline will occur.[838]

787. These agreed and uncontested propositions give rise to both legal and evidential questions.

788. In relation to "impacts" under the MRA, while this appears to contradict the approach taken in the *Xstrata* case,[839] the Court held in the *Alpha* case that the "the public right and interest" necessarily includes a consideration of the indirect impacts of a mine

[829] Exhibit 33; JR006 (Climate Change Joint Experts Report) p 8, para 17.
[830] Exhibit 33; JR006 (Climate Change Joint Experts Report) p 8, para 17.
[831] Exhibit 33; JR006 (Climate Change Joint Experts Report) p 10, para 22.
[832] Exhibit 33; JR006 (Climate Change Joint Experts Report) p 9, para 18.
[833] Exhibit 12; OL014 (Prof. Hoegh-Guldberg's Climate Change & GBR Expert Report) para 52.
[834] Exhibit 33; JR006 (Climate Change Joint Experts Report) p 7, para 12.
[835] Exhibit 33; JR006 (Climate Change Joint Experts Report) p **7**, para 12.
[836] Exhibit 33; JR006 (Climate Change Joint Experts Report) p 8, para 16.
[837] Exhibit 35; OL013 (A/Prof. Meinshausen's Climate Change Expert Report) para 3, with reference to Exhibit 121; OL069 (McGlade and Ekin's paper).
[838] Exhibit 12; OL014 (Prof. Hoegh-Guldberg's Climate Change & GBR Expert Report) paras 34-47, especially para 38.
[839] *Xstrata* case [2012] QLC 013; (2012) 33 QLCR 79.

through the burning of coal produced by it contributing to climate change.[840] As set out above, we submit that these indirect impacts are relevant to consider under the MRA both when considering "adverse environmental impact" and "the public right and interest".

789. Similarly, it is submitted that environmental harm likely to be caused by the greenhouse gases produced by the mining, transport and use of the coal obtained from the mine is clearly harm which is a "direct or indirect" result of the mining activities as comprehended by s 14 of the EPA. It follows, therefore, that the fact that a decision to approve an environmental authority for the mine would authorise that "environmental harm" requires the Court to consider the contribution that the mine would make to climate change through the mining, transport and use of the coal from the mine.

790. If those submissions are accepted then the issue of whether the impact of the emissions are to be considered – as a matter of law – on a net change basis will become live. As set out above, the First Respondent submits that whether someone else will supply an equivalent amount of coal if this mine is not approved is an irrelevant consideration. What matters for the purposes of the MRA and the EPA is the *positive contribution* to the harm caused by the relevant activity on a physical cause-and-effect basis.

791. In the alternative, the First Respondent also challenges the previously accepted proposition that, because the thermal coal market is "demand driven", if this mine does not go ahead then an equivalent amount of coal will be supplied from elsewhere and consumption (and therefore emissions) will remain the same. Evidence from Mr Tim Buckley (energy markets analyst) and from Dr Richard Dennis (economist) indicates that this proposition is at odds with conventional economics. The expected impact of an increase in supply of a commodity is a price reduction resulting in a movement of the demand curve leading to increased consumption. The impact of supply on the price of commodities is currently seen both in relation to oil and iron ore. There is no reason for coal to be excluded from the application of conventional economics. There is no reason not to expect that this effect will manifest in the case of this mine, particularly given that it is estimated to increase world seaborne thermal coal supply by between 3.7% and 6%.[841] This evidence is examined in more detail below in the context of economics, thermal coal markets and the financial viability of the project.

[840] *Alpha* case [2014] QLC 12 at [218].
[841] Exhibit 38; OL015 (Mr Buckley's First Energy Demand & Financial Analysis Expert Report) soft page 26, section 3.1.

ECONOMICS

Outline

792. Until January 2015, the Applicant relied on apparently substantial economic benefits from the Project presented in the EIS for each preceding stage of assessment.

793. Key claims included around 10,000 jobs generated by the mine[842] and around $22 billion and State taxes and royalties.[843]

794. After being pressed by experts called by the First Respondent in these proceedings, the expert called by the Applicant, Dr Fahrer, candidly admitted that "the benefits of this project are not about jobs"[844] and would produce "not many jobs"[845] being a net increase of only 1,206 jobs in Queensland. The royalties were ultimately recalculated at $7.8 billion real Australian dollars over 30 years, the present value[846] of which would be approximately $3.8 to $4.8 billion if the Applicant's low discount rates are applied. If more standard discount rates are applied, or if coal prices remain at or near current prices, then the value of royalties would be lower still.

795. The economic modelling relied on by the Applicant in every step until these proceedings should be discarded as deficient with significant recognised shortcomings. Any conclusions of regulators based on these assessments should be – at best for the Applicant – treated with great caution.

796. The two new economic models presented by the Applicant in response to questions from the First Respondent expert both suffer from unreliable input data and profoundly unrealistic assumptions. When plausible inputs and assumptions are substituted in, there is a strong likelihood that the economic impact of this mine will be negative for Australia and for Queensland. At best for the Applicant this mine is, in the words of the Applicant's expert Mr Stanford, "an extremely risky project".[847]

797. The input data is contained in Attachment B to Dr Fahrer's report[848] and was largely provided by the Applicant, including:

    (a) expected coal prices, which are the central determinant of revenue and profit yet are contrary to current and futures prices supplied by the market;

    (b) royalties calculated on those artificially high prices; and

    (c) corporate tax estimates that do not appear to account for deductions for interest costs, depreciation or use of offshore trading hubs.

798. For each of these data inputs there was no witness who could justify or stand by those numbers. Mr Lezar and Mr Gupta from the Applicant could not answer basic questions about them and Dr Fahrer accepted them on face value without applying a critical eye.

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[842] MR158 (SEIS, Volume 4, Appendix E – Economic Assessment Report) soft page 30, Table 9.
[843] Exhibit 110; OL062 (Extract from Adani's Website); Transcript 15-44, line 14 (Mr Gupta).
[844] Transcript 16-42, line 15 (Dr Fahrer).
[845] Transcript 16-42, lines 20-26 (Dr Fahrer).
[846] Present value is explained by Dr Denniss at Transcript 17-37 from line 36.
[847] Transcript 19-57, line 21.
[848] Exhibit 43; AA006 (Dr Fahrer's First Economic Assessment Expert Report).

Given the pivotal nature of those assumed inputs to the calculated benefits of the project, very little reliance can be placed on purported benefits so derived.

799. Assumptions in the computable general equilibrium (**CGE**) model include, critically, that there would be perfect substitution of other coal supplies with no price effect. The rationale for constraining conventional economics in this way remains unclear and is contradicted by other witnesses, including Mr Stanford for the Applicant.

800. This choice of assumptions guarantees the unrealistic conclusions that opening the largest coal mine in Australia:

(a) will not increase the supply of thermal coal markets; and

(b) will not reduce coal prices.

801. These unrealistic conclusions are, in turn, essential for the applicant to maintain the fiction that this mine will not increase coal consumption (and therefore greenhouse gas emissions) and that it will not negatively affect other Australian coal miners who are already at a breaking point on today's prices.

802. What the Applicant should have modelled is that this mine will – as all new mines before it have done – increase the supply of coal, reduce the price of thermal coal and increase consumption. If consumption increases, then more carbon will be emitted into the atmosphere. When price decreases, the claimed economic benefits of this mine to Queensland risk turning into actual economic losses.

803. The energy markets are undergoing structural change with energy efficiency, pollution regulation and technology presenting an existential threat to the thermal coal export industry. With high prices unlikely to ever return, there is a real risk the project will become unviable within the 30 year lease period currently sought, if it is not unviable already.

804. The relevant experts agreed that thermal coal prices have been in decline over the last four years. An inflection point is coming after which there will be structural decline, In reality it may already have been reached. The experts differ only as to **when** the inflection point will occur and thus when the existential threat to thermal coal exports will realise. The experts at least agree that it will be within the life of the project.

805. Mr Buckley also gave evidence that this project is financially unviable. His analysis was not based on his view that thermal coal is currently in structural decline. It was based instead on conservative assumptions about the future coal price and the costs of winning coal from this mine.

806. No witness was nominated opposite Mr Buckley in respect of the financial viability of the project although Mr Stanford admitted in cross-examination that "… this is an extremely risky project … everybody knows that, I admit that."[849] Mr Buckley's conservative estimates of future demand and price demonstrated a real risk that this mine is financially unviable and will become a stranded asset if it is constructed at all.

[849] Transcript 19-57, lines 21-22. See also Transcript 19-57, line 20 to 19-58, line 11.

807. If the likely risk that this mine will become a stranded asset comes to pass then significant environmental harm is certain with economic benefits unrealised.

Economic benefits

Predictions of the EIS analysis are deficient and unrealistic

808. Before these proceedings commenced the Applicant relied on the assessment of economic benefits contained in the EIS Documents based on an Input/Output (I/O) analysis.[850]

809. This analysis of economic benefits was relied on for each preceding stage of assessment, including by the Coordinator-General[851] when concluding "the project would deliver substantial economic benefits".[852]

810. Once these claims of economic benefits were challenged in these proceedings, the expert nominated by the Applicant, Dr Fahrer, agreed that:

(a) "The economic assessment methodology relied upon in the Environmental Impact Statement documents is deficient";[853]

(b) "Input/Output modelling has significant recognised shortcomings";[854] and

(c) "it is likely to have overestimated the employment benefits".[855]

811. Dr Fahrer acknowledged that the use of I/O analysis for project assessment was not accepted by economists by and large,[856] who had known about the short comings for 'a really long time',[857] but that the use of I/O had been accepted by Courts,[858] at least until recently in NSW.[859]

812. Dr Fahrer described the choice by GHD to undertake I/O analysis for the 2012 EIS as follows:

> It's a choice that I think was standard for in the evaluation of mining projects at the time that GHD made the – did their studies. As you said, the courts didn't seem to have any problems with it. Now, people like me have been saying for a long time that you should be using CGE modelling, not input-output modelling. The evolution of analysis in these contexts seems to have reached a stage where CGE modelling is accepted, or at least accepted compared to input-output modelling. And I think that's a good thing. So before we condemn GHD, we have to – you have to look at what was accepted in the context of

[850] See, e.g., MR158 (SEIS, Volume 4, Appendix E – Economic Assessment Report).
[851] See, for example, Exhibit 6(a); SP001.12 (Coordinator-General's Report) soft page 205, section 5.1.9.
[852] Exhibit 6(a); SP001.12 (Coordinator-General's Report) soft page 348, s 9 (Conclusion),
[853] Exhibit 41; JR003 (I/O Economic Assessment Joint Experts Report) Table 1, issue 103.
[854] Exhibit 41; JR003 (I/O Economic Assessment Joint Experts Report) Table 1, issue 105.
[855] Exhibit 41; JR003 (I/O Economic Assessment Joint Experts Report) Table 1, issue 106.
[856] Transcript 17-20, lines 1-2.
[857] Transcript 17-28, lines 34-35.
[858] Transcript 17-20, lines 1-2.
[859] *Bulga Milbrodale Progress Association Inc v Minister for Planning and Infrastructure and Warkworth Mining Limited* [2013] NSWLEC 48 [451] and [454] to [463] confirmed on appeal in *Warkworth Mining Limited v Bulga Milbrodale Progress Association Inc* [2014] NSWCA 105**;** *Hunter Environment Lobby Inc v Minister for Planning and Infrastructure (No 2)* [2014] NSWLEC 129 at [461].

> mining assessments at the time that they did their assessment. If it had been me, I wouldn't have done it.[860]

813. Dr Fahrer was instructed that the I/O analysis complied with the Terms of Reference for the Coordinator General's assessment[861] and expressed the view under cross-examination that it "appeared to comply with the Terms of Reference".[862]

814. However, when pressed, Dr Fahrer expressed the view that the I/O analysis only "gives a regulator an idea, an order of magnitude of the economic impact of a project".[863]

815. In any event, compliance or otherwise with the Terms of Reference is irrelevant to the statutory questions that this Court must ask and answer.

816. The Court should place no weight on a form of analysis which the Applicant's own witness considers is deficient, has significant shortcomings, and is likely to overstate the employment benefits. This is particularly so where the Applicant has proffered further forms of economic analysis which their witness considers "more sophisticated … more refined, and in my opinion a more accurate measure of the economic impacts of the project on the economy".[864]

817. The I/O analysis also purported to assess the impact of the project on economic output measured as Gross State Product (GSP) or Gross Regional Product (GRP) (essentially a measure of the value of goods and services produced within a particular geographical area).[865]

818. This type of analysis generates very big numbers but they are apt to mislead. The reason why economic output figures are apt to mislead is because a very large proportion of the increase in economic output in this case will flow immediately offshore to the Applicant's overseas shareholders.[866]

819. It is for this reason that Dr Fahrer used economic output numbers as a component of his assessment of real income rather than as a measure of economic benefit in and of itself.[867] This is because the real income analysis takes account of (i.e. removes) profits that flow offshore.[868]

820. Dr Fahrer repeatedly confirmed, the output of his CGE model is the real income benefits not the economic output numbers.[869]

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[860] Transcirpt, 17-29, lines 1-10.
[861] Exhibit 43; AA006 (Dr Fahrer's First Economic Assessment Expert Report) soft page 69.
[862] Transcript 17-30, lines 12-13.
[863] Transcript 16-7, lines 11-12.
[864] Transcript 16-7, lines 15-18.
[865] Exhibit 41; JR003 (I/O Economic Assessment Joint Experts Report) soft page 2, issue 104. See for example MR158 (SEIS, Volume 4, Appendix E – Economic Assessment Report) Tables 5, 8, 9 and 11.
[866] See Exhibit 43; AA006 (Dr Fahrer's First Economic Assessment Expert Report) 'Net foreign income transfers' in Table 2 on soft page 21.
[867] Transcript 17-24, lines 44-46.
[868] Transcript 17-24, lines 29-31.
[869] Transcript 17-24, line 39 to 17-25, line 13.

821. The EIS economic analysis – as well as using a "deficient" approach to job assessment – also relied on economic output as a measure of benefits without acknowledging (as Dr Fahrer does) that a large proportion of those benefits flow offshore.

In reality "the benefits of this project are not about jobs"

822. One of the unrealistic assumptions of the I/O analysis that led to it overestimating the jobs benefits is the assumption that the labour market is unconstrained,[870] i.e. there is an unlimited pool of skill workers to draw upon.[871]

823. Dr Fahrer explained that the unconstrained labour case "is not realistic, for it effectively assumes labour market conditions associated with a deep recession, but lasting for over 30 years".[872] Under cross-examination Dr Fahrer agreed that it is a situation not seen in modern economies and is wholly unrealistic.[873] As Dr Denniss put it "ten thousand people are not just sitting around hoping someone would – would – would build a mine".[874]

824. Applying the wholly unrealistic assumption of an unconstrained labour market the I/O analysis estimated the number of Queensland jobs generated by the mine alone to be over 10,000 full-time-equivalent (**fte**) jobs per annum at peak operation from 2024.[875]

825. Applying the more realistic case of a partially constrained labour market in his more sophisticated Computable General Equilibrium (**CGE**) model, Dr Fahrer estimates that the Carmichael Coal and Rail Project will increase average annual employment by 1,206 fte jobs in Queensland, and 1,464 fte jobs in Australia.[876]

826. Dr Fahrer agreed that his jobs estimates were an order of magnitude apart from the employment estimates of more than 10,000 in the EIS.[877]

827. Even accounting for the fact that the I/O analysis was based on a 60 million tonne per annum (mtpa) project and Dr Fahrer analysed a 40 mpta project, Dr Fahrer admitted that "it is certainly the case that the 10,000 was estimated using input-output methods and therefore would be too high even if you did it for a 40 megatonne a year mine".[878]

828. Dr Fahrer also agreed that, relative to total employment in Queensland, the increase in jobs from the Project is "very small",[879] emphatically repeating that "[i]t's not many jobs. We can agree on that… Not many jobs… No argument. Not many jobs",[880] and

[870] Transcript 16-14, lines 13-19.
[871] Exhibit 41; JR003 (I/O Economic Assessment Joint Experts Report) Table 1, issue 105(a).
[872] Exhibit 43; AA006 (Dr Fahrer's First Economic Assessment Expert Report) soft page 28, para 82.
[873] Transcript 16-40, lines 14-20.
[874] Transcript 17-39, lines 9-35.
[875] MR158 (SEIS, Volume 4, Appendix E – Economic Assessment Report) p 30, Table 9. See also Exhibit 45; OL022 (Dr Denniss' CGE & CBA Analysis Expert Report) page 2, section 1.4.
[876] Exhibit 43; AA006 (Dr Fahrer's First Economic Assessment Expert Report) soft page 24, para 68.
[877] Transcript 17-31, line 37.
[878] Transcript 17-28, lines 25 -27.
[879] Transcript 16-42, line 14.
[880] Transcript 16-42, lines 20-26.

going so far as to say "again, the benefits of this project are not about jobs; they're about incomes".[881]

829. We will address incomes in more detail below but, given the concessions of the Applicant's own witness, the Court cannot safely rely on the very small jobs benefits as a matter of significant weight to counter balance the environmental impacts of the Project.

Two new economic analyses remain dependent on input data and assumptions

830. In response to the shortcomings of the I/O analysis, the Applicant produced two new economic models: a Computable General Equilibrium (CGE) model and Cost Benefit Analysis (CBA).

831. As Dr Denniss explained, the results of an economic model revolve around two things:

(a) the data that you "pour into the model"; and

(b) the assumed relationships between variables within the model.[882]

832. If either the input data or assumptions are unrealistic then the model results are likely to be unrealistic.

833. The two new models prepared by the Applicant have some shared input data[883] which we will deal with first before turning to the unique assumptions of each model.

Analysis of reliability of Applicant's model input data

<u>Estimated royalties are unproven and unreliable</u>

834. Dr Fahrer agreed that "[t]he economic assessment methodology relied upon in the Environmental Impact Statement documents is deficient, in particular it does not estimate royalties or any other fiscal benefits to the state".[884]

835. The Applicant's website asserts that the Project would generate "around $22 billion in state mining taxes and royalties in just the first half of the project life".[885] However the Applicant's head of tax, Mr Gupta,[886] said that, contrary to the website, the $22 billion figure included income tax, GST[887] and corporate tax[888] and was calculated by "an independent expert"[889] approximately 12 to 18 months earlier.[890] No witness in these proceedings attested to the $22 billion figure or anything coming close to it.

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[881] Transcript .16-42, lines 15-16.
[882] Transcript 17-36, line 45-47.
[883] Exhibit 43; AA006 (Dr Fahrer's First Economic Assessment Expert Report) Attachment B (Table B1 – Data used in CGE analysis and CBA) soft page 60.
[884] Exhibit 41; JR003 (I/O Economic Assessment Joint Experts Report) issue 103(c).
[885] Exhibit 110; OL062 (Extract from Adani's Website).
[886] Transcript 14-70, lines 30-44.
[887] Transcript 15-45, lines 30-34.
[888] Transcript 15-44, lines 33-36.
[889] Transcript 15-44, lines 33.
[890] Transcript 15-45, lines 25.

836. The documents submitted with the mining lease application in 2010 stated "Estimated benefits to the State Government of Queensland - royalty payments in excess of $20 billion generated"[891] but Mr Gupta could not assist with that number[892] and no witness was called in support of it.

837. After these proceedings commenced, the Applicant's Mining Operations Head, Mr Lezar, affirmed to assist this Court in determining whether public right and interest will be prejudiced, that "It is estimated that the royalties payable to the State over a period of 30 years is approximately $14.19 billion".[893]

838. However under cross-examination, Mr Lezar could not answer whether that estimation was in real or nominal terms, whether it was discounted to present day value and could not even be sure whether it was in Australian or US dollars.[894] Mr Lezar explained "[t]hat's the number I received from the financial department… I have not generated it. I've asked for it, and they've provided it to me".[895]

839. Later in the trial the Applicant's Group Financial Controller, Mr Gupta, confirmed that the number provided to Mr Lezar came from one of his team members.[896] Mr Gupta believed the figure was in US dollars but could not be 100% sure.[897] Mr Gupta could not remember if the number was real or nominal.[898] Mr Gupta believed it was an undiscounted number,[899] but could not assist the Court with what the discounted number would be,[900] or why it differed from the estimation of royalties presented by Dr Fahrer.[901]

840. Mr Gupta did agree, however, that the royalties provided to Dr Fahrer were the best estimate that the Applicant currently makes.[902]

841. The royalties presented in Attachment B to Dr Fahrer's report are expressed in real Australian dollars and sum to $7.845 billion.[903] The source of those royalties is expressed in Dr Farher's report to be "Source: data coal volumes, prices, capital expenditure, operating expenditure, selling costs and **royalties** provided by Adani".[904]

842. Dr Fahrer clarified in cross-examination that the royalties were calculated based on information he was given by the Applicant, estimates in US dollars nominal per tonne,[905] by multiplying them by the volume of coal and then converting them to the

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[891] MR010 (Application for Mining Lease) soft page 63.
[892] Transcript 15-41 to 15-43.
[893] Exhibit 4; AA005 (Mr Lezar's Second Affidavit) soft page 25, para 112.
[894] Transcript 1-67, lines 25-33.
[895] Transcript 1-67, lines 17-21.
[896] Transcript 15-37, line 24.
[897] Transcript 15-37, lines 34-35.
[898] Transcript 15-37 line 39 to 15-38, line 39.
[899] Transcript 15-38 line 10.
[900] Transcript 15-30, lines 10-19.
[901] Transcript 15-40.
[902] Transcript 15-42, lines 22-24.
[903] Exhibit 43; AA006 (Dr Fahrer's First Economic Assessment Expert Report) Attachment B, soft page 60-61, column 14 (Royalties).
[904] Exhibit 43; AA006 (Dr Fahrer's First Economic Assessment Expert Report) Attachment B, Notes on soft page 61. [*Emphasis added*]
[905] Transcript 16-22, lines 20-24.

real Australian dollar figures presented in his report.[906] But Dr Fahrer agreed that he did not know how the Applicant did the calculation of royalties in the figure he was provided, he just accepted the data as it was given.[907]

843. The royalties presented in Dr Fahrer's Attachment B were not discounted to present day value. Dr Fahrer agreed that "if we want to understand … that number, $7.845 billion in royalties, as a component of the outputs of [his] CGE model, we need to discount its present-day value".[908]

844. Applying the discount rates of 2.8% and 4.3% from Dr Fahrer's own report, Dr Fahrer did not disagree that the present day value of the royalties expressed in his report would be approximately $4.8 billion and $3.8 billion respectively.[909]

845. There are both Commonwealth[910] and New South Wales[911] guidelines for setting discount rates which Dr Fahrer chose not to follow. If the standard discount rates from the NSW guidelines of 7% and 10% were used, Dr Fahrer did not disagree that this would result in royalties of net present value of $2.56 billion[912] and $1.74 billion[913] respectively. Dr Fahrer did not choose to use those discount rates himself and did not even reference them in his Reports in order to explain why he had chosen not to use them.

846. The royalties are also calculated on the basis of coal prices[914] and are highly dependent on it. Mr Gupta indicated that the royalties given to Dr Fahrer were calculated on the coal prices given to Dr Fahrer.[915]

847. Mr Gupta agreed that if coal prices were lower the royalties would be lower[916] and, conversely, Dr Fahrer agreed that the royalties calculations would be too high if the Applicant's estimated coal price was too high.[917]

848. We will consider the impact of misestimating coal prices below, but for the purposes of royalties it is significant that no witness was provided to confidently attest to the accuracy of the royalty figures provided to this Court, and the figures that were provided rapidly evaporated once tested in cross-examination.

849. For these reasons, little reliance can be placed by the Court on the royalty figures provided by the Applicant.

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[906] Transcript 16-29, lines 17-28.
[907] Transcript 16-30, line 25-27.
[908] Transcript 16-29, lines 36-38; See also Transcript 16-30, lines 1-3.
[909] Transcript 16-29, lines 40-47.
[910] Exhibit 113; AA057 (Commonwealth Handbook of Cost Benefit Analysis 2006).
[911] Exhibit 114; AA058 (NSW Guidelines for Cost Benefit Analysis).
[912] Transcript 17-23, lines 33 to 17-24, line 2.
[913] Transcript 17-24, lines 7-9.
[914] Transcript 15-41, line 16.
[915] Transcript 15-41, line 21.
[916] Transcript 15-41, line 32-34.
[917] Transcript 16-30, line 30-31.

Coal prices are unjustified and unrealistically high

850. Two estimates of coal prices for the product coal over the life of the project were provided in evidence to this Court:

(a) those provided by the Applicant to Dr Fahrer and presented in Attachment B to his report;[918] and

(b) those estimated by Mr Buckley following the process set out in section 1.2 of his Supplementary Expert Report and presented in his Attachment A.[919]

851. The Applicant's prices were apparently derived from a Wood Mackenzie analysis[920] but this analysis was not disclosed and no expert from Wood Mackenzie was called to explain how they were derived. Mr Gupta could not assist the Court with those prices[921] and Dr Fahrer admitted in cross-examination that all he did was receive and rely on those prices.[922] Dr Fahrer had viewed the Wood Mackenzie spreadsheet[923] but he did not know how Wood Mackenzie arrived at its prices.[924] He later conceded under cross-examination that at least the nominated Adani price for 2017 is "probably high".[925]

852. Dr Fahrer repeatedly volunteered in cross-examination that he is not an expert in coal markets or coal prices.[926] He was not nominated in that area and did not participate in the joint meeting on that issue.[927] Nonetheless, Dr Fahrer was critical of Mr Buckley's price estimates, asserting that Mr Buckley's price from 2021 onwards was 40% below the current Newcastle benchmark price for high quality coal.[928]

853. The core of Dr Fahrer's critique was based on the misapprehension that Mr Buckley had derived his estimates based on an assumption of a structural decline in the world market for coal.[929] He did not.

854. When Dr Fahrer was taken through each of the five steps actually applied by Mr Buckley to derive the coal price estimate, independent of any views of structural decline, Dr Fahrer agreed, or lacked the expertise to disagree, with each of those steps.[930] In particular:

(a) Mr Buckley relied on the futures prices for the Newcastle high quality benchmark out to 2021 and Dr Fahrer agreed that "there isn't anything better" as a predictor of the future price of coal.[931] The futures price relied on at the time by Mr Buckley for

[918] Exhibit 43; AA006 (Dr Fahrer's First Economic Assessment Expert Report) Attachment B, Column 4 (Coal Price $A real AFY2014-15).
[919] Exhibit 39; OL021 (Mr Buckley's Supplementary Energy Demand & Financial Analysis Expert Report) soft pages 5 and 12.
[920] Transcript 15-33, line 6; Transcript 16-50, lines 43 – 46; Transcript 16-54, lines 26-29.
[921] Transcript 15-33, line 9.
[922] Transcript 16-46, line 13.
[923] Transcript 16-54, lines 26-29.
[924] Transcript 16-57, lines 32-33.
[925] Transcript 16-57, line 8.
[926] Transcript 16-49, lines 17-18; Transcript 16-47, line 7; Transcript 16-50, line 2; Transcript 16-57, line 37.
[927] Transcript 16-46, lines 21 and 37-42.
[928] Exhibit 44; AA016 (Dr Fahrer's Second Economic Assessment Expert Report) soft page 18, para 78.
[929] Exhibit 44; AA016 (Dr Fahrer's Second Economic Assessment Expert Report) soft page 18, para 79.
[930] Transcript 16-49, line 23 to 16-50, line 40.
[931] Transcript 16-49, line 45; Transcript 16-51, line 1.

2021, US$64.55 nominal, is conservative when compared to more recent future prices for 2021 under US$60.[932]

(b) Mr Buckley converted the US nominal futures prices to real prices using an inflation rate of 2.5%, which Dr Fahrer agreed is exactly what he himself did.[933]

(c) Mr Buckley extended the 2021 prices flat in real terms for the life of the mine, and Dr Fahrer agreed this was a similar trend to the Applicant's prices[934] which peak in 2030 and then finally drop below the 2017 starting price.

(d) Mr Buckley applied a 30% discount from the Newcastle high quality benchmark to reflect the low quality of the Carmichael coal (4,950 kcal NAR and 26% ash)[935] relative to the high quality benchmark (6,000 kcal NAR and 12-14% ash).[936] The Applicant admits that some discount from the benchmark to reflect the low quality of Carmichael coal is reasonable.[937]

(e) Mr Buckley then converted the prices to Australian dollars using the current exchange rate of 0.78, which Dr Fahrer agreed was more beneficial to the Applicant than the 0.85 exchange rate Dr Fahrer applied.[938]

855. Dr Fahrer's central criticism appears to be that, despite Mr Buckley's assumption of flat prices from 2021 being similar to the trend assumed by the Applicant, he would have preferred a supply and demand analysis from someone who knows the world coal market, he admitted that this was not him and he did not know if it was Mr Buckley.[939]

856. In fact, it is Mr Buckley.

857. In September 2014, Mr Buckley participated in global supply and demand analysis of the kind Dr Fahrer sought as referenced in his First Individual Report.[940] This work was done in conjunction with Wood Mackenzie and Mr Buckley confirmed that he continues to have access to the Wood Mackenzie database.[941]

858. In contrast to Mr Buckley's extensive expertise and the rigorous analysis underpinning his coal price estimates, no witness was proffered in direct support of the coal prices presented by the Applicant.

859. Dr Fahrer, despite his lack of expertise in the area and unquestioning acceptance of the figures provided by the Applicant, opined in his joint report with Dr Denniss that he had

[932] Exhibit 135; OL073 (E-Signal Newcastle Coal Futures Printout).
[933] Transcript 16-50, line 20.
[934] Transcript 16-48, line 30.
[935] Transcript 1-64, line 43.
[936] Exhibit 8; AA013 (Mr Lezar's Third Affidavit) soft page 4, para 14(b).
[937] Exhibit 8; AA013 (Mr Lezar's Third Affidavit) soft page 4, para 15.
[938] Transcript 16-50, line 38.
[939] Transcript 16-51, lines 15-30
[940] Exhibit 38; OL015 (Mr Buckley's First Energy Demand & Financial Analysis Expert Report) soft page 17, footnote 61, and soft page 27, footnote 89.
[941] Transcript 20-7, lines 24-32. See also Transcript 20-81, line 47 to 20-82, line 4.

reviewed the source of the coal prices and satisfied himself that a reasonable methodology was used.[942]

860. However he admitted in cross-examination that "I don't know how Wood Mackenzie arrives at its prices"[943] and did not apply the same critical eye to those prices as he did to those provided by Mr Buckley.[944] Dr Fahrer simply took the prices provided by the Applicant and assumed that they were the best estimate that could be made.[945]

861. In particular, Dr Fahrer did not remark until it was pointed out to him that the discounted price provided by the Applicant for 2017 of US$78.67[946] was already 20% above the Newcastle high quality benchmark he identified in his February report (for the purpose of criticising Mr Buckley) of US$65.79. Dr Fahrer agreed that the 2017 discounted price provided by the applicant must reflect an even higher undiscounted price for the Newcastle high quality benchmark price,[947] and is "probably high".[948] Dr Fahrer also agreed that since his February report, coal prices have fallen further to a benchmark of about US$60,[949] which is 30% below than the Applicant's undiscounted price for 2017.[950]

862. It is submitted that the Applicant's coal price estimates should be rejected, and Mr Buckley's estimates preferred, considering:

(a) Dr Fahrer's professed lack of expertise in the area;

(b) Dr Fahrer's uncritical acceptance of the Applicant's coal prices; and

(c) the lack of any other witness proffered in support of the Applicant's figures.

863. Mr Buckley's more realistic coal prices have significant consequence for all of the Applicant's asserted economic benefits, in particular, lower coal prices;

(a) reduce the royalty estimates as discussed above;

(b) reduce the gross income for the project and consequential benefits estimated by the CGE model, as discussed below;

(c) reduce any marginal profits and therefore any corporate tax payable, as discussed below;

(d) render the net result of the CBA negative rather than positive, as discussed below; and

[942] Exhibit 42; JR008 (CGE & CBA Economic Assessment Joint Experts Report) soft page 10, issue 119.
[943] Transcript 16-57, lines 32 -33.
[944] Transcript 16-43, line 46 to 16-44, line 3; Transcript 16-55, line 16.
[945] Transcript 16-54, lines 2-3.
[946] Exhibit 43; AA006 (Dr Fahrer's First Economic Assessment Expert Report) Attachment B, Column 3 (Coal Price $US nominal).
[947] Transcript 16-54, line 47.
[948] Transcript 16-57, line 8.
[949] Transcript 16-55, lines 20 and 39.
[950] Transcript 16-56, line 12 -13.

(e) diminish any prospects of financial viability, as discussed below.

Corporate tax does not account for deductions or tax havens

864. The input data to the CGE and CBA models includes and estimation of corporate tax in the far right column (column 15) of Attachment B to Dr Fahrer's first report.

865. Mr Gupta initially said he did not know whether these figures were provided by the Applicant or Dr Fahrer[951] but later agreed that the inputs were given to Dr Fahrer by the Applicant.[952]

866. Despite being the Group Financial Controller responsible for compliance with tax requirements,[953] and agreeing that corporate tax is a key budget line which was incorporated in the Applicant's internal financial model, Mr Gupta could not comment on the corporate tax numbers displayed in Dr Fahrer's report.[954]

867. In particular, Mr Gupta was not sure if borrowing costs (the interest costs on financing) were included in the costs provided to Dr Fahrer, although he assumed they were not.[955]

868. Similarly, Mr Gupta could not verify whether the costs provided to Mr Buckley included depreciation but offered the general comment that "if the capital expenditures have been already considered, depreciation should not have been included in the operating expenditure".[956]

869. Mr Gupta also made it clear that the Applicant would be "optimising tax".[957] While he initially could not comment on the use of "trading hubs",[958] he did admit that the Applicant's parent entity in Singapore, Adani Global Private Limited, would do coal trading[959] and that Singapore generally has lower tax rates,[960] reported in the accounts for Adani Global Private Limited as 5 to 17 %.[961]

870. When Mr Gupta was taken directly up the Adani corporate structure to the next holding company, Adani Global Limited in Mauritius, which Mr Buckley describes as a tax haven, Mr Gupta professed not to have any idea what that company does.[962]

871. After Mr Gupta had given evidence, Dr Fahrer revealed in oral evidence that, although the Applicant had not been listed as the source for that data, he had indeed received from the Applicant an estimate in nominal US dollars per tonne of corporate tax to be

[951] Transcript 15-26, lines 1–4. Transcript 15-35, lines 15 -16.
[952] Transcript 15-36, lines 9–12 and 23.
[953] Transcript 14-70, line 41.
[954] Transcript 15-35.
[955] Transcript 15-34, lines 24–27.
[956] Transcript 15-35, lines 5-7.
[957] Transcript 15-47, lines 10-11 and 41.
[958] Transcript 15-48, line 18. Compare however with 15-50, line 39.
[959] Transcript 15-48, line 31 to Transcript 15-49 line 11.
[960] Transcript 15-50, line 6.
[961] Transcript 15-50, line 25. Exhibit 111; OL062 (Adani Global Pte Ltd Financial Statements).
[962] Transcript 15-51, line 12.

paid, which he converted to real Australian dollars accordingly.[963] He did not enquire as to how it was derived.[964]

872. Mr Buckley calculated that the data provided by Dr Fahrer suggests an average corporate tax rate of 32% which makes no allowance for deductible depreciation or borrowing costs,[965] and does not take into account "Adani Group's current tax minimisation strategies including the financing structure of the Australian entities and the creation of a number of legal entities in offshore tax havens".[966] On that basis, Mr Buckley is of the opinion that deductions were not made for borrowings costs, depreciation, or 'tax optimisation' through trading hubs.

873. Dr Fahrer agreed that the figures as presented would sum to $9.967 billion in real Australian Dollars.[967] He also agreed it would need to be discounted to present day value[968] and did not disagree that at his discount rates of 2.8 and 4.3 per cent the present values of corporate taxes would be $5.989 billion and $4.468 billion respectively.[969] Dr Fahrer also did not disagree with the figure of $3.037 billion if the more standard discount rate of 7% was applied.[970]

874. Whatever the figure, Dr Fahrer agreed that only about 20% of those federal taxes would be spent in Queensland.[971] Depending on the discount rate this comes to between $1.19 Billion and $607 Million, recalling that the project extends over 30 years.

875. No reliance should be placed on corporate tax figures provided by the Applicant as:

(a) no witness was proffered in direct support of the calculations;

(b) the calculations do not appear to take into account potentially significant deductions for borrowing costs, depreciation or 'tax optimisation' measures; and

(c) the numbers rapidly deflated once tested in cross-examination.

876. We note that Mr Buckley calculates that the Applicant will not pay any tax for the simple reason that he does not expect them to make any profit,[972] as will be discussed below.

<u>Costs are optimistically underestimated</u>

877. Two estimates of project costs were provided in evidence to this Court:

[963] Transcript 16-22, line 40–42. Transcript 16-31, lines 16-17.
[964] Transcript 16-31, line 20.
[965] Exhibit 38; OL015 (Mr Buckley's First Energy Demand & Financial Analysis Expert Report) soft pages 14-15, section 1.4, paras 4 and 5.
[966] Exhibit 38; OL015 (Mr Buckley's First Energy Demand & Financial Analysis Expert Report) soft page 15, section 1.4, para 5, footnote 50.
[967] Transcript 16-31, lines 21–23.
[968] Transcript 16-31, lines 27.
[969] Transcript 16-31, lines 29-38.
[970] Transcript 17-24, lines 11–12.
[971] Transcript 17-24, lines 15.
[972] Transcript 20-31, lines 37–41.

(a) Those provided by the Applicant to Dr Fahrer and presented in Attachment B to his report;[973] and

(b) Those estimated by Mr Buckley following process set out in sections 1.4 to 1.7 of his Supplementary Report,[974] the entirety of his Second Supplementary Report and presented in his Attachment A.[975]

878. Dr Fahrer was critical of Mr Buckley's costs estimates, primarily on the basis that Mr Buckley "appears willing to contradict Adani's own information regarding its costs and the efficiency of its operations".[976]

879. Dr Fahrer lists the Applicant as the source of the "capital expenditure, operating expenditure, selling costs" data inputs listed in his Attachment B[977] however Mr Gupta could provide little assistance to the Court with what was included in selling costs.[978]

880. Dr Fahrer's uncritical acceptance of the Applicant's provided costs was evident in the fact that errors in two of these costs columns were only realised the day before he gave oral evidence, requiring corrections in the witness box[979] and consequential changes to the outputs of his analysis.[980]

881. For one of the columns, column 8 (selling costs), Dr Fahrer had not realised was in US nominal dollars and needed to be converted to real Australian Dollars.[981]

882. The other column, column 6 (operating costs), Dr Fahrer did not realise until the day before his oral evidence that "It's just a nonsense number".[982]

883. In defence of this "nonsense number", among others, Dr Fahrer had earlier been willing to criticise Mr Buckley's contradiction of the estimates provided by the Applicant to Dr Fahrer.[983] Yet it was later revealed that the Applicant appeared willing to contradict its own estimates of the rail and port charges used in its confidential Bankable Feasibility Study with different estimates provided by the Applicant to Dr Fahrer.[984]

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[973] Exhibit 43; AA006 (Dr Fahrer's First Economic Assessment Expert Report) Attachment B, Columns 5 (Capital Expenditure) to 9 (Rail Costs), soft page 60.
[974] Exhibit 39; OL021 (Mr Buckley's Supplementary Energy Demand & Financial Analysis Expert Report) soft pages 5 and 12.
[975] Exhibit 40; OL025 (Mr Buckley's Second Supplementary Energy Demand & Financial Analysis Expert Report).
[976] Exhibit 44; AA016 (Dr Fahrer's Second Economic Assessment Expert Report) soft pages 18-19, paras 82 and 83.
[977] Exhibit 43; AA006 (Dr Fahrer's First Economic Assessment Expert Report) Attachment B, Notes soft page 61.
[978] Transcript 15-34.
[979] Exhibit 43; AA006.1 Corrections to Attachment B to Exhibit 43; AA006 (Dr Fahrer's First Economic Assessment Expert Report).
[980] Exhibit 43; AA006.2 Corrected Tables 5-8 to Exhibit 43; AA006 (Dr Fahrer's First Economic Assessment Expert Report).
[981] Transcript 16-3, lines 5-10.
[982] Transcript 16-45, line 29.
[983] Exhibit 44; AA016 (Dr Fahrer's Second Economic Assessment Expert Report) soft pages 18-19, paras 82 and 83.
[984] Refer to separate sealed submissions.

884. Mr Lezar, for the Applicant, was the only witness proffered to support the mine costs as reasonable[985] however that support must be treated with caution now that one of those costs columns was revealed by Dr Fahrer to be "nonsense" after Mr Lezar had given evidence.

885. Leaving the "nonsense" numbers to one side, the remaining difference between Mr Lezar and Mr Buckley is one of degree. Mr Buckley assumed some cost advantage to the Applicant, as Mr Lezar suggested, from the scale of the operation. However, Mr Buckley granted a generous scale cost advantage of 30% below comparable Australian mines rather than the massive 48% cost advantage implicitly assumed by the Applicant.[986]

886. Considering that significant errors in the Applicant's costs calculations were not identified until the final week of oral evidence, they must be handled with care.

887. It is submitted that the more reliable estimates of costs are those derived from similar operating mines as prepared by Mr Buckley.

Summary of unreliability of input data to Applicants CGE and CBA models

888. In summary the key data inputs to the Applicants CGE and CBA models, as presented in Attachment B to Dr Fahrer's first report, are unreliable. In particular:

(a) **Columns 3 & 4 (Coal price)**: These prices are discounted from a benchmark price that is at least 30% above the current benchmark and no witness was called in support of these prices.

(b) **Columns 5 to 9 (Costs)**: Several costs were revealed to be either in error or nonsense in the final week of evidence and other costs were presented in contradiction to the Applicant's own financial model.

(c) **Column 14 (Royalties)**: The royalties presented in this column contradict statements by the Applicant in the affidavit of Mr Lezar, the application for Mining Lease and publicly on its website. No witness was proffered to support the calculations, they became vanishingly small once discounted to present day values and remain critically dependant on the assumed coal price.

(d) **Column 15 (Corporate tax)**: Only after Mr Gupta's evidence were these figures revealed to have been provided by the Applicant to Dr Fahrer and no witness was proffered in direct support of them. The figures do not, on their face, appear to account for deductions due to borrowing costs, depreciation or 'tax optimisation' through trading hubs.

889. These inputs should be treated with great caution and little reliance placed upon them due to their shifting and unproven nature.

890. Yet the CGE and CBA results depend on these key inputs, for example:

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[985] Exhibit 8; AA013 (Mr Lezar's Third Affidavit) soft page 6, para 24.

[986] Exhibit 40; OL025 (Mr Buckley's Second Supplementary Energy Demand & Financial Analysis Expert Report) soft pages 7-8, sections 1.2.2 to 1.2.6.

(a) the real income estimated by the CGE model includes a distribution of the royalties and taxes;[987]

(b) the royalties are included in the benefits of the project under the CBA;[988] and

(c) the CBA (excluding consumer surplus, which are profits to the operators of coal fired power stations in India and elsewhere) comes out negative at current coal prices.[989]

891. The CBA's dependence on the input data was confirmed by Dr Fahrer being required to correct the outputs of that model after identifying the errors and "nonsense" in his input data identified the day before his oral evidence.

892. As is well known in modelling: 'Garbage In = Garbage Out', so the unreliability of the inputs to the CGE and CBA must translate to unreliability in the modelled estimates of benefits from the project.

Analysis of assumptions in Applicant's CGE model

893. After the input data you "pour into a model", the second key element is the assumed relationships between the variables within the model.

894. The relationships assumed by the modeller for the Applicant's CGE model are highly unrealistic.

<u>Conventional economics would see increased supply increasing consumption and reducing price</u>

895. In conventional economics the price and quantity of a product are determined by the interaction of supply and demand. This was explained by Dr Denniss[990] and Mr Buckley,[991] and accepted by Mr Lezar.[992]

896. This is typically represented as a supply and demand curve.

897. As Dr Denniss explained using Exhibit 117 (copied below) if a producer decides to enter the market then, all other things being equal, the supply curve would shift to the right such that quantity increases (Q_2 to Q_3) and price decreases (P_2 to p).

[987] Exhibit 43; AA006 (Dr Fahrer's First Economic Assessment Expert Report) soft page 23, paras 58 and 59.
[988] Exhibit 43; AA006 (Dr Fahrer's First Economic Assessment Expert Report) soft page 31, para 99.
[989] Transcript 16-93, line 31-34; Transcript 16-94, lines 6-10.
[990] Transcript 17-43, line 37 to 17-44 line 32.
[991] Transcript 20-24, line 14-16.
[992] Transcript 1-66, lines 8-11.

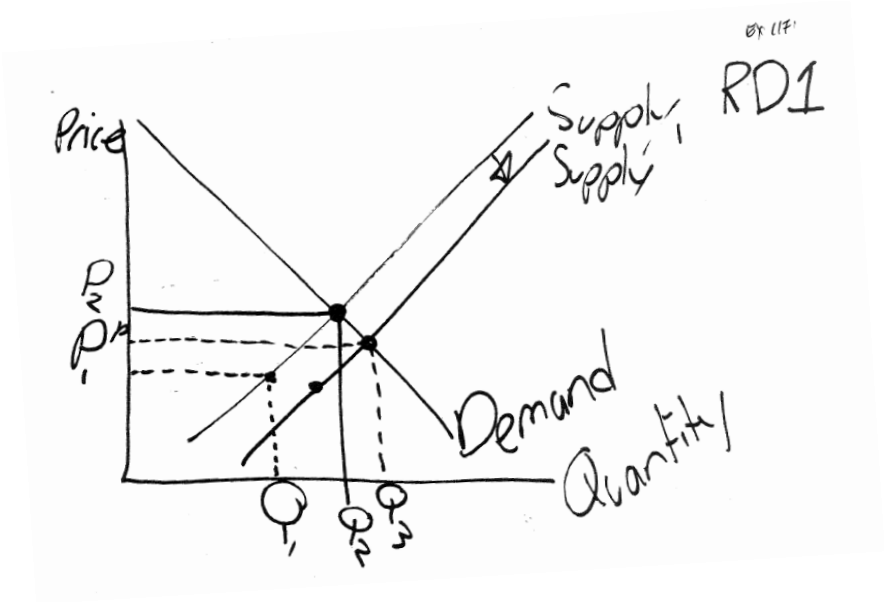
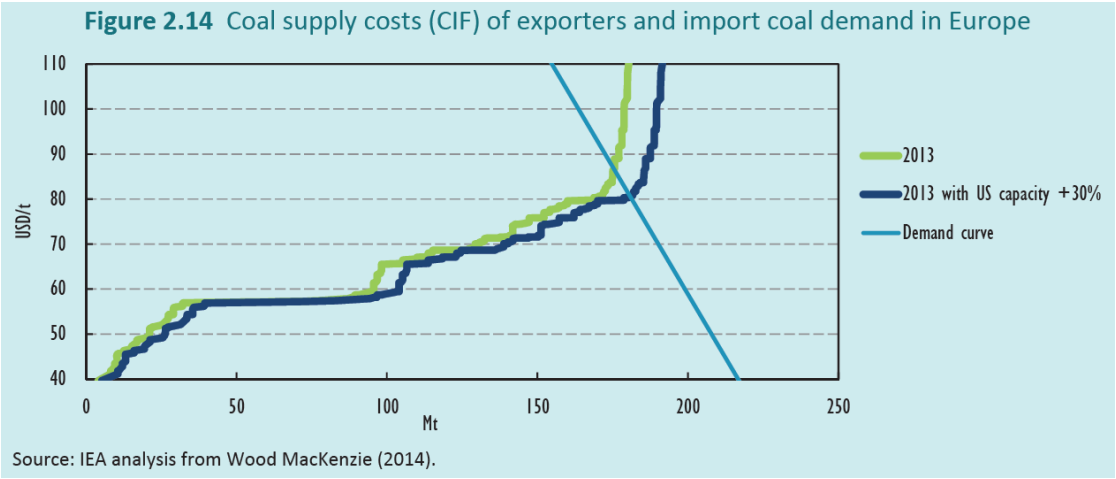


Exhibit 117 (Supply-Demand Curve drawn by Dr Deniss on whiteboard)

898. In the opinion of Dr Denniss[993] and Mr Buckley,[994] coal markets operate like other commodities following conventional economics and are not a special case. In their view the Carmichael coal mine should be considered to increase the world supply of coal.[995] Thus, all other things being equal, the price will go down and quantity consumed will increase.[996]

899. The International Energy Agency (**IEA**), who is heavily relied on by the Applicant's witnesses, uses similar supply and demand curves to analyse the global coal market, for example the following figure from the IEA Coal Medium Term Market Report 2014:[997]



900. There may be consequential or secondary effects, such as the reduction in prices pushing out higher cost producers thereby reducing supply and increasing price again.[998] But

[993] Transcript 17-44, lines 15-20.
[994] Transcript 20-24, lines 14-28
[995] Transcript 17-44, line 15–39; Transcript 20-24, lines 14-28.
[996] Transcript 20-24, lines 14-16.
[997] Exhibit 130; OL071 (IEA Coal Medium Term Market Report (2014)) soft page 58.
[998] Transcript 20-24, lines 39-43.

Dr Denniss argues that these should be modelled separately so as to understand the relative effect of each step.[999]

901. This classical conception of supply and demand is sufficient to make sense of recent price fluctuations in the thermal coal market with supply growth outstripping demand growth, leading to an oversupplied market and falling coal prices over the last four years.[1000]

902. Mr Stanford's response to conventional economics is discussed in more detail below. However, the primary response appeared to be – in effect – that all other things are not equal. In particular, he notes demand does not hold still but can be assumed to continue to increase. This entirely misses the point. As long as the increased supply from this project does not in itself shift the demand curve (which no one has suggested) then the increase in supply from this mine will have the impacts on consumption and price that Dr Denniss and Mr Buckley described.

Applicant's model conflates several assumptions

903. Dr Denniss gave evidence that the foundation of economic analysis is that to try and describe what they observe, economists create models where they change one thing and see how it affects other things.[1001]

904. Dr Fahrer however modelled three changes between the base case and project case simultaneously:

(a) a mine producing 40 megatonnes of coal per annum;

(b) an identical increase in world demand for coal; and

(c) a shift in world preferences to the Carmichael coal over other coal in precisely the quantity of coal that the mine produces. [1002]

905. Dr Fahrer agreed that each of these elements would have separate impacts and could have been separately modelled.[1003]

906. Dr Dennis explained that the result of the choice to not model these effects separately, is to prevent the Court from being able to distinguish the benefits that come from increased demand and the benefits that come from building a new coal mine.[1004]

Applicant's model assumes perfect substitution ("if we don't do it someone else will") of quantity

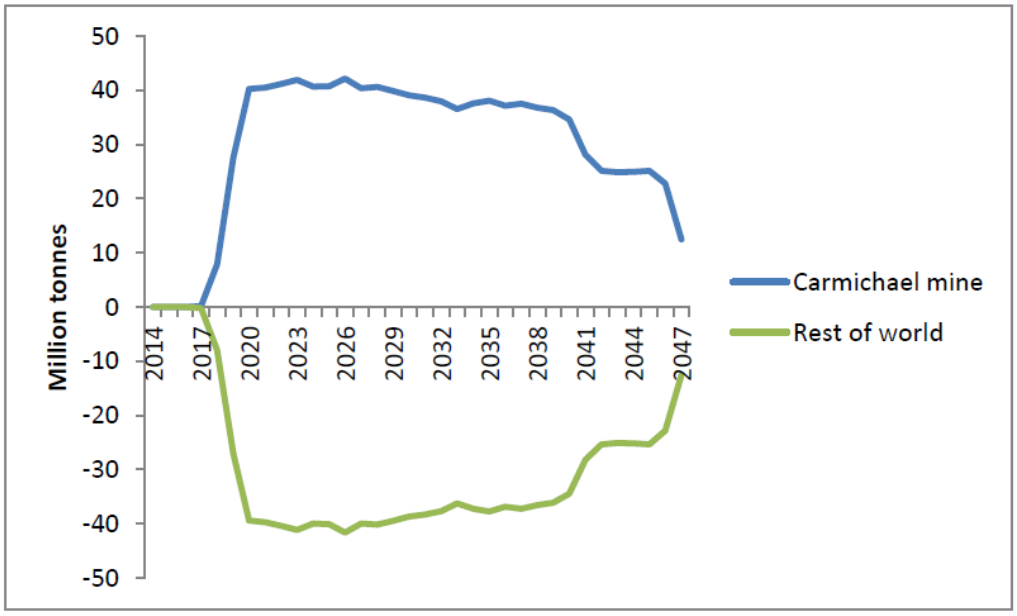
907. The Applicant's model assumes that world demand for coal will increase by 40 megatonnes and that if the mine proceeds it will perfectly substitute an identical supply

[999] Transcript 17-46, line 37-41.
[1000] Transcript 20-22, line 42 to 20-23, line 2.
[1001] Transcript 17-41, line 44 to 17-42, line 1.
[1002] Transcript 17-16, lines 28–38.
[1003] Transcript 17-17, lines 1-9.
[1004] Transcript 17-46, line 37-41.

of 40 megatonnes that is assumed will occur in the event that this mine does not proceed.[1005]

908. In other words, the model has an **inbuilt assumption** that 'if we don't do it somebody else will' such that there will be no more coal consumed in the world as a result of the Carmichael coal mine. Dr Denniss graphed this assumed relationship based on Dr Fahrer's data in Figure 1 of Dr Denniss' report (replicated below).

Figure 1: Coal supply assumptions



Source: based on data supplied by Dr Fahrer on request

909. The assumption laid bare by the above diagram is at best odd and – in any event – unjustifiable. The CGE model has this assumption at its core and its outputs are heavily impacted by it.

910. It is clear that this was a modelling **choice** and no evidence was brought in support of this assumption being a factual reality. Dr Fahrer sought to place some reliance on the assumption that the coal would be largely sold to the Applicant's related entities[1006] however, after the corporate restructure (discussed below), these transactions must now be on 'at arm's length' basis such that coal purchases cannot be immune to market prices.

911. The unreality of this assumption of perfect substitution was made clear by the fact that the Applicant accepted that the coal market was highly competitive[1007] and could not explain how or why other producers would perfectly restrict supply without a price signal.

[1005] Transcript 16-72, lines 42-46.
[1006] Transcript 17-18, lines 31-39.
[1007] Transcript 16-75, lines 14–19.

912. Dr Fahrer agreed that he had modelled a preference shift from world coal to Carmichael coal with no price signal.[1008] No reason for that preference shift was proffered.

913. Dr Fahrer chose to assume the Applicant would meet new demand no one else is meeting,[1009] agreeing that the Applicant has "identified a perfect pocket of demand which no one else is going to compete to meet".[1010] Again, no logical reason for this odd assumption was proffered.

914. The consequences of this modelling assumption lead the model to predict the palpably strange result that building the largest coal mine in Australia would in fact **reduce** the world supply of coal.[1011]

915. Dr Fahrer agreed that by assuming perfect substitution the model proceeds on the basis that no additional coal would be burned as a result of the mine.[1012]

916. This is a modelling choice without connection to reality. It requires the suspension of conventional economics which says that introducing 40 million tonnes of coal to the thermal coal market would ordinarily increase supply, depress prices and increase the quantity of coal consumed, leading to higher greenhouse gas emissions.

Effect of the assumption of perfect substitution on coal prices

917. Dr Fahrer also agreed that the second consequence of **assuming** perfect substitution is that there will necessarily be no affect on coal prices from building an extremely large coal mine.[1013]

918. However, Dr Fahrer went further, opining that even if price were affected (i.e. if conventional economics is not suspended) the affect would be trivially small.

919. Dr Fahrer justified this opinion by comparing the supply from the Carmichael mine of 40 million tonnes to the size of the world's production of coal, including domestic production in China.[1014]

920. In doing so, he ignored the fact that the relevant destination market for the coal is the seaborne market which is a much smaller subset of all the coal produced in the world. Mr Buckley considered this to be the relevant market as most producers lack the infrastructure and or economics to compete in the global market. Mr Stanford suggests that the relevant market is the even smaller subset of the Asian market.[1015] But even on the more conservative view of Mr Buckley, the coal from the proposed mine would be a significant component of the market and, as a consequence, be likely to have a price effect of up to 5%.[1016]

[1008] Transcript 17-17, lines 17-32.
[1009] Transcript 16-77, line 15.
[1010] Transcript 16-74, lines 36-37. See also Transcript 17-20, lines 23-24.
[1011] Exhibit 45; OL022 (Dr Denniss' CGE & CBA Analysis Expert Report) soft page 9, section 3.7.
[1012] Transcript 16-78, lines 14-15.
[1013] Transcript 16-78, lines 24-27; Transcript 17-22, lines 21-22.
[1014] Transcript 16-79, lines 30-33.
[1015] Transcript 19-23, line 10.
[1016] Exhibit 39; OL021 (Mr Buckley's Supplementary Energy Demand & Financial Analysis Expert Report) soft page 9, section 2.

921. As Dr Fahrer admitted that he lacked expertise in coal markets, the views of Mr Buckley and Mr Stanford should be preferred.

922. The consequence of Dr Fahrer's assumption of perfect substitution, and his erroneous conclusion that any price effect would be minimal, is that he chose not to model any price effect.[1017] At the very least, Dr Fahrer's CGE model should have sensitivity tested for the consequences of a price effect which on the available evidence is at least plausible.

923. Dr Denniss demonstrated, using another CGE model prepared by the Centre of Policy Studies, that a price impact could have dramatic consequences on the projected benefits of the model, becoming negative if even just a 1% price effect is modelled.[1018]

924. The Applicant's witnesses did not deny that at least 50% of Australian coal miners are currently operating at a loss.[1019] The industry cannot cope with a self-inflicted further price decrease. The economic damage will be extensive and has not been revealed or quantified by the Applicant.

Applicant's CGE model assumes objectively low discount rates

925. Dr Denniss explained that to value future income in present day values we need to adjust the future income for:

(1) the risk that it might not be realised (i.e. a risk premium); and

(2) the returns that could be earned if the income was available to be invested today.[1020]

The combination of these two adjustments is called the discount rate, which is in essence a subjective attempt to value the future.[1021]

926. Dr Denniss explained that there is no objectively accurate discount rate; it is a choice for the decision maker. However, in his view, a modeller should prove a range of discounts so that the decision maker may choose the most appropriate in the circumstances.

927. Both the Commonwealth[1022] and New South Wales[1023] produce guidelines for selecting discount rates in Cost Benefit Analysis of major projects. While not mandatory in their application in Queensland, they provide a useful benchmark against which to assess reasonableness of the discount rates selected by Dr Fahrer.

928. Dr Denniss observed that the discount rate of 7% used in NSW Guidelines, with a lower range of 4% and upper range of 10%, were conventional in CBA modelling.[1024] Dr

[1017] Transcript 16-82, line 21.
[1018] Exhibit 45; OL022 (Dr Denniss' CGE & CBA Analysis Expert Report) Table 1, soft page 15.
[1019] Mr Stanford at Transcript 19-73, lines 10-13 and Transcript 19-75, lines 16-19. Dr Fahrer was not aware but was not surprised at Transcript 16-83, lines 1-7 and 26-28. See also Exhibit 38; OL015 (Mr Buckley's First Energy Demand & Financial Analysis Expert Report) soft page 27, section 3.3.
[1020] Transcript 17-37 from line 36.
[1021] Transcript 17-38, line 46.
[1022] Exhibit 113; AA057 (Commonwealth Handbook of Cost Benefit Analysis 2006).
[1023] Exhibit 114 AA058 (NSW Guidelines for Cost Benefit Analysis).
[1024] Transcript 17-39, lines 2-4.

Fahrer agreed that had he applied the Commonwealth or NSW Guidelines he would have used significantly higher discount rates.[1025] Dr Denniss believes Dr Fahrer should have provided further justification for departing from these standards when he choose the very low discounts of 2.8% and 4.3% applied in his model.[1026]

<u>At the very least these key assumptions should have been disclosed in the report</u>

929. Dr Fahrer admitted in cross-examination that the assumption that building the largest coal mine in Australia would not increase the world supply of coal was not explained in his report because he considered it a non-issue.[1027]

930. It is submitted that due to the non-conventional nature of the above assumptions, their apparent disconnect from reality and their potential to dramatically affect the model results, the basis for their selection should have been openly disclosed in the report. It was not.

Applicant's CBA model is highly susceptible to assumptions

931. In addition to being vulnerable to unreliable input data the CBA contains assumptions that if perturbed would rapidly reverse the estimated benefits.

<u>The CBA only creates a net benefit if benefits that flow overseas are included</u>

932. Dr Fahrer made a modelling choice[1028] that the scope of the CBA was global[1029] and included global benefits such as profits accruing offshore to the Applicant[1030] (producer surplus) and benefits accruing to the owners of coal fired power stations in India and elsewhere (consumer surplus).[1031] This choice meant that very big economic benefits were included in the CBA calculus even though they only accrue outside Queensland.

933. Dr Fahrer notes in his corrected Table 5 (copied below), that if his CBA includes consumer surplus (benefits to the owners of coal fired power stations) it predicts benefits of between $45.34 and $35.147 Billion.[1032] The two figures represent different present day value discount rates.

[1025] Transcript 16-37, lines 25-31.
[1026] Transcript 17-38, lines 25-34.
[1027] Transcript 16-77, lines 45-47.
[1028] Transcript 16-86, lines 12-13; Transcript 17-12, line 1.
[1029] Transcript 16-85, line 23.
[1030] Transcript 16-88, line 6-7.
[1031] An explanation of consumer surplus and producer surplus can be found at Exhibit 43; AA006 (Dr Fahrer's First Economic Assessment Expert Report) soft page 31, paras 95 and 96.
[1032] Exhibit 43; AA006.2 Corrected Tables 5-8 to Exhibit 43; AA006 (Dr Fahrer's First Economic Assessment Expert Report).

Table 5 **Present Value of Project Benefits and Costs ($m, real, $2014-15)**

	r=2.8%	r=4.3%
Benefits (excluding CS)	$55,424	$44,263
Costs	$37,796	$31,248
Consumer surplus (CS)	$27,712	$22,132
Benefits minus Costs (excluding CS)	**$17,628**	**$13,015**
Benefits minus Costs (including CS)	**$45,340**	**$35,147**
Benefit Cost Ratio (excluding CS)	1.5	1.4
Benefit Cost Ratio (including CS)	2.2	2.1

Source: Author's estimates

934. The corrected Table 5 notes that if consumer surplus is excluded but producer surplus is included then the CBA predicts benefits of between $13.015 and $17.628 Billion. These would be smaller again if more standard discount rates are applied.

935. Dr Fahrer did not set out the net result of the CBA if producer surplus (i.e. the benefits that flow offshore to Adani's shareholders) is excluded. He agreed in cross-examination that he had not "worked it out".[1033] However, Table 2 to Dr Fahrer's Report permits the conclusion that it is at least (AUD real) $31.65 Billion.

936. If the Court chooses – as it should – to exclude from the calculus of costs and benefits both consumer surplus and producer surplus then the CBA is already negative.

<u>The modeller has chosen to exclude the largest negative externality</u>

937. As discussed, Dr Fahrer made the contestable modelling choice to have a global CBA thus including very large economic benefits to Adani's shareholders in India and to the owners of coal fired power stations in India and elsewhere.

938. Having made that choice he should, it is submitted, have been consistent and at least attempted to include global costs.

939. The justification for including benefits to the owners of coal fired power stations but not the costs of the carbon emissions from those power stations was essentially for practical reasons[1034] and on the assumption that those costs and benefits are more appropriately accounted for by the power station.[1035]

940. Dr Dennis pointed out that, there is no consensus among economists how far downstream one goes when considering the scope of a global CBA.[1036] He described the present situation as follows:

> And, you know, really, around the world everyone's pointing at everybody else, saying well, I haven't included climate change in my cost-benefit analysis because I thought you were going to include it in yours, and then you say well, I didn't include in mine because I thought you were going to include it in yours. So, you know, we've got a big problem with the way

[1033] Transcript 16-88, lines 1-15.
[1034] Transcript 17-13, lines 10-11.
[1035] Transcript 17-13, lines 40-44.
[1036] Transcript 17-53, line 38.

> we're looking at the costs and benefits of these projects, because, you know, it's a – it's an intellectual form of jurisdiction shopping. You know, everyone's just saying relax, someone else is taking this into account. No one is.[1037]

941. Dr Dennis argued that for consistency, if the CBA includes global benefits then it should include global costs.[1038] One of those costs is the impact to the world from carbon dioxide emissions.

942. Dr Fahrer has selected a carbon cost of $126 per tonne of carbon emissions.[1039] He applied this cost to scope 1 and 2 emissions but not to emissions from the burning of the coal from this project.[1040]

943. If Dr Fahrer's assumed cost of carbon was applied to total emissions from coal from this Project,[1041] it would be around $560 billion in externality costs to the world[1042] which vastly exceed the benefits of the project estimated by Dr Fahrer's CBA.[1043]

944. This calculation gives a sense of the scale of carbon emissions as an unpriced negative externality even using the Applicant's own witness' assessment of the cost of emitting a tonne of carbon.

945. Even if a fraction of the cost of scope 3 emissions was included in the CBA it would dwarf the claimed benefits given a cost of $126 per tonne of carbon and the knowledge that a tonne of coal produces more than two tonnes of carbon.

946. For example, if only 10% of the scope 3 emissions for 40 megatonnes of output per year was included in this CBA, and a conservative assumption of two tonnes of carbon per tonne of coal was applied,[1044] then the cost to the world of emitting that carbon – based on Dr Fahrer's own carbon cost – would be AUD$1.008 Billion per year.

947. Over the 30 year life of the Project this cost would be more than AUD$30.24 Billion. Even at this level it would result in the Applicant's CBA concluding that the economic costs of this project plainly outweigh the benefits, when benefits that flow offshore to Adani are excluded.

<u>No meaningful attempt was made to price negative externalities</u>

948. Dr Fahrer agreed that one of the key tasks of a CBA is to include unpriced externalities[1045] such as pollution,[1046] in particular the quintessential externality of greenhouse gas impacts.[1047]

[1037] Transcript 17-53, line 47 to 17-54, line 8.
[1038] Transcript 17-70, lines 12-19.
[1039] Exhibit 43; AA006 (Dr Fahrer's First Economic Assessment Expert Report) soft page 48, para 221.
[1040] Transcript 17-13, line 36.
[1041] Estimated in Exhibit 33; JR006 (Climate Change Joint Experts Report) at para 17, to be between 4.49 and 4.64 billion tonnes.
[1042] $126 per tone carbon cost times 4.49 to 4.64 billion tonnes equals $565.74 to 584.64 billion.
[1043] Exhibit 43; AA006 (Dr Fahrer's First Economic Assessment Expert Report) Table, soft page 43.
[1044] Dr Fahrer thought that 'sounds about right… but I couldn't really authoritatively say' at Transcript 17-14, lines 37-40.
[1045] Transcript 17-5, lines 5-8.
[1046] Transcript 17-5, lines 11.
[1047] Transcript 17-6, lines 31-33.

949. Dr Fahrer agreed that to do so you would first identify the extent of the impact, then attempt to put a price on it.[1048]

950. Dr Fahrer agreed that there are environmental impacts from the Project,[1049] but he did not cost any of them in his CBA[1050] as he considered there was no agreement as to the extent of impacts and no reliable method of assigning values.[1051] He instead applied the alternative approach of asking how big the external costs would have to be to undo the benefits of the CBA.[1052]

951. Dr Denniss on the other hand argues that some attempt should have been made to ascribe a value to the anticipated impacts and that uncertainty in those values could have been made clear through error bars.[1053] Dr Denniss explained that if he was asked to assess the value of the loss of groundwater dependent ecosystems, for example, he would call those in CSIRO who work in that area of valuing ecosystem services.[1054] By not attempting to value these external impacts, Dr Denniss argues that Dr Fahrer has implicitly placed a value of zero of those impacts.[1055]

952. In effect Dr Fahrer's CBA fails in the key task of assigning values to externalities.

Benefits are already negative at the current coal price

953. Dr Fahrer's CBA identified that the estimated benefits "depends largely on forecasts for thermal coal prices and volumes".[1056]

954. Dr Fahrer undertook an analysis of the sensitivity of the estimated benefits to price, to find the price below which the estimated benefits became negative (the break even price).

955. These prices had to be corrected in Dr Fahrer's oral evidence to account for the errors in his input tables identified the day before. The amended figures gave an implied average break even coal price of AUD$60.34 to $60.46 (at an exchange rate of 0.70).[1057]

Table 6 **Break even percentage reduction in coal prices and implied average prices (real AFY 2014-15 prices)**

	r=2.8%	r=4.3%
Exchange rate $A=US$0.85	31.8% A$58.24	29.4% A$60.29
Exchange rate $A=US$0.70	41.8% A60.34	39.7% A$62.46

Source: Author's estimates

[1048] Transcript 17-7, lines 21-25.
[1049] Transcript 17-8, line 8.
[1050] Transcript 17-8, line 10.
[1051] Transcript 17-10, lines 1-4.
[1052] Transcript 17-8, lines 17-18.
[1053] Transcript 17-68, lines 19-20.
[1054] Transcript 17-68, lines 6-14
[1055] Transcript 17-69, lines 16-17.
[1056] Exhibit 43; AA006 (Dr Fahrer's First Economic Assessment Expert Report) soft page 44, para 187.
[1057] See Exhibit 43; AA006.2 Corrected Table 6 to Exhibit 43; AA006 (Dr Fahrer's First Economic Assessment Expert Report).

956. However futures prices out to 2021, which Dr Fahrer considered the best forward estimate of prices, are already below $US60 for the high quality Newcastle benchmark.[1058] If an exchange rate of 0.70 is applied, together with a 30% discount to reflect the low quality coal as proposed by Mr Buckley, then the price for the Carmichael coal is already below $AUD60 and therefore below the price at which the estimated benefits become negative.

The state of the thermal coal market and financial viability of the project

The global coal market faces an existential threat within the life of this mine

957. All experts who proffered a view on the thermal coal market agreed that the Newcastle benchmark coal price has fallen around 60% since 2011,[1059] after the Applicant commenced this application process.

958. No expert disputed that the thermal coal market is subject to change as a result of:

(a) technological changes improving the competitiveness of other energy sources such as wind, solar, gas and nuclear;

(b) increasing energy efficiency;[1060]

(c) regulation to control local pollution issues; and

(d) regulation to control climate change.

959. Mr Stanford, for the Applicant, agreed that if the world takes significant action against climate change, "the global coal industry would face a serious existential threat that would begin to be felt in the very near future".[1061] He later reiterated this view as follows:

> …if the world takes significant action against climate change the global coal industry is likely to face an existential threat. On the balance of current probabilities, this is likely to occur from around the year 2030. If a strong agreement is reached at this year's CoP in Paris, however, the threat may occur earlier than this.[1062]

960. A peak in 2030 and decline thereafter is consistent with the trend in estimated real Australian coal prices provided by the Applicant to Dr Fahrer as discussed above.

961. Mr Buckley agreed with Mr Stanford that the global coal industry faces an existential threat,[1063] based on the global demand and supply analysis he participated in September 2014, and estimates the peak in coal demand to occur much sooner, by 2016.

[1058] Exhibit 135; OL073 (E-Signal Newcastle Coal Futures Printout).
[1059] Mr Stanford at Transcript 19-75, lines 25-26; Transcript 19-62, lines 34-35; Transcript 19-64, lines 26-27. Mr Buckley at Transcript 20-22, line 46. Dr Fahrer at Transcript 16-83, lines 23-24.
[1060] See, for example, Mr Buckley at Transcript 20-23, lines 4-11.
[1061] Exhibit 37; AA009 (Mr Stanford's Climate Change Economics Expert Report) soft page 18, lines 473-475.
[1062] Exhibit 37; AA009 (Mr Stanford's Climate Change Economics Expert Report) soft page 18, lines 492-496.
[1063] Transcript 20-8, lines 9-10.

962. Consequently both experts nominated in energy demand see an existential threat to the global coal market within the 30 year life of this mine. They differ primarily in how soon they expect that to occur.

963. Mr Stanford relied primarily on published reports of the IEA, in particular the World Energy Outlook 2014 and Coal Market Medium Term Report 2014, which sees coal demand in China continuing plateauing in 2030 and declining from 2035.[1064]

964. Mr Buckley noted that the IEA relied on outdated data and pointed to the two key document relied on by Mr Stanford, the World Energy Outlook 2014 and Coal Medium Term Market Report 2014, and showed their long term forecast is predicated on data from 2012.[1065] Mr Buckley explained:

> I've subscribed to the IEA and I've only just been able to access 2013 data literally last week. So the data is always one, two years out of date. Now, when Dr Fahrer mentioned earlier this week that tipping points are really hard to model and they're hard to predict, I would agree with that comment. I mean, I've spent 25, 30 years studying financial markets, studying industries, looking at changes like that and I would agree with the statement. But if you actually don't even use data from 2014, we're in 2015 and the IEA's relying on 2013 data, it's very hard to predict a change when you're actually not even presented with the 5 data that actually illustrates that change.[1066]

965. In addition to the IEA, Mr Buckley relied on the global supply demand analysis he undertook with IEEFA, Carbon Tracker and Wood Mackenzie in September 2014, recent analysis by global investment banks and data directly from India and the Chinese National Energy Administration.[1067]

966. Mr Buckley pointed to evidence showing that the world market for thermal coal has fundamentally changed as demonstrated by:

(a) a 60% decline in prices for thermal coal over the last four years;[1068]

(b) the futures market predicting that prices will continue to slump;[1069]

(c) continuing evidence of a historic reversal in demand for thermal coal from China,[1070] such as the decoupling of GDP growth from energy consumption;[1071]

(d) a policy shift away from imported coal in India; [1072]

[1064] Exhibit 122; AA068 (World Energy Outlook 2014) soft page 211.
[1065] Transcript 20-9, lines 35-39; Transcript 20-10, lines 8-13.
[1066] Transcript 20-9, lines 45-46.
[1067] Transcript 20-13, lines 20-29; Exhibit 132 (National Energy Agency translated data); Transcript 20-14, lines 5-24.
[1068] Transcript 20-22, line 46 to 20-23, line 2.
[1069] Exhibit 38; OL015 (Mr Buckley's First Energy Demand & Financial Analysis Expert Report) soft page 5, section 1.2.1; Exhibit 135; OL073 (E-Signal Newcastle Coal Futures Printout).
[1070] Exhibit 38; OL015 (Mr Buckley's First Energy Demand & Financial Analysis Expert Report) soft page 5, section 1.2.1.
[1071] Transcript 20-14, line 40 to 20-16, line 26.
[1072] Transcript 20-20, line 9-20; Exhibit 38; OL015 (Mr Buckley's First Energy Demand & Financial Analysis Expert Report) soft page 25, section 2.4.

(e) increasing international adoption of measures to reduce greenhouse gas emissions;[1073]

(f) the views of the large and credible finance and investment houses;[1074]

(g) unprecedented wealth destruction in mining companies internationally and in Australia; and

(h) mothballing of major coal projects, for example, the proposed Wandoan mine.[1075]

967. These led him to form the view that coal demand would peak in 2016.[1076] However the data that has come out of China this year has shown that coal demand in China, contrary to the IEA predictions, is likely to have peaked in 2013.[1077] This was a trend anticipated by Proffessor Garnaut some months earlier.[1078]

968. Whether the existential threat occurs in 2030, 2016 or is already upon us, it is a fundamental threat to the viability of this mine within its expected life, which should have been factored into the likelihood that the estimated benefits would ever be realised.

969. As Mr Stanford admitted in cross-examination "this is an extremely risky project … everybody knows that, I admit that".[1079] Mr Buckley agrees.[1080]

The project is presently unlikely to be viable, independent of the timing of structural decline

970. As discussed above, Mr Buckley analysed the cost and price data provided by the Applicant to Dr Fahrer (Attachment B) and concluded that costs are underestimated and revenue is overestimated.

971. Particular issues discussed by Mr Buckley are:

(a) The fact that the coal from this mine is of a **low quality** compared to the Newcastle benchmark standard in both energy and ash content. Mr Buckley considers that it will attract a 30% discount to the Newcastle benchmark price for thermal coal.

It appears that the Applicant has not incorporated sufficient discount and started from an indefensibly inflated price assumption.

(b) The assumptions as to the price of thermal coal are inflated without justification. Mr Buckley proposes an alternative assumption about price based on the price that coal is trading on the futures markets. The Applicant, on the other hand, assumes

[1073] Exhibit 38; OL015 (Mr Buckley's First Energy Demand & Financial Analysis Expert Report) soft page 24, section 2.3.3.
[1074] Exhibit 38; OL015 (Mr Buckley's First Energy Demand & Financial Analysis Expert Report) soft page 17, section 2.1.
[1075] Exhibit 38; OL015 (Mr Buckley's First Energy Demand & Financial Analysis Expert Report) soft page 13.
[1076] Transcript 20-10, line 35; Exhibit 38; OL015 (Mr Buckley's First Energy Demand & Financial Analysis Expert Report) soft page 20, section 2.2.
[1076] Transcript 20-44, lines 43-45.
[1077] Transcript 20-44, lines 43-45.
[1078] Transcript 20-10, lines 26-43; Exhibit 38; OL015 (Mr Buckley's First Energy Demand & Financial Analysis Expert Report) soft page 20, section 2.2.
[1079] Transcript 19-57, lines 21-22.
[1080] Transcript 20-28, line 9.

a coal price for the life of the mine at a 30% premium above the current Newcastle benchmark price, even before the discount for low quality is taken into account. Mr Buckley considers this estimate to be extremely optimistic.[1081]

(c) There are particular costs that either do not appear to have been included in Attachment B or, if they are, are not made explicit. These include borrowing costs, rail costs and port loading costs.

972. Mr Buckley concludes that the mine is not financially viable and is unlikely to attract financing necessary to begin construction. If it does, Mr Buckley considers that it is at real risk of becoming a stranded asset.

973. The Applicant did not nominate an expert witness in relation to the financial viability of the project. The Applicant's expert witness, Mr John Stanford, did not examine this issue and "could not understand why the financial capability of the applicant has any particular relevance to the matters before the court".[1082]

974. The Court of Appeal has held to the contrary that "whilst there is no specific reference in s 269(4) of the *Mineral Resources Act 1989* to the 'economic viability' of a project, it is relevant to interpreting the information about mineralisation and to at least the matters set out in s 269(4)(c)."[1083]

975. Financial viability is also relevant to the objections decision under the EPA. If this mine is developed but becomes a stranded asset, then there will only be environmental harm without much – if any – economic benefit. Such an outcome would not represent Ecologically Sustainable Development because the entire point of the development from the State's perspective (economic benefit accrued by the development and operation of the mine) would not be realised.

Financial capabilities of the Applicant

976. To assist the Court in forming a view about the financial capability of the Applicant,[1084] Mr Gupta gave evidence that the Applicant is a wholly owned subsidiary of Adani Enterprises Limited, an Indian company, which had a revenue of AU$10 billion for the year ending 31 March 2014.[1085]

977. The purpose of that evidence was to say that Adani Enterprises Limited has the financial capability to fund the project.[1086]

978. However Mr Gupta agreed that about 40% of that revenue was from Adani Ports and Adani Power[1087] and that those parts would be taken out of Adani Enterprises Limited in the recent restructure.[1088] Mr Gupta also agreed that prior to the restructure, Adani

[1081] Transcript 20-29, line 25.
[1082] Exhibit 36; JR007 (Energy Markets & Financial Analysis Joint Experts Report) soft pages 2, 11, 14 and 16.
[1083] *Armstrong v Brown* [2004] 2 Qd R 345 at 348-8 [15] (per McMurdo J with whom McPherson JA and Jerrard JA agreed).
[1084] Exhibit 5; AA003 (Mr Gupta's First Affidavit) soft page 7, para 28.
[1085] Exhibit 5; AA003 (Mr Gupta's First Affidavit) soft page 2, para 4; Transcript 15-15, line 20-34.
[1086] Transcript 15-17, line 42-45.
[1087] Transcript 15-19, line 6.
[1088] Transcript 15-18, lines 13-14.

Ports and Adani Power accounted for approximately 80% of the revenue of Adani Enterprises Limited.[1089]

979. Mr Gupta could not say how this would affect the ability of Adani Enterpises Limited to raise funds for the project but Mr Buckley's opinion was:

> …there will no longer be any commercial ownership by Adani Enterprises and Adani Ports. So the revenues, as Mr Gupta said in his affidavit, were approaching $10 billion last year. Post restructuring, the revenues will shrink materially. The profitability is probably, to me, far more important than revenue. Don't borrow against revenue. You borrow against profits. The profitability of Adani Enterprises will drop by north of 80 per cent on current projections or current pro rata interests….if your earnings power pre-interest drops by 80 per cent, your ability to borrow will drop commensurately.[1090]

980. Mr Buckley also points to the level of debt in the Applicant to form the view that the Applicant is unable to finance the project without substantial investment from banks.[1091]

981. Mr Buckley believes it is unlikely that banks would fund the project given his estimates of its financial unviability and further risks of structural decline.

982. However the greater concern, is that a large Australian bank will take the risk of funding the project and lose money which concerns Mr Buckley because, as he puts it:

> Ultimately, the Australian banks are owned by Australian superannuation funds, and so almost everyone in Australia, almost everyone in this room will have interest in the Australian banks through their superannuation money, so it's our superannuation money which is actually going to be invested in projects that, if they come to fruition, will actually flood the market with additional coal, push the price down, and damage Australia's national interest, so that will then damage the royalties the Australian Government will get and the net will be a loss to the Australian Government and a loss to Australian banks and a loss to us as superannuation trustees.[1092]

The mine's effect on climate change based on the economic evidence

Perfect substitution does not reflect reality - additionality is in no doubt

983. Dr Taylor and Dr Meinshausen agreed that "All Emissions from the burning of product coal from this Mine will have a climate impact in the physical cause-effect sense".[1093]

984. Dr Taylor calculated those emissions as 4.64 billion tonnes of carbon dioxide,[1094] and it was agreed that these are among the highest in the world for any individual project.[1095]

985. It was agreed that this is a worst case or maximum impact on net global emissions as the change in net global emissions would depend on:

[1089] Transcript 15-23, line 10.
[1090] Transcript 20-36, lines 14-24.
[1091] Exhibit 38; OL015 (Mr Buckley's First Energy Demand & Financial Analysis Expert Report) soft page 6, section 1.2,
[1092] Transcript 20-82, lines 22-31.
[1093] Exhibit 33; JR006 (Climate Change Joint Experts Report) soft page 7, para 12.
[1094] Exhibit 33; JR006 (Climate Change Joint Experts Report) soft page 8, para 17.
[1095] Exhibit 33; JR006 (Climate Change Joint Experts Report) soft page 10, para 22.

(a) whether the projected amount of coal would be produced over the course of the lifetime of this mine or limited before its end-of-lifetime (e.g. due to new climate policies);

(b) whether carbon sequestration and storage technology is used when burning the coal; and

(c) the net change in global coal consumption resulting from the approval of the Mine.

986. In respect of paragraph 985(a) above, new polices, Mr Stanford agreed that these policies presented and existential threat to the coal industry and was likely to occur within the life of the mine[1096] as discussed in detail **above/below** in respect of the viability of the project.

987. In respect of paragraph 985(b) above, Dr Taylor agreed that the progress on carbon capture and storage (CCS) was limited,[1097] and Mr Stanford and Mr Buckley are both pessimistic about the future commerciality of the technology.[1098] Mr Stanford agreed that the outlook for CCS at this stage was not favourable[1099] and Mr Buckley elaborated that there was no evidence to say that it can be deployed commercially.[1100]

988. In respect of paragraph 985(c) above, Dr Taylor went further in his individual report to support the view of Mr Stanford that "[if] global coal demand will not change as a result of the mine then the cumulative impact of the mine would be negligible".[1101] However he conceded in cross-examination that whether the "climate impacts are additional to what would have occurred in the absence of the mine's approval depends on the extent the mine increases global coal consumption" and Dr Taylor admitted that he was not an expert in global coal consumption.[1102]

989. Dr Taylor's comments regarding additionally are appropriately premised on the views of the Applicant's nominated expert in Energy Markets, Mr Stanford.[1103] Dr Taylor was not nominated in the area of Energy Markets and did not participate in the joint meeting on that topic. Consequently, no weight should be placed on Dr Taylor's view of additionality based on assumptions of global coal consumption.

990. Those experts nominated in the fields of economics and energy markets agreed that, in principle, consumption and price are determined by interaction of supply and demand.

991. The economics experts for the First Respondent said that the interaction of supply and demand was perfectly adequate to explain the operation of the thermal coal market in the recent past, with historically high demand increasing prices and stimulating

[1096] Exhibit 37, AA039 (Individual Report of Mr Stanford), soft page 18, lines 492-496.
[1097] Transcript 18-7, lines 40-43.
[1098] Exhibit 36; JR007 (Energy Markets & Financial Analysis Joint Experts Report) soft page 4, fourth dot point. See also Transcript 19-21, lines 30-31; Transcript 19-22, lines 15-20; Transcript 20-64, lines 31-39.
[1099] Exhibit 36; JR007 (Energy Markets & Financial Analysis Joint Experts Report) soft page 10.
[1100] Transcript 20-64, lines 31-39.
[1101] Exhibit 34; AA007 (Dr Taylor's Climate Change Expert Report) soft page 13, section 4.1.1.6 and soft page 15, section 5.1.1.3.
[1102] Transcript 18-16, lines 38-45.
[1103] Exhibit 34; AA007 (Dr Taylor's Climate Change Expert Report) soft page 13, section 4.1.1.6; Transcript 18-16, line 35 and 18-28, lines 1-4.

additional supply which overshot demand leading to oversupply and falling prices in the last four years.[1104]

992. The economists for the First Respondent saw no reason to suspend conventional economics for this coal mine. Mr Buckley, in his 25+ years of analysing markets, had never seen it done any other way.[1105]

993. Following conventional theory, building this mine would result in an increase in supply which would decrease prices and lead to increased consumption.[1106] The decreased prices may force some higher cost producers (such as Australian mines)[1107] out of the market, thereby reducing supply and restoring prices[1108] but the scale of this effect has not been modelled by the Applicant. In the words of Mr Buckley "Additionality is in no doubt".[1109]

994. The economists for the Applicant both sought to suspend conventional economics to ensure that this Project would not lead to any additional consumption however they did so by different, and contradictory, means.

995. Dr Fahrer, as was explained in more detail above, chose to assume a reduction in world supply of coal which perfectly matched the output from this Project which, when combined with an exchange rate effect, lead to a modelled reduction in world supply coal as a result of this coal mine proceeding. A necessary consequence of Dr Fahrer's assumption of perfect substitution was no effect on price which, if modelled, would have negatively affected other Australian coal producers.

996. Contrary to Dr Fahrer's assumptions, Mr Stanford agreed that, at least in the short to medium term, the increase in supply from this mine would reduce prices,[1110] which may cause some higher cost Australian producers to shut down.[1111]

997. However, Mr Stanford considered demand for thermal coal to be unresponsive to price or supply. He predicated this view from the perspective of the construction of a new coal fired power stations which demand, in Mr Stanford's view, a fixed amount of coal.[1112]

998. In essence, Mr Stanford treated the demand curve as vertical, although he never conceded as much.

999. Mr Buckley gave evidence however that demand for electricity can be met from a number of fuel sources and the key growth markets of China and India are rapidly

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[1104] Transcript 20-22, line 26 to 20-23, line 2.
[1105] Transcript 20-24, lines 23-28.
[1106] Exhibit 38; OL015 (Mr Buckley's First Energy Demand & Financial Analysis Expert Report) soft page 26, section 3 - Additionality. See also Transcript 20-24, lines 7-16 and Exhibit 134; (Whiteboard Diagram of Tim Buckley – TB1).
[1107] Transcript 20-25, lines 5-6.
[1108] Transcript 20-24, lines 39-41.
[1109] Exhibit 38; OL015 (Mr Buckley's First Energy Demand & Financial Analysis Expert Report) soft page 2, Executive Summary.
[1110] Transcript 19-75, lines 32-34; Transcript 19-76, lines 23-25; Transcript 19-77, line 46; Transcript 19-84, lines 1-11.
[1111] Transcript 19-84, lines 13-26.
[1112] Transcript 19-75, lines 45-47.

diversifying away from coal.[1113] Mr Buckley gave evidence that coal fired power stations were currently operating on average at about 60% in India[1114] and Mr Stanford accepted the average capacity of a coal power station in China is about 53% so they could shift their capacity, i.e. demand for coal, based on price, which in turn has an effect on consumption.[1115] Mr Stanford further conceded that consumption of coal was sensitive to price impacts such as through a carbon price.[1116]

1000. Dr Denniss also pointed out that coal fired power stations are being built but without knowing how many are being closed the net effect on coal demand cannot be known.[1117]

1001. Consequently, the reference to coal fired power stations did not, in Dr Denniss and Mr Buckley's view, in any way make the coal market a special case where demand was unresponsive to price.

1002. Mr Stanford attempted a different rationale for his conclusion that this coal mine will not increase the consumption of coal. While conceding at points during cross-examination that an increase in supply will increase consumption and reduce price, Mr Stanford repeatedly claimed that demand will also be increasing and therefore consumption will not be affected.

1003. This entirely misses the point. As long as the increased supply from this project does not in itself shift the demand curve (which no one has suggested) then the increase in supply from this mine will have an impact on consumption and price relative to a world in which the additional supply is not added into the market. That world may or may not have increasing demand. Whatever the level of demand in that world, increasing the supply of coal in the market by permitting this coal to be mined and traded will increase consumption and reduce price relative to a world in which the mine is not approved.

1004. Mr Stanford's error is relatively easily identifiable. The language that he deploys in his statement – and which has been picked up by this Court in prior decisions – treats the relevant decision as one to "ban"[1118] or "prohibit"[1119] this mine with the effect of "restricting"[1120] or "constraining" the supply of coal to the seaborne thermal coal market.[1121] This turns reality on its head. The decision here is whether to add coal to the seaborne thermal coal market or to leave the coal in the ground.[1122] There is no reduction in supply by this mine not proceeding, only an increase in supply if it does proceed.

1005. The additional supply from this mine is therefore best considered to reduce price and increase consumption. The increase in consumption would result in up to 4.64 billion tonnes of carbon dioxide emission. The net consumption may be less if the resulting

[1113] Transcript 20-11, line 30 to 20-12, line 23. Transcript 20-20, line 9 to Transcript 20-21, line 14.
[1114] Transcript, 20-25, line 47.
[1115] Transcript, 19-66, lines 28-45.
[1116] Transcript, 19-67, lines 13-34.
[1117] Transcript 17-64, lines 1-10.
[1118] Exhibit 37; AA009 (Mr Stanford's Climate Change Economics Expert Report) lines 155, 226, 281, 597 and 601; Transcript 19-3, lines 17, 23, 27 and 30; Transcript 19-59, line 2.
[1119] Exhibit 37; AA009 (Mr Stanford's Climate Change Economics Expert Report) lines 54, 77, 95 and 187; Transcript 19-3, line 24.
[1120] Exhibit 37; AA009 (Mr Stanford's Climate Change Economics Expert Report) line 560.
[1121] Exhibit 37; AA009 (Mr Stanford's Climate Change Economics Expert Report) line 240.
[1122] Mr Stanford agreed at Transcript 19-69, lines 30-34.

reduction in price forces other suppliers to close down but the magnitude of this effect has not been modelled by the Applicant as Dr Fahrer assumed no price impact. Consequently the approval of the Project must be considered to increase supply and therefore consumption of coal, resulting in up to 4.68 billion tonnes of additional carbon dioxide emissions.

Even assuming perfect substitution, Carmichael coal would likely increase emissions

1006. Mr Stanford pointed in his individual report to the fact that "Australian thermal coal exports are of extremely high quality, with NSW and Queensland black thermal coal exports generally reporting an energy content above 5500 Kcal/kg, which compares favourably to Indonesian coal which has an estimated range of between 4200 and 5200".[1123]

1007. Mr Stanford appears to be suggesting in generality it is better for greenhouse gas emissions to approve Australian mines with higher quality coal than allowing Indonesian mines with coal quality less than 5,200 Kcal/kg. However in doing so Mr Stanford neglects the specific facts of this case which is for coal with an average quality of 4,950 Kcal/kg,[1124] far less than the Australian average.

1008. Mr Stanford also conceded that further reductions in prices are likely to push out higher cost producers,[1125] which on Mr Buckley's evidence, include Australian coal mines.

1009. Therefore, even under the Applicant's unrealistic assumption of perfect substitution it is likely that the lower cost, low quality, coal from this mine would replace the higher cost, higher quality, coal from other Australian mines, leading to increased emissions.

CONCLUSION

1010. As noted in the First Respondent's separate, short summary of its submissions, the Court is far better informed of the likely costs, benefits and risks of the mine to Queensland that any of the previous decision-makers who have assessed these applications. Even with the far greater amount of information and expert analysis available to the Court, there remain very grave uncertainties and risks. The trial process has served to uncover these uncertainties and risks, which had been ignored or papered over in the EIS and SEIS process by the Applicant and its consultants.

1011. In the circumstances, the risks of this proposal are just too great to justify it, particularly in the light of the dramatically reduced economic benefits and very questionable financial viability of it. Consequently, the Court should recommend refusal of the mine under both the EPA and the MRA.

Saul Holt QC
Dr Chris McGrath
14 May 2015

[1123] Exhibit 37; AA009 (Mr Stanford's Climate Change Economics Expert Report) soft page 12, lines 251-254.
[1124] Transcript 20-27, lines 12-24.
[1125] Transcript 19-75, lines 13-19.