

Date : 27/05/2019 9:47:27 AM  
From : "WELLS Melissa"  
To : "BENNINK Kate" , "MCCOSKER Juliana"  
Subject : FW: Proposal for advice request from DHES around the Adani Carmichael mine  
Attachment: GDEMP TRACK CHANGES v10 to v11.pdf;GDEMP TRACK CHANGES v11a to v11b.pdf;DES CSIRO\_GA Request REVISED.docx;image001.png;image002.png;image004.png;



**Melissa Wells**  
Executive Director  
Coal and Central Qld Compliance  
Department of Environment and Science

P 07 4987 9343

99 Hospital Road, Emerald QLD 4720  
PO Box 3028, Emerald QLD 4720

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**From:** WELLS Melissa  
**Sent:** Wednesday, 22 May 2019 12:06 PM  
**To:** '(6) Personal info (L&W, Black Mountain)'  
**Cc:** '(6) Personal info'  
**Subject:** RE: Proposal for advice request from DHES around the Adani Carmichael mine  
**Importance:** High

Dear (6) Personal info (cc James),

Thank you for your proposal. In light of the feedback and information that CSIRO/GA have sought clarification on, DES has significantly reviewed the initial scope of the request to provide more clarity and direction in relation to DES's interests.

The revised scope provides clarity and focusses on the track changed versions of the GDEMP. The scope provides confirmation that the review does *not* include the updated GMMP and includes a refined list of questions. Accordingly, please find attached a narrowed and refined scope for the review and the 'track changed' GDEMPs (for ease of reference). Again, given the urgency around timeliness, if you could please review and provide an update proposal (costings/timeframes) at your earliest convenience.

If you would like to discuss or seek clarification I would be happy to arrange a meeting as soon as possible.

Kind regards,  
Melissa.



**Melissa Wells**  
Executive Director  
Coal and Central Qld Compliance  
Department of Environment and Science

P 07 4987 9343

99 Hospital Road, Emerald QLD 4720  
PO Box 3028, Emerald QLD 4720

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**From:** '(6) Personal info (L&W, Black Mountain)' (6) Personal info@csiro.au>  
**Sent:** Monday, 20 May 2019 3:31 PM  
**To:** WELLS Melissa  
**Cc:** Johnson James  
**Subject:** Proposal for advice request from DHES around the Adani Carmichael mine

Dear Melissa (cc James),

Thank you for your request on Friday May 10<sup>th</sup> for GA and CSIRO to provide advice about the type of investigation and research that may provide greater certainty regarding your Department's interest in relation to the identification of the source aquifer(s) to the Doongmabulla Springs Complex.

GA and CSIRO would be happy to undertake the work detailed in your email.

Please find attached our joint proposal, noting we are seeking clarification on aspects of the advice you are seeking. In summary, we have estimated the cost at \$103,072 (GST exclusive) and the advice delivered to you within 20 working days following contract execution.

Please engage with [redacted] as the primary contact in relation to contractual issues (E: [redacted] csiro.au, T: [redacted])

With regards [redacted]

[redacted]

Director

CSIRO Land and Water

E: [redacted] csiro.au

T: [redacted]

<https://www.csiro.au/en/Research/LWF>

*CSIRO acknowledges the Traditional Owners of the lands that we live and work on across Australia and pays its respect to Elders past and present.*

GPO Box 1700  
CSIRO Black Mountain Site  
Clunies Ross St, Canberra ACT 2601

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**DES CSIRO/GA GDEMP 11b Advice request – REVISED based on CSIRO/GA feedback and clarification provided 20 May 2019**

Review documents (*for clarification please note DES does not require a review of the GMMP*):

1. GDEMP v11b (track change versions v10 – v11 and v11a-11b attached);

Following the department's review of the CSIRO/GA 2019 Report, the department seeks your advice about the type of investigation and research that may provide greater certainty regarding the department's interest in relation to the identification of the source aquifer(s) to the Doongmabulla Springs Complex (DSC).

The environmental authority (EA) for the Carmichael Coal Mine requires Adani to develop and implement a Groundwater Dependent Ecosystems Management Plan (GDEMP). The term GDEMP is defined in the EA and states, among other things, that a GDEMP must include '*detailed baseline research to establish the source aquifer(s) for groundwater supply to each groundwater dependent ecosystem [potentially or indirectly impacted by mining activities]*'.

Your 2019 Report states that:

*'It is plausible and reasonable that the Clematis Sandstone is a major source aquifer for the DSC... It is not plausible and reasonable to state unequivocally that the Clematis Sandstone is the sole source aquifer for the DSC...'* (p2); and

*'Available evidence supports the conceptualisation that the Clematis Sandstone is a likely source aquifer for the DSC. However, the proposed monitoring and management approaches do not sufficiently address the uncertainty regarding the potential alternative or additional source aquifers (refer Section 3.2 and 3.3).'* (p9); and

*'To constrain the source aquifer(s) of the DSC, a more sophisticated statistical analysis of hydrochemistry data is required. This includes assessing a wider variety of groundwater and surface water analytes, as well as appropriate use of isotope hydrochemistry analysis. Further information on potential techniques is provided (CSIRO and Geoscience Australia, 2018) and other readily available references.'* (p10)

Further, in advice given to the Commonwealth Department of the Environment and Energy, '*Advice on draft research plans to the Department of the Environment and Energy*', dated November 2018, you state:

*'An integrated analysis of existing and newly acquired geological, hydrodynamic and hydrochemical data would improve the conceptual understanding of the groundwater sources of the DSC.'* (at page 5); and

*'Further information on the specific methods and techniques to be applied to chemically assess the springs source and groundwater flow processes is required for a more detailed assessment to be made. This includes the need to define the*

*analytical suite, quality assurance and quality control methods, and use of a broader range of isotopic and environmental traces...*' (at page 13).

Having regard to **the 2019 Report, the 2018 advice, and our meeting of 16 April 2019**, the department has the understanding that the following further research (steps) would improve the certainty about the source aquifer(s) of the DSC and other groundwater dependent ecosystems:

- a) hydrogeochemical analysis of water samples for comparison within and across relevant aquifers (Clematis Sandstone, Dunda Beds and Rewan Formation);
  - b) incorporation of the use of isotope and ageing tracers in the above hydrogeochemical analysis;
  - c) a comprehensive review of groundwater level and quality data from relevant aquifers including data from new proposed nested bores in the vicinity of DSC;
  - d) detailed geological mapping including cores from bores drilled in the vicinity of DSC and facies modelling to better inform hydraulic connectivity within and across all aquifers;
  - e) incorporation of the airborne electro-magnetic modelling recently completed by Geoscience Australia (and available to Adani by June 2020); and
  - f) revision of the conceptual understanding of the source aquifer(s) for DSC and groundwater system based on information collected from the above for incorporation into the groundwater model review (re-run).
1. Does the above summary accurately reflect the CSIRO/GA advice with respect to further work that could increase certainty of the source aquifer(s) for the DSC?
  2. Would CSIRO/GA recommend any additional measures?
  3. Would it be appropriate from an adaptive management framework for all the above matters to be undertaken over a set period i.e. prior to the model review (re-run)?

**Based on GDEMP 11b (track change version/s) and the CSIRO/GA advice dated November 2018 and February 2019, the department seeks your additional advice on the following questions:**

4. Generally, in respect to groundwater research and modelling, is it acceptable and/or common from a scientific basis to have some level of uncertainty? i.e. can source aquifer(s) ever be categorically determined or definitively identified? Can you have absolute certainty? Is there always some level of uncertainty?
5. Are the groundwater drawdown trigger thresholds proposed in the updated GDEMP 11b appropriate and suitable to ensure the long-term protection of the DSC in light of your advice that the numerical model is not fit for purpose?
6. For question 5, are the adaptive management measures and commitments in the updated GDEMP appropriate? If not, please provide suggestions to address this?

This advice will assist the department's review and assessment of the latest version of the GDEMP 11b.

Please note there is a high level of urgency to your advice given the department wishes to progress the assessment of the GDEMP and work with Adani to finalise the plan.

**DES CSIRO/GA GDEMP 11b Advice request – REVISED based on CSIRO/GA feedback and clarification provided 20 May 2019**

Review documents (*for clarification please note DES does not require a review of the GMMP*):

1. GDEMP v11b (track change versions v10 – v11 and v11a-11b attached);

Following the department's review of the CSIRO/GA 2019 Report, the department seeks your advice about the type of investigation and research that may provide greater certainty regarding the department's interest in relation to the identification of the source aquifer(s) to the Doongmabulla Springs Complex (DSC).

The environmental authority (EA) for the Carmichael Coal Mine requires Adani to develop and implement a Groundwater Dependent Ecosystems Management Plan (GDEMP). The term GDEMP is defined in the EA and states, among other things, that a GDEMP must include '*detailed baseline research to establish the source aquifer(s) for groundwater supply to each groundwater dependent ecosystem [potentially or indirectly impacted by mining activities]*'.

Your 2019 Report states that:

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*'Available evidence supports the conceptualisation that the Clematis Sandstone is a likely source aquifer for the DSC. However, the proposed monitoring and management approaches do not sufficiently address the uncertainty regarding the potential alternative or additional source aquifers (refer Section 3.2 and 3.3).'* (p9); and

*'To constrain the source aquifer(s) of the DSC, a more sophisticated statistical analysis of hydrochemistry data is required. This includes assessing a wider variety of groundwater and surface water analytes, as well as appropriate use of isotope hydrochemistry analysis. Further information on potential techniques is provided (CSIRO and Geoscience Australia, 2018) and other readily available references.'* (p10)

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*'Further information on the specific methods and techniques to be applied to chemically assess the springs source and groundwater flow processes is required for a more detailed assessment to be made. This includes the need to define the*

*analytical suite, quality assurance and quality control methods, and use of a broader range of isotopic and environmental traces...*' (at page 13).

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  - c) a comprehensive review of groundwater level and quality data from relevant aquifers including data from new proposed nested bores in the vicinity of DSC;
  - d) detailed geological mapping including cores from bores drilled in the vicinity of DSC and facies modelling to better inform hydraulic connectivity within and across all aquifers;
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1. Does the above summary accurately reflect the CSIRO/GA advice with respect to further work that could increase certainty of the source aquifer(s) for the DSC?
  2. Would CSIRO/GA recommend any additional measures?
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**Based on GDEMP 11b (track change version/s) and the CSIRO/GA advice dated November 2018 and February 2019, the department seeks your additional advice on the following questions:**

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6. For question 5, are the adaptive management measures and commitments in the updated GDEMP appropriate? If not, please provide suggestions to address this?

This advice will assist the department's review and assessment of the latest version of the GDEMP 11b.

Please note there is a high level of urgency to your advice given the department wishes to progress the assessment of the GDEMP and work with Adani to finalise the plan.

**Date :** 8/05/2019 5:17:41 PM  
**From :** "CLAUS Sonia"  
**To :** "MCCOSKER Juliana"  
**Subject :** comments on report  
**Attachment :** WRNB 2278 GDEMP.docx;image001.png;image002.png;

Hi Juliana

See attached draft comments on the second report. I have started putting detailed comments into the pdf. But am only half way. The main issue is still the consistency issues with the indicators between sections and tables. I have summarised these and provided examples based on the Carmichael River GDE.

I'll be working at home tomorrow and will be contactable after 10:30 if you have any questions.

Thanks  
Sonia



**Dr Sonia Claus**  
A/Principal Scientist  
Environmental Monitoring and Assessment Science, Science Division  
Department of Environment and Science

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**P 3170 5559**  
EcoSciences Precinct, Level 1 Block B, East Wing  
41 Boggo Road, Dutton Park 4102  
GPO Box 2454, Brisbane QLD 4001

Customers first | Ideas into action | Unleash potential | Be courageous | Empower people

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# Memorandum

Department of  
**Environment and Science**

**Enquiries** Sonia Claus

**Telephone** 3170 5559

## Your reference

**Our reference** WRNB 2278  
(<http://wqsci.lands.resnet.qg/workrequest/>)

8/05/2019

To	Juliana McCosker, Manager
	Emerald Office, Coal Business Centre Department of Environment and Science
From	Dr Sonia Claus, Principal Scientist
	Water Sciences, Environmental Monitoring and Assessment, Science Delivery, Department of Environment and Science

**Subject: Review of Carmichael Coal project Groundwater Dependant Ecosystem Management Plan**

Further to your work request dated 10/4/2019, the Water Sciences group has reviewed the Groundwater Dependant Ecosystem Management Plan (GDEMP).

Advice provided by CSIRO and GeoScience Australia (GA) and the summary of that advice and Adani's response prepared by Department of Environment and Energy (DoEE) were also reviewed.

The specific information provided for the review included:

- AECOM 2019. Groundwater Management and Monitoring Program. Carmichael Coal Project. 15 March 2019. Version 7.
- Ecological 2019. Groundwater Dependant Ecosystem Management Plan. Carmichael Coal Mine Project. 19 March 2019. Version 11b
- CSIRO and GeoScience Australia. 2019. Carmichael Coal Mine. Advice on Groundwater Management and Monitoring and Groundwater Dependent Ecosystem Management plans to the Department of the Environment and Energy. February 2019.
- DoEE. 2019. Summary of CSIRO and Geoscience Australia Advice on Groundwater Management Plans and Response.

Water Sciences also attended a briefing on 16<sup>th</sup> April by CSIRO, GA and DoEE regarding the advice and Adani's responses and revisions to the groundwater management plans. A summary of the advice and Adani's responses is provided in WRNB 2278 GMMP.

The indicators listed in Sections 6.6.1 and 6.6.2 are:

- Population structure
- Community condition
- Weeds and pests or weed cover and pests
- Riparian community health
- Fauna use of riparian habitat
- Canopy cover
- Wetland vegetation
- Threatened and endemic flora populations
- Spring wetland extent
- Groundwater level
- surface water level
- surface water flow
- Groundwater quality
- surface water quality
- presence of weed species
- extent of weed coverage
- presence of pest species
- extent of pest disturbance.

The list of indicators in Table 6-9 are:

- Riparian community health
- Fauna use of riparian habitat
- Weed and pests (within areas controlled by Adani)
- Groundwater Level
- Groundwater Quality
- Surface Water Flow (periods of flow)
- Surface Water Level (periods of no flow)
- Surface Water Quality

It maybe that a number of indicators listed in Sections 6.6.1 and 6.6.2 are classed as parameters in Table 6-9. However, this is not the case for community condition or population structure. In addition, wetland vegetation, threatened and endemic flora populations and spring wetland extent are not listed in Table 6-9, however they are included in Section 6.6.1.

In section 6.6.1, the indicator of population structure is included in the riparian condition and aquatic ecology surveys. However, this indicator will measure different communities and this is not addressed in Table 6-9.

Indicators included in Table 6-10 per issue number, but not other sections above include:

#2 – Subsidence indicators

#5 - Visual evidence of clearing or disturbance, area cleared, Rehabilitation success parameters as listed in Appendix 2 of the EA (native fauna species, plant regeneration, weed abundance, pest abundance), erosion

#6 - Fuel load levels and ground composition

#8 - Visual observation and records

#9 - dB(A), peak particle velocity (PPV)

#10 – Total suspended particulate matter

#11 - Observations of amount of light falling on Carmichael River.

**Disclaimer:**

*Any opinions, advice or comments provided in this memo (i.e. the work request 'response') or associated attachments or emails should not be used as part of legal proceedings or expert statements. Please advise the Water Sciences (WS) group immediately if the response to this work request could be used in relation to legal proceedings.*

*WS work request responses are based on the information provided by other parties. Although the information provided will be cross-checked and verified wherever possible, WS cannot be held liable for interpretations based on incorrect, inaccurate, incomplete or otherwise invalid information, nor for any subsequent decisions or actions made by any individuals or organisations that were based on misinformed responses.*

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GDE	Monitoring survey	Table 5-1 - Monitoring attributes or methods	Indicators from Section 6.6.1 – pre impact	Indicators from Section 6.6.2 - impact	Table 6-9 - indicator	Table 6-9 - Parameter	Relevant Table 6-10 Issue number	
Carmichael River (Section 6.6)	Ecological features map of the Carmichael River	Threatened and endemic flora locations						
		Weed and pest locations	Weeds and pests					
		Riparian vegetation composition and health	Riparian community health Population structure Community composition (it is assumed that these are equivalent)		Riparian community health	Structural formation, leaf litter cover, rock cover, bare ground, cryptogram cover, crown cover, species composition and cover (by species and by stratum), height of each strata, cover of coarse woody debris, number of large trees (eucalypt and non-eucalypt), diameter at breast height (DBH) of eucalypt and non- eucalypt trees, weed cover, erosion and severity, disturbances and severity, stem count for woody vegetation, basal area.		
		Fauna use of riparian habitat	Fauna use of riparian habitat		Fauna use of riparian habitat	Abundance of key species.		
		Areas of connectivity or disconnection with groundwater						
		Gaining / losing areas relative to groundwater						
		Location of deep pools						
		Location of riffles						
		Location and size of aquatic macrophyte beds						
		Other key aquatic habitat features						
	Riparian condition surveys	CORVEG and/or BioCondition surveys						
			Weed cover and pests					#7
			Riparian community health Population structure Community composition Canopy cover	Riparian community health	Riparian community health	Structural formation, leaf litter cover, rock cover, bare ground, cryptogram cover, crown cover, species composition and cover (by species and by stratum), height of each strata, cover of coarse woody debris, number of large trees (eucalypt and non-eucalypt), diameter at breast height (DBH) of eucalypt and non- eucalypt trees, weed cover, erosion and severity, disturbances and severity, stem count for woody vegetation, basal area.		#5
			Fauna use of riparian habitat	Fauna use of riparian habitat	Fauna use of riparian habitat	Abundance of key species.		
			Wetland vegetation (unclear whether this is appropriate here)					
			Groundwater level (described in text, but not included in list for pre-impact but included in impact monitoring)	Groundwater level				
	Aquatic Ecological Surveys	Vertebrate species presence, in particular at remnant pools						
		Ecological condition (e.g. using AusRivAS)	Community condition (it is assumed that these are equivalent)					
		Ecological patterns (macrophytes, fish, invertebrates)	Population structure (it is assumed that these are equivalent)					
			Weeds and pests					
			Riparian community health (it is unclear why this indicator is included in this survey)					
			Fauna use of riparian habitat (it is unclear why this indicator is included in this survey)					
			Spring wetland extent (it is unclear why this indicator is included in this survey)					
			Wetland vegetation (it is unclear why this indicator is included in this survey)					
			Threatened and endemic flora locations (should this be macrophytes?)					



Department of  
**Environment and Science**

10 May 2019

Dr James Johnson  
Chief Executive Officer  
Geoscience Australia  
Cnr Jerrobomberra Avenue and Hindmarsh Drive  
SYMONSTON ACT 2609

By email: [james.johnson@ga.gov.au](mailto:james.johnson@ga.gov.au)

[Redacted: sch4p4( 6) Personal information]

Director  
CSIRO Land and Water  
Black Mountain Science and Innovation Park  
Clunies Ross Street  
ACTON ACT 2601

By email: [Redacted: 4p4( 6) Personal information]@[csiro.au](mailto:csiro.au)

Dear Dr Johnson and [Redacted: 4p4( 6) Personal information]

Thank you for meeting with the Department of Environment and Science (the department) on 16 April 2019 to discuss the CSIRO and Geoscience Australia Report '*Advice on Groundwater Management and Monitoring and Groundwater Dependent Ecosystem Management plans to the Department of the Environment and Energy (CSIRO and Geoscience Australia, February 2019)*' (the 2019 Report).

Following the department's review of the 2019 Report, the department wishes to seek your advice about the type of investigation and research that may provide greater certainty regarding the department's interest in relation to the identification of the source aquifer(s) to the Doongmabulla Springs Complex (DSC).

The environmental authority (EA) for the Carmichael Coal Mine requires Adani to develop and implement a Groundwater Dependent Ecosystems Management Plan (GDEMP). The term GDEMP is defined in the EA and states, among other things, that a GDEMP must include '*detailed baseline research to establish the source aquifer(s) for groundwater supply to each groundwater dependent ecosystem [potentially or indirectly impacted by mining activities]*'.

Your 2019 Report states that:

*'It is plausible and reasonable that the Clematis Sandstone is a major source aquifer for the DSC... It is not plausible and reasonable to state unequivocally that the Clematis Sandstone is the sole source aquifer for the DSC...'* (p2); and

*'Available evidence supports the conceptualisation that the Clematis Sandstone is a likely source aquifer for the DSC. However, the proposed monitoring and management approaches do not sufficiently address the uncertainty regarding the potential alternative or additional source aquifers (refer Section 3.2 and 3.3).'* (p9); and

*'To constrain the source aquifer(s) of the DSC, a more sophisticated statistical analysis of hydrochemistry data is required. This includes assessing a wider variety of groundwater and surface water analytes, as well as appropriate use of isotope hydrochemistry analysis. Further information on potential techniques is provided (CSIRO and Geoscience Australia, 2018) and other readily available references.'* (p10)

Further, in advice given to the Commonwealth Department of the Environment and Energy, 'Advice on draft research plans to the Department of the Environment and Energy', dated November 2018, you state:

*'An integrated analysis of existing and newly acquired geological, hydrodynamic and hydrochemical data would improve the conceptual understanding of the groundwater sources of the DSC'. (at page 5); and*

*'Further information on the specific methods and techniques to be applied to chemically assess the springs source and groundwater flow processes is required for a more detailed assessment to be made. This includes the need to define the analytical suite, quality assurance and quality control methods, and use of a broader range of isotopic and environmental traces...'* (at page 13).

Having regard to the 2019 Report, the 2018 advice, and our meeting of 16 April 2019, the department has the understanding that the following further research (steps) would improve the certainty about the source aquifer(s) of the DSC and other groundwater dependent ecosystems:

1. hydrogeochemical analysis of water samples for comparison within and across relevant aquifers (Clematis Sandstone, Dunda Beds and Rewan Formation);
2. incorporation of the use of isotope and ageing tracers in the above hydrogeochemical analysis;
3. a comprehensive review of groundwater level and quality data from relevant aquifers including data from new proposed nested bores in the vicinity of DSC;
4. detailed geological mapping including cores from bores drilled in the vicinity of DSC and facies modelling to better inform hydraulic connectivity within and across all aquifers;
5. incorporation of the airborne electro-magnetic modelling recently completed by Geoscience Australia (and available to Adani by June 2020); and

6. revision of the conceptual understanding of the source aquifer(s) for DSC and groundwater system based on information collected from the above for incorporation into the groundwater model review (re-run).

Is this understanding correct? Does the above summary accurately reflect the CSIRO and GA advice with respect to further work required to increase certainty of the source aquifer(s) for the DSC?

In addition, the department seeks your advice on the following questions:

1. What is the level of confidence that the Clematis Sandstone aquifer is the main source for the DSC?
2. If there is a high level of uncertainty, what work should be undertaken to address and reduce the level of uncertainty regarding the potential alternative or additional source aquifers for the DSC?
3. For any additional work recommended for question 2, what is a realistic timeframe for the completion of each element of the additional work?
4. Are the groundwater drawdown trigger thresholds proposed in the new GDEMP appropriate and suitable to ensure the long-term protection of the DSC in light of your advice that the conceptual model is not fit for purpose?
5. Based on GDEMP version 11b, are there any other matters or recommendations that CSIRO and GA would highlight in order to ensure the effectiveness of the management plan in relation to environmental authority conditions?

This advice will assist the department's review and assessment of the GDEMP.

Given that the department wishes to progress the assessment of the GDEMP in a timely manner, there is some urgency to your advice. Could you please advise when you anticipate to be in a position to provide your advice.

By way of background, please refer to the GDEMP (version 11b) that was submitted to the department on 9 April 2019 (available at <https://www.adaniaustralia.com/-/media/Project/Australia/Our-Projects--Businesses/mine-environment-reporting/GDEMP-Final-V11b-19March2019.pdf?la=en&hash=C4988A8485428FD234C4A09023D08B34>), and the enclosed document 'Research Study Report – Source Aquifer to Doongmabulla Springs' that was provided to the department by Adani in November 2018.

Please do not hesitate to contact me on (07) 4987 9343 or at [Melissa.Wells@des.qld.gov.au](mailto:Melissa.Wells@des.qld.gov.au) should you require further information about this request.

Yours sincerely,

sch4p4(6) Personal information

**Melissa Wells**  
**Executive Director**  
**Coal and Central Queensland Compliance**

Enc.

*Research Study Report – Source Aquifer to Doongmabulla Springs* (revision 03, Adani, November 2018)

Date : 13/05/2019 6:17:53 PM  
From : "WELLS Melissa"  
To : "MERRICK Jamie"  
Subject : FW: Actions  
Attachment : image001.jpg;image002.png;image003.png;image006.png;

FYI



**Melissa Wells**  
Executive Director  
Coal and Central Qld Compliance  
Department of Environment and Science

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99 Hospital Road, Emerald QLD 4720  
PO Box 3028, Emerald QLD 4720

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**From:** WELLS Melissa  
**Sent:** Monday, 13 May 2019 6:16 PM  
**To:** s.73  
**Cc:** ELLWOOD Dean  
**Subject:** RE: Actions

Good evening s.73

On behalf of Dean I can confirm DES will be in a position to provide Adani comments on the GMMP this week. As you are aware, a meeting request has been sent out for the BTFMP workshop and the meeting will take place in Rockhampton from 2.30-5pm this Wednesday. As discussed in our meeting last week, the relevant staff are unavailable to meet again later this week and the next earliest opportunity is Monday 20 May. If you have a preference for the meeting location please let me know and we can send a calendar invitation.

In regards to the questions posed to GA/CSIRO I can advise that DES is seeking clarification and feedback regarding the level of certainty around the source aquifer/s, its monitoring and management in light of the GA/CSIRO report, the resubmitted GDEMP (version 11b) and the relevant environmental authority conditions in accordance with the *Environmental Protection Act 1994*.

In relation to timing for clarification sought from GA/CSIRO, DES has expressed the urgency around the request. From discussions with GA today, DES is advised they are currently reviewing the request and will be in a position to provide certainty around timeframes later this week as the contract is in place .

We look forward to receiving your comments on the BTFMP prior to the workshop this Wednesday and finalising the BTFMP.

Kind regards,  
Melissa



**Melissa Wells**  
Executive Director  
Coal and Central Qld Compliance  
Department of Environment and Science

P 07 4987 9343

99 Hospital Road, Emerald QLD 4720  
PO Box 3028, Emerald QLD 4720

---

**From:** s.73 <[redacted]@adani.com.au>  
**Sent:** Monday, 13 May 2019 2:59 PM  
**To:** ELLWOOD Dean; WELLS Melissa  
**Subject:** Actions

Dean

Thank you for your time on Friday to talk through the finalisation of our management plans.

We have been consistent in requesting clarity of both process and timing to finalise the outstanding management plans. Based on the discussions from last Friday we understand that the following actions were committed to:

- In relation to the GMMP, DES will provide comments to Adani this week in a similar format to that provided for the BTFMP;
- Adani and DES will meet in a workshop to work through feedback on the GDEMP and GMMP. We note you offered Monday 20<sup>th</sup> May to hold this workshop. We stated our preference and desire for a meeting during the course of this week and we respectfully request that DES provide an opportunity for that timing to be met.
- For the BTFMP, on a forward looking basis, we agreed to meet on Wednesday the 15th of May to workshop the matters as expressed in

the reasons in your Attachment A.

- Prior to that workshop this Wednesday, Adani will send through high level comments in relation to the reasons set out in your Attachment A of the BTFMP decision of 2 May 2019. These comments are being provided in the context of Adani considering resubmission and are without prejudice to any other right me may have with respect to the BTFMP decision.

We also again request that DES provide to Adani the questions asked of CSIRO & GA regarding the Source Aquifer (GDMP), and the timing in which CSIRO & GA will respond to those questions. As discussed in the meeting you undertook to provide me with this information today.

Thanks

s.73

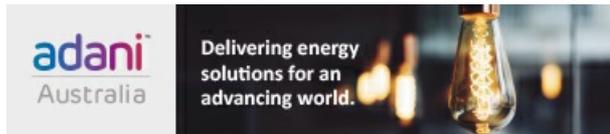
E [s.73@adani.com.au](mailto:s.73@adani.com.au)

P office: +61 7 3223 4800 | direct: s.73

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Date : 14/05/2019 7:04:11 PM  
From : "WELLS Melissa"  
To : "HALLIDAY Genevieve"  
Cc : "MERRICK Jamie" , "LAWRENCE Rob"  
Subject : Fwd: Adani response to DES email 13 May 2019  
Attachment : image568012.jpg;  
FYI

Sent from my iPhone

Begin forwarded message:

**From:** [REDACTED] s.73 <[REDACTED]@adani.com.au>  
**Date:** 14 May 2019 at 6:51:38 pm AEST  
**To:** WELLS Melissa <Melissa.Wells@des.qld.gov.au>  
**Cc:** [REDACTED] s.73 <[REDACTED]@adani.com.au>, ELLWOOD Dean <Dean.Ellwood@des.qld.gov.au>  
**Subject:** Re: Adani response to DES email 13 May 2019

Melissa

Thank you for your email. As per my email this morning, can you please advise Adani as to when DES will provide Adani with a copy of the questions that you have provided CSIRO/GA in relation to the GDEMP?

[REDACTED] s.73  
**Adani Australia**  
Level 25, AMP Place, 10 Eagle Street, Brisbane, QLD 4000  
Phone: [REDACTED] s.73  
[REDACTED] s.73 <[REDACTED]@adani.com.au>

[REDACTED] s.73  
E [REDACTED] s.73 <[REDACTED]@adani.com.au>  
P office: +61 7 3223 4800 | direct: [REDACTED] s.73  
A Level 25, 10 Eagle Street, Brisbane, QLD, 4000  
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On 14 May 2019, at 6:26 pm, WELLS Melissa <Melissa.Wells@des.qld.gov.au> wrote:

[REDACTED] s.73

I refer to your email of this morning, 14 May 2019 concerning the departments review of the resubmitted Adani GDEMP.

I remind you that the review of the Adani GDEMP undertaken by CSIRO/GA (the review) was commissioned by the Department of the Environment and Energy (DOEE).

While the department was consulted by DOEE on the review's terms of reference and attended a presentation of the CSIRO/GA's Tranche 1 advice, the department did not further participate or meet with CSIRO/GA during the DOEE independent review. Nor did the department have any commercial arrangement with CSIRO/GA regarding the DOEE review.

The final review (advice/report) was not provided to department until 9 April 2019, some four weeks after multiple requests by the department to DOEE, including requests at Ministerial level.

Again, given that Adani has submitted a revised version of the GDEMP (version 11b), a version that is different to the one that the CSIRO/GA review (advice/report) relied on, the department is simply seeking clarification from CSIRO/GA about its review in light of the revised GDEMP. This clarification will assist the department in part to decide whether the GDEMP is in compliance with the conditions of the environmental authority (EA) granted to Adani under the *Environmental Protection Act 1994* (Act) for the Carmichael Mine. This is not a 'new' review of the GDEMP, and it is entirely consistent with the clear message provided to Adani that the department would rely upon advice from CSIRO/GA and not seek other third party advice.

Given the resource implications and urgency around the timeliness of the advice sought from CSIRO/GA, the department considers the requirement of a contract and fee for service by CSIRO/GA as reasonable and consistent with any necessary governance in relation to a process such as this.

To date, the department has communicated with Dr James Johnson, CEO Geoscience Australia and Ms Jane Coram, Director CSIRO in relation to the department's request.

The names of the officers of CSIRO/GA who will be involved in preparing advice for the department is a matter for CSIRO/GA. I am neither furnished with the information nor would it be appropriate for me to comment on the CSIRO/GA officers who were involved with the DOEE GDEMP review.

The department's actions in relation to the Adani GDEMP are directed solely at ensuring the proper administration of the Act and compliance with the conditions of the environmental authority.

My email of yesterday, gave you an indication on the timing of the review of the GDEMP by the department and the advice of CSIRO/GA.

Kind regards  
Melissa

<image001.png> **Melissa Wells**  
Executive Director  
Coal and Central Qld Compliance  
Department of Environment and Science

---

P 07 4987 9343

99 Hospital Road, Emerald QLD 4720  
PO Box 3028, Emerald QLD 4720

---

**From:** [REDACTED] s.73 @adani.com.au  
**Sent:** Tuesday, 14 May 2019 10:21 AM  
**To:** ELLWOOD Dean  
**Cc:** WELLS Melissa; [REDACTED] s.73  
**Subject:** Adani response to DES email 13 May 2019

Dean

I refer to Melissa Well's email sent last evening. It would appear despite DES' public claims that you would not be seeking a new or further review of the scientific evidence presented by CSIRO /GA, you are in fact engaging in another review as evidenced by Ms Well's reference to having to put in place a new contract. If this round of questions was simply an extension of the work undertaken we do not see how there would be any requirement for a new contract.

Furthermore we submit that the email fails to provide Adani with the necessary clarity regarding the "contract" between DES and CSIRO/GA or the substance of the questions that have been presented to CSIRO/GA by DES. Accordingly and consistent with our request on Friday 10 May, we once again request a copy of the questions you have asked CSIRO/GA to consider under this new contract. This request is reasonable given DES is commissioning a new review or assessment of Adani's GDEMP, and that DES previously provided Adani with a copy of the Terms of Reference for the so-called Wintle Review of the BTFMP. An ability to consider the questions as posed by the DES to CSIRO/GA would seem a normal part of this process and is clearly required to permit us to fully participate.

Could you also clarify whether the officers of CSIRO/GA engaged by DES were directly involved in the GDEMP review process commissioned by the Department of Environment and Energy? Can you also provide Adani with the names of all CSIRO/GA officers engaged for the DES contract? Can you confirm that DES were consulted and participated with DoEE in the original questions put to CSIRO/GA?

We request the above information by close of business today. Please contact me if I can provide further information.

[REDACTED]  
s.73

E [REDACTED] s.73 @adani.com.au

P office: +61 7 3223 4800 | direct: [REDACTED] s.73

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Date : 14/05/2019 6:27:12 PM  
From : "WELLS Melissa"  
To : "MERRICK Jamie" , "LAWRENCE Rob"  
Subject : FW: Adani response to DES email 13 May 2019  
Attachment : image002.png;image004.jpg;image001.png;image006.png;

FYI



**Melissa Wells**  
Executive Director  
Coal and Central Qld Compliance  
Department of Environment and Science

P 07 4987 9343

99 Hospital Road, Emerald QLD 4720  
PO Box 3028, Emerald QLD 4720

---

**From:** WELLS Melissa  
**Sent:** Tuesday, 14 May 2019 6:26 PM  
**To:** s.73  
**Cc:** s.73; ELLWOOD Dean  
**Subject:** RE: Adani response to DES email 13 May 2019

s.73

I refer to your email of this morning, 14 May 2019 concerning the departments review of the resubmitted Adani GDEMP.

I remind you that the review of the Adani GDEMP undertaken by CSIRO/GA (the review) was commissioned by the Department of the Environment and Energy (DOEE).

While the department was consulted by DOEE on the review's terms of reference and attended a presentation of the CSIRO/GA's Tranche 1 advice, the department did not further participate or meet with CSIRO/GA during the DOEE independent review. Nor did the department have any commercial arrangement with CSIRO/GA regarding the DOEE review.

The final review (advice/report) was not provided to department until 9 April 2019, some four weeks after multiple requests by the department to DOEE, including requests at Ministerial level.

Again, given that Adani has submitted a revised version of the GDEMP (version 11b), a version that is different to the one that the CSIRO/GA review (advice/report) relied on, the department is simply seeking clarification from CSIRO/GA about its review in light of the revised GDEMP. This clarification will assist the department in part to decide whether the GDEMP is in compliance with the conditions of the environmental authority (EA) granted to Adani under the *Environmental Protection Act 1994* (Act) for the Carmichael Mine. This is not a 'new' review of the GDEMP, and it is entirely consistent with the clear message provided to Adani that the department would rely upon advice from CSIRO/GA and not seek other third party advice.

Given the resource implications and urgency around the timeliness of the advice sought from CSIRO/GA, the department considers the requirement of a contract and fee for service by CSIRO/GA as reasonable and consistent with any necessary governance in relation to a process such as this.

To date, the department has communicated with Dr James Johnson, CEO Geoscience Australia and s.73(6) Personal information Director CSIRO in relation to the department's request.

The names of the officers of CSIRO/GA who will be involved in preparing advice for the department is a matter for CSIRO/GA. I am neither furnished with the information nor would it be appropriate for me to comment on the CSIRO/GA officers who were involved with the DOEE GDEMP review.

The department's actions in relation to the Adani GDEMP are directed solely at ensuring the proper administration of the Act and compliance with the conditions of the environmental authority.

My email of yesterday, gave you an indication on the timing of the review of the GDEMP by the department and the advice of CSIRO/GA.

Kind regards  
Melissa

**Melissa Wells**  
Executive Director  
Coal and Central Qld Compliance  
Department of Environment and Science

P 07 4987 9343

Date : 16/05/2019 5:39:36 PM  
From : "WELLS Melissa"  
To : "MERRICK Jamie" , "LAWRENCE Rob"  
Subject : Fwd: Adani response to DES email 13 May 2019  
Attachment : image002.png;image003.jpg;  
FYI

Sent from my iPhone

Begin forwarded message:

**From:** WELLS Melissa <[Melissa.Wells@des.qld.gov.au](mailto:Melissa.Wells@des.qld.gov.au)>  
**Date:** 16 May 2019 at 5:15:23 pm AEST  
**To:** [REDACTED] s.73 @adani.com.au  
**Cc:** [REDACTED] s.73 @adani.com.au, ELLWOOD Dean <[Dean.Ellwood@des.qld.gov.au](mailto:Dean.Ellwood@des.qld.gov.au)>  
**Subject:** RE: Adani response to DES email 13 May 2019

Hi [REDACTED] s.73

As stated, the CSIRO/GA advice is to provide clarification to the department about its original review in light of the revised GDEMP. Adani will be provided with a copy of the CSIRO/GA advice once it becomes available.

Kind regards,  
Melissa.



**Melissa Wells**  
Executive Director  
Coal and Central Qld Compliance  
Department of Environment and Science

P 07 4987 9343

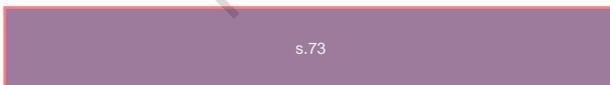
99 Hospital Road, Emerald QLD 4720  
PO Box 3028, Emerald QLD 4720

---

**From:** [REDACTED] s.73 @adani.com.au  
**Sent:** Tuesday, 14 May 2019 6:52 PM  
**To:** WELLS Melissa  
**Cc:** [REDACTED] s.73 ELLWOOD Dean  
**Subject:** Re: Adani response to DES email 13 May 2019

Melissa

Thank you for your email. As per my email this morning, can you please advise Adani as to when DES will provide Adani with a copy of the questions that you have provided CSIRO/GA in relation to the GDEMP?

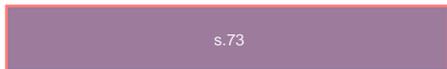


Adani Australia

[Level 25, AMP Place, 10 Eagle Street, Brisbane, QLD 4000](#)

Phone [REDACTED] s.73

[REDACTED] s.73 @adani.com.au



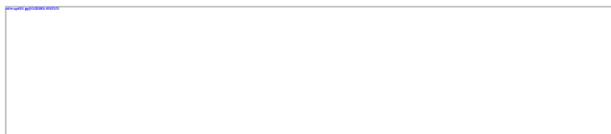
E [REDACTED] s.73 @adani.com.au

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s.73

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The names of the officers of CSIRO/GA who will be involved in preparing advice for the department is a matter for CSIRO/GA. I am neither furnished with the information nor would it be appropriate for me to comment on the CSIRO/GA officers who were involved with the DOEE GDEMP review.

The department's actions in relation to the Adani GDEMP are directed solely at ensuring the proper administration of the Act and compliance with the conditions of the environmental authority.

My email of yesterday, gave you an indication on the timing of the review of the GDEMP by the department and the advice of CSIRO/GA.

Kind regards  
Melissa

<image001.png> **Melissa Wells**  
Executive Director  
Coal and Central Qld Compliance  
Department of Environment and Science

-----  
P 07 4987 9343

99 Hospital Road, Emerald QLD 4720  
PO Box 3028, Emerald QLD 4720

---

**From:** [redacted] s.73 <[redacted]@adani.com.au>  
**Sent:** Tuesday, 14 May 2019 10:21 AM  
**To:** ELLWOOD Dean  
**Cc:** WELLS Melissa, [redacted] s.73  
**Subject:** Adani response to DES email 13 May 2019

Dean

I refer to Melissa Well's email sent last evening. It would appear despite DES' public claims that you would not be seeking a new or further review of the scientific evidence presented by CSIRO /GA, you are in fact engaging in another review as evidenced by Ms Well's reference to having to put in place a new contract. If this round of questions was simply an extension of the work undertaken we do not see how there would be any requirement for a new contract.

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Could you also clarify whether the officers of CSIRO/GA engaged by DES were directly involved in the GDEMP review process commissioned by the Department of Environment and Energy? Can you also provide Adani with the names of all CSIRO/GA officers engaged for the DES contract? Can you confirm that DES were consulted and participated with DoEE in the original questions put to CSIRO/GA?

We request the above information by close of business today. Please contact me if I can provide further information.

s.73

E s.73 @adani.com.au

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-----

17 May 2019

Private & Confidential

Mr Jamie Merrick  
Director-General  
Department of Environment and Science  
Queensland Government  
400 George Street  
Brisbane QLD 4000

By email: [jamie.merrick@des.qld.gov.au](mailto:jamie.merrick@des.qld.gov.au)

Dear Jamie

### Adani Mining Pty Ltd – Groundwater Management Plans

We refer to our previous correspondence in relation to groundwater management plans, in particular the Groundwater Dependent Ecosystems Management Plan (**GDEMP**) and the Groundwater Monitoring and Management Plan (**GMMP**) for Adani Mining Pty Ltd (**Adani**), and in particular our letter to you more than a month ago on 12 April 2019 which sought clarity from you on the process and timing for approval of those plans. In the most recent email from your Ms Melissa Wells at 5:15pm on 16 May 2019, we have been advised by the Department of Environment and Science (**DES**) that:

*"...the CSIRO/GA advice is to provide clarification to the department about its original review in light of the revised GDEMP. Adani will be provided with a copy of the CSIRO/GA advice once it becomes available..."*

This latest correspondence from Ms Wells was in response to our request where we had once again sought that DES provide us with the questions that DES has put to CSIRO / GA. We understand that these questions form the basis for a new contract being entered into between DES and CSIRO / GA. The latest email from DES is, at best, unresponsive and we ask:

**Question 1: Can the DES please provide us with the questions that have been asked of CSIRO / GA?**

It would seem fairer and simpler if you just provided us with these basic details so we have a proper opportunity to understand and engage in the process.

However, given the apparent unwillingness to meet this very simple request we have also submitted a formal Right to Information application (copy attached). As that RTI application exclusively relates to ourselves, DES and then to CSIRO / GA (who seem able to respond very rapidly to such requests) it is our expectation that this application will be dealt with as a priority.

Adani Mining Pty Ltd  
Level 25  
10 Eagle Street, Brisbane QLD 4000  
GPO Box 2569, Brisbane QLD 4001  
Australia

Tel +61 7 3223 4800  
[www.adaniaustralia.com](http://www.adaniaustralia.com)

**Question 2: When will you receive the advice from CSIRO / GA?**

Separately, with respect to the latest correspondence from Ms Wells, there is a reference to advice from CSIRO / GA and its provision to us when it becomes available. We would expect it is a very short time frame given what seems to be, by implication, a strictly limited scope and we wish to be prepared to respond once it is available.

We are only seeking clarity as to process and timing and would appreciate the ability to be able to fully engage with the DES with a proper understanding of what is happening.

We remain committed to working collaboratively to finalise these plans so that we can get on with the task of delivering thousands of jobs for Queenslanders.

Yours sincerely



**Attachment** 2019\_05\_16\_Application\_RTI\_to\_DES\_re\_GMMP\_and\_GDEMP\_(Lodged).pdf

**cc** Ms Mellissa Wells Melissa.Wells@des.qld.gov.au  
Mr Dean Ellwood Dean.Ellwood@des.qld.gov.au

**ATTACHMENT A – DES comments on GDEMPv11b 7 June 2019 (to be read in conjunction with the CSIRO/GA advice dated 7 June 2019).**

***The plan must include detailed baseline research to establish the source aquifer(s) for groundwater supply to the GDE***

**Requirements prior to model re-run:**

1. Adani must make a commitment to undertake and complete the following additional work progressively to improve the understanding of the spring source aquifers prior to the 2 year model re-run.
  - Hydrogeochemical analysis of samples from different springs groups within each spring complex to provide better understanding and discern the source aquifers of the Doongmabulla Springs Complex. Bulk hydrochemistry must be completed within 3 months of approval and tracer analyses within 12 months. Hydrogeochemical analyses must include but not limited to:
    - a. noble gases - e.g. helium to identify any deeper groundwater contributes to the springs (id of source aquifers);
    - b. radioactive noble gases to identify source aquifer of recent (decades) to intermediate (centuries) and
    - c. strontium isotopes – to identify the source rock of a particular groundwater system.
  - Incorporation of the use of isotope and ageing tracers in the above hydrogeochemical analysis;
  - A comprehensive review of groundwater level and quality data from relevant aquifers including data from new proposed nested bores in the vicinity of Doongmabulla Springs Complex;
  - Undertake hydrochemistry interpretation from surface and spring samples to provide more detailed hydrogeology system understanding;
  - Detailed geological mapping including cores from bores drilled in the vicinity of Doongmabulla Springs Complex and facies modelling to better inform hydraulic connectivity within and across all aquifers;
  - At new monitoring locations, use the opportunity to acquire drill cores to better understand the intact hydrostratigraphy being drilled through to inform the conceptual model. Conduct test on core samples to assess and quantify hydraulic properties being implemented in the numerical model. Completion of core analysis within 2 years.
  - Incorporation of the airborne electro-magnetic (AEM) modelling recently completed by Geoscience Australia (and available to Adani by June 2020). Adani must undertake specific interpretation and analysis of AEM data. The analysis should be conducted with consideration of relevant site-specific data and alternative conceptualisations to be tested to ensure the interpretation derives appropriate conclusions regarding hydrogeology at the scale of investigation of interest to Adani. Adani's AEM investigation should articulate how the objectives of the AEM data analysis will seek to improve hydrogeological knowledge to ensure the interpretation yields desired outcomes;
  - Revision of the conceptual understanding of the source aquifer(s) for Doongmabulla Springs Complex and the groundwater system based on information collected from the above for incorporation into the groundwater model review (re-run);

- Undertake measures identified by the Queensland Herbarium in the Lake Eyre Basin Springs Assessment project for the Doongmabulla Springs Complex including seismic surveys within 12 months;
  - Optimise the spatial distribution of monitoring bores, including nested or co-located bores intersecting different aquifer units, to enable improved future analysis of water level and hydrochemistry data.
2. To address the level of uncertainty of the source aquifer(s) for all the Groundwater Dependent Ecosystems and to provide transparency and a better appreciation of the limitations and opportunities for further data collection or modelling, the department recommends that Adani make the following commitments:
- a. Adani make a commitment to systematically address all the sources of uncertainty and other modelling limitations identified by the CSIRO/GA reviews when the groundwater model is re-run and reviewed as required by EA condition E6 (to be conducted within 2 years of commencement of any mining activities associated with the box cut excavation).
  - b. For the model re-run, Adani make a commitment to sample the entire plausible parameter space and make predictions probabilistically by spreading attention across refining distributions of the most sensitive model parameters and efficient stochastic modelling (Turnadge et al. 2018).
  - c. For the model re-run, Adani make a commitment to define scale dependent parameters such as hydraulic conductivity at the appropriate spatial scale i.e. commensurate with the size of the numerical grid cell of the groundwater model.
  - d. For the model re-run, Adani make a commitment to run a sufficient range of plausible scenarios that encompass the range of identified uncertainties.
  - e. Adani make a commitment to undertake and include an uncertainty estimation in accordance with the Australian Groundwater Guidelines based on the 2 year re-run.

***The plan must include detailed baseline research to establish GDE ecosystem pressure response to groundwater level/pressure fluctuation***

***The plan must include a description of the potential impact on each GDE from each project stage including impacts from subsidence, mine dewatering of aquifers, water discharge, hydrological changes and weed and pest infestation***

**Requirements:**

Groundwater drawdown triggers must be set for all monitoring locations for which water level thresholds are defined and use a timeframe that is comparable with routine monitoring data assessment and agreed groundwater model review periods.

The bore locations must consider the localised changes that may impact on groundwater dependent ecosystems and changes to groundwater conditions following planned longwall panel excavation beneath of two of the 3 interim drawdown rate trigger bores.

A commitment to install new groundwater drawdown trigger threshold bore to replace those lost to mining/underground mining must be made.

**To ensure the effective management of these unique ecosystems the GMMP and the GDMP must be consistent and ‘talk to each other’.**

- Address all inconsistent descriptions and reporting of groundwater drawdown trigger thresholds between the GDMP and GMMP as detailed in section 4 of the CSIRO/GA advice 7 June 2019.
- Address inconsistencies in the level of commitment for corrective actions for each GDE that are applied when groundwater drawdown trigger levels are exceeded as detailed in section 5 of the CSIRO/GA advice 7 June 2019.
- Address inconsistencies between the GDMP and GMMP with regard to adaptive management measures and commitments as detailed in section 5 of the CSIRO/GA advice 7 June 2019.

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RTI Act 2009



Department of  
**Environment and Science**

Our Ref: GDEMP\_CSIRO/GA

7 June 2019

s.73

Adani Mining Pty Ltd  
Level 25, 10 Eagle Street  
Brisbane QLD 4000

By email: s.73 [@adani.com.au](mailto:s.73@adani.com.au)

Dear s.73

The Department of Environment and Science (the department) has now received the clarification and advice sought from the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and Geoscience Australia (GA) in relation to Adani's Groundwater Dependent Ecosystem Management Plan (GDEMP).

The department has now considered this advice and requires the matters set out in Attachment A to be addressed to progress the finalisation of the GDEMP.

It is the department's view that the advice from CSIRO/GA reinforces advice provided by the department to date and is not inconsistent with discussions held previously between the department and Adani.

Accordingly, this advice should be read and addressed in conjunction with the preliminary GDEMPv11b comments provided on the 31 May 2019 and discussed at our meeting on the 6 June 2019.

To provide further background and context a copy of the CSIRO/GA advice is enclosed.

Should you require any further information, please contact Juliana McCosker, Manager of Business Centre (Coal) of the department on telephone (07) 4987 9356 or by email at [juliana.mccosker@des.qld.gov.au](mailto:juliana.mccosker@des.qld.gov.au).

Yours sincerely

s.73  
sch4p4( 6) Personal information

Melissa Wells  
**Executive Director**  
**Coal and Central Queensland Compliance**  
**Environmental Services and Regulation**

**Enc:**

*Attachment A – Departmental comments on the GDEMP v11b (dated 7 June 2019); and Attachment B – Carmichael Coal Mine, Advice on Groundwater Dependent Ecosystem Management Plan v11b to the Queensland Department of Environment and Science (June 2019).*

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Department of  
**Environment and Science**

Our Ref: Groundwater Dependent Ecosystem Management Plan

13 June 2019

s.73

Adani Mining Pty Ltd  
Level 25, 10 Eagle Street  
Brisbane QLD 4000

Dear s.73

As a delegate under the Environmental Protection Act 1994, I have decided to approve the *Groundwater Dependent Ecosystem Management Plan – Carmichael Coal Mine Project version 12a (June 2019)* as required by the Carmichael Coal Mine Environmental Authority (EPML01470513). The submitted Groundwater Dependent Ecosystem Management Plan satisfies the requirements of environmental authority conditions I11, I12, I13 and the definition requirements in Appendix A of the environmental authority.

Should you require any further information, please contact me on telephone (07) 4987 9356 or by email at [juliana.mccosker@des.qld.gov.au](mailto:juliana.mccosker@des.qld.gov.au).

Yours sincerely

sch4p4(6) Personal information

Juliana McCosker  
**Manager**  
**Business Centre Coal**  
**Coal and Central Queensland Compliance**  
**Environmental Services and Regulation**



Department of  
**Environment and Science**

5 March 2019

Mr Dean Knudson  
Deputy Secretary  
Environment Protection Group  
Department of the Environment and Energy  
John Gorton Building, King Edward Terrace  
Parkes Canberra ACT 2600

Email: [dean.knudson@environment.gov.au](mailto:dean.knudson@environment.gov.au)

Dear Mr Knudson,

I understand the Commonwealth Department of the Environment and Energy has received the final report from the independent scientific review by CSIRO and GeoScience Australia of Adani's Groundwater Dependent Ecosystem Management Plan (GDEMP) and Groundwater Management and Monitoring Program (GMMP).

As co-regulator for the Adani project, and taking into consideration the Bilateral arrangements the Queensland Department of Environment and Science (the department) has with the Commonwealth, including any Administrative Access Policy, I request a copy of the independent scientific review report.

This will enable the delegate to consider the report in the assessment of the GDEMP and GMMP with respect to the relevant environmental authority condition requirements under the *Environmental Protection Act 1994*.

I look forward to the continued successful cooperation between our departments to ensure a robust scientific approach supports both the State and Commonwealth approval processes.

Any questions in relation to this correspondence please don't hesitate to contact me on (07) 4987 9343 or [melissa.wells@des.qld.gov.au](mailto:melissa.wells@des.qld.gov.au).

Yours sincerely

sch4p4( 6) Personal information

Melissa Wells  
**Executive Director**  
**Coal and Central Queensland Compliance**



Department of  
**Environment and Science**

Our Ref: Groundwater Dependent Ecosystem Management Plan

5 April 2019

s.73

Adani Mining Pty Ltd  
Level 25, 10 Eagle Street  
Brisbane QLD 4000

By email: [s.73@adani.com.au](mailto:s.73@adani.com.au)

### **Groundwater Dependent Ecosystem Management Plan**

Dear [s.73](mailto:s.73)

I am writing in regards to references made and published today, 5 April 2019, by a number of media outlets about the Groundwater Dependent Ecosystem Management Plan (GDMEP).

As you are aware, both the Department of Environment and Science (the department) and the Commonwealth Department of Environment and Energy (DOEE) are required to approve the GDMEP. The Commonwealth and State approvals also require the final approved GDMEP to be published on a website. Accordingly, consistent with the terms of the Commonwealth's approval and the department's previous advice to Adani, a combined document should be prepared to address both State and Commonwealth conditions.

I understand that the latest version of the GDMEP held by the department was received in January 2019. I am advised that discussions between departmental staff and representatives of Adani have confirmed that this version does not include changes recommended by the department in the latest comments provided to Adani in December 2018.

However, comments ascribed to you in a number of media articles today, strongly suggest that Adani has incorporated the recommendations made in the independent scientific review (the review) of the GDMEP prepared by CSIRO and Geoscience Australia into an updated and final version of the GDMEP. It can also be reasonably inferred that the updated GDMEP was submitted to the DOEE on or around 15 March 2019.

In the circumstances, it is of concern that the department does not currently have the latest version of the GDMEP. I would request you please provide the department as soon as possible with a copy of the latest version of the GDMEP that Adani has submitted to the DOEE. This is important to enable a timely consideration of the updated GDMEP.

It is relevant in this context, to also let you know that the department formally requested a copy of the review from DOEE on 5 March 2019. This was followed up with a further request by the Queensland Minister for Environment to her federal counterpart on the 12 March 2019, on behalf of the department. To date the department has not received a copy of the review. The department is committed to making a decision on GDEMP using the best available science and therefore considers it very important that it be able to consider the review's findings and recommendations as part of its decision-making process.

Should you require any further information, please contact Melissa Wells on telephone (07) 4987 9343 or by email at [melissa.wells@des.qld.gov.au](mailto:melissa.wells@des.qld.gov.au).

Yours sincerely

A handwritten signature in black ink, appearing to read 'Merrick', with a long horizontal stroke extending to the right.

Jamie Merrick  
**Director-General**

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Australian Government  
Geoscience Australia

Friday 5 April 2019

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and Hindmarsh Drive,  
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Mr. Finn Pratt

Secretary

Department of the Environment and Energy

finn.pratt@environment.gov.au

cc: Mr Dean Knudson (dean.knudson@environment.gov.au)

*Finn*

Dear Mr Pratt,

Thank you for the extensive briefing from Department of Environment and Energy regarding the actions agreed to by Adani in the revised Groundwater Management and Monitoring and Groundwater Dependent Ecosystem Management plans in response to advice provided your Department from Geoscience Australia and CSIRO on 22 February 2019. Based on this briefing Geoscience Australia is of the view that Adani have addressed the issues and concerns raised in our recommendations.

Sincerely,

sch4p4(6) Personal information

Dr. James Johnson

Chief Executive Officer



sch4p4( 6) Personal informatio

Coordinator-General  
Department of State Development  
PO Box 15009  
CITY EAST QLD 4002

Dear sch4( 6) Personal info

### EPBC 2010/5736 Carmichael Conservation and Research Program

I am writing to advise you of my decision regarding Adani Mining Pty Ltd's *Carmichael Conservation and Research Program, 3 April 2019, version 6* (proposal) and *The Galilee Basin Conservation & Research Fund – Funding Deed* (the trust deed). The proposal and the trust deed were submitted to the Department of the Environment and Energy (Department) in accordance with conditions 15, 16 and 18 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) approval decision 2010/5736 Carmichael Coal Mine and Rail Project (action).

The Department has considered the proposal and the trust deed, and based on the advice provided to me, I am satisfied that they meet the requirements of conditions 15, 16 and 18.

In accordance with condition 17 of the EPBC Act approval, the approval holder is now required contribute \$100,000 (GST exclusive) to a unit trust over 10 consecutive years from the beginning of the commencement of mining operations. The Department is to be notified when the establishment of and/or contribution to the Trust has occurred.

In accordance with condition 19, the approval holder is also required to undertake a review of funding five years after the establishment of the pool of funds and/or commencement of the action or as otherwise agreed by the Minister in writing. I have advised the proponent that I that the five years should be calculated from the date of the first contribution to the pool of funds.

Should you require any further information on my decision, please contact Robin Nielsen, Project Officer, Post Approvals Section, on 02 6274 1004 or by email, [robin.nielsen@environment.gov.au](mailto:robin.nielsen@environment.gov.au).

Yours sincerely

sch4p4( 6) Personal information

Greg Manning  
Assistant Secretary  
Assessment (WA, SA, NT) & Post Approvals Branch

8/4/ 2019

9 April 2019

**Private & Confidential**

Mr Jamie Merrick  
Director-General  
Department of Environment and Science  
Queensland Government  
400 George Street  
Brisbane QLD 4000

*By email: [jamie.merrick@des.qld.gov.au](mailto:jamie.merrick@des.qld.gov.au)*

Dear Jamie

**Adani Mining Pty Ltd – Groundwater Dependent Ecosystem Management Plan**

We refer to your correspondence of 5 April 2019 in relation to the Groundwater Dependent Ecosystems Management Plan (**GDEMP**) and also the opportunity for us to meet on 8 April 2019.

As you are aware, we have been working with both the Federal and State Departments in relation to the finalisation of this plan for more than two years. Unfortunately, despite repeated requests from Adani, the Queensland Government has been unwilling to provide commitments in relation to timing and process to finalise outstanding management plans. This lack of clarity has been evident throughout the Department's approach to finalising the Black -Throated Finch Management Plan (**BTFMP**), which is still dragging on and which has been the subject of last minute interventions, such as the highly questionable review led by Professor Wintle about which we have raised serious concerns.

In relation to the CSIRO and GeoScience Australia report, as we understand it, this was work commissioned for use by both the Federal and State Department; accordingly we find it inexplicable that the Queensland Government is now stating that it does not have access to the report. We would have thought it reasonable that the Queensland Government would have had sufficient foresight and planning to ensure the timely delivery of the report in order to enable the finalisation of the plan. Accordingly, for this to now be offered up as an excuse for continued delay is not reasonable from our perspective.

Absent the Queensland Government detailing a defined process and timing to finalise the GDEMP, the requirements are unclear and it seems the goal posts continue to shift in the same way we have experienced with finalisation of the BTFMP. More specifically, the approach undertaken by the State in assessing the BTFMP has been reflective of the State's apparent desire to create two versions of the same plan. Accordingly, we assumed a similar approach was intended for the GDEMP. Nonetheless, the GDEMP was submitted to the Department on 9 April 2019.

We remain committed to working collaboratively to finalise these plans so that we can get on with the task of delivering thousands of jobs for Queenslanders.

Yours sincerely

s.73

s.73

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Black Mountain Science and Innovation Park, Clunies Ross Street, Acton ACT 2601  
GPO Box 1700, Canberra, ACT 2601, Australia  
T (02) 6246 4383 • ABN 41 687 119 230

5 April 2019

Mr Dean Knudson  
Deputy Secretary, Environmental Protection Group  
Department of the Environment and Energy  
GPO Box 787  
CANBERRA ACT 2600  
(dean.knudson@environment.gov.au)

Dear Mr Knudson

**RE: Advice on Groundwater Management Plans and Response**

Thank you for briefing me on the actions agreed to by Adani in their two groundwater-related management plans, following the advice that CSIRO and Geoscience Australia and CSIRO provided to you in late February 2019. CSIRO was responsible for the modelling component of this advice, and our comments here relate to that component of Adani's responses.

Our examination of Adani's actions is based on today's briefing and the summary information ("Summary of CSIRO and Geoscience Australia (GA) Advice on Groundwater Management Plans and Response") subsequently provided to CSIRO by your Department.

CSIRO is of the view that Adani's responses should satisfy the recommendation to update the groundwater models, and are directed to address the modelling related issues and concerns raised in our advice, noting that there are still components of that advice that will need to be addressed through the approval of the research plan.

Yours sincerely

sch4p4(6) Personal information

Director  
**CSIRO Land and Water**

cc Finn Pratt, Secretary, Department of the Environment and Energy  
Greg Manning, Assistant Secretary, Assessment & Post Approvals Branch,  
Department of the Environment and Energy



Australian Government

Geoscience Australia

Friday 5 April 2019

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Mr. Finn Pratt

Secretary

Department of the Environment and Energy

finn.pratt@environment.gov.au

cc: Mr Dean Knudson (dean.knudson@environment.gov.au)

*Finn*

Dear Mr Pratt,

Thank you for the extensive briefing from Department of Environment and Energy regarding the actions agreed to by Adani in the revised Groundwater Management and Monitoring and Groundwater Dependent Ecosystem Management plans in response to advice provided your Department from Geoscience Australia and CSIRO on 22 February 2019. Based on this briefing Geoscience Australia is of the view that Adani have addressed the issues and concerns raised in our recommendations.

Sincerely,

sch4p4( 6) Personal information

Dr. James Johnson

Chief Executive Officer

# Carmichael Coal Mine

Advice on Groundwater Management and Monitoring and  
Groundwater Dependent Ecosystem Management plans to the  
Department of the Environment and Energy

FEBRUARY 2019

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# Executive Summary

The Department of the Environment and Energy requested CSIRO and Geoscience Australia to assess draft research and management plans submitted by Adani Pty Ltd for the Carmichael Coal Project under *Environment Protection and Biodiversity Conservation Act (1999)* approval conditions (EPBC ref: 2010/5736). This advice addresses questions for the Groundwater Dependent Ecosystem Management Plan (version 10a) and the Groundwater Management and Monitoring Plan (version 5).

Modelling underpins the approaches in the management and monitoring plans. The review found that the modelling used is not suitable to ensure the outcomes sought by the EPBC Act conditions are met. A number of limitations were also identified in the proposed monitoring and management approaches indicating they are not sufficiently robust to monitor and minimise impacts to protected environments.

**Q2a.** *How appropriate is the numerical model scenario selected by the approval holder to inform the Groundwater Management and Monitoring Plan and Rewan Formation Connectivity Research Plan and for incorporation into the Groundwater Dependent Ecosystem Management Plan as required by the conditions of approval?*

The SEIS model used by the GMMP is the most conservative of the model scenarios as it predicts the greatest impacts from the mine development in all aquifers. However, being the best choice of available model runs does not mean that this model run is considered to be fit-for-purpose. The rationale to support this statement is provided in *Section 2 Numerical modelling scenarios*.

**Q2b.** *Are there any other model scenarios put forward by the approval holder that are more appropriate to ensure the outcomes sought by the conditions of approval are met?*

The review of the available model scenarios did not identify any other model scenarios put forward by the approval holder that are considered more appropriate. However, this review has identified a number of limitations, which mean that the model is not suitable to ensure the outcomes sought by the conditions of approval are met. These limitations are detailed in *Section 2.3 Limitations of modelling*.

**Q3.** *Are the monitoring and management approaches proposed in the GMMP and GDEMP consistent with the most plausible conceptualisation and sufficiently robust to ensure the outcomes above are met?*

The proposed monitoring and management approaches described are consistent with the most plausible conceptualisation of groundwater source to the Doongmabulla Springs complex. However, limitations identified mean that the proposed monitoring and management approaches are not sufficiently robust to ensure the outcomes set out in 2b are met. These limitations are described in *Section 3 Monitoring and management approaches*.

If the Proponent implements the recommendations in this advice they will be able to refine the conceptualisation and improve the robustness of the modelling, monitoring and management approaches to address the intended outcomes of the approval conditions.

# 1 Introduction

On 24 January 2019, the Department of the Environment and Energy (DoEE) requested Geoscience Australia and CSIRO to provide groundwater-related advice on draft management plans provided by Adani Mining Pty Ltd (the Proponent) in accordance with *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) approval conditions for the Carmichael Coal Mine. These plans include the draft Groundwater Management and Monitoring Plan revision 5 dated January 22, 2019 (GMMP) and the draft Groundwater Dependent Ecosystem Management Plan version 10a dated January 21, 2019 (GDEMP). This advice follows earlier advice provided on draft research plans (CSIRO and Geoscience Australia, 2018).

DoEE sought advice specifically on an additional three questions relating to these draft management plans, set out below:

**Q2a.** *How appropriate is the numerical model scenario selected by the approval holder to inform the GMMP and RFCRP and for incorporation into the GDEMP as required by the conditions of approval?*

**Q2b.** *Are there any other model scenarios put forward by the approval holder that are more appropriate to ensure the outcomes sought by the conditions of approval are met?*

*The relevant outcomes sought by the conditions are to:*

- *monitor and minimise impacts to water resources of the Great Artesian Basin;*
- *ensure groundwater drawdown at Doongmabulla Springs Complex does not exceed 0.2m and that there is no ecological impact at the springs; and*
- *monitor and minimise impacts to other groundwater-dependent ecosystems.*

*Note: The conditions require that results of the groundwater flow model re-run inform the GMMP and RFCRP and be incorporated into the GDEMP. The focus of question 2 is on the selection of a numerical modelling scenario from those available, i.e. the options around the general head boundary considered as part of the groundwater model re-run, and previous scenarios, i.e. the SEIS and EIS models.*

**Q3.** *Are the monitoring and management approaches proposed in the GMMP and GDEMP consistent with the most plausible conceptualisation and sufficiently robust to ensure the outcomes above are met?*

This advice provides an assessment of how these draft plans address the three questions. This assessment relied on the draft plans, and additional information, including studies undertaken since the time of approval and provided by the Proponent. Other references are included as in-text citations and in the reference list provided. Appendix B is that initial advice on some matters raised prior to undertaking this review, Appendix A provides a review of the Proponent's responses to Appendix B. CSIRO and Geoscience Australia (2018), an assessment on draft research plans, is provided for completeness, as Appendix C.

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## 2 Numerical modelling scenarios

### 2.1 Summary

**Q2a.** *How appropriate is the numerical model scenario selected by the approval holder to inform the GMMP and RFCRP and for incorporation into the GDEMP as required by the conditions of approval?*

Of the available numerical modelling scenarios selected by the approval holder to inform the GMMP and RFCRP and for incorporation into the GDEMP as required by the conditions of approval, the Supplementary Environmental Impact Statement (SEIS) model (GHD, 2013) is considered to be the most appropriate. There are still issues with the model scenario including:

1. Comparison of the SEIS model and the two alternate re-run models shows that the location of the western model boundary has little impact on drawdown predictions (refer Section 2.2).
2. The SEIS model includes the most recent calibrated parameter set developed for the Carmichael Coal Mine in 2013. Although, it must be noted that model errors increased from 4.5% RMS error reported for the SEIS model to 7.2% when compared to updated data following resurveying bore locations. This degradation in calibration statistic is equivalent to 0.8 m of groundwater level (refer Section 2.3.2).

**Q2b.** *Are there any other model scenarios put forward by the approval holder that are more appropriate to ensure the outcomes sought by the conditions of approval are met?*

The review of the available model scenarios did not identify any other model scenarios put forward by the approval holder that are considered more appropriate to ensure the outcomes sought by the conditions of approval are met. However, this review has identified a number of limitations, which mean that the SEIS model is not suitable to ensure the outcomes sought by the conditions of approval are met. In particular, the SEIS model under-predicts groundwater drawdown arising from mine development for the following reasons:

1. Representation in the model of surface water flows for the Carmichael River over-predicts flows from the river into the groundwater. As a result the groundwater drawdown in the alluvium (Carmichael River GDEs) will be greater than the predicted model (refer Section 2.3.1).
2. Reduced confidence in the ability of the calibrated model parameters to accurately predict groundwater drawdown arising from mine development due to revision of some bore elevations. When model predictions are compared with corrected bore heights scaled RMS error increases from 4.5% to 7.2% (refer Section 2.3.3).
3. Combined effect of revised bore heights and evapotranspiration, in the unconfined parts of the Clematis Sandstone model layer, on the accuracy of the 0.19 m predicted drawdown at the Doongmabulla Springs complex (DSC) by the SEIS model (refer Section 2.3.3).
4. Parameterisation of the Rewan Formation and Clematis Sandstone by the SEIS model. Calibrated hydraulic conductivity values for the Rewan Formation are very low compared with measured values, which minimises vertical water movement, and hydraulic conductivity values for the Clematis Sandstone are high, which increases the lateral transfer of water. In combination these hydraulic conductivity values minimise predicted drawdown at the DSC (refer Section 2.3.4).

## 2.2 Selection of available numerical model scenarios

The GMMP uses the calibrated SEIS model run as the basis for the calculation of groundwater level thresholds. This model run has been accepted as part of the assessment, conditioning and approval of the proposed action. The report states that the model re-runs have informed the GMMP by adding confidence to the predictions made using the SEIS model. Previous comments on the suitability of numerical models are provided by CSIRO and Geoscience Australia (2018)

The model re-runs differ from the SEIS model in the location of the General Head Boundaries (GHB) on the western edge of the model domain and in the magnitude of the conductance for all GHBs in the model. These changes were made following discussions with DoEE and the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (IESC), reflected in Condition 23 of the EPBC Act approval conditions. This results in three model run choices being available. There is little difference in the drawdown predictions between the SEIS model and the two alternate re-run models. The groundwater flow direction is mostly along the western boundary from the north and south rather than across the boundary from east to west, this is why the location of the boundary has little influence on the predictions. The flow directions predicted by the SEIS model are consistent with the generated piezometric surfaces from field observations. The boundary in the SEIS model on the topographic divide seems appropriate for the predictions being made.

**Issue:** The re-run models were not calibrated as this was not required by Condition 23, they used the existing parameterisation from the SEIS model. Not having a specific calibration for each of the re-run models has reduced the confidence in the predictions that they make. The re-run models predict less drawdown at the Doongmabulla Springs Complex (DSC) and more baseflow depletion in the Carmichael River than the SEIS model, although these variations are not significant. Comparison of predicted maximum impact for different models shows similar extent and magnitude overall (GMMP Section 2.3.3.1).

**Recommendation:** A re-calibration is warranted to improve confidence in model predictions.

The SEIS model used by the GMMP is considered to be the most conservative of the available model scenarios as it predicts the greatest impacts from the mine development in all aquifers. However, being the best choice of available model runs for use in the GMMP does not mean that this model run is considered to be fit-for-purpose, as outlined in the following sections.

## 2.3 Limitations of modelling

**Issue:** The approach used to model potential impacts to the groundwater system due to mining indicates that the model will under-estimate the amount of drawdown predicted at the DSC and the Carmichael River GDE as a result of model representation of:

- the unrealistically high modelled flow in the Carmichael River,
- error in the bore heights used to calibrate the model, and
- hydraulic conductivity in the Clematis Sandstone and Rewan Formation model layers.

If the predicted drawdown has been underestimated as a result of these factors, then issues with predicted drawdowns are propagated into the GMMP. It is unclear what impact these limitations will

have on the timing of impacts on the DSC. The implication is that the thresholds and triggers will be reached sooner than anticipated based on this modelling, which means that relying on the model in its current form may not be an appropriate approach to deriving monitoring and management regimes. Each of the three factors are discussed in more detail below.

### 2.3.1 Impact of Carmichael River flow on predictions

**Issue:** The model under predicts drawdown in the Alluvium along the Carmichael River corridor because of the way the model provides a source of water to offset drawdown. The SEIS report (Table 10) shows observed dry season stream-flow percentiles, the 90<sup>th</sup> percentile is 460 m<sup>3</sup>/d at the gauge upstream of the proposed mining area on the western edge of the mine lease and 0 m<sup>3</sup>/d at the gauge on the eastern edge of the mine lease, downstream of proposed mining. In contrast, the SEIS model steady-state run shows baseflow in Carmichael River above 4000 m<sup>3</sup>/d at the upstream gauge and above 3000 m<sup>3</sup>/d at downstream gauge (SEIS Figure 33). Simulated baseflow is an order of magnitude too high and is perennial at the downstream gauge rather than ephemeral, this has the effect of mitigating the drawdown in the alluvium (the Carmichael River GDE). The predicted stream depletion due to mining is ~1000 m<sup>3</sup>/d at the downstream gauge (SEIS Figure 39) which is physically impossible from the river (as the river only flows for short periods each year) and will subsequently deplete groundwater, contributing to drawdown.

The observed baseflow in the river was not used as a constraint in model calibration and therefore the baseflow predictions are physically impossible (i.e. too high). This means that predictions in drawdown to the Alluvium along the Carmichael River are unrealistically small.

**Recommendation:** Carmichael River flow and under-estimated drawdown can be addressed in subsequent model updates. Future updates of the model should also use stream flow as one of the calibration parameters. To facilitate this, ongoing stream flow gauging should be undertaken.

### 2.3.2 Impact of revised bore heights on calibration

**Issue:** The revision of the bore heights, resulting from resurveying of collar locations undertaken by the Proponent, has degraded the calibration of the SEIS model. The SEIS report uses the scaled RMS error between 88 observation bores and model predictions as the calibration statistic. This report says that the scaled RMS error is 4.5% for all bores and 5.9% for the 39 Proponent bores and therefore below the threshold for an acceptable model from the MDBC guidelines (Middlemis, 2000) (<5% is acceptable) which is used by the Proponent to justify the model performance. The revision of the bore heights and longer time series of groundwater level data available has degraded the scaled RMS to 7.2% for all bores and 12.2% for the 41 Proponent bores (no explanation is given for the discrepancy in the number of bores). These revised calibration statistics are outside of the nominated threshold from the SEIS report of 5%.

**Recommendation:** The updated Australian Groundwater Modelling Guidelines (Barnett et al., 2012), and the IESC Explanatory Note *Uncertainty analysis—Guidance for groundwater modelling within a risk management framework* (Middlemis and Peeters, 2018) provide more refined expectations of using uncertainty analysis in modelling, and how this may affect management and monitoring decisions. These should be considered in future model updates.

**Issue:** The Carmichael Coal Mine - Groundwater level review (Adani, 2019) adopts a value of +/- 7 m as an indication of significant variation in mismatch between calibrated and observed groundwater level. This value is justified as being close to the average RMS error of 6.8 m from the SEIS calibration

and the 7.6 m average RMS error calculated from the revised bore heights. There is no analysis given for what this error means for the predicted drawdown. The revised bore heights have degraded the average RMS error of the simulated groundwater levels by 0.8 m. The interim threshold drawdown at the DSC is 0.2 m (EPBC Act approval condition 3.d), and represents a quarter of the degradation in model performance due to the revised bore heights.

As a conclusion from the revision to the bore heights, the Carmichael Coal Mine - Groundwater level review (Adani, 2019) states:

*“The changes in calibration statistics are not material from a modelling perspective.” (page 1)*

This statement is at odds with the clearly degraded model performance of the updated calibration dataset using the whole dataset and in particular, the nominated subset of the Proponent’s bores. The 40 bores drilled since the SEIS model calibration could provide an independent validation dataset for the calibrated model but have not been assessed.

The GMMP states there is a continuous improvement to the model as new information becomes available:

*“Continuous refinement of the models with new data as it becomes available ensures they are robust and defensible for use to accurately predict potential impacts because of the CCP” (page34)*

*“The numerical model has been refined over time as additional information has become available.” (page 81)*

The model run used in the GMMP is from the SEIS report. This has not been updated since 2013. The revised bore heights and the new bores drilled since that time are clearly new information that could improve the model but these have not been part of the continuous refinement process claimed in the GMMP.

**Recommendation:** The Proponent has committed to updating the groundwater model two years after mining commences. This commitment includes the collection, analysis and use of additional groundwater data to refine conceptualisations (GMMP Section 2.2.9), as well as incorporating groundwater monitoring information and response to dewatering (GMMP Section 6.2 and Section 7.1.1). Model updates should include recalibration, and clearly define bore reference levels, how they have changed over time and how these changes affect model prediction and performance.

### 2.3.3 Impact of revised bore heights on predictions

**Issue:** Confined groundwater systems act in a linear fashion so the offset errors associated with the revised bore heights will have little effect on drawdown predictions in the confined aquifers. This is not the case with unconfined groundwater systems which do not act linearly. Bore HD02 is in the unconfined part of the Clematis Sandstone and is the closest bore to the DSC, it has had its elevation revised downward by 4 m. This means that the groundwater level is deeper than the GW model was trying to calibrate to (in the SEIS model); the model is over-predicting the elevation of the groundwater

level at this location. In areas with shallow water tables the model is simulating evapotranspiration from the watertable, any predicted drawdown in these areas will capture some of this evapotranspiration. If the simulated water table is too high in the baseline model run then there is potentially more evapotranspiration available to capture and this will result in less drawdown than would otherwise be predicted. With the predicted drawdown from the SEIS model at the DSC being 0.19 m (1 cm less than the acceptable threshold set out in EPBC Act Approval Condition 3.d), a correction to the overestimate of the captured evapotranspiration could be enough to increase the drawdown to greater than 0.2 m.

**Recommendation:** Future groundwater model updates should incorporate recalibration to the revised bore heights to provide confidence that captured evapotranspiration is not limiting drawdown to the DSC and the Carmichael River GDE.

### 2.3.4 Impact of model parameterisation on predictions of groundwater drawdown at the Doongabulla Springs Complex

**Issue:** Previous reviews have described the hydraulic conductivity used in the modelling for the Rewan Formation as lower than the field measurements on site (this is discussed in more detail in CSIRO and Geoscience Australia, 2018). A previously unidentified issue is that the calibrated hydraulic conductivity of the Clematis Sandstone in the model is too high when compared to field measurement data. The calibrated hydraulic conductivity of the Clematis Sandstone is 1.55 m/d. There is one field measurement of 15 m/d from a shallow bore in the weathered zone and two measurements, from areas where the Clematis Sandstone is confined, of 0.01 m/d (Table 6, GMMP). Data for the China Stone project, immediately to the north of Carmichael, yield hydraulic conductivities of 0.005 m/d and 0.09 m/d (Australasian Groundwater and Environmental Consultants Pty Ltd (AGES), 2015). The Clematis Sandstone is confined by the Moolayember Formation in the vicinity of the DSC.

The calibration undertaken for the SEIS model was a deterministic calibration, i.e. there is only one value of each parameter for the entire model domain. A parameterisation which recognises the spatial heterogeneity in K values and reports confidence intervals of predicted parameters, and importantly, confidence intervals (based on the probability distribution function, pdf) of drawdowns is more robust and in line with international best practice.

**Recommendation:** Future model updates should use locally appropriate parameterisations.

**Issue:** The sensitivity analysis undertaken for the groundwater model shows that the high hydraulic conductivity of the Clematis Sandstone acts to limit drawdown at the DSC (SEIS addendum Figure 12). The sensitivity analysis shows that the drawdown is equally sensitive to the hydraulic conductivity of the Clematis Sandstone as it is to the hydraulic conductivity of the Rewan Formation. The SEIS and SEIS addendum are incorrect when discussing the sensitivity of predictions to the hydraulic conductivity of the Clematis Sandstone (e.g. SEIS addendum Section 3.5.1); high conductivity allows the lateral transfer of water and minimises the drawdown, hence the high value adopted in the calibration being a concern.

The sensitivity analysis was of a one-at-a-time type, which does not allow for parameter interaction. One-at-a-time analysis does not enable assessment of parameter sensitivity to simultaneous changes in parameters. This is in contrast to a global sensitivity analysis, such as that used in Peeters et al. (2018), which accounts for simultaneous parameter variation, and enables analysis of sensitivity to parameter interactions. Individually, an order of magnitude change in the hydraulic conductivity of either the Clematis Sandstone or Rewan Formation can produce a drawdown of greater than 0.3 m.

The cumulative effect on drawdown prediction of varying both parameters, were they changed at the same time, is untested.

**Recommendation:** Sensitivity analysis undertaken for future model updates should seek to assess cumulative sensitivity.

**Issue:** The hydraulic enhancement after the collapse of the goaf in the long wall panels was not included in the sensitivity analysis. In the SEIS model the hydraulic conductivity was increased by a factor of 50 for 75 m above the long wall panel and by a factor of 10 for between 75 m and 150 m above the long wall panel. Poulsen et al. (2018) and Adhikary and Poulsen (2018) have shown that the hydraulic enhancement can be up to 8 orders of magnitude (a factor of  $10^8$ ) immediately above the goaf and decline exponentially with increasing height for up to 500 m (also a smaller hydraulic enhancement below the long wall panels). The recommendations from the SEIS subsidence report for the groundwater modelling include:

*“Accordingly the expected height of fracturing at the Carmichael Project, is expected to extend from the AB1 seam to the surface over much of the proposed longwall footprint.”*

*“Conservatively adopting 160 metres based on Klenowski (ACARP C5016, 2000) would be considered a reasonable height for preliminary modelling of the height of direct hydraulic connection. Above this height, it is anticipated that there will be increase in the strata permeability due to fracturing through beds and bedding plane dilation, however the likelihood of hydraulic connectivity from the surface to the seam is anticipated to be low given the presence of aquiclude and aquitard materials in the overburden.”*

The subsidence report shows there is the possibility for the enhancement of hydraulic conductivity from the coal seams to the surface; this includes the full thickness of the Rewan Formation (averaging 250 m) above the longwall panels.

**Recommendation:** The way the hydraulic enhancement after the collapse of the goaf has been implemented in the modelling is not conservative (i.e. is likely to underestimate impact) and the omission of the associated parameters from the sensitivity analysis means that the impact these assumptions have on drawdown at the DSC is untested. Future model updates should include analysis of the sensitivity of the model to parameter changes due to underground mining.

# 3 Monitoring and management approaches

## 3.1 Summary

**Q3.** *Are the monitoring and management approaches proposed in the GMMP and GDEMP consistent with the most plausible conceptualisation and sufficiently robust to ensure the outcomes above are met?*

The proposed monitoring and management approaches described in the GMMP and GDEMP are consistent with a plausible conceptualisation of groundwater source to the Doongmabulla Springs complex (DSC). However, this review has identified a number of limitations, which mean that the proposed monitoring and management approaches are not sufficiently robust to ensure the outcomes sought by the conditions of approval are met:

1. The SEIS model under-predicts groundwater drawdown arising from mine development by up to 0.8 m, which means that the adopted thresholds and triggers will be reached sooner than anticipated and so are not a suitable foundation for the proposed monitoring and management approaches (refer Section 2.2).
2. Available evidence supports the conceptualisation that the Clematis Sandstone is a likely source aquifer for the DSC. However, the proposed monitoring and management approaches do not sufficiently address the uncertainty regarding potential alternative or additional source aquifers (refer Section 3.2 and 3.3).
3. There is a lack of stream flow gauging. Gauging provides critical information on the state of the Carmichael River. This data would assist in and verifying the reliance of Carmichael River GDEs on groundwater along sections with different characteristics (refer Section 3.3). This would also contribute to model calibration.
4. The water level thresholds and triggers chosen are based on predicted drawdown. A large number of bores are predicted to exceed their thresholds as a result of approved mining activities (refer Section 3.4).
5. The chosen definition of thresholds and triggers for hydrogeochemical analytes, as well as definition of contaminant limits, will result in frequent trigger exceedances. No defined workflow for subsequent investigation is provided. In addition, there are different notification mechanisms to DoEE for water level and chemical exceedances, without a rationale as to why this is the case (refer Section 3.5).
6. The GDEMP systematically addresses the management objectives, performance criteria, adaptive management triggers and corrective actions. Monitoring is based on the GDE Toolbox approach, and is considered adequate. The GDEMP relies heavily on the conceptualisations and modelling outlined in the GMMP and other research plans, and as such is subject to any limitations of these plans (refer Section 3.6)

While the Proponent considers comments relating to model updates and refinement out of scope for the GMMP, they are included here to assist DoEE understand the limitations of the GMMP resulting from the model limitations. Issues arising from model performance and predictions is a fundamental

underpinning of the approaches set out in the GMMP and GDEMP. They are critical in assessing if measures set out are sufficiently robust to ensure environmental outcomes are met.

## 3.2 Hydrogeological conceptualisation

**Issue:** It is plausible and reasonable that the Clematis Sandstone is a major source aquifer for the DSC. This is supported by water level and groundwater flow information presented by the proponent, as well as by other studies (Evans et al., 2018; Fensham et al., 2016; JBT Consulting, 2015), and by some aspects of hydrogeochemistry of the springs and the Clematis Sandstone (Fensham et al., 2016; Webb et al., 2015). It is not plausible and reasonable to state unequivocally that the Clematis Sandstone is the sole source aquifer for the DSC, as sufficient uncertainty surrounding hydrogeochemistry, inter-aquifer connectivity and groundwater flow exists (Currell et al., 2017; Lewis et al., 2018; Webb et al., 2015) to necessitate a precautionary approach to the conceptualisation (as ruled by the Land Court of Queensland, 2015).

Documents provided by the Proponent, including the GMMP, support the conceptualisation that the Clematis Sandstone is a source aquifer, but there is enough uncertainty around the information provided, as acknowledged by the Proponent, such as in GDEMP Section 4.3.1, to necessitate a robust assessment of potential alternative or additional source aquifers. The paucity of water level and hydrochemistry data for units other than the Clematis Sandstone in the vicinity of the DSC means that it is not possible to conclusively determine the source aquifer or aquifers for the DSC based on available evidence, and thus the precautionary principle must apply.

As stated in CSIRO and Geoscience Australia (2018), the hydrochemistry information provided does not preclude alternative conceptualisations of the source aquifers for the springs:

1. The GMMP shows only sodium/chloride and chloride/sulfate bivariate plots comparing groundwater in the Permian sediments and Clematis Sandstone with the Joshua Spring vent only.
2. No chemistry data or groundwater pressure data from the Dunda Beds is presented for comparison, nor any data from other spring vents.
3. The bores proposed for groundwater quality monitoring near the DSC are not screened in source aquifers that have been identified in alternative conceptualisations, such as the Dunda Beds.

Consequently, the hydrochemistry data collected to date, and proposed to be collected, will not contribute to the assessment of other or additional potential source aquifers for the DSC below the Clematis Sandstone.

**Recommendation:** To constrain the source aquifer(s) of the DSC, a more sophisticated statistical analysis of hydrochemistry data is required. This includes assessing a wider variety of groundwater and surface water analytes, as well as appropriate use of isotope hydrochemistry analysis. Further information on potential techniques is provided in (CSIRO and Geoscience Australia, 2018) and other readily available references.

## 3.3 Water monitoring network design

Early warning monitoring bores need to be located sufficiently close to mining operations to experience measurable drawdowns relatively quickly after mining operations commence. Deviation of this drawdown from predictions can provide a prompt indication that greater than predicted impacts will likely occur in the future, and can be predicted to be observed years in advance of the impacts

reaching matters of national environmental significance (MNES) to enable implementation of management and mitigation actions. The use of control bores, as required under EPBC Act conditions, can also assist in this assessment.

**Issue:** To adequately monitor for the impacts of mining, for the plausible groundwater conceptualisations, monitoring bores should be distributed across all potentially impacted formations within the zone of predicted impact. The GMMP includes abundant monitoring locations on-lease, which is adequate to assess impacts across all units. However, most of the on-lease bores are likely to be affected by surface or mining operations. The GMMP does not define the process for replacing such bores as mining operations progress.

Groundwater-dependent MNES lie to the west of the lease boundary (DSC), as well as within the alluvium of mapped drainage features (Carmichael River GDEs). To adequately monitor potential impacts to these MNES, the monitoring network needs to consider all possible source aquifers, and predicted areas of impact, as well as the use of control bores.

The monitoring network set out in the GMMP is designed to monitor potential impacts to the DSC based on the conceptualisation that the springs are sourced solely from the Clematis Sandstone. The distribution of monitoring bores is not adequate if other units provide a direct source to the DSC, or through the Clematis Sandstone to the DSC, either by transmission through interconnectivity of hydrostratigraphic units or via structural pathways (not limited to geological faults). The GMMP monitoring network does not provide adequate spatial or geological unit coverage to monitor for groundwater impacts if aquifers other than the Clematis Sandstone contribute flow to the DSC. This effectively means that the proposed GMMP monitoring network will only be able to identify potential impacts that may affect the DSC where they are evident in a source aquifer in the Clematis Sandstone.

In the GMMP, there are 54 off-lease monitoring bores (Table 1 and Figure 1 below). The off-lease monitoring bores are primarily designed to monitor the Joe Joe Group and the Clematis Sandstone. These are the source aquifers proposed by the proponent for the Mellaluka Springs and DSC respectively. The monitoring network set out in the GMMP for the Mellaluka Springs appears adequate, given that these are sourced from the Joe Joe Group and Tertiary<sup>1</sup> sediments.

**Recommendation:** Installation of bores to monitor the groundwater system in the Dunda Beds and Rewan Formation (upper Rewan and lower Rewan) at existing monitoring points in the west of the central zone would allow an assessment of any dewatering impact propagating through the Rewan Formation (in effect, nested monitoring bores). The current monitoring network does not address any contributions to the springs from the Dunda Beds or Rewan Formation, or from deeper units. These potential spring contributions need to be considered and factored into monitoring design. Monitoring these two units is considered a bare-minimum. Ideally all units from outcrop to sub-Joe Joe coal (Jericho Formation) would be monitored. Co-location with existing points would remove any significant access issues, and would enable at least spatially comparable data to be collected.

**Recommendation:** It is strongly recommended that the monitoring program includes stream flow gauging upstream and downstream of the mine area. Stream gauging similar to that undertaken for the EIS would address this, provided it is part of ongoing monitoring programmes. Stream flow is a critical calibration parameter for the groundwater model. The current model is based on very limited surface water monitoring data and the status of the gauges installed to acquire this data is unknown.

<sup>1</sup> "Tertiary" is a non-standard term used by Adani, and so this use is continued throughout this advice. The standard terms applied to the Geological Timescale are available from the International Commission on Stratigraphy (<http://www.stratigraphy.org/index.php/ics-chart-timescale>).

Additionally, an improved and re-calibrated flow-discharge relationship for each gauge would improve the accuracy of the data.

Baseflow conditions across the site varies, with the Carmichael River switching from gaining to losing and to gaining again, ongoing. Consequently gauging where the river enters and leaves the lease is necessary to better understand the interactions between surface water and groundwater, and the implications for the Carmichael River GDEs in this area. Gauging data would also address issues with stream flow identified in Section 2.3.1.

*Table 1 Number of off-lease monitoring bores by formation.*

<b>Formation</b>	<b>Number of bores</b>
<b>Springs</b>	7
<b>Alluvium</b>	3
<b>Tertiary sediments</b>	1
<b>Moolayember Formation</b>	2
<b>Clematis Sandstone</b>	10
<b>Clematis/Dunda</b>	1
<b>Dunda Beds</b>	3
<b>Rewan Formation</b>	5
<b>Bandanna Formation</b>	3
<b>Joe Joe Group</b>	15
<b>Tertiary sediments / Joe Joe Group</b>	4

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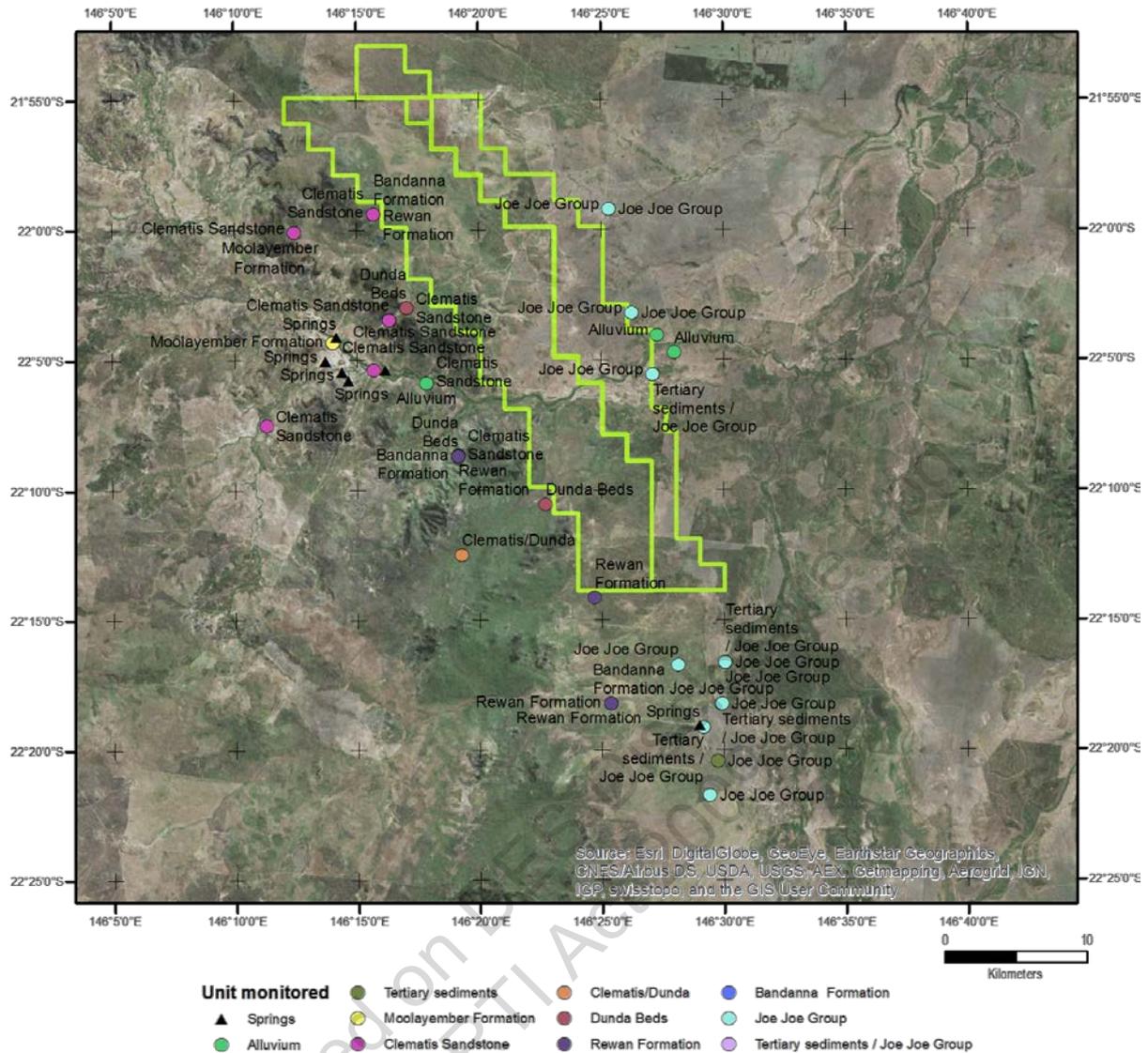


Figure 1. Spatial distribution of off-lease monitoring bores. Note that some locations represent nested bore sites. The green polygon shows the Proponent's mining lease areas.

### 3.4 Management approaches: water level thresholds and triggers

**Issue:** The use of drawdown rate triggers for the Rewan Formation and Dunda Beds (GMMP section 5.3.5.2) as part of the groundwater level monitoring and management regime represents a valid, well-considered approach to adaptive management. This approach relies heavily on predicted impacts. Bores C555P1 and C556P1, two of the three bores for which drawdown rate limits have been set, lie within the underground mining footprint. These may be impacted directly by mining activity.

The Proponent presents predicted impact hydrographs based on modelling in Appendix E. The hydrographs presented indicate that the bores listed in Table 2 will exceed nominated threshold levels. These drawdowns are all attributable to "approved mining activities", and most of the Alluvium, Tertiary, Clematis and Dunda bores will experience these exceedances within 40 years of commencement of "approved mining activities". The introduction of drawdown rate limits for selected Rewan Formation and Dunda Beds bores represents a positive approach to adaptive management for early warning of potential impacts. However, these limits do not address the concern that overall groundwater level thresholds will be exceeded by a large number of bores.

**Recommendation:** All monitoring locations for which water level thresholds are defined should also have drawdown rate limits derived. Evaluation of drawdown rate limits should form part of routine monitoring data assessment and be included in the Impact Threshold Assessment approach outlined in GMMP Section 5.3.5.3 and GMMP Plate 24.

*Table 2 Monitoring bores identified as exceeding thresholds during operation*

C022P1	C016P2	C025P1	C025P2	C027P2	C029P1
C029P2	C555P1	C556P1	C558VWP1	C848SP	C851VWP2
C968VWP_P2	C968VWP_P5	C9553P1R	C9845SPR	C14004SP	C14006SP
C14008SP	C14011SP	C14012SP	C14013SP	C14015SP	C14016SP
C14020SP	C14021SP	C14023SP	C14024SP	C14028SP	C14029SP
C914030SPR	C14033SP	C14206VWP_1	C180116SP	C180117SP	C180118SP

**Issue:** The threshold proposed for C025P1 appears inappropriate. It will trigger immediately as the bore has been reported dry for 4 years.

**Recommendation:** This bore should not be used as a threshold monitoring point until a deeper replacement has been installed. The threshold for the new bore should only be set after the acquisition of sufficient baseline data.

**Issue:** GMMP Section 5.3.3.1 and Section 5.3.5.1 indicate the processes by which a threshold will be triggered and an investigation initiated, for bores across the monitoring network and early warning trigger bores, respectively. Some of the actions presented are inconsistently applied or poorly defined.

**Recommendation:** To ensure clarity of management processes and that DoEE are aware that an investigation report is being produced, the Proponent should explicitly state that the Commonwealth regulator will be notified whenever a groundwater level exceedance occurs. The Proponent should commit to a maximum timeframe in which the investigation will be completed (for example three months) in the GMMP.

**Issue:** Quantification of non-mining influences on water levels (such as other land uses or climatic variability) has proven to be a complex and contentious process for other projects.

**Recommendation:** It is recommended that the Proponent provide details of how this process will occur during investigation of threshold exceedances, so that an agreed approach is in place before any exceedances occur.

**Issue:** Mitigation actions are not presented in the GMMP, and a number of references are made to actions presented in the GAB Spring Research Plan (GABSRP) or the Biodiversity Offset Strategy (BOS, out of scope for this advice). CSIRO and Geoscience Australia (2018) provides comments about the mitigation actions described in the GABSRP. EPBC Act approval condition 3.d) indicates that mitigation measures to protect the DSC must be incorporated into the GMMP.

### 3.5 Management approaches: hydrogeochemical triggers and thresholds

Groundwater quality is a key monitoring attribute for all GDEs in the GDEMP (Table 5-1) and groundwater quality triggers will be used to assess potential impacts on GDEs. The Proponent has

established contaminant (groundwater quality) trigger levels and contaminant limits with the Queensland Department of Environment and Science (DES). The trigger levels allow for investigation and implementation of mitigation measures prior to reaching any groundwater quality limits. Contaminant limits (presented in Appendix D of GMMP) will be used to assess the potential for environmental harm, presumably resulting from a trigger exceedance. The GMMP states that triggers and limits may be revised if they are exceeded due to natural conditions.

**Issue:** As was the case in previous versions of the GMMP, there are trigger levels for up to 38 analytes for bores and hydrostratigraphic units, based on the 85<sup>th</sup> percentile of background data where more than 12 results are beyond the limit of laboratory detection. This is a sound approach, but does mean trigger levels should be reached 15% of the time for each analyte.

**Recommendation:** Given the regularity with which exceedances are expected to occur, consideration should be given to:

- the implication of frequent triggering,
- how these exceedances will be investigated,
- how the Proponent will be able to differentiate between a trigger that does not result in environmental harm and one that might,
- ensuring that frequently exceeded triggers do not result in the conclusion that it is always due to natural variability,
- how an investigation into the cause of the exceedance will be undertaken, such as how an exceedance will be evaluated as being due to natural variability or mining activities,
- providing a timeline of how long an investigation will take and what data the Proponent will need to undertake this investigation, such as groundwater use volumes by other users.

There have been some changes to trigger levels compared to previous versions following discussions between the Proponent and the Queensland DES. There is now a “two consecutive exceedances approach” to trigger values, such that an investigation will only be initiated after two consecutive exceedances are detected. This is an appropriate approach. The “two consecutive exceedances approach” results in approximately 6 months passing before an exceedance is identified, based on groundwater monitoring events occurring every 3 months. The GMMP states that DoEE will not be notified when an exceedance occurs; notification will only occur 28 days after completion of the investigation into the cause of the exceedance. Given the length of time this may take (no time frame is provided in the GMMP), DoEE may not be notified of an exceedance until many months after it was first identified.

**Recommendation:** Consideration should be given to extending the approach to two exceedances within 12 months (~4 sampling events) rather than just consecutive exceedances, to ensure triggers can provide an early warning of potential impacts. The management actions would also be strengthened by providing a maximum time frame for an investigation.

If the investigation finds that the exceedances are due to mining activities, the Proponent commits to undertaking a further investigation to determine if ‘environmental harm’ has occurred. The GMMP states that the contaminant limits are ‘for consideration’ when assessing the potential for environmental harm, however it is not clear how they will be used or if they are enforceable limits. There may also be a time lag between a trigger exceedance and the realisation of ‘environmental harm’.

**Issue:** Table 45 in the GMMP describes the proposed trigger level methodology and step 4 states that *'all trigger levels derived from the baseline monitoring program (at least eight results greater than LOR) are compared to the ANZECC & ARMCANZ 2000 guideline values per analyte (95th protection and low reliability). In instances where the ANZECC & ARMCANZ 2000 guideline value is higher, this ANZECC value should be adopted as the proposed trigger level.'* In some cases, this results in trigger levels far in excess of baseline conditions (e.g. manganese and boron in bores screened in the Clematis Sandstone). This is contradictory to the principles of the Guidelines, which recommend that the default guideline values are a generic starting point for assessing water quality and specify that there is a distinct advantage in tailoring guideline values to reflect local conditions for the protection of aquatic ecosystems. The triggers and limits appear to be based on data collected in April 2017.

**Recommendation:** A clear statement regarding whether triggers and limits will be updated when additional pre-operational hydrochemistry data are collected should be included. Some bores may then have the required number of analyses to calculate baseline trigger values at that point, which would be preferable to using generic triggers derived from the ANZECC guidelines.

**Issue:** The GMMP and GDEMP state that the hydrochemistry triggers are interim for two years. This is generally a good approach for adaptive management, however care will need to be taken to ensure this does not result in triggers creeping up to avoid exceedances that will occur with the triggers set at the 85<sup>th</sup> percentile of baseline.

**Issue:** Setting static trigger levels does not account for trends in hydrochemistry that may provide an early indication of impact.

**Recommendation:** An assessment of trends in the hydrochemistry data following each monitoring event will identify if groundwater quality is changing over time, which may provide an early warning of triggers being approached.

**Issue:** The GMMP states that monitoring data will be verified and then reviewed on a regular basis and reported to the regulators.

**Recommendation:** This should include an assessment of hydrochemistry at the site, in addition to presenting raw data.

**Issue:** Detailed issues with the triggers and limits are as follows:

- The increased number of analytes that have a contaminant limit assigned to them compared to previous versions (including aluminium, cadmium, chromium, lead, molybdenum, selenium, silver, vanadium, mercury and nitrate) is an improvement over previous versions of the GMMP.
- Contaminant limits for "HD03A and C14021SP" and "All other Clematis bores" seem to have been swapped between the current version of the GMMP and previous versions.
- In many cases, the trigger is the same as the contaminant limit or not substantially different (e.g. <5mg/L difference). In these instances, no time is allowed for investigation and required implementation of mitigation measures prior to reaching contaminant limits.

**Issue:** Previous versions of the GMMP presented contaminant limits recommended by DES for all hydrostratigraphic units. However, Appendix D in the current draft GMMP only presents contaminant limits for bores screened in the Alluvium, Tertiary Sediments and the Clematis Sandstone.

**Recommendation:** Limits for the Dunda Beds need to be included in Appendix D at a minimum, until alternative conceptualisations for the source aquifer for the DSC has been resolved as the Dunda Beds are likely to be a contributing water source.

**Issue:** There are instances where the trigger level is higher than the contaminant level in bores screened in the Alluvium and Clematis Sandstone. It is not clear how an investigation into an exceedance would progress in this scenario.

In some cases, the contaminant limit is far in excess of the background conditions at the site. In particular, the limits for boron, manganese and iron are consistently higher than baseline data.

**Issue:** For Clematis Sandstone bores, many dissolved metals have a no value (NV) contaminant limit. This means that there are not contaminant limits defined for the Proponent's preferred source aquifer for the DSC.

**Recommendation:** Given that the Proponent considers the Clematis Sandstone as the sole source aquifer for the DSC, contaminant limits for the Clematis Sandstone are required.

### 3.6 Ecological monitoring

The GDEMP sets out how to minimise and manage the environmental impacts of the Project on the four groundwater-dependent ecosystems listed in the approval conditions, through the combination of specific ecological measurements and links with other research and management plans (GMMP, GABSRP, RFCRP, Receiving Environment Management Plan, BOS, Great Artesian Basin Offset Strategy, Offset Area Management Plans, and MNES Plans). Proposed ecosystem measurements are based on relevant research and management guidelines. However, limitations identified for other management plans, in particular the GMMP, RFCRP and GABSRP, mean that the proposed groundwater monitoring approaches are not sufficiently robust to ensure the outcomes sought by the conditions of approval are met.

The design of the ecological monitoring approach follows the GDE Toolbox approach and relevant research and management plans, which is considered to be adequate for monitoring potential impacts to GDEs. In the event that trigger levels are exceeded, the GDEMP will investigate the cause and notify the administering authority within 28 days. If mining activities are identified as the cause, the plan will revise monitoring and management approaches, including ecological and/or groundwater triggers; relevant operational constraints to manage groundwater drawdown impacts, such as revised mine planning or associated activities; changes to research priorities and additional mitigation and/or offset measures.

The GDEMP systematically addresses the management objectives, performance criteria, adaptive management triggers and corrective actions for each of the four GDEs identified in the approval conditions:

- Waxy Cabbage Palm (*Livistona lanuginosa*)
- Carmichael River (Carmichael River and its riparian zone between the Doongmabulla springs and the Belyando River)
- The Mellaluka Springs-complex
- Community of native species dependent on discharge from the Great Artesian Basin (Doongmabulla Springs-complex) including the Salt Pipewort *Eriocaulon carsonii*; and the Blue Devil *Eryngium fontanum*.

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# Appendix A

## A.1 Initial review of GMMP revision 4 water levels, triggers and thresholds

### A.1.1 Revised hydrographs

Specific issues relating to water levels and hydrographs have been compiled and are provided in Table 1. The column “contoured” indicates if a bore has been used to derive groundwater contours or not. The column “hydrogeochemistry” indicates if a bore has been sampled and data provided as part of the chemical characterisation of groundwater. For bores C008P1 and C035P1, no data has been provided, however a geochemical trigger value is provided.

A key point identified in this work is that Appendix C and E of GMMP revision 4 show differences between hydrographs for individual bores. Appendix C shows a shorter time series, whereas Appendix E shows a more complete time series, extending further back and including more recent data. In addition, Appendix E appears to contain hydrographs constructed from data which has been corrected in some part as a result of feedback on previous versions of the GMMP. Groundwater level contour maps provided in Appendix C are described as being derived from the average water level for each bore. It is unclear if this is the average water level for data presented in Appendix C, or if it is for the entire time series. The contour maps for the Alluvium, Tertiary Sediments, Dunda Beds, Rewan Formation, Bandanna Formation (AB Seam), Colinlea Seam (D Seam), and Joe Joe Group are derived from “Average Groundwater Elev (mAHD)” according to the legend and statement on each map (Figures F1, F2, F4, F5, F6, F7, F8a and F8b). The groundwater contour map for the Clematis Sandstone is derived from the “April 2018 water level data” according to the legend to Figure F3, although the Notes for the map state that “SWL (mAHD) data is the average water level based on hydrographs by NRC (on behalf of Adani).” These statements are mutually exclusive. The “Notes” to the groundwater level maps appear to be based on a template, whereas the “Legend” is map-specific.

GMMP revision 4 Appendix C and Appendix E both contain observation hydrographs from monitoring bores. There are however inconsistencies between the two appendices, including but not limited to:

1. Discrepancy in hydrographs from the same bore for the same time period:  
HB03B, C027P2, C029P2, C14005SP, C016P2, C555P1
2. Concerns with hydrographs in the alluvium are still not addressed in GMMP revision 4 appendices:  
HD02 (05/2013 to 05/2015), C027P2 (11/2012 to 03/2015), C025P2 (entire record)
3. Unexplained offsets in values between bore water levels which are not related to resurveyed reference elevations:  
C9180124SPR common reference value of 224.29m
4. Unexplained changes, shifts or deletion of logger data and/or manual data:  
C14005SP– removal of manual measurements and changes to hydrograph  
C011P1– removal of period between 03/2013 and 09/2013 as well as shift in manual measurements by approximately 2-3 months.

Additional detailed work on understanding issues with water level data from bore HD02 subsequent to provision of the GMMP revision 4 was provided to Geoscience Australia and CSIRO on 5 December 2018. This work rectified issues identified with this bore's water level data. The new hydrograph accords with the reported hydrogeological setting HD02 is in, and the thorough and detailed explanation put forward for the corrections. The work undertaken shows an appreciation of the importance of robust scientific analysis in this type of work. The new water level work undertaken for HD02 raises further questions:

1. How does this effect the integrated interpretation of data near the springs given there is now a drop of ~0.6m in 4years in GMMP revision 4 as opposed to the 0.2m in the GMMP revision 1 graphs for HD02?
2. Should the trigger values consider this rate of decline (i.e. no increase in rate) as part of the early warning assessment of the 0.2m limit?
3. Why was data only corrected up until 2016?

Rainfall data can be used to help constrain the alluvium and unconfined components of the groundwater system. The same cannot be said for bores screened in confined aquifers. These bores warrant more detailed investigation; however, this diverges from the questions being posed under Tranche 2.

It is unclear why minimum and maximum water levels are calculated from automated logger data for some bores, and from manual water level readings for other bores. Similarly, it is unclear why some bore records have been used to derive water level contours, as opposed to including all bore records available. A significant change between previous versions of the GMMP is the omission in revision 4 of vibrating wire piezometer data. Hydrographs do not report data for 2017 or 2018. Figure F3 from Appendix C states, however, that contours for the Clematis Sandstone are based on April 2018 water level data. As noted in reviews of previous revisions, as well as in peer reviews of the GMMP provided by the Proponent, groundwater contour maps must contain the subcrop or extents of hydrogeological units. For example, Figures F1 through F4 and F8a and 8b do not include mapped extents, whereas Figures F5 through F7 do. Another feature not present on all maps is the location of the interpreted groundwater synform. This feature appears for all units stratigraphically below the Clematis Sandstone, although the axis does not appear to match with the groundwater contours. For example, the synform in Figure F4 trends in a northeasterly direction, whereas the contours would imply such a feature trends in an easterly direction, coincident with the orientation of the Carmichael River.

### **A.1.2 Issues relating to revised water level data that relate to modelling and modelled impacts**

The numerical groundwater model has not been recalibrated since the SEIS report. When the observation bores were surveyed and the heights updated the model was not recalibrated. The model re-runs changed the western boundary conditions (location, elevation and conductance) but did not recalibrate. There are several issues with the model calibration which makes the drawdown predictions unreliable, including that the model was calibrated to incorrect bore heights; the parameterisation of the Rewan and Clematis are at the extremes of the expected range; and, the river flows were not part of the calibration.

Having the incorrect bore heights in the calibration dataset has forced the model to have the incorrect groundwater levels. Bore HD02 is the closest bore to Doongmabulla Springs and has shifted elevation by 4m. When the springs are potentially sensitive to drawdown of 0.2m an error of 4m is substantial. The drawdown is calculated as the difference between two model runs, if the model behaved in a linear fashion then the 4m offset would not be a problem. However, the model boundary conditions associated with ET and the river are not linear and neither is the flow in the top unconfined layer. We cannot estimate the error in predicted drawdown due to the change in bore elevations without re-calibrating the model.

The hydraulic conductivity of the Rewan formation is extremely low and this minimises the propagation of drawdown into the Clematis. The hydraulic conductivity of the Clematis is at the high end of the expected value which allows the model to draw more water in horizontally and thus minimising the drawdown to Doongmabulla Springs. The sensitivity analysis shows that if either of these parameters were changed to their expected values then the drawdown at the springs would be greater than 0.2m. If both were changed it would be greater again.

The 90<sup>th</sup> percentile of river flows measured at the upstream gauge was 400 m<sup>3</sup>/d but the calibrated baseflow in the model was 4000 m<sup>3</sup>/d. The predicted maximum impact on the flow in the river was 1000 m<sup>3</sup>/d, which is more than the measured baseflow. In the model the Carmichael River is acting as a source of water that doesn't exist and so drawdown in the Carmichael River GDE is underestimated. The model needs baseflow in the river to be a calibration target to ensure that the predicted drawdown in the target to ensure that the predicted drawdown in the GDE is accurate.

The status of the interaction between baseline water level data, modelled drawdown predictions, revised hydrographs, and triggers and thresholds is not clear from this initial assessment.

### A.1.3 Hydrogeochemistry

As stated in Tranche 1 review, the proposed groundwater quality monitoring bores in the vicinity of the Doongmabulla Springs Complex (DSC) are not screened in alternative spring source aquifers such as the Dunda Beds. Consequently, the groundwater chemistry monitoring data that has been collected to date and is proposed to be collected, will not contribute to the assessment of alternative source aquifers for the DSC.

In some cases, groundwater trigger levels have been set for individual bores. In other cases, the trigger level is set for the hydrostratigraphic unit. The Proponent describes the methodology they used to calculate trigger levels, however the results of this methodology are not presented in the GMMP. For example there are no box and whisker plots; there are no piper diagrams to identify why some bores are considered to have different water quality to other bores in the same hydrostratigraphic unit. No clear evidence is presented for why bore C0227P2 in the Dunda Beds has variable groundwater quality compared to other bores in the Dunda Beds. Time series graphs in Appendix D indicate this bore is not consistently different across a range of groundwater quality indicators from other bores in the Dunda Beds.

Other issues associated with the proposed groundwater quality triggers include:

1. Some trigger levels are set far in excess of baseline concentrations. The trigger levels for boron, manganese and iron seem to be consistently higher than baseline data. The Proponent do not provide an explanation for why their proposed triggers differ from those recommended by Queensland Department of Environment and Science (DES).
2. Setting trigger levels does not account for trends in groundwater chemistry that may provide an early indication of impact. Following the recommendation from DES (DES review August 2018), the Proponent state that two consecutive groundwater chemistry results above the trigger value will prompt an investigation. Some assessment of trends in the groundwater chemistry data following each monitoring event to identify if groundwater quality is changing over time should also form part of the monitoring strategy.
3. Few bores are classified as 'sentinel' bores have site-specific groundwater trigger levels set. The trigger levels for these bores defaults to hydrostratigraphic unit-wide trigger levels. Whilst this may be a suitable approach to investigate aquifer-wide changes to groundwater chemistry; the protection of specific receptors requires site-specific triggers to provide early warning of potential impacts to the springs. Individual triggers need to be set for sentinel bores which are "a monitoring point where groundwater level and quality changes can be monitored before changes occur at a receptor (p.32)".

#### A.1.4 Recommendation

While Geoscience Australia and CSIRO have assessed water levels and associated information provided, this does not constitute the detailed work necessary to address Tranche 2 of the current work program. That work will commence once a decision has been reached by Geoscience Australia, CSIRO and DoEE taking into consideration the information provided here. Geoscience Australia and CSIRO have previously provided DoEE with time lines for completion of Tranche 2 work, factoring in contingencies relating to provision of appropriate documentation by the Proponent. That documentation has been provided. Based on this initial assessment, Geoscience Australia and CSIRO recommend allowing the proponent to reconsider their submission for Tranche 2. Tranche 2 will include the work undertaken in this initial assessment of water levels for GMMP revision 4.

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Table 3. Compilation of specific comments relating to hydrographs presented in GMMP revision 4.

Bore ID	Initial Review comments	Contoured	Hydrochemistry
<b>Quaternary Alluvial Deposits</b>			
C025P1	<ul style="list-style-type: none"> <li>Used in the contour plot, however has been reported dry since 2015. Since dry, they use a rounded value of terminal depth as the WL. This is not correct. This data point should be discounted and not used in the contour (or in model calibration). - its only value is to indicate maximum possible water level if checking modelled data over the historic period.</li> <li>This bore is shown in the Tertiary formation in Figure 12</li> </ul>	Y	N
C027P1	Value used in contour plot is over 1 metre higher than long term value and most recent reading on hydrograph. A rise of WL of this amount is inconsistent with long term trends.	Y	Y
C029P1	Manual dips diverged from logger data for a few readings. (Logger not being reset at each dip)	Y	Y
HD03B	<ul style="list-style-type: none"> <li>RL has shifted &gt;3m. Concern this shift will impact model calibration.</li> <li>Logger and manual dips divergent, this not explained.</li> </ul>	Y	Y
C14027SP	Contour plot uses long term minimum, instead of long term average	Y	N
C14028SP	The hydrograph is characterised by a peak (associated with flooding) in 2012. Then subsides to a significantly lower value that is fairly steady from 2014 to 2017. The average value uses data from the peak and so gives a long term average that is more than a metre higher than the apparent long term average value.	Y	Y
<b>Tertiary Age Sediments</b>			
C025P2	<ul style="list-style-type: none"> <li>Outlying data point removed - approximately Jan 2015, no explanation.</li> <li>Plot in Appendix C still inverted version.</li> </ul>	Y	Y

Bore ID	Initial Review comments	Contoured	Hydrochemistry
C029P2	The early manual dip readings are no longer included (from 2011)	Y	Y
C558P1	<ul style="list-style-type: none"> <li>Step change in data values still present and not explained. Concern that model calibrated using GHD logger values, whereas long-term dataset is &gt;0.5m higher.</li> <li>Appears to be 3 manual dip readings between 2014 and early 2015 removed from data set without explanation.</li> </ul>	Y	Y
C9180121SPR	No overlap between logger and manual dips, however logger used to calculate max, min and average values.	Y	Y
C9845SPR	nil comment	Y	Y
C971SP (C896G)	no hydrographs presented	N	N
<b>Triassic Age Units (GAB Units)</b>			
<b>Moolayember Formation</b>			
C14020SP	nil comment (not contoured)	N	N
<b>Clematis Sandstone</b>			
HD02	<ul style="list-style-type: none"> <li>Values transposed down approximately 4m compared with SEIS hydrograph. This likely to impact validity of model calibration.</li> <li>Parts of plot appear upside down. If so this would fix the divergence between manual dips and logger data.</li> <li>Hydrograph does not include any data beyond mid 2016.</li> </ul>	Y	Y
HD03A	Manual dips not included on hydrograph	Y	Y
C180118SP	<ul style="list-style-type: none"> <li>Hydrograph indicates well is blocked from mid 2015, suggesting value should not be used on contour plot.</li> <li>Value used on contour plot is &gt;1m lower than last value on hydrograph, not clear if it is now unblocked, but if so value shows a dramatic drop from previously steady readings.</li> </ul>	Y	Y

Bore ID	Initial Review comments	Contoured	Hydrochemistry
C14021SP	<ul style="list-style-type: none"> <li>This point lies outside the formation boundary for the Clematis (likely Tertiary or Dunda Beds). Thus is used incorrectly on the Clematis contour plot.</li> <li>Manual dip readings (in Appendix C) not provided on Appendix E hydrograph</li> </ul>	Y	Y
C14033SP	nil comment	Y	Y
C14011SP	<ul style="list-style-type: none"> <li>Value on contour plot is approximately 1m higher than last value on hydrograph. Given the very steady long-term groundwater levels it is unprecedented for the hydrograph to rise sufficiently to make contour value likely.</li> <li>Maximum water level on hydrograph appears to be calculated from manual dips, if so value is incorrect.</li> </ul>	Y	Y
C14012SP	Value on contour plot is approximately 1m higher than last value on hydrograph. Given the very steady long-term groundwater levels it is unprecedented for the hydrograph to rise sufficiently to make contour value likely	Y	Y
C14013SP	Value on contour plot is approximately 1m higher than last value on hydrograph. Given the very steady long-term groundwater levels it is unprecedented for the hydrograph to rise sufficiently to make contour value likely	Y	Y
C18001SP	new, artesian	Y	N
C18002SP	new	Y	N
C18010SP	new	Y	N
C18011SP	new	Y	N
C18012SP	new	Y	N
C18013SP	new	Y	N
C18014SP	new	Y	N
<b>Dunda Beds</b>			
C022P1	nil comment	Y	Y

Bore ID	Initial Review comments	Contoured	Hydrochemistry
C027P2	<ul style="list-style-type: none"> <li>Early manual dip readings appear to have been shifted up 1m in the Appendix E hydrograph Section of the plot is possibly inverted (ie rainfall response)</li> <li>Manual dip readings in mid 2016 appear to have been omitted (are present in Appendix C data).</li> </ul>	Y	Y
C14023SP	nil comment	Y	N
C180117SP	Early manual dip readings (March to November 2014) have not been included in Appendix E hydrograph	Y	Y
<b>Rewan Formation</b>			
C008P1	Manual dip readings in Appendix C and Appendix E do not match - possibly a time shift in the data, or several points omitted.	Y	? Have trigger
C035P1	<ul style="list-style-type: none"> <li>Time scale on Appendix E plot has malfunctioned (mid 2013 to 4/2015 missing).</li> <li>Data ends at 2/2016.</li> <li>Appears that manual dip points are missing/Plots in appendices C and E very different.</li> </ul>	Y	? Have trigger
C555P1	<ul style="list-style-type: none"> <li>Approximately 1m jump in water levels in mid 2013 - not explained.</li> <li>Logger data from approximately 9/2015 in Appendix E appears to be a plotting error (different to App C).</li> <li>Calculated average water level is incorrect (appears to be 1m higher than correct value - typo?), the incorrect value is used in the contour plot.</li> </ul>	Y	N
C556P1	Outlying manual dip reading has been removed - but not mentioned/discussed/explained.	Y	N

Bore ID	Initial Review comments	Contoured	Hydrochemistry
C9553P1R	<ul style="list-style-type: none"> <li>Data ends 7/2016.</li> <li>Early data (2012 to 7/2013) has two logger plots that don't coincide. No explanation given as to why data is different.</li> <li>Need to clarify which data was used for the model calibration.</li> </ul>	Y	N
C180116SP	Nil comment	Y	N
C9838SPR	Logger and manual dips diverge from mid 2016 - not discussed/explained.	Y	N
<b>Permian Age Units</b>			
<b>Bandanna Formation</b>			
<b>B-C Sandstone</b>			
C006P1	Nil comment	N	N
C018P1	Short period in early part of plot with 2 sets of logger data. Need to clarify which was used in the model calibration	N	N
C847SP	2 outlier manual dips from early 2015 removed in Appendix E without discussion.	N	N
<b>AB Seam</b>			
C007P2	Nil comment	Y	Y

Bore ID	Initial Review comments	Contoured	Hydrochemistry
C008P2	5/2016 outlier manual dip removed - no discussion.	Y	Y
C014P2	Nil comment	Y	Y
C016P2	Appears to be a small vertical shift (<0.5m) downward in data. Difficult to confirm due to variable scales.	Y	Y
C020P2	Nil comment	Y	Y
C032P2	Appears to be a small vertical shift upward of data in 2013/2014 (approximately 0.5m).	Y	Y
C034P1	<ul style="list-style-type: none"> <li>• Single manual dip - significantly different to logger data - not discussed/ explained.</li> <li>• Logger appear to malfunction from 7/2016 - not discussed/explained.</li> </ul>	N	N
C035P2	Nil comment	Y	Y
<b>AB Interburden</b>			

Bore ID	Initial Review comments	Contoured	Hydrochemistry
C011P1	<ul style="list-style-type: none"> <li>It appears the elevation of the data has shifted by approximately 1m. This may impact model calibration.</li> <li>Appendix C and Appendix E are inconsistent, and the issues identified in 2017 have not been addressed.</li> </ul>	N	N
<b>C Seam</b>			
C823SP	<ul style="list-style-type: none"> <li>Hydrograph behaviour strange (opera house) - either logger error (as indicated in Appendix E) or issues with gw sampling (as indicated in Appendix C) this issued should be clarified and resolved. Has been going since end of 2014.</li> <li>Plots in Appendix C and E are different (logger coincides with manual dip in E, but not in C).</li> </ul>	N	N
C832SP	Divergence of manual readings and logger data in later 2016 not explained	N	N
<b>C Seam interburden</b>			
C9839SPR	2 manual dip outliers (early 2015) removed in Appendix E without discussion	N	N
C844SP	Nil comment	N	N
<b>Other Bandanna Formation</b>			
C018P2	1.5 metre step down in data in approximately 8/2012. Not explained.	N	N

Bore ID	Initial Review comments	Contoured	Hydrochemistry
C034P1	<ul style="list-style-type: none"> <li>• Single manual dip - significantly different to logger data - not discussed/ explained.</li> <li>• Logger appears to malfunction from 7/2016 - not discussed/explained.</li> </ul>	N	N
<b>Colinlea Sandstone</b>			
<b>C-D Sandstone</b>			
C972SP (C897G)	Not included	N	N
C974SP (C899G)	Nil comment	N	N
<b>D Seam</b>			
C006P3R	<ul style="list-style-type: none"> <li>• Two sets of logger data provided for early (10/11 to 5/13) part of plot. One plot has peaks in the data not present in the other.</li> <li>• The logger plot that continues as the long-term logger appears to be inverted (potential rainfall response falling instead of rising).</li> </ul>	Y	Y
C007P3	Nil comment	Y	Y
C011P3	Nil comment	Y	Y
C018P3	Nil comment	Y	Y
C024P3	Nil comment	Y	Y
C034P3	<ul style="list-style-type: none"> <li>• Logger appears to have failed in late 2015 - no comment/ explanation (however data appears not to be used in calculation of average).</li> <li>• Manual dips shown in Appendix E do not appear to match those in Appendix C.</li> </ul>	N	Y

Bore ID	Initial Review comments	Contoured	Hydrochemistry
C180114SP	Nil comment	Y	Y
C833SP	<ul style="list-style-type: none"> <li>Logger and manual readings do not match throughout monitoring period. No discussion about why.</li> </ul>	Maybe - with typo as C883?	Y
C848SP	Nil comment	Y	Y
C9849SPR	Appendix C includes many more manual readings than Appendix E.	N	Y
C975SP (C900G)	Nil comment	Y	N
<b>D Seam interburden</b>			
C829SP	Outlying manual dip included in Appendix C but not E - no explanation	N	N
<b>D-E Sandstone</b>			
C825SP	Nil comment	N	N
C840SP	Outlying manual dip included in Appendix C but not E - no explanation	N	N
<b>E-F Sandstone</b>			
C180112SP	Outlying manual dip included in Appendix C but not E - no explanation	N	N
<b>Other Colinlea Sandstone</b>			
C827SP	Nil comment	N	N
C834SP	<ul style="list-style-type: none"> <li>Appendix C includes manual dips, none are included in Appendix E.</li> <li>Dips diverge from logger data - no discussion/explanation.</li> </ul>	N	N
<b>Joe Joe Group</b>			

Bore ID	Initial Review comments	Contoured	Hydrochemistry
C012P1	Nil comment	Y	Y
C012P2	Nil comment	Y	Y
C180119SP	Manual dips included in appendix C but not appendix E.	Y	Y
C9180124SPR	<ul style="list-style-type: none"> <li>Water levels in appendix C are approximately 3 metres lower than Appendix E values.</li> <li>Appendix C includes manual dips, none are included in Appendix E.</li> <li>Dips do not coincide with logger data - no discussion/explanation.</li> </ul>	Y	Y
C9180125SPR	<ul style="list-style-type: none"> <li>Appendix C includes manual dips, none are included in Appendix E.</li> <li>Dips do not coincide with logger data - no discussion/explanation</li> </ul>	Y	Y
C180123SP	Manual dips included in appendix C but appendix E.	Y	Y
C14002SP	Manual readings have shifted vertically from Appendix C to Appendix E.	Y	N
C914001SPR	Nil comment	Y	Y
C14014SP	<ul style="list-style-type: none"> <li>Early manual dips in Appendix C and Appendix E do not correspond.</li> <li>Notes indicate farmer using bore, consequently is the bore suitable as a monitoring point?</li> </ul>	Y	Y

Bore ID	Initial Review comments	Contoured	Hydrochemistry
C14032SP	<ul style="list-style-type: none"> <li>No hydrograph provided in appendix C.</li> <li>Step change in water levels in approximately October 2015 (3m down) - not explained/explored. Could it be a resurvey of the monitoring point? (water levels appears relatively steady before and after the step change)</li> </ul>	Y	N
C14008SP	Manual dips and logger data do not coincide - not discussed/explained	Y	Y
C14015SP	No manual dip data provided	Y	Y
C14017SP	Manual dips and logger data do not coincide - not discussed/explained	Y	Y
C14006SP	<ul style="list-style-type: none"> <li>Manual dip readings not presented in Appendix E.</li> <li>Dips and logger do not coincide - not discussed/explained</li> </ul>	Y	Y
C914030SPR	Manual dips and logger data do not coincide - not discussed/explained	Y	N
C14004SP	Early outlier in Appendix C removed in Appendix E (probably reasonable, but not explained).	Y	N
C14016SP	nil comment	Y	Y
C14003SP	Outlying manual dips from Appendix C not in E.	Y	Y
<b>Composite Sample Points</b>			
C180122SP	<ul style="list-style-type: none"> <li>No manual dips included in appendix E.</li> <li>Manual dips do not coincide with logger data - no explanation</li> </ul>	N	N
C180120SP	<ul style="list-style-type: none"> <li>No manual dips included in appendix E.</li> <li>Manual dips diverge from logger data - no explanation</li> </ul>	N	N
C973SP (C898G)	Not included in Appendix C	N	N
C14031SP	No manual dips included in appendix E.	N	N

Bore ID	Initial Review comments	Contoured	Hydrochemistry
C14024SP	Not included in Appendix C	N	N
C14005SP	<ul style="list-style-type: none"> <li>• Plots in Appendix C and Appendix E are very different: several data steps in Appendix C, none in Appendix E.</li> <li>• No manual dips in Appendix E.</li> <li>• Several small downward data spikes not explained.</li> <li>• Logger and manual readings divergent</li> </ul>	N	N
C14029SP	Not included in Appendix C	N	N

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## Appendix B

CSIRO Comment location in App A	CSIRO Comment	Adani Comment response	Location where CSIRO comment to be addressed in GMMP rev 5	GA response post GMMPv5
Paragraph 1, Attachment A (Revised Hydrographs)	For bores C008P1 and C035P1, no data has been provided, however a geochemical trigger value is provided.	No data on Rewan formation is provided in Appendix D. However in GMMP report body, triggers for C008P1 are provided.	Section 5.4.3.4.5 of GMMP (Rev 5)	Adequately addressed and data is now provided in Appendix D: Geochemistry tables
Paragraph 2, Attachment A (Revised Hydrographs)	A key point identified in this work is that Appendix C and E of GMMP revision 4 show differences between hydrographs for individual bores.	Appendix C has been revised to include only groundwater contours; Appendix E includes hydrographs	Refer to Appendix E of the revised GMMP (Rev 5)	
Paragraph 2, Attachment A (Revised Hydrographs)	Groundwater contour figures: notes and legend between Clematis and all other maps are different. The “Notes” to the groundwater level maps appear to be based on a template, whereas the “Legend” is map-specific.	Groundwater contour figures have been updated per action specified in next column	The maps legend has been corrected. Please refer to maps in Appendix C.	
Paragraph 3, Attachment A (Revised Hydrographs)	Inconsistencies between App C and App E	Hydrographs in App C have been removed and App E includes most recent hydrographs accepted by	Refer to Appendix E for hydrographs in revised GMMP	

CSIRO Comment location in App A	CSIRO Comment	Adani Comment response	Location where CSIRO comment to be addressed in GMMP rev 5	GA response post GMMPv5
DNRME				
Paragraph 4 and subsequent dot points, Attachment A (Revised Hydrographs)	<p>Revised HD02 hydrograph (accounting for DNRME comments) raises questions:</p> <ol style="list-style-type: none"> <li>How does this effect the integrated interpretation of data near the springs given there is now a drop of ~0.6m in 4years in GMMP revision 4 as opposed to the 0.2m in the GMMP revision 1 graphs for HD02?</li> <li>Should the trigger values consider this rate of decline (i.e. no increase in rate) as part of the early warning assessment of the 0.2m limit?</li> <li>Why was data only corrected up until 2016?</li> </ol>	<ol style="list-style-type: none"> <li>The min GWL is 234.07 and max GWL is 234.58, The decline of 0.6m is not observed. The bore is also influenced by flooding of Carmichael River.</li> <li>The rate of decline in HD02 which is a Clematis Sst bore is a naturally occurring phenomena, as this bore is influenced by the flooding of Carmichael River. However mining related impacts are also monitored in units below Clematis by assigning triggers based on a rate of decline and which will occur prior to the impact reaching HD02.</li> </ol>	The hydrograph for HD02 has been reviewed, and all inconstancies have been addressed and explanation provided and signed off by DNRME. The hydrograph has been updated up to 2017.	
Paragraph 6 (Revised Hydrographs)	<ol style="list-style-type: none"> <li>It is unclear why minimum and maximum water levels are calculated from automated logger data for some bores, and from manual water level readings for other bores.</li> </ol>	<ol style="list-style-type: none"> <li>The GMMP details the dataset utilised to calculate average groundwater elevation for each bore and rationale</li> <li>The GWL data collected by manual dipping and</li> </ol>	The GWL statistics has been derived by using the most accurate data. DNRME has agreed with the approach followed in selecting the data sets for	

CSIRO Comment location in App A	CSIRO Comment	Adani Comment response	Location where CSIRO comment to be addressed in GMMP rev 5	GA response post GMMPv5
	2. Similarly, it is unclear why some bore records have been used to derive water level contours, as opposed to including all bore records available.	automated logger for each bore is assessed and as per assessment the most valid data is used for generating the hydrographs. For generating hydrographs, only data within the same horizon/aquifer is considered.	deriving the GWL stats. See Section 3.4 of the revised GMMP.	
		3. As per DNRME advice all VWP data was not considered for generating hydrographs		
	3. A significant change between previous versions of the GMMP is the omission in revision 4 of vibrating wire piezometer data. Hydrographs do not report data for 2017 or 2018.	4. Figures F1 and F2 are for alluvium and tertiary where extents exist throughout the area. Extents of Clematis SSt and Dunda Beds may be included in Figures F3 and F4 respectively.	See Section 3.3 of GMMP	
	4. As noted in reviews of previous revisions, as well as in peer reviews of the	5. Synform does not extend through all hydrostratigraphic units	The sub crop lines where identified from the geological model are now	

CSIRO Comment location in App A	CSIRO Comment	Adani Comment response	Location where CSIRO comment to be addressed in GMMP rev 5	GA response post GMMPv5
	<p>GMMP provided by the Proponent, groundwater contour maps must contain the subcrop or extents of hydrogeological units. For example, Figures F1 through F4 and F8a and 8b do not include mapped extents, whereas Figures F5 through F7 do.</p> <p>5. Another feature not present on all maps is the location of the interpreted groundwater synform. This feature appears for all units stratigraphically below the Clematis Sandstone, although the axis does not appear to match with the groundwater contours.</p>		<p>incorporated in the maps. For sub crops not identified in the geological model an indicative sub crop are included. Refer to updated maps in Appendix C.</p>	
<p>Paragraph 1 (Issues relating to..... modelled impacts)</p>	<p>There are several issues with the model calibration which makes the drawdown predictions unreliable, including that the model was calibrated to incorrect bore heights; the parameterisation of the Rewan and Clematis are at the extremes</p>	<p>Model review is outside scope/objective of GMMP.</p>	<p>See Section 2.2.9</p>	

CSIRO Comment location in App A	CSIRO Comment	Adani Comment response	Location where CSIRO comment to be addressed in GMMP rev 5	GA response post GMMPv5
	of the expected range; and, the river flows were not part of the calibration.			
Paragraph 1 (Issues relating to..... modelled impacts)	...We cannot estimate the error in predicted drawdown due to the change in bore elevations without re-calibrating the model.	Model review is outside scope/objective of GMMP.	See Section 2.2.9	
Paragraph 2 (Issues relating to..... modelled impacts)	The hydraulic conductivity of the Rewan formation is extremely low and this minimises the propagation of drawdown into the Clematis. The hydraulic conductivity of the Clematis is at the high end of the expected value which allows the model to draw more water in horizontally and thus minimising the drawdown to Doongmabulla Springs. The sensitivity analysis shows that if either of these parameters were changed to their expected values then the drawdown at the springs would be greater than 0.2m. If both were changed it would be greater again.	Model review is outside scope/objective of GMMP	See Section 2.2.9	

CSIRO Comment location in App A	CSIRO Comment	Adani Comment response	Location where CSIRO comment to be addressed in GMMP rev 5	GA response post GMMPv5
<b>Hydrogeochemistry</b>				
Paragraph 2	The Proponent describes the methodology they used to calculate trigger levels, however the results of this methodology are not presented in the GMMP. For example there are no box and whisker plots; there are no piper diagrams to identify why some bores are considered to have different water quality to other bores in the same hydrostratigraphic unit.	Further information has been detailed with respect to the adopted approach to finalise the trigger levels in consultation with DES	Section 5.4.3.2 and Section 5.4.3.3	Additional information has been provided here. It would be beneficial to provide the results of the assessments of hydrochemistry to see the evidence for why bores within a formation have been differentiated for the purpose of defining trigger levels.
Paragraph 2	No clear evidence is presented for why bore C0227P2 in the Dunda Beds has variable groundwater quality compared to other bores in the Dunda Beds. Time series graphs in Appendix D indicate this bore is not consistently different across a range of groundwater quality indicators from other bores in the Dunda Beds.	As the site is currently a greenfield site, the reported variability is considered to be a representation of the existing (baseline) environment. A conservative approach has been adopted for this bore by the development of bore-specific trigger levels.	Section 5.4.3.4.4	The raw data is now presented in the geochemistry tables in Appendix D. Presenting this information on something like a Piper diagram would be helpful to illustrate that C0227P2 has a different hydrochemistry to other bores in the Dunda Beds.
Other issues associated with the proposed groundwater quality	1. Some trigger levels are set far in excess of baseline concentrations. The trigger levels for boron,	Further information has been detailed with respect to the adopted approach to finalise the trigger levels in consultation	Section 5.4.3.2 and Section 5.4.3.3	Additional information is provided in Table 45. With regards to trigger levels for some analytes being higher

CSIRO Comment location in App A	CSIRO Comment	Adani Comment response	Location where CSIRO comment to be addressed in GMMP rev 5	GA response post GMMPv5
triggers include:	<p>manganese and iron seem to be consistently higher than baseline data. The Proponent do not provide an explanation for why their proposed triggers differ from those recommended by Queensland Department of Environment and Science (DES).</p> <p>2. Setting trigger levels does not account for trends in groundwater chemistry that may provide an early indication of impact. Following the recommendation from DES (DES review August 2018), the Proponent state that two consecutive groundwater chemistry results above the trigger value will prompt an investigation. Some assessment of trends in the groundwater chemistry data following each monitoring event to</p>	<p>with DES</p> <p>Assignment of site-specific triggers to provide early warning for ‘specific receptors’ is not related to GMMP, or the objective of GMMP as per EA as this will be for GDEMP to prescribe. But EPBC approval require GMMP to assign triggers for MNES. Therefore, the hydrostratigraphic unit</p>		<p>than baseline data, Table 45 states that in Step 4: <i>‘trigger levels derived from the baseline monitoring program are compared to the ANZECC &amp; ARMCANZ 2000 guideline values per analyte (95th protection and low reliability). In instances where the ANZECC &amp; ARMCANZ 2000 guideline value is higher, this ANZECC value should be adopted as the proposed trigger level.’</i> GA notes the ANZECC guidelines are only used in preference to the baseline data when they are higher than baseline data, not lower. GA considers that site-specific triggers are preferential to using the ANZECC guideline trigger values.</p>

CSIRO Comment location in App A	CSIRO Comment	Adani Comment response	Location where CSIRO comment to be addressed in GMMP rev 5	GA response post GMMPv5
	<p>identify if groundwater quality is changing over time should also form part of the monitoring strategy.</p> <p>3. Few bores are classified as 'sentinel' bores have site-specific groundwater trigger levels set. The trigger levels for these bores defaults to hydrostratigraphic unit-wide trigger levels. Whilst this may be a suitable approach to investigate aquifer-wide changes to groundwater chemistry; the protection of specific receptors requires site-specific triggers to provide early warning of potential impacts to the springs. Individual triggers need to be set for sentinel bores which are "a monitoring point where groundwater level and quality changes can be monitored before changes occur at a receptor (p.32)".</p>	<p>which is the source of springs is MNES.</p>		

# Appendix C

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# Carmichael Coal Mine

Advice on draft research plans to the Department of the Environment and Energy

NOVEMBER 2018

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## 1. Introduction

On 25 October 2018, the Department of the Environment and Energy (DoEE) requested Geoscience Australia and CSIRO to provide groundwater-related advice on draft plans provided by Adani Mining Pty Ltd (the Proponent) in accordance with *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) approval conditions for the Carmichael Coal Mine. These plans include the draft Great Artesian Basin Springs Research Plan (GABSRP) and the draft Rewan Formation Connectivity Research Plan (RFCRP), required under EPBC Act conditions 25 and 26, and 27 and 28, respectively.

The DoEE sought advice specifically on two questions relating to these draft plans:

**Q1a.** Based on the information currently available, how plausible and reasonable is it that the Clematis Sandstone is the source aquifer for Doongmabulla Springs Complex?

**Q1b.** How adequately do the methods and techniques put forward in the research plans address uncertainties about:

1. the source of the springs
2. the capacity of the Rewan Formation to prevent impacts to the springs, and
3. methods to prevent, mitigate and remediate ecological impacts to the springs?

These questions were to be based on available information including:

4. the draft GABSRP (Final draft, dated 21 May 2018)
5. the draft RFCRP (Revision L, dated 6 August 2018)
6. a Statement of claims about the springs source and additional information about the conceptualisation provided by the Proponent to DoEE on 12 October 2018 (Supplementary information)
7. the draft Groundwater Management and Monitoring Plan – Carmichael Coal Project Revision 3, dated August 8, 2018 (GMMP).
8. the draft Groundwater Dependent Ecosystem Management Plan – Carmichael Coal Mine Project, Version 9 dated 5 July, 2018 (GDEMP)

This document provides an assessment of how the methodology and rationale for each draft research plan addresses Q1a and Q1b. This assessment relied on the draft plans, the statement of claims about the springs source and additional information about the conceptualisation, including some studies undertaken since the time of approval. Other references are included as in-text citations and in the reference list provided.

### a. Advice on the draft research plans

In general, the draft research plans provide approaches to address some data gaps and areas of uncertainty about the source of the Doongmabulla Springs Complex and the hydrogeological characteristics of the Rewan Formation. However, they will not address the differing hydrogeological conceptualisations or potential uncertainties outlined above in the 12 month work programs specified in the plans. The plans provide a number of techniques and methods to address their aims; however they are poorly referenced, and generic in nature. The draft research plans lack the specificity required to assess if the methods are appropriate given the known geological and hydrogeological characteristics of the Carmichael Coal Project area, and the different components of the

conceptualisations being tested. Both plans also set out to confirm the proponent's preferred conceptualisation, as opposed to seeking to collect data and information with which to develop and evaluate multiple conceptualisations. Some inconsistencies between the documentation also exist, such as differing maps between plans.

## 2. Based on the information currently available, how plausible and reasonable is it that the Clematis Sandstone is the source aquifer for Doongmabulla Springs Complex?

It is plausible and reasonable that the Clematis Sandstone is a major source aquifer for the Doongmabulla Springs Complex (DSC). This is supported by water level and groundwater flow information presented by the proponent, as well as by other studies (Evans et al., 2018; Fensham et al., 2016; JBT Consulting, 2015), and by some aspects of hydrogeochemistry of the springs and the Clematis Sandstone (Fensham et al., 2016; Webb et al., 2015). It is not plausible and reasonable to state unequivocally that the Clematis Sandstone is *the* sole source aquifer for the DSC, as sufficient uncertainty surrounding hydrogeochemistry, inter-aquifer connectivity and groundwater flow (Currell et al., 2017; Lewis et al., 2018; Webb et al., 2015) exists to necessitate a precautionary approach to the conceptualisation, as ruled by Land Court of Queensland (2015). Evidence provided in the GABSRP supports the conceptualisation that the Clematis Sandstone is a source aquifer, but there is enough uncertainty around the information provided, as acknowledged by the Proponent, to necessitate a robust assessment of potential alternative or additional source aquifers. In addition, and as summarised below, the body of existing evidence available in the public domain shows that there is ambiguity in the source aquifers of the Doongmabulla Springs Complex (Currell et al., 2017; Evans et al., 2018; Fensham et al., 2016; Land Court of Queensland, 2015; Lewis et al., 2018; Webb et al., 2015; Webb, 2015). Addressing the spring source aquifer question relies mostly on the work proposed under the GABSRP, with locally specific application of the RFCRP also important.

## 3. How adequately do the methods and techniques put forward in the research plans address uncertainties?

The GABSRP aims to investigate and evaluate the source of water feeding the DSC. The RFCRP aims to evaluate the presence, extent, and influence of various structural and stratigraphic characteristics of Rewan Formation and how these may influence the behaviour of that unit with respect to allowing interconnection between overlying and underlying units. The GABSRP and RFCRP present programs of work that extend over 12 month periods. Some of the data collection has already been undertaken, while some of the work will include collection of new data. The methods and techniques proposed in the GABSRP and the RFCRP include:

9. Geological mapping
10. Geophysical processing and interpretation
11. Reprocessing and reinterpreting historical seismic reflection data
12. Possibly using other existing geophysical data (e.g. regional magnetic data) to inform seismic interpretation

13. Geological data analysis
14. Lithofacies analysis including petrophysical analysis
15. Fault modelling
16. Juxtaposition analysis
17. Shale gouge and fault membrane seal analysis
18. Fault leakage analysis
19. Hydrogeological data analysis
20. Hydrogeological parameter testing and analysis
21. Groundwater level and pressure analysis
22. Hydrochemistry

The methods and techniques proposed will provide information and data to allow for evaluation of the potential for hydrological connectivity pathways to transect the Rewan Formation. The main pathways that the geological and geophysical techniques seek to evaluate are direct interconnection of the Upper Permian units and the Clematis Sandstone via fault offsets. Another model by which the Rewan Formation can provide preferential flow pathways is via physically connected zones of higher permeability materials, such as connected sandstone bodies, small offset faults and fractures, or combinations of these. The methods and techniques proposed in the RFCRP will provide additional data and reduce uncertainty in the understanding and conceptualisation of the hydraulic behaviour of this unit. For the GABSRP, some aspects of the general approach, such as water level mapping, geological mapping and hydrogeochemical analysis are sound, however not enough detail on some methods is provided to adequately assess how these will address uncertainty in the springs conceptualisation. There are areas of both plans that will not provide the necessary information to inform GMMP or Groundwater Dependent Ecosystems Management Plan in a timely manner.

In general, the groundwater monitoring network shown in documents supplied is not well suited to monitor potential mining-related effects to the springs or to determine Rewan Formation connectivity. In order to adequately monitor changes that may result from mining, the Clematis Sandstone requires installation of several additional monitoring bores, in particular south of the Carmichael River along the strike of the tenement and to the west of the springs. Land Court of Queensland (2015) specified that monitoring must be undertaken in all units across and adjacent to the mine site to confirm groundwater flow patterns and monitor drawdown. The bore distribution shown in the GMMP does not meet this requirement, most notably to the west of the mine site. Given that groundwater is interpreted to flow from the west (Appendix C, GMMP; Evans et al., 2018), it is important that monitoring bores be located in all units to the west of the mine. Locating monitoring bores to the west will also allow for data collection pertinent to springs source aquifer identification and characterising the ability of the Rewan Formation to prevent impact propagation to springs.

There is limited groundwater monitoring of the hydrostratigraphic units below the Clematis Sandstone (Dunda Beds, Rewan Formation and Permian units) outside of the tenement. These are the units that are modelled to be most affected by mine dewatering which could pose a potential risk to the springs, in the event that these aquifers contribute discharge or are hydraulically connected to the springs (Land Court of Queensland, 2015).

Ideally, the Clematis Sandstone monitoring sites would include nested monitoring wells for other underlying and overlying units. These sites would provide water level and pressure data and stratigraphic and parameter information to help to calibrate the numerical groundwater model and

could also be used as early warning sites for the springs, particularly where groundwater pressure reductions at the monitoring bores exceed modelled drawdown predictions.

Additional monitoring bores below the base of Clematis Sandstone would also help to answer the question about the source(s) of the DSC by providing additional hydrochemistry and water level data to compare with springs values. Additional drilling in the Rewan Formation and underlying Permian units could enable collection and analysis of further information on hydraulic conductivity.

## a. Spring source

The GABSRP identifies the source aquifer of the DSC (hypothesis 1) as a key uncertainty associated with preventing predicted ecological impacts to the springs from the Project. The Proponent has assessed the potential risks arising from this uncertainty in the following way:

1. The Clematis Sandstone is the source aquifer for the Doongmabulla Springs Complex – **Medium risk** to the DSC if the source aquifer is below the Rewan Formation under the alternate scenario, which would lead to an increase in impact to the springs (high consequence), but is considered by the Proponent to be unlikely (low likelihood).

The information provided and available in the public domain indicates that it is both plausible and reasonable that units other than the Clematis Sandstone, including below the Rewan Formation may be a source aquifer for the DSC. If these other units are providing flow to the DSC, then this would lead to an increase in impacts to the springs (high consequence) and is considered plausible (medium likelihood) – **High risk**.

The Proponent's conceptualisation of the DSC is that all of the springs from the Moses, Joshua and Little Moses groups are likely to be fed by groundwater sourced solely from the Clematis Sandstone aquifer which, in the case of most of the springs, discharges through the overlying Moolayember Formation and/or Quaternary alluvium. Under this model, the springs associated with outcropping sandstone are conceptualised as gravity-fed outcrop springs. These outcrop springs are located on the Dunda Beds and the Clematis Sandstone to the east of the spring groups covered by the GABSRP. The springs the Proponent includes in the DSC are predominantly interpreted as discharge springs. For the discharge springs to remain active, sufficient artesian head (i.e. pressure) in source aquifers such as the Clematis Sandstone is necessary to provide upward flow through the overlying Moolayember Formation or alluvium, which has been eroded where Carmichael Creek and Bimbah Creek converge (Fensham et al., 2016; Lewis et al., 2018).

An alternative spring source conceptualisation is also plausible based on available evidence. Webb (2015) proposed that the springs are sourced in part from the Colinlea Sandstone, via preferential upward leakage through the Rewan Formation and Dunda Beds. The Colinlea Sandstone is one of the units that will be actively dewatered during mining operations at Carmichael.

The main objective of the GABSRP is to confirm the hypothesis that the DSC is sourced from the Clematis Sandstone. However, previous investigations have concluded that there is ambiguity in the source aquifers based on currently available data. These studies agree that for the springs west of Little Moses (i.e. the discharge springs) the Clematis Sandstone is the likely primary source aquifer, based on the geology and groundwater potentiometry at these springs. However, it is unclear if the Clematis Sandstone is the sole source aquifer for these springs (Currell et al., 2017; Fensham et al., 2016; JBT Consulting, 2015; Lewis et al., 2018; Webb, 2015). For the outcrop springs (including Little Moses), based on descriptions in Fensham et al. (2016) it is more likely that the springs are water table fed, and that local geological units are the source aquifer (the outcropping Clematis Sandstone

and Dunda Beds). Despite relying in part on descriptions of the DSC provided by Fensham et al. (2016), the Proponent does not include all of the spring vents mapped in that study within their definition of the DSC. This results in a disparity whereby the GABSRP seeks to assess approximately 80 vents, whereas Fensham et al. (2016) mapped 187 vents forming 160 separate wetlands. The reason for this discrepancy may be due to the updated state of knowledge between the approval of the mine and the work of Fensham et al. (2016). The GABSRP does not propose to investigate outcrop springs. In addition, the hydraulic interplay between the underlying hydrogeological units and the alluvium on the springs needs to be considered. To determine potential impacts on the springs and address requirements for mitigation measures, and given that there are a variety of spring types in the DSC, conceptual models for each spring type need to be developed and tested, and a detailed water balance will also need to be prepared.

An integrated analysis of existing and newly acquired geological, hydrodynamic and hydrochemical data would improve the conceptual understanding of the groundwater sources of the DSC.

Regarding geological interpretations, the Proponent states:

*“Based on geological mapping, the source aquifer for the DSC is thought to be the Clematis Sandstone and/or the underlying Dunda Beds....Detailed mapping of faults around the area of the springs has not been undertaken.” (GABSRP pg 40)*

Regarding hydrodynamic analysis, the Proponent states:

*“Although the available data supports the concept of the Clematis Sandstone being the spring source aquifer, there is a lack of groundwater head data in other potential source aquifers beneath the springs, such as the Dunda Beds or even deeper Permian strata, from which to rule other sources out. On the basis of the available head data therefore, it is not possible to categorically rule out other aquifers besides the Clematis Sandstone as potentially contributing to spring discharge at the DSC.” (GABSRP pg 41)*

Regarding hydrochemical analysis, the Proponent states:

*“The studies associated with the EIS and SEIS did not directly compare the groundwater chemistry of the DSC with that of the Clematis Sandstone or other potential source aquifers. As such, based on the current hydrochemistry data, it is not possible to categorically rule out other aquifers besides the Clematis Sandstone as potentially contributing to spring discharge at the DSC.” (GABSRP, pg 41)*

Based on these three statements and until such time as more data is provided in the research and management plans, the conceptualisation whereby the Clematis Sandstone is recognised as the sole source aquifer is not the only reasonable and plausible conclusion.

To that end, the assessment of the draft plans with respect to addressing uncertainty in the source aquifer of the DSC relies on the commitments within the plan to undertake appropriate geological (including structural geology), hydrodynamic and hydrochemical studies.

The GABSRP sets out a timeline and identifies expertise required to undertake the plan, as well as general subjects to be addressed. However, the GABSRP methods lack the required level of specific detail required to adequately assess how they will address the aims of the plan.

## **Geological and geophysical mapping**

The geological mapping approach described in the GABSRP will provide additional information about the regional geology and hydrogeology. The inclusion of geophysical techniques to map distribution

and thickness of the main geological units below surface is warranted, and may create linkages with the RFCRP, and better inform the GMMP. Geophysical data including seismic reflection (original and reprocessed), and airborne magnetics, reveal potential geological complexity at depth which will inform the updated geological knowledge.

More information is required on the extent and scale of mapping, the methods proposed, and the availability of the Proponent's geological models and mapping to inform this work in order to assess how well-suited the approach is to addressing the goals of the research plans. A specific linkage between this work, the GMMP and the RFCRP would provide more assurance that research plans and management plans are based on the same information and conceptualisations. It is unclear what is planned in the "soils survey" mentioned, as there are a variety of types of soil survey. The particular methods and standards, and how they will address knowledge gaps is not provided in the GABSRP, and is an important oversight. In addition, other landscape surveys including high-resolution elevation models and geomorphology, would allow for a better integration between the geology, hydrogeology and springs typology. The plan would benefit by including discussion on the different geological mapping available to demonstrate how the proposed work would address knowledge gaps and discrepancies, such as the disparity between available local (1:100 000 and finer scale), regional (1:250 000), and state wide (1:500 000 and coarser) geological mapping.

### Groundwater pressure

The use of groundwater pressures and head to map flow directions is well supported and is a standard method in hydrogeology at all scales.

Any consideration of groundwater pressure in different aquifers, and associated flows, relies on spatially and temporally representative data. Where a multiple aquifer system is envisaged, as is the case for the DSC, this means that relevant hydrostratigraphic units require representative data. Based on the information supplied in the research plans, no data is being collected or analysed for any units below the Dunda Beds outside the Carmichael mining lease. In addition, no measured groundwater pressure data is available, or planned to be collected west of bore HD03 in units below the Clematis Sandstone. This means that the monitoring bore network is insufficient to resolve potentiometric surfaces in these units up-gradient of the lease, or the DSC. This lack of spatially representative groundwater head data limits scope to reduce the uncertainty of the springs source aquifer or the Rewan Formation connectivity outside of the mining lease. Nested or adjacent bores installed to measure pressure in multiple hydrostratigraphic units are required to adequately assess groundwater pressure as it relates to springs, and also to address data gaps identified in the broader hydrogeological conceptualisation. Based on the information provided, the proposed monitoring network will not be able to provide the required data to improve the evaluation of alternative source aquifer conceptualisations (Currell et al., 2017; Land Court of Queensland, 2015).

A high resolution ground surface elevation model is required to properly assess groundwater pressures in relation to groundwater interaction with the land surface and contributions to and from surface water bodies. Similarly, accurate stream gauging data is required. This also extends to a need for representative spring flow measurements. There is no mention in the draft plans of the elevation model or surveying methods to be used, or whether stream gauging or spring flow measurements will be taken. Bioregional Assessment work (Lewis et al., 2018) has shown the value and utility of using time-series remote sensing data to identify stream reaches that form important components of the springs conceptualisation.

## Hydrochemistry

If undertaken appropriately, hydrochemistry investigations can provide strong supporting evidence of spring source formations. It is '*plausible and reasonable*' that the Clematis Sandstone forms the source aquifer for discharge springs in the DSC, but no hydrochemical evidence is presented in the GABSRP to support this conclusion. The GABSRP confirms that it is not currently possible to rule out contributions to DSC flow from other formations. Similarly, hydrochemistry investigations could provide strong supporting evidence of connectivity through the Rewan Formation.

The hydrochemistry investigations described in the Chemical Analysis subsection of Section 5.1.2 of the GABSRP require revision. For example, there are few cited references to existing analytical techniques. There is insufficient information on the analytical suite and research methodology, and the proposed isotope suite may be insufficient to identify spring source formations. Details of sampling and analysis methods (including Quality Assurance and Quality Control components) are also lacking. The GABSRP and RFCRP (and relevant parts of the GMMP) provide limited detail on the methodology of proposed environmental tracer sampling. The RFCRP lists  $\delta^{18}\text{O}$ ,  $\delta^2\text{H}$ ,  $^3\text{H}$  and  $^{14}\text{C}$  as potential tracers to assess connectivity, evaporation, source, recharge conditions, groundwater mixing and mean residence time. These tracers alone do not cover the range of groundwater residence time scales expected in the groundwater systems under investigation, considering that an older formation (the Clematis Sandstone) is currently proposed as the source aquifer of the springs. Processes operating over timeframes beyond those measured by  $^{14}\text{C}$  should be considered to aid in determining spring source aquifers and characterising groundwater flow in the Rewan Formation. This needs to consider timescales in the order of  $10^5$  to  $10^6$  years. Noble gas tracers which are not influenced by geochemical or water-rock interactions would also aid these assessments by providing valuable information on groundwater flow in and through the Rewan Formation.

The proposed radioactive isotopes are useful in detecting and assessing the processes affecting younger groundwater in a mixed system. However, the draft plans do not consider analysing and assessing older components of groundwater by other radiogenic tracers, such as helium. In a setting such as the DSC, where alternative hypotheses may include groundwater contribution from deeper formations flowing through shallower hydrostratigraphic units via faults and discharging at springs, there is a need to assess the potential mixing of older and younger groundwater. Methane has also been used to successfully identify interaquifer mixing across the Rewan Formation in the Eromanga-Galilee Basin system further to the west (Moya et al., 2016), and is not discussed in the draft plans.

The proposed monitoring bores in the area of the DSC do not include several potential spring source formations. As shown in the GMMP, formation water chemistry can vary spatially. The research plan may therefore not provide data suitable for assessing the source aquifers for the DSC without including monitoring wells in all relevant formations near the spring vent locations.

Although the GABSRP acknowledges that various dissolved species are reactive, there is no commitment to undertake reactive transport modelling or testing of solid formation materials to inform such modelling. While this may not prove necessary, it could be usefully considered. The GABSRP briefly outlines a desktop phase of study that will precede field investigations. It would be useful if this phase was included in the proposed GABSRP to refine the hydrochemistry study components (including the analytical suite, field locations and investigation methods). This would enable review of the hydrochemistry components of the research plan prior to their implementation, as well as identification of key knowledge and data gaps.

Appropriate geochemical characterisation for each potential contributor to spring flow is necessary to identify spring source aquifers. This includes aquifer materials, surface water and groundwater. This type of assessment should consider a broad suite of parameters including but not limited to anions,

cations, trace metals, and isotopes with analytical detection limits at trace levels, including parameters that are commonly associated with coal. This analysis and assessment should involve chemical and isotopic measurements of aquifer formations and springs, as well as alluvium and surface water. This is because most of the springs are located within the footprint of the alluvium and near to Carmichael River and Bimbah Creek. The distribution of mapped spring vents within the DSC could indicate the influence of near-surface geological structures (Fensham et al., 2016). This highlights the importance of considering synoptic baseline surveys of the streams for parameters including, but not limited to, major ions, trace elements,  $^{222}\text{Rn}$ , He and  $\text{CH}_4$  to determine if there is any influence of geological structures in the vicinity of the springs. Geological influence on streams may be identified by anomalies in the distribution of the proposed variables along the stream course, as observed in the Avon River (e.g. Mallants et al., 2018).

Limited groundwater isotopic data are available to support the conceptual model presented in the GABSRP and the GMMP. Any assessment seeking to understand and conceptualise the springs and their aquifer connectivity needs to encompass a wide range of variables to identify which tracers may be useful for long-term monitoring.

Isotope data from the Galilee and Eromanga basins, including  $^{87}\text{Sr}/^{86}\text{Sr}$  data from the hydrostratigraphic units relevant to the Carmichael Coal Project are publically available (Moya et al., 2016). However, these data are not discussed in the documents provided by the Proponent.

## b. Rewan Formation

The GABSRP identifies that thickness and hydraulic properties of the Rewan Formation (hypothesis 2) as a key uncertainty associated with preventing predicted ecological impacts to the springs from the Project. The Proponent has assessed the risk to springs due to this uncertainty as:

2. The thickness and hydraulic properties of the Rewan Formation will prevent significant groundwater pressure reduction from mine site dewatering propagating to the Clematis Sandstone at the DSC – **Medium risk** to the DSC if the Rewan vertical hydraulic conductivity is significantly higher than modelled under the alternate scenario, which would lead to an increase in impact to the springs (high consequence), but is considered by the Proponent to be unlikely (low likelihood).

As described below, it is considered plausible that the thickness of the Rewan Formation is more variable and the hydraulic conductivities are higher than modelled, which means that the alternate scenario would lead to an increase in impacts to the springs (high consequence) and is considered plausible (medium likelihood) – **High risk**.

The characterisation of the Rewan Formation as an aquitard relies mainly on the work proposed under the RFCRP. In addition, work undertaken to inform revisions of the GMMP, including pump testing in 2015 and drilling, downhole geophysical logging, and groundwater level and chemistry monitoring in 2016 are not included in the RFCRP. The structure of the RFCRP is poorly organised and appears focused towards a single conceptualisation of the Rewan Formation as a thick, homogenous aquitard rather than considering a range of conceptualisations. Figure 6 of the RFCRP, presented much later in the plan, provides a well-considered representation of the various potential preferential flow pathways through the Rewan Formation. Information provided by the Proponent shows that the intercepted thickness of the Rewan Formation in drilling varies from 263 m to 337 m, although it is unclear whether the Dunda Beds are considered as part of this unit or not in various documents. At one field location, the Rewan Formation is shown to be 234 m and 306 m thick in two co-located bores (C14206VWP

and C14204VWP respectively). This suggests that the Rewan Formation may show significant variations in thickness at a local scale.

Hydraulic conductivity values used to model pressure reductions in the Clematis Sandstone at the DSC (hypothesis 3) is another key uncertainty identified in the GABSRP associated with preventing predicted ecological impacts to the springs from the Project:

3. Pressure reductions in the Clematis Sandstone at the DSC will be small – **Medium risk** to the DSC if the pressure reduction at the DSC is greater than model predictions under the alternate scenario, which would lead to an increase in impact to the springs (high consequence), but is considered by the Proponent to be unlikely (low likelihood).

This review indicates that it is considered plausible (medium likelihood) that the low vertical hydraulic conductivity values used to model the Rewan Formation and high hydraulic conductivity values used to model the Clematis Sandstone would lead to an increase in impacts to the springs (high consequence) under the alternate scenario – **High risk**. The proposed uncertainty and sensitivity analysis would improve confidence in the groundwater model parameters.

Previous reviews of the Proponent's numerical groundwater modelling have raised concerns about the appropriateness of the hydraulic parameters assigned to the Rewan Formation, as they are lower by up to 5 orders of magnitude than field measurements from the Carmichael Coal project area, and adjacent projects (Currell et al., 2017; Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development, 2013; Webb et al., 2015). In addition, the hydraulic conductivity of the Clematis Sandstone as applied in the groundwater model is potentially too high, based on information provided in the GMMP. The calibrated hydraulic conductivity is 1.55 m/d. The available measured hydraulic conductivities from field tests at two bores where the Clematis Sandstone is confined is 0.01 m/d, and from one field test where the Clematis Sandstone is unconfined is 15 m/d (Table 6, GMMP). The conceptualisation presented in the GABSRP and GMMP for the DSC is that the Clematis Sandstone source aquifer is confined by the Moolayember Formation. Using a higher conductivity in the model than shown by the limited field data allows the lateral transfer of water and minimises the drawdown. The sensitivity analysis of the groundwater modelling by the proponent shows that the high hydraulic conductivity of the Clematis Sandstone limits drawdown at the DSC. This analysis also shows that drawdown is equally sensitive to the conductivity of the Clematis Sandstone as it is to the Rewan Formation. It is unclear how any data or information obtained through the GABSRP or RFCRP will be incorporated into model reviews or updates, despite both plans being linked to the GMMP and GDEMP.

Analysis, interpretation and collation of all existing geological data proposed in the RFCRP are appropriate for this type of study. A good approach to geological analysis includes detailed facies analysis, and explicit commitments to incorporate exploration geological modelling and mapping. The outcome of these work packages is unclear, however a three dimensional geological model, including geological structures and lithofacies variation would provide extremely valuable information to underpin any hydrogeological conceptualisation, including the characteristics of the Rewan Formation. How any detailed site-based geological modelling is extrapolated off site, or incorporated in regional exploration models is not discussed in the RFCRP. The detailed assessment of the material properties and hydraulic behaviour of faults at a localised scale is an appropriate approach, but needs to be further refined to incorporate these findings with the rest of the RFCRP and the GMMP as a whole. Future updates to numerical modelling will include relevant parameters such as updated recharge estimate and hydraulic conductivity values, acquired where not currently available. The specific application of fault seal and shale gouge analysis requires clarification, with reference to relevant applications. Any characterisation of potential connectivity pathways through the Rewan Formation

should consider other pathways, such as increased fracturing localised around fold hinges, in addition to pathways via faults. Structural and geological analysis of the kind presented in the draft RFCRP is predicated on the availability of appropriately detailed geological mapping and modelling over the area of interest. It is unclear how the required geological data to do the type of analysis planned is going to be acquired to the west of the mine lease area.

Reprocessing historical seismic reflection data, as proposed, has been previously been undertaken by different parties (Comet Ridge Limited, 2015; QER Pty Ltd, 2013). Both reprocessing efforts reported good outcomes for the target depths, below the Rewan Formation. Reprocessing and reinterpretation was successful for these deeper units, with poor resolution of units above the Permian coal seams. Faulting within the Rewan Formation, and across the Betts Creek Beds was identified on lines 82-23, 25 and 27 (Velseis Processing Pty Ltd, 2010). These lines are proposed to be reprocessed. Velseis Processing Pty Ltd is the nominated geophysical reprocessing company in the RFCRP. Given the difficulties in resolving the early time portion (which equates to the shallower depths) of the historical seismic data, it is unclear how further reprocessing will add value. The orientation of historical seismic lines proposed for reprocessing are optimally oriented to test certain structural geometries, at the expense of testing others. This may bias the structural interpretation due to the potential orientation of some features. The Proponent makes reference to "high quality 2D seismic" data available from within their lease. These data are vital to assessing the facies and structural aspects of the Rewan Formation. Interpretation is limited by the resolution of seismic data used, and it is not apparent what the resolution of the seismic data to be reprocessed will limit this analysis to. Fensham et al. (2016) specifically recommended high resolution seismic reflection surveying adjacent to the Doongmabulla Springs as "...an appropriate technique to reveal structural weakness within the Rewan Formation down to depths of about 500 m". Figure 3 of Currell et al. (2017) presented part of an interpreted seismic line acquired by the Proponent in 2011, but this is not included in the RFCRP. This line is northeast of the DSC, and on the Carmichael mining lease. It shows a possible fault structure extending from the Colinlea Sandstone upwards through the Rewan Formation into the overlying units. This structure suggests that potential pathways for aquifer connectivity of these hydrogeologic units across the Rewan Formation do exist. Additional seismic data acquisition may be warranted, given the data quality issues that may affect reprocessing historical data outlined above.

There is considerable overlap between the proposed GABSRP and RFCRP approaches to hydrochemical data analysis. More cross-referencing between the two research plans is required. As for the GABSRP, the RFCRP does not include adequate referencing of published material relating to proposed methods. The RFCRP does not stipulate a full analytical suite or fully outline how data will be analysed. Sampling and analysis is not proposed for all formations that may interact with the Rewan Formation. It is unclear why certain formations are not included in the analysis when they may provide useful information on groundwater flows across the Rewan Formation, such as the underlying Permian units in the vicinity of the DSC and off-lease, or the alluvium. The distribution of monitoring bores is particularly important since the GMMP shows that groundwater chemistry can vary spatially within the same hydrostratigraphic unit. The proposed monitoring locations may not supply the required information on connectivity because different formations are monitored in different plan locations. In this instance, assumptions may need to be made on groundwater evolution along flow lines which increases uncertainty. Drilling proposed to test hydraulic connectivity across geological structures needs to be appropriately oriented. If vertical drilling is used, geological structures may not be intersected, or the intersections may not allow adequate testing. Inclined drilling allows structures to be intersected, and hydraulic testing to be undertaken in a more controlled fashion. The draft plans do not specify if any drilling will be non-vertical. Details of sampling and analysis methods (including quality assurance, quality control and field parameter measurements) are lacking.

Whereas the GABSRP includes some discussion of work undertaken since initial drafting (e.g. Fensham et al., 2016), the RFCRP does not. Additional drilling planned for 2014-2015 is mentioned, however not discussed in detail. This work forms the basis of the URS (2016) report, and should be included in the summary of existing work.

## 4. Ecological impact prevention, mitigation and remediation

The GABSRP identifies three key uncertainties (4a, 4b, 4c) associated with preventing predicted ecological impacts to the springs from the Project. For uncertainty related to water pressure variability in the Clematis Sandstone, the Proponent concludes:

- 4a Natural groundwater pressure fluctuations in the Clematis Sst are greater than the predicted pressure reduction resulting from the Project – Very Low risk to the DSC associated with the natural groundwater pressure fluctuations in the Clematis Sst at the DSC being smaller than the predicted groundwater pressure reduction from the Project, which would lead to a reduction in impact to the springs (low consequence), but is considered by the Proponent to be unlikely (low likelihood).

While this assumption is reasonable in the case of groundwater-dependent terrestrial vegetation that can adapt their rooting depth to accommodate fluctuations in groundwater levels, it is not a reasonable assumption for springs, where the cumulative impacts of natural fluctuations in addition to predicted drawdown may mean that groundwater levels fall below spring vent elevations, leading to springs that stop flowing for extended periods. Therefore, this alternate scenario could lead to an increase in impacts to the springs (medium consequence) that is considered plausible (medium likelihood) – **Medium risk**.

Inconsistent groundwater levels, fluctuations and broken links in this section of the report make it difficult to assess the veracity of the analysis. Of note, maximum groundwater levels in bore C14012SP assigned to the Clematis Sandstone and located nearest to the Joshua Springs is reported as 249.5 mAHD in the text on page 40 and 242.73 mAHD in Table 4.1 of the GABSRP. In comparison, the ground elevation at Joshua Springs is approximately 246 mAHD (page 40). Maximum natural fluctuations reported in Table 4.1 – Groundwater level monitoring summary of the GMMP are 0.5 m, not 1.01 m as cited on page 43. The magnitude of natural fluctuation that can be tolerated is unclear.

The Proponent assesses the level of risk to the DSC from reduced flow (hypothesis 4b) as:

- 4b. Small predicted impacts to source aquifer pressure will result in small fluctuations in the spring wetland water balance – **Low risk** to the DSC associated with the small predicted reductions in aquifer pressure at the DSC resulting in a higher than anticipated effect on the wetland water balance, which could lead to an increase in impact to the springs (medium consequence), but is considered by the Proponent to be unlikely (low likelihood)

Again, the cumulative impacts of natural fluctuations in addition to predicted drawdown may mean that groundwater levels fall below spring vent elevations, leading to springs that stop flowing for extended periods. Therefore, this alternate scenario could lead to an increase in impacts to the springs (medium consequence) and is considered plausible (medium likelihood) – **Medium risk**.

The proposed wetland water balance approach does not consider the special circumstances associated with springs, where the difference between vent elevation and groundwater pressures drives flow into the springs. No details are provided for how to measure these indicators in the field or

how field measurements will reduce uncertainty associated with the predicted impacts. A number of copy and paste errors occur in Table 5.1 of the GABSRP. The critical question of spring vent elevation relative to minimum predicted groundwater levels is not addressed. Further, the proposed actions do not look to test or improve the conceptualisation or magnitude of modelled groundwater discharge described on p 48 of the GABSRP.

With regard to the ability of the ecosystem being able to adapt to changed flow conditions in the event of any impact to the wetland water balance for the DSC (hypothesis 4c), the Proponent assessed that:

- 4c. The Ecological community of the DSC are already adapted to the small fluctuations in the wetland water balance – **Medium risk** to the DSC associated with the ecological community not being able to tolerate small fluctuations in the spring wetland water balance, which would lead to an increase in impact to the springs (high consequence), but is considered by the Proponent to be unlikely (low likelihood)

An alternative assessment based on other information (discussed below) is that the ecological community is unable to tolerate small fluctuations in wetland water balance, which would lead to an increased impact at the springs (high consequence), however ecological resilience research indicates that the alternate scenario is unlikely to occur (low likelihood) – **Medium risk**.

The proposed Baseline springs survey program draws on recent research from Queensland Office of Groundwater Impact Assessment and the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development and is considered adequate. The Species specific study does not explain how the leaf water potential and stable isotope of water measurements will characterise the environmental water requirements and the resilience of the two EPBC Act listed threatened species found within the DSC (*Eriocaulon carsonii* and *Eryngium fontanum*) with respect to changes in the wetland water balance. Further, it is unclear why the Waxy Cabbage Palm (*Livistona lanuginosa*) that is known to occur at the Little Moses and Joshua Spring Group wetlands (p 33) is not considered in this section.

The GABSRP considers a number of potential measures to mitigate ecological impacts to the springs, including direct recharge – both surface and sub-surface techniques, and indirect techniques developed for the Surat Basin coal seam gas (CSG) operations. This summary is general in nature and favours offsetting potential impacts to groundwater levels by reducing up gradient groundwater use in the Clematis Sandstone, but does not attempt to quantify its effects. No references to the GDEMP or GMMP are provided to support the general qualitative assumptions supporting potential mitigation measures.

The methods and techniques to address uncertainties about the source of the springs and the capacity of the Rewan Formation to prevent impacts to the springs (described above) will strengthen the conceptual understanding, monitoring bore network, hydrochemical and environmental tracer analyses necessary to adequately assess potential mitigation measures. Measures to mitigate or remediate ecological impacts to the springs are not discussed in the RFCRP.

## 5. Concluding remarks

The GABSRP relies on a risk assessment approach to address uncertainties associated with the springs. A similar approach is not undertaken in the RFCRP; however given the links between the

research plans and management plans, it is instructive to address the questions DoEE posed in the context of the GABSRP risk framework.

In their current form, the GABSRP and RFCRP present approaches that will not comprehensively address the uncertainty surrounding the source aquifers of the springs, or the characterisation of the Rewan Formation as an aquitard or leaky aquitard. In order to more fully address these uncertainties, the plans require more comprehensive discussion of the methods proposed, with better reference to other work seeking to address similar questions.

The plans are set out in order to support the assertion that the Clematis Sandstone is the sole source aquifer for the Doongmabulla Springs Complex. The information provided in both plans, as well as in the public domain is clear that uncertainty still exists in this regard. While the Clematis Sandstone may be a principal source aquifer for the springs, based on the information currently available, it is not reasonable to assert that it is the sole source aquifer.

The methods and techniques outlined in the draft plans will provide some information to reduce uncertainty in the source of water feeding the DSC. The methods proposed in the RFCRP will provide some information to evaluate the presence, extent, and influence of various structural and stratigraphic characteristics of the Rewan Formation and how these may influence the behaviour of that unit with respect to allowing interconnection between overlying and underlying units.

There may not be enough information available from existing bores to evaluate the potential connectivity across the Rewan Formation, in particular at and adjacent to the springs to the west of the mine lease. Nested bores are required in order to provide the best information on potential inter-aquifer connectivity, as well as to provide additional data to inform refinement of springs and hydrogeological conceptualisation in areas where this information is sparse.

Further information on the specific methods and techniques to be applied to chemically assess the springs source and groundwater flow processes is required for a more detailed assessment to be made. This includes the need to define the analytical suite, quality assurance and quality control methods, and use of a broader range of isotopic and environmental tracers as outlined above. Incorporation of these amendments would provide necessary descriptions of proposed approaches, as well as the data necessary to address the aim of identifying spring source aquifers.

The approach to ecological impact mitigation based on a risk assessment is heavily reliant on the conceptualisation of springs and Rewan Formation connectivity. Therefore, changes to the conceptualisation based on the outcomes of the research plans may necessitate a change in the risk assessment. Any change in risk ratings would mean that the mitigation approaches would need to be revised.

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# Summary of CSIRO and Geoscience Australia (GA) Advice on Groundwater Management Plans and Response

## Advice on monitoring

### 1. CSIRO and GA recommended that Adani:

- a. Install more bores to monitor the deeper groundwater units in the central zone between the mine and the Doongmabulla springs. Installing these bores at existing points would remove any significant access issues, and would enable comparison to existing data.

**Action:** The Department required that Adani install additional deeper bores at existing sites (condition 3a/iii/6b) and collect suitable baseline data (condition 3b) at these sites.

**Response:** Adani have committed (refer section 7 of the GMMP) to install deeper bores at, or within 500m of, three existing monitoring locations in the central zone. These bores will not monitor all of the deeper units. Adani will investigate drilling bores into deepest units where coal occur for monitoring and research purposes. These commitments have also been referenced in the GDMP (see sections 4.3.2 and 8.8).

- b. Include stream flow gauging upstream and downstream of the mine area in their ongoing monitoring program, with updated height-discharge surveys

**Action:** The Department required more precise gauging locations and commitments for future height-discharge surveys in the GDMP (condition 6b).

**Response:** Adani have committed in the GDMP to install an additional 3 gauging locations, in addition to the two existing locations, and further surveys to determine height-discharge relationships (see section 6.6.1).

- c. include a more sophisticated statistical analysis of hydrochemistry data to constrain the source aquifer(s) of the Doongmabulla Springs. This includes assessing a wider variety of groundwater and surface water parameters.

**Action:** The Department required clarity on these methods, which are a requirement of research under the *Great Artesian Basin Springs Research Plan (GABSRP)* at condition 25e and rely on installation of additional nested bores to the west of the site.

**Response:** Adani will address this issue in revisions to the GABSRP.

## Advice on management

2. The limitations of the numerical groundwater model mean that drawdown could be under-predicted, so the adopted thresholds and triggers will be reached sooner than anticipated and are not a suitable foundation for the proposed monitoring and management approaches.

**Action:** The Department required that Adani adopt a more conservative approach to monitoring and management until the model is reviewed within two years of the first box cut (or first extraction of coal). For example, more conservative measures might include:

- Monitoring additional parameters, e.g. spring flow / flux, in addition to groundwater level and pressure;
- Committing to a particular mine plan or number of tonnes of coal; and/or

- Applying rate-based triggers for more bores to verify model predictions and to other GDEs to ensure they are protected.

**Response:** Adani has:

- included monitoring of spring flow under the GDEMP (refer section 8.7).
- not committed to a scaled-down mine plan, but has included further details about the proposed mine plan for the first five years of operations in the GMMP (refer section 2.6 and Appendix B).
- committed to investigating any drawdown rates that are faster than predicted as per standard practices at model review and update (see section 5.3.5.2 of the GMMP).

3. The proposed monitoring and management approaches do not sufficiently address the uncertainty regarding potential alternative or additional source aquifers of Doongmabulla Springs. Recommendations to address this uncertainty include: the installation of monitoring bores between the mine and the Doongmabulla springs, streamflow gauging and a more sophisticated statistical analysis of hydrochemistry data as described under item 2 above.

**Action:** The Department required that Adani address the actions under item 2 and commit to apply triggers and limits for the additional nested bores to the west of the site. These triggers must be based on baseline condition (condition 6f).

**Response:** Adani has addressed the advice under item 2 and committed to apply triggers and limits to the additional nested bores in the GMMP (see section 7). The revised early warning triggers and impact thresholds will be submitted to the Department for approval as part of review of the GMMP. The Department will ensure that these triggers and limits are set to ensure the protection and long-term viability of the Doongmabulla Springs Complex.

4. CSIRO and GA advice on the design of water level thresholds and triggers included that:

- a. All monitoring locations for which water level thresholds are defined should also have drawdown rate limits derived. Evaluation of drawdown rate limits should form part of routine monitoring data assessment and be included in the Impact Threshold Assessment approach.

**Action:** The Department required that rate limits are applied for both the Carmichael River and the Doongmabulla Springs in the GDEMP, based on the requirement for early-warning triggers at these GDEs (condition 6f), not all bores.

**Response:** Early warning triggers have been included in the GDEMP for both the Carmichael River and the Doongmabulla Springs (see Appendix B).

**Action:** To account for model limitations, and likely underpredictions, the Department required that Adani apply drawdown rate limits until the model is reviewed within two years of the first box cut.

**Response:** Adani has committed to investigating any drawdown rates that are faster than predicted as per standard practices at model review and update (see section 5.3.5.2 of the GMMP).

- b. A bore in the alluvium, 'C025P1', has been dry during the baseline monitoring period and should not be used as a threshold monitoring point.

**Action:** The Department required that a trigger not be set at C025P1.

**Response:** Adani has committed in the GMMP (see section 7) that bore C025P1 will be replaced. In the interim, if bore C025P1 is dry, or has no water level readings longer than 6 months, the trigger will be exceeded (section 5.3.3.1). This trigger is cross-referenced in the GDEMP Appendix B.

5. CSIRO and GA provided advice to improve the investigation procedures. Recommendations included that the GMMP:

- a. Explicitly state that the Commonwealth regulator will be notified whenever a groundwater exceedance occurs

**Action:** The Department required that Adani commit to notify the Department whenever a groundwater exceedance occurs

**Response:** Section 4.7.2.2 of the GMMP now states: The administering authority will be notified when an investigation is to be instigated for both groundwater quality and levels.

- b. Commit to a maximum timeframe in which the investigation will be completed (for example three months).

**Action:** The Department required that Adani specify a timeframe in which a groundwater exceedance investigation will be completed.

**Response:** Section 4.7.2.2 of the GMMP now states: If the groundwater level thresholds exceedance is because of authorised mining activities, the investigation will be prioritised and, depending on the nature of the impact, completed within three months.

- c. Provide details of the process to remove non-mining influences will occur during investigation of threshold exceedances.

**Action:** The Department required upfront details of these investigations so when there is an exceedance it can be assigned to the cause.

**Response:** Adani has provided further details of the trend analysis that will be undertaken in the GMMP (section 4.7.2.2) , which will include assessing at least 12 months of groundwater data for the bore and comparing it to climate data, nearby bores, other local projects and assessing the potential for cumulative impact.

- d. Present mitigation actions in the GMMP itself

**Action:** The Department required that mitigation actions be summarised within the GMMP to address condition 3d, rather than just references to mitigation in other plans.

**Response:** The GMMP (section 4.7.2.2) uses examples of mitigation actions in response to an exceedance, including:

- review of the mine plan (including sequencing of mining);
- limiting thickness of extraction of coal seams and reviewing extraction of multiple coal seams for the underground longwall mining; and
- freezing mine development at current levels until the completion of investigations and assessments which conclude that further development will not exceed approved impacts.

6. CSIRO and GA provided advice on the design of water quality thresholds and triggers

**Action:** The Department notes that water quality triggers and limits are not a requirement of the EPBC conditions of approval. This advice will be provided to DES for their information.

**Response:** Not applicable for the groundwater management plans under EPBC conditions.

## Advice on modelling

7. The review found that the numerical groundwater model used by the GMMP is the most conservative of the model scenarios available. However CSIRO and GA do not consider the model fit-for-purpose for achieving the outcomes sought by the conditions of approval, and have provided recommendations, including:
- a. fixing identified errors in the bore heights used to calibrate the model, explaining how they have changed over time and how these changes affect model prediction and performance
  - b. using locally-appropriate parameters (which dictate how water moves through the model layers) to represent the Carmichael River, Rewan Formation and Clematis Sandstone, and subsidence above longwall mining
  - c. recalibrating the model using the revised information in (a) and (b), using the baseflow in the Carmichael River as a target to ensure it produces realistic values
  - d. global sensitivity analysis and uncertainty analysis to determine the full range of likely impacts and the influence of each parameter and
  - e. validating the model based on data from new bores drilled since approval of the mine.

**Action:** The Department required that Adani commit in the GMMP and GDMP to these updates as part of the model review required within two years of the first box cut under Queensland's EA.

**Response:** Adani have committed to address the limitations identified by the CSIRO and GA review in the groundwater model re-run - see section 7 of the GMMP and section 4.3.2 of the GDMP.

Published on DES Disclosure Log  
RTI Act 2008

**Date :** 11/04/2019 4:43:12 PM  
**From :** "VAN DER LAAK Vivienne"  
**To :** "MERRICK Jamie" , "LAWRENCE Rob"  
**Subject :** Registers

Hi Jamie and Rob

Relevant sections and link to published GDEMP below.

Please let me know if you need anything else.

Viv

Relevant sections:

**Environment Protection Act 1994:** <https://www.legislation.qld.gov.au/view/html/inforce/current/act-1994-062>

540: Registers to be kept by administering authority

- 540(1)(eb)(i)
- 540(1)(k)

542: Inspection of Registers

**Environment Protection Regulation 2008:** <https://www.legislation.qld.gov.au/view/html/inforce/current/si-2008-0370>

112: prescribed information for relevant monitoring programs

**GDEMP on Website**

<https://www.adaniaustralia.com/-/media/Project/Australia/Our-Projects--Businesses/mine-environment-reporting/GDEMP-Final-V11b-19March2019.pdf?la=en&hash=C4988A8485428FD234C4A09023D08B34>

Published on DES Disclosure Log  
RTI Act 2009

12 April 2019

**Private & Confidential**

Mr Jamie Merrick  
Director-General  
Department of Environment and Science  
Queensland Government  
400 George Street  
Brisbane Qld 4000

*By email: [jamie.merrick@des.qld.gov.au](mailto:jamie.merrick@des.qld.gov.au)*

Dear Jamie

### **Adani Mining Pty Ltd – Groundwater Management Plans**

We refer to our previous correspondence and meetings in relation to groundwater management plans, in particular the Groundwater Dependent Ecosystems Management Plan (**GDEMP**) for Adani Mining Pty Ltd (**Adani**).

Given the Department's continued refusal to provide certainty of process and timing, we thought it important to clarify our understanding of accepted and established practice as it pertains to the assessment of environmental management plans. Consequently we have outlined both what constitutes accepted and established practice in addition to detailing relevant legal requirements as they relate to the process which needs to be followed by the Department for approval of the GDEMP.

### **Purpose and intent of environmental management plans**

1. It is fundamental that consideration of the GDEMP occurs within the context of the purpose and intent of environmental management plans. It is the following principles which have governed our work on the GDEMP alongside your Department for over two years and it is this purpose and intent which must therefore inform the decision on approval of the GDEMP. In particular:
  - a. The role and function of environmental management plans is to facilitate the adaptive management of any project's environmental impacts over the project life as described below;<sup>1</sup>
  - b. The Department is not constrained to a binary role of only giving projects either a green light or a red light, instead environmental management plans enable a

<sup>1</sup> See, for example, Gregory R, Ohlson D and Arvai J, "Deconstructing Adaptive Management: Criteria for Applications to Environmental Management" (2006) 16(6) Ecological Applications 2411 at 2411

more sophisticated regulatory approach and one more suitable for regulating the environmental impacts of large and complex projects;<sup>2</sup>

- c. The concept of 'adaptive environmental management' means that, as a complex project proceeds, its environmental impacts can be carefully and continuously monitored and, if monitoring results show impacts above a certain trigger level for particular environmental values, the reasons for that are investigated and reported and the future development of the project may have to be adjusted in an appropriate way well before the project can cause irreversible impacts to those environmental values.<sup>3</sup>

2. With those key principles in mind this means:

- a. An environmental management plan is not a static 'sub-approval' for a project but rather a dynamic, adaptive tool which, in the case of groundwater (as is the case with our GDEMP), is used by a project proponent and a regulator to learn about and understand a groundwater system across the life of a project but without giving the project an unqualified green light at the outset;<sup>4</sup>
- b. We, as the project proponent and the Department, as the regulator, can progressively build a detailed body of knowledge of the groundwater in the area of our project and irreversible impacts to the environment can be avoided.<sup>5</sup>

3. This approach of '*adaptive environmental management*':

- a. Is recognised, endorsed and implemented in Queensland (by your Department)<sup>6</sup>, around Australia and globally by regulators (especially in relation to groundwater systems);<sup>7</sup> and
- b. Is a well understood and advanced scientific and regulatory approach which is the polar opposite of a system which would bluntly prohibit all activity in an area until prior development of a full knowledge bank of every aspect of a

<sup>2</sup> Gregory et al, n 1.

<sup>3</sup> Gregory et al, n 1.

<sup>4</sup> The role and use of environmental management plans have been recognised and considered in leading Australian environmental law cases such as *Blue Wedges Inc v Minister for the Environment, Heritage and the Arts* [2008] FCA 399 and *Lawyers for Forests Inc v Minister for Environment, Heritage and the Arts and Another* [2009] FCA 330

<sup>5</sup> Pahl-Wostl C, "Requirements for Adaptive Water Management" in Pahl-Wosti C, Kabat P and Moltgen J (eds), *Adaptive and Integrated Water Management* (Springer, Dordrecht, 2007) p 4.

<sup>6</sup> See: <https://environment.des.qld.gov.au/management/non-mining/adaptive-management.html>

<sup>7</sup> For example, in New South Wales see: <https://www.environment.nsw.gov.au/research/adaptive-management.htm> and at the Commonwealth level see: <http://www.environment.gov.au/water/coal-and-coal-seam-gas/case-study-adaptive-management>. For references to the application of adaptive environmental management in overseas jurisdictions see articles referenced elsewhere in this memorandum.

relevant groundwater system (which of course, in complex groundwater systems, may never be achieved in any event).

4. In the processes leading to the grant of the primary environmental approvals for the Carmichael Mine, both the Queensland and Federal processes openly utilised the principles of adaptive environmental management including specifically in relation to managing impacts on groundwater. For example:

a. In her hearing of objections to the Carmichael mining lease applications which led to the Carmichael environmental authority being granted, the President of the Queensland Land Court said:

*"The conditions about the GMMP [Groundwater Management and Monitoring Program] will ensure that dewatering of the Springs will be appropriately monitored and mitigated. I consider that the conditions represent aspects of the adaptive management approach referred to in [Telstra Corporation Ltd v Hornsby Shire Council, a leading Australian case on the subject]."*<sup>8</sup>; and

b. Subsequently, in his statement of reasons for approving the Carmichael mine and rail project, the Federal Environment Minister said specifically in relation to the project's likely impacts on water resources:

*"I required an adaptive management approach for mitigation, monitoring, review and offsets to deal with any uncertainties over the proposed 60 year life of the proposed action."*<sup>9</sup>

5. The concept of adaptive environmental management has also been recognised in other Queensland courts and endorsed as "a proper approach to deal with uncertainty as to potential impacts".<sup>10</sup>

6. To illustrate the above in very practical terms, we draw your attention to the groundwater conditions in Schedule E to the Carmichael Environmental Authority (**Carmichael EA**). Those groundwater conditions in the Carmichael EA import key features of adaptive environmental management referred to in the preceding paragraphs. These include requirements for:

a. a Carmichael Groundwater Management and Monitoring Program (**Carmichael GMMP**) to cover 'life of mine' activities;<sup>11</sup>

<sup>8</sup> See *Adani Mining Pty Ltd v Land Services of Coast and Country Inc & Ors* [2015] QLC 48 at paragraph 271. See also more generally paragraphs 268 to 275.

<sup>9</sup> See para. 165 of the Minister's statement of reasons at page 31:  
[http://epbcnotices.environment.gov.au/\\_entity/annotation/45c02035-e672-e511-b93f-005056ba00a7/a71d58ad-4cba-48b6-8dab-f3091fc31cd5?t=1555033795707](http://epbcnotices.environment.gov.au/_entity/annotation/45c02035-e672-e511-b93f-005056ba00a7/a71d58ad-4cba-48b6-8dab-f3091fc31cd5?t=1555033795707)

<sup>10</sup> See *Harris and Another v Scenic Rim Regional Council and Others* [2014] QPEC 16.

<sup>11</sup> Carmichael EA, Condition E4.

- b. Establishment of impact triggers and requirements for monitoring and reporting against those triggers;<sup>12</sup>
- c. Significantly, a requirement to investigate and report on matters where trigger points are reached;<sup>13</sup> and
- d. Where such investigations point to possible environmental harm, a requirement for immediate implementation of measures to reduce potential for environmental harm.<sup>14</sup>

Each of these elements is demonstrative of the application of and adherence to an 'adaptive environmental management' approach by the Department and which Adani are implementing.

7. The GDEMP under the EA must undertake monitoring and research to establish further information pertaining to a range of relevant matters. The GDEMP proposes details of these activities, and approval of the GDEMP is the trigger to commence those activities. There is no support for an interpretation that these activities are to be completed prior to approving the GDEMP. In that scenario, there would be a) no agency oversight of those activities as they would be scoped and completed outside regulatory processes and b) reduced scope, content and need for the GDEMP as the work would be completed. Accordingly, the only reasonable interpretation of the GDEMP conditions is that they are consistent with other conditions in the EA, and by association the EPBC approval conditions in that they:
  - a. Describe forward looking activities and actions, that are undertaken concurrent with project development as part of the implementation of an approved GDEMP;
  - b. Seek to measure actual impacts as they arise in accordance with predicted impacts from the EIS process and are adapted and modified by reference to that data;
  - c. Are undertaken in a manner consistent with the principles of adaptive management and the precautionary principle; and
  - d. Direct ongoing activities and changes to activities to ensure compliance with the conditions of the EA.

### **Requiring the identification of the source aquifer**

Further, in applying those absolutely fundamental principles of 'adaptive environmental management' one aspect of key aspect which has been the subject of our extensive engagement with the Department and apparent conjecture in the media

<sup>12</sup> Carmichael EA, Condition E13.

<sup>13</sup> Carmichael EA, Conditions E3 and E8.

<sup>14</sup> Carmichael EA, Conditions E13 and E15.

are questions related to the source aquifer the subject of the GDEMP. In the context of approval for the GDEMP and specifically in the context of the source aquifer we note:

1. When considering any environmental management plan submitted by a project proponent, a regulator can only approach it in a way that conforms with the principles set out above. To do otherwise – that is, to apply a blunt prohibition pending further studies – would sit illogically alongside an EA which was cast in terms of adaptive environmental management. (EAs containing provisions requiring submission and approval of environmental management plans are, by necessity, created with adaptive environmental management in mind.) In our assessment any such blunt prohibitive action by a regulator would be actionable as an unreasonable exercise of authority to consider and approve a submitted environmental management plan;
2. It would be entirely inconsistent with the principles above, if the Department were to insist a groundwater management plan, including our GDEMP, had to include a commitment to prior development of a full technical understanding of one or more features of a groundwater system (such as identification of a source aquifer or any other parameter of the system) before the project could commence. To do that would run completely counter to the concept of adaptive environmental management hardwired in to the EA<sup>15</sup>;
3. Further to and separate from the above, in the case of the Carmichael GMMP, the regulator's consideration of that plan as submitted by Adani must be handled by the regulator consistently with the relevant condition (condition E4) of the Carmichael EA which is the source of authority for the regulator's approval of the Carmichael GMMP. In particular:
  - a. There is no a condition in the Carmichael EA which supports or necessitates the Carmichael GMMP including prior identification of a source aquifer before mining activities can commence, any insistence on such a requirement, including by the Department, on such requirement would be baseless and outside the scope of the relevant authority; and
  - b. The provisions of Condition E4 of the Carmichael EA set a list of 10 objectives for the Carmichael GMMP. That list is a finite list (the list is not stated in terms of 'objectives including the 10 listed' but rather as setting 10 objectives) and is expressed in a very significant amount of detail. Those 10 stated objectives 'cover the field' of what the Carmichael GMMP needs to achieve. They are the only objectives Adani's submitted Carmichael GMMP needs to meet; and

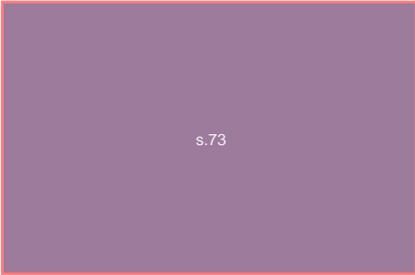
<sup>15</sup> For example, the EA has a number of conditions that require development of forward management and monitoring plans and programs. Within these requirements, are explicit requirements for the inclusion of adaptive management processes, for example the groundwater model review under condition E6; investigation response under conditions E12 and E14; the regular revision and updating of management plans as per conditions F22, I2, I7, I14 and J4.

- c. If any attempt was made to insist that the Carmichael GMMP contains a requirement of prior identification of a source aquifer it is our view that this is not mandated by any of those objectives and any falls outside those 10 objectives in Condition E4 and would be legally invalid.

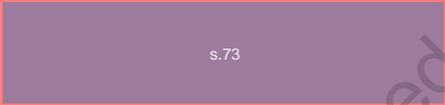
In the context of the above principles and their direct application to the GDEMP and the GMMP it is our expectation that this approach will be followed by the Department and it is reasonable for us to expect that with access to the reports of the CSIRO and GeoScience Australia and the extensive period of consultation to date, that the Department will manage the requisite approval process promptly. Accordingly, we ask again that the Department immediately provide us with clarity as to the next steps to apply these principles and the timing of each step to the approval.

We remain committed to working collaboratively to finalise these plans so that we can get on with the task of delivering thousands of jobs for Queenslanders.

Yours sincerely



s.73



s.73



Department of  
**Environment and Science**

Our Ref: Groundwater Dependent Ecosystem Management Plan

24 April 2019

s.73

Adani Mining Pty Ltd  
Level 25, 10 Eagle Street  
Brisbane QLD 4000

By email: s.73@adani.com.au

### **Groundwater Dependent Ecosystem Management Plan**

Dear s.73

I am writing in regards to your correspondence of 9 and 12 April 2019 about the Groundwater Dependent Ecosystem Management Plan (GDMEP).

This letter responds specifically to your request for clarification of next steps in the approval process for the GDMEP. The Department of Environment and Science (the department) is considering the broader matters raised in your letters, particularly your letter of 12 April 2019, and may respond separately to them.

After requests to both the Commonwealth Department of the Environment and Energy (DoEE) and Adani Mining Pty Ltd (Adani), the department received the following documents on 9 April 2019:

- (a) the independent scientific review of version 10a of the GDMEP and version 5 of the Groundwater Management and Monitoring Program (GMMP) prepared by CSIRO and Geoscience Australia for DOEE (the review);
- (b) version 11b of the GDMEP dated 19 March 2019; and
- (c) version 7 of the GMMP dated 15 March 2019.

The department is presently:

- (a) considering the review findings and recommendations in the context of the updated GDMEP (version 11b) and GMMP (version 7), and may seek further clarification from CSIRO and Geoscience Australia to ensure an accurate understanding of issues raised and recommendations made, as well as how these have been addressed by Adani in the updated plans; and

- (b) assessing version 11b of the GDEMP against the requirements of Adani's environmental authority, which will require consideration of relevant components of version 7 of the GMMP given that the data within the GMMP is fundamental to quantifying the impacts to the groundwater dependent ecosystems and ensuring that the mitigation measures presented in the GDEMP are effective.

As you are aware, these documents, particularly the GMMP, are lengthy and complicated and the department is therefore unable to say precisely when it expects to complete its consideration. However, the department is working as quickly as possible to progress the matter.

Once the department has completed its review of the documents and obtained any necessary further advice from CSIRO and Geoscience Australia, we will inform you if any further information, or changes to the GDEMP, are required in order for the GDEMP to be approved.

Should you require any further information, please contact Juliana McCosker, Manager on telephone (07) 4987 9356 or by email at [Juliana.McCosker@des.qld.gov.au](mailto:Juliana.McCosker@des.qld.gov.au).

Yours sincerely

sch4p4(6) Personal information

Melissa Wells  
**Executive Director**  
**Coal and Central Queensland Compliance**



Department of  
**Environment and Science**

10 May 2019

Dr James Johnson  
Chief Executive Officer  
Geoscience Australia  
Cnr Jerroomberra Avenue and Hindmarsh Drive  
SYMONSTON ACT 2609

By email: [james.johnson@ga.gov.au](mailto:james.johnson@ga.gov.au)

[Redacted] sch4p4( 6) Personal information

Director  
CSIRO Land and Water  
Black Mountain Science and Innovation Park  
Clunies Ross Street  
ACTON ACT 2601

By email: [Redacted] [Redacted]@csiro.au

Dear Dr Johnson and [Redacted] [Redacted] (p4( 6) Personal information)

Thank you for meeting with the Department of Environment and Science (the department) on 16 April 2019 to discuss the CSIRO and Geoscience Australia Report '*Advice on Groundwater Management and Monitoring and Groundwater Dependent Ecosystem Management plans to the Department of the Environment and Energy (CSIRO and Geoscience Australia, February 2019)*' (the 2019 Report).

Following the department's review of the 2019 Report, the department wishes to seek your advice about the type of investigation and research that may provide greater certainty regarding the department's interest in relation to the identification of the source aquifer(s) to the Doongmabulla Springs Complex (DSC).

The environmental authority (EA) for the Carmichael Coal Mine requires Adani to develop and implement a Groundwater Dependent Ecosystems Management Plan (GDEMP). The term GDEMP is defined in the EA and states, among other things, that a GDEMP must include '*detailed baseline research to establish the source aquifer(s) for groundwater supply to each groundwater dependent ecosystem [potentially or indirectly impacted by mining activities]*'.

Your 2019 Report states that:

*'It is plausible and reasonable that the Clematis Sandstone is a major source aquifer for the DSC... It is not plausible and reasonable to state unequivocally that the Clematis Sandstone is the sole source aquifer for the DSC...'* (p2); and

*'Available evidence supports the conceptualisation that the Clematis Sandstone is a likely source aquifer for the DSC. However, the proposed monitoring and management approaches do not sufficiently address the uncertainty regarding the potential alternative or additional source aquifers (refer Section 3.2 and 3.3).'* (p9); and

*'To constrain the source aquifer(s) of the DSC, a more sophisticated statistical analysis of hydrochemistry data is required. This includes assessing a wider variety of groundwater and surface water analytes, as well as appropriate use of isotope hydrochemistry analysis. Further information on potential techniques is provided (CSIRO and Geoscience Australia, 2018) and other readily available references.'* (p10)

Further, in advice given to the Commonwealth Department of the Environment and Energy, 'Advice on draft research plans to the Department of the Environment and Energy', dated November 2018, you state:

*'An integrated analysis of existing and newly acquired geological, hydrodynamic and hydrochemical data would improve the conceptual understanding of the groundwater sources of the DSC'. (at page 5); and*

*'Further information on the specific methods and techniques to be applied to chemically assess the springs source and groundwater flow processes is required for a more detailed assessment to be made. This includes the need to define the analytical suite, quality assurance and quality control methods, and use of a broader range of isotopic and environmental traces...'* (at page 13).

Having regard to the 2019 Report, the 2018 advice, and our meeting of 16 April 2019, the department has the understanding that the following further research (steps) would improve the certainty about the source aquifer(s) of the DSC and other groundwater dependent ecosystems:

1. hydrogeochemical analysis of water samples for comparison within and across relevant aquifers (Clematis Sandstone, Dunda Beds and Rewan Formation);
2. incorporation of the use of isotope and ageing tracers in the above hydrogeochemical analysis;
3. a comprehensive review of groundwater level and quality data from relevant aquifers including data from new proposed nested bores in the vicinity of DSC;
4. detailed geological mapping including cores from bores drilled in the vicinity of DSC and facies modelling to better inform hydraulic connectivity within and across all aquifers;
5. incorporation of the airborne electro-magnetic modelling recently completed by Geoscience Australia (and available to Adani by June 2020); and

6. revision of the conceptual understanding of the source aquifer(s) for DSC and groundwater system based on information collected from the above for incorporation into the groundwater model review (re-run).

Is this understanding correct? Does the above summary accurately reflect the CSIRO and GA advice with respect to further work required to increase certainty of the source aquifer(s) for the DSC?

In addition, the department seeks your advice on the following questions:

1. What is the level of confidence that the Clematis Sandstone aquifer is the main source for the DSC?
2. If there is a high level of uncertainty, what work should be undertaken to address and reduce the level of uncertainty regarding the potential alternative or additional source aquifers for the DSC?
3. For any additional work recommended for question 2, what is a realistic timeframe for the completion of each element of the additional work?
4. Are the groundwater drawdown trigger thresholds proposed in the new GDEMP appropriate and suitable to ensure the long-term protection of the DSC in light of your advice that the conceptual model is not fit for purpose?
5. Based on GDEMP version 11b, are there any other matters or recommendations that CSIRO and GA would highlight in order to ensure the effectiveness of the management plan in relation to environmental authority conditions?

This advice will assist the department's review and assessment of the GDEMP.

Given that the department wishes to progress the assessment of the GDEMP in a timely manner, there is some urgency to your advice. Could you please advise when you anticipate to be in a position to provide your advice.

By way of background, please refer to the GDEMP (version 11b) that was submitted to the department on 9 April 2019 (available at <https://www.adaniaustralia.com/-/media/Project/Australia/Our-Projects--Businesses/mine-environment-reporting/GDEMP-Final-V11b-19March2019.pdf?la=en&hash=C4988A8485428FD234C4A09023D08B34>), and the enclosed document 'Research Study Report – Source Aquifer to Doongmabulla Springs' that was provided to the department by Adani in November 2018.

Please do not hesitate to contact me on (07) 4987 9343 or at [Melissa.Wells@des.qld.gov.au](mailto:Melissa.Wells@des.qld.gov.au) should you require further information about this request.

Yours sincerely

sch4p4( 6) Personal information

Melissa Wells  
**Executive Director**  
**Coal and Central Queensland Compliance**

Enc.

*Research Study Report – Source Aquifer to Doongmabulla Springs* (revision 03, Adani, November 2018)

Date : 13/05/2019 6:17:53 PM  
From : "WELLS Melissa"  
To : "MERRICK Jamie"  
Subject : FW: Actions  
Attachment : image001.jpg;image002.png;image003.png;image006.png;

FYI



**Melissa Wells**  
Executive Director  
Coal and Central Qld Compliance  
Department of Environment and Science

P 07 4987 9343

99 Hospital Road, Emerald QLD 4720  
PO Box 3028, Emerald QLD 4720

---

**From:** WELLS Melissa  
**Sent:** Monday, 13 May 2019 6:16 PM  
**To:** [REDACTED] s.73  
**Cc:** ELLWOOD Dean  
**Subject:** RE: Actions

Good evening [REDACTED] s.73

On behalf of Dean I can confirm DES will be in a position to provide Adani comments on the GMMP this week. As you are aware, a meeting request has been sent out for the BTFMP workshop and the meeting will take place in Rockhampton from 2.30-5pm this Wednesday. As discussed in our meeting last week, the relevant staff are unavailable to meet again later this week and the next earliest opportunity is Monday 20 May. If you have a preference for the meeting location please let me know and we can send a calendar invitation.

In regards to the questions posed to GA/CSIRO I can advise that DES is seeking clarification and feedback regarding the level of certainty around the source aquifer/s, its monitoring and management in light of the GA/CSIRO report, the resubmitted GDEMP (version 11b) and the relevant environmental authority conditions in accordance with the *Environmental Protection Act 1994*.

In relation to timing for clarification sought from GA/CSIRO, DES has expressed the urgency around the request. From discussions with GA today, DES is advised they are currently reviewing the request and will be in a position to provide certainty around timeframes later this week as the contract is in place .

We look forward to receiving your comments on the BTFMP prior to the workshop this Wednesday and finalising the BTFMP.

Kind regards,  
Melissa



**Melissa Wells**  
Executive Director  
Coal and Central Qld Compliance  
Department of Environment and Science

P 07 4987 9343

99 Hospital Road, Emerald QLD 4720  
PO Box 3028, Emerald QLD 4720

---

**From:** [REDACTED] s.73 <[REDACTED]@adani.com.au>  
**Sent:** Monday, 13 May 2019 2:59 PM  
**To:** ELLWOOD Dean; WELLS Melissa  
**Subject:** Actions

Dean

Thank you for your time on Friday to talk through the finalisation of our management plans.

We have been consistent in requesting clarity of both process and timing to finalise the outstanding management plans. Based on the discussions from last Friday we understand that the following actions were committed to:

- In relation to the GMMP, DES will provide comments to Adani this week in a similar format to that provided for the BTFMP;
- Adani and DES will meet in a workshop to work through feedback on the GDEMP and GMMP. We note you offered Monday 20<sup>th</sup> May to hold this workshop. We stated our preference and desire for a meeting during the course of this week and we respectfully request that DES provide an opportunity for that timing to be met.
- For the BTFMP, on a forward looking basis, we agreed to meet on Wednesday the 15th of May to workshop the matters as expressed in

the reasons in your Attachment A.

- Prior to that workshop this Wednesday, Adani will send through high level comments in relation to the reasons set out in your Attachment A of the BTFMP decision of 2 May 2019. These comments are being provided in the context of Adani considering resubmission and are without prejudice to any other right me may have with respect to the BTFMP decision.

We also again request that DES provide to Adani the questions asked of CSIRO & GA regarding the Source Aquifer (GDEMP), and the timing in which CSIRO & GA will respond to those questions. As discussed in the meeting you undertook to provide me with this information today.

Thanks

s.73

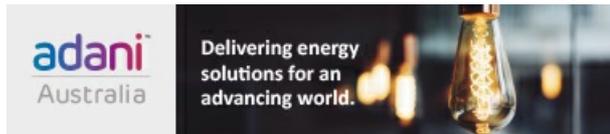
E s.73 @adani.com.au

P office: +61 7 3223 4800 | direct: s.73

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W [adaniaustralia.com](http://adaniaustralia.com)



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Date : 14/05/2019 7:04:11 PM  
From : "WELLS Melissa"  
To : "HALLIDAY Genevieve"  
Cc : "MERRICK Jamie" , "LAWRENCE Rob"  
Subject : Fwd: Adani response to DES email 13 May 2019  
Attachment : image568012.jpg;  
FYI

Sent from my iPhone

Begin forwarded message:

From: [REDACTED] s.73 <[REDACTED]@adani.com.au>  
Date: 14 May 2019 at 6:51:38 pm AEST  
To: WELLS Melissa <Melissa.Wells@des.qld.gov.au>  
Cc: [REDACTED] s.73 <[REDACTED]@adani.com.au>, ELLWOOD Dean <Dean.Ellwood@des.qld.gov.au>  
Subject: Re: Adani response to DES email 13 May 2019

Melissa

Thank you for your email. As per my email this morning, can you please advise Adani as to when DES will provide Adani with a copy of the questions that you have provided CSIRO/GA in relation to the GDEMP?

[REDACTED] s.73

[REDACTED] s.73

Adani Australia

[Level 25, AMP Place, 10 Eagle Street, Brisbane, QLD 4000](#)

Phone: + [REDACTED] s.73

[REDACTED] s.73 adani.com.au

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W adaniaustralia.com

□

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On 14 May 2019, at 6:26 pm, WELLS Melissa <Melissa.Wells@des.qld.gov.au> wrote:

[REDACTED] s.73

I refer to your email of this morning, 14 May 2019 concerning the departments review of the resubmitted Adani GDEMP.

I remind you that the review of the Adani GDEMP undertaken by CSIRO/GA (the review) was commissioned by the Department of the Environment and Energy (DOEE).

While the department was consulted by DOEE on the review's terms of reference and attended a presentation of the CSIRO/GA's Tranche 1 advice, the department did not further participate or meet with CSIRO/GA during the DOEE independent review. Nor did the department have any commercial arrangement with CSIRO/GA regarding the DOEE review.

The final review (advice/report) was not provided to department until 9 April 2019, some four weeks after multiple requests by the department to DOEE, including requests at Ministerial level.

Again, given that Adani has submitted a revised version of the GDEMP (version 11b), a version that is different to the one that the CSIRO/GA review (advice/report) relied on, the department is simply seeking clarification from CSIRO/GA about its review in light of the revised GDEMP. This clarification will assist the department in part to decide whether the GDEMP is in compliance with the conditions of the environmental authority (EA) granted to Adani under the *Environmental Protection Act 1994* (Act) for the Carmichael Mine. This is not a 'new' review of the GDEMP, and it is entirely consistent with the clear message provided to Adani that the department would rely upon advice from CSIRO/GA and not seek other third party advice.

Page 122 redacted for the following reason:

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s.37(3)(d) Deferral of access

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Date : 16/05/2019 5:39:36 PM  
From : "WELLS Melissa"  
To : "MERRICK Jamie" , "LAWRENCE Rob"  
Subject : Fwd: Adani response to DES email 13 May 2019  
Attachment : image002.png;image003.jpg;  
FYI

Sent from my iPhone

Begin forwarded message:

**From:** WELLS Melissa <[Melissa.Wells@des.qld.gov.au](mailto:Melissa.Wells@des.qld.gov.au)>  
**Date:** 16 May 2019 at 5:15:23 pm AEST  
**To:** [REDACTED] s.73 <[REDACTED]@adani.com.au>  
**Cc:** [REDACTED] s.73 <[REDACTED]@adani.com.au>, ELLWOOD Dean <[Dean.Ellwood@des.qld.gov.au](mailto:Dean.Ellwood@des.qld.gov.au)>  
**Subject:** RE: Adani response to DES email 13 May 2019

Hi [REDACTED] s.73

As stated, the CSIRO/GA advice is to provide clarification to the department about its original review in light of the revised GDEMP. Adani will be provided with a copy of the CSIRO/GA advice once it becomes available.

Kind regards,  
Melissa.



**Melissa Wells**  
Executive Director  
Coal and Central Qld Compliance  
Department of Environment and Science

P 07 4987 9343

99 Hospital Road, Emerald QLD 4720  
PO Box 3028, Emerald QLD 4720

---

**From:** [REDACTED] s.73 <[REDACTED]@adani.com.au>  
**Sent:** Tuesday, 14 May 2019 6:52 PM  
**To:** WELLS Melissa  
**Cc:** [REDACTED] s.73 ELLWOOD Dean  
**Subject:** Re: Adani response to DES email 13 May 2019

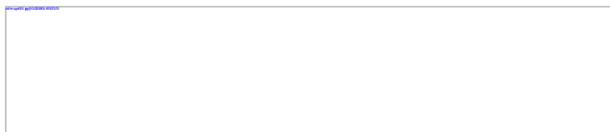
Melissa

Thank you for your email. As per my email this morning, can you please advise Adani as to when DES will provide Adani with a copy of the questions that you have provided CSIRO/GA in relation to the GDEMP?

[REDACTED] s.73

[REDACTED] s.73 | Adani Australia  
[Level 25, AMP Place, 10 Eagle Street, Brisbane, QLD 4000](#)  
Phone: [REDACTED] s.73  
[REDACTED] s.73 @adani.com.au

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E [REDACTED] s.73 @adani.com.au  
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On 14 May 2019, at 6:26 pm, WELLS Melissa <Melissa.Wells@des.qld.gov.au> wrote:

s.73

I refer to your email of this morning, 14 May 2019 concerning the departments review of the resubmitted Adani GDEMP.

I remind you that the review of the Adani GDEMP undertaken by CSIRO/GA (the review) was commissioned by the Department of the Environment and Energy (DOEE).

While the department was consulted by DOEE on the review's terms of reference and attended a presentation of the CSIRO/GA's Tranche 1 advice, the department did not further participate or meet with CSIRO/GA during the DOEE independent review. Nor did the department have any commercial arrangement with CSIRO/GA regarding the DOEE review.

The final review (advice/report) was not provided to department until 9 April 2019, some four weeks after multiple requests by the department to DOEE, including requests at Ministerial level.

Again, given that Adani has submitted a revised version of the GDEMP (version 11b), a version that is different to the one that the CSIRO/GA review (advice/report) relied on, the department is simply seeking clarification from CSIRO/GA about its review in light of the revised GDEMP. This clarification will assist the department in part to decide whether the GDEMP is in compliance with the conditions of the environmental authority (EA) granted to Adani under the *Environmental Protection Act 1994* (Act) for the Carmichael Mine. This is not a 'new' review of the GDEMP, and it is entirely consistent with the clear message provided to Adani that the department would rely upon advice from CSIRO/GA and not seek other third party advice.

Given the resource implications and urgency around the timeliness of the advice sought from CSIRO/GA, the department considers the requirement of a contract and fee for service by CSIRO/GA as reasonable and consistent with any necessary governance in relation to a process such as this.

To date, the department has communicated with Dr James Johnson, CEO Geoscience Australia and Ms Jane Coram, Director CSIRO in relation to the department's request.

The names of the officers of CSIRO/GA who will be involved in preparing advice for the department is a matter for CSIRO/GA. I am neither furnished with the information nor would it be appropriate for me to comment on the CSIRO/GA officers who were involved with the DOEE GDEMP review.

The department's actions in relation to the Adani GDEMP are directed solely at ensuring the proper administration of the Act and compliance with the conditions of the environmental authority.

My email of yesterday, gave you an indication on the timing of the review of the GDEMP by the department and the advice of CSIRO/GA.

Kind regards  
Melissa

<image001.png> **Melissa Wells**  
Executive Director  
Coal and Central Qld Compliance  
Department of Environment and Science

-----  
P 07 4987 9343

99 Hospital Road, Emerald QLD 4720  
PO Box 3028, Emerald QLD 4720

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**From:** s.73 <[redacted]@adani.com.au>

**Sent:** Tuesday, 14 May 2019 10:21 AM

**To:** ELLWOOD Dean

**Cc:** WELLS Melissa; s.73

**Subject:** Adani response to DES email 13 May 2019

Dean

I refer to Melissa Well's email sent last evening. It would appear despite DES' public claims that you would not be seeking a new or further review of the scientific evidence presented by CSIRO /GA, you are in fact engaging in another review as evidenced by Ms Well's reference to having to put in place a new contract. If this round of questions was simply an extension of the work undertaken we do not see how there would be any requirement for a new contract.

Furthermore we submit that the email fails to provide Adani with the necessary clarity regarding the "contract" between DES and CSIRO/GA or the substance of the questions that have been presented to CSIRO/GA by DES. Accordingly and consistent with our request on Friday 10 May, we once again request a copy of the questions you have asked CSIRO/GA to consider under this new contract. This request is reasonable given DES is commissioning a new review or assessment of Adani's GDEMP, and that DES previously provided Adani with a copy of the Terms of Reference for the so-called Wintle Review of the BTFMP. An ability to consider the questions as posed by the DES to CSIRO/GA would seem a normal part of this process and is clearly required to permit us to fully participate.

Could you also clarify whether the officers of CSIRO/GA engaged by DES were directly involved in the GDEMP review process commissioned by the Department of Environment and Energy? Can you also provide Adani with the names of all CSIRO/GA officers engaged for the DES contract? Can you confirm that DES were consulted and participated with DoEE in the original questions put to CSIRO/GA?

We request the above information by close of business today. Please contact me if I can provide further information.

s.73

E s.73 @adani.com.au

P office: +61 7 3223 4800 | direct: + s.73

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17 May 2019

Private & Confidential

Mr Jamie Merrick  
Director-General  
Department of Environment and Science  
Queensland Government  
400 George Street  
Brisbane QLD 4000

By email: [jamie.merrick@des.qld.gov.au](mailto:jamie.merrick@des.qld.gov.au)

Dear Jamie

### Adani Mining Pty Ltd – Groundwater Management Plans

We refer to our previous correspondence in relation to groundwater management plans, in particular the Groundwater Dependent Ecosystems Management Plan (**GDEMP**) and the Groundwater Monitoring and Management Plan (**GMMP**) for Adani Mining Pty Ltd (**Adani**), and in particular our letter to you more than a month ago on 12 April 2019 which sought clarity from you on the process and timing for approval of those plans. In the most recent email from your Ms Melissa Wells at 5:15pm on 16 May 2019, we have been advised by the Department of Environment and Science (**DES**) that:

*"...the CSIRO/GA advice is to provide clarification to the department about its original review in light of the revised GDEMP. Adani will be provided with a copy of the CSIRO/GA advice once it becomes available..."*

This latest correspondence from Ms Wells was in response to our request where we had once again sought that DES provide us with the questions that DES has put to CSIRO / GA. We understand that these questions form the basis for a new contract being entered into between DES and CSIRO / GA. The latest email from DES is, at best, unresponsive and we ask:

**Question 1: Can the DES please provide us with the questions that have been asked of CSIRO / GA?**

It would seem fairer and simpler if you just provided us with these basic details so we have a proper opportunity to understand and engage in the process.

However, given the apparent unwillingness to meet this very simple request we have also submitted a formal Right to Information application (copy attached). As that RTI application exclusively relates to ourselves, DES and then to CSIRO / GA (who seem able to respond very rapidly to such requests) it is our expectation that this application will be dealt with as a priority.

**Adani Mining Pty Ltd**  
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GPO Box 2569, Brisbane QLD 4001  
Australia

**Tel** +61 7 3223 4800  
[www.adaniaustralia.com](http://www.adaniaustralia.com)

**Question 2: When will you receive the advice from CSIRO / GA?**

Separately, with respect to the latest correspondence from Ms Wells, there is a reference to advice from CSIRO / GA and its provision to us when it becomes available. We would expect it is a very short time frame given what seems to be, by implication, a strictly limited scope and we wish to be prepared to respond once it is available.

We are only seeking clarity as to process and timing and would appreciate the ability to be able to fully engage with the DES with a proper understanding of what is happening.

We remain committed to working collaboratively to finalise these plans so that we can get on with the task of delivering thousands of jobs for Queenslanders.

Yours sincerely



**Attachment** 2019\_05\_16\_Application\_RTI\_to\_DES\_re\_GMMP\_and\_GDEMP\_(Lodged).pdf

**cc** Ms Mellissa Wells Melissa.Wells@des.qld.gov.au  
Mr Dean Ellwood Dean.Ellwood@des.qld.gov.au

Date : 9/04/2019 3:57:26 PM  
From : "MERRICK Jamie"  
To : "ELLWOOD Dean" , "WELLS Melissa" , "LAWRENCE Rob"  
Subject : FW: Groundwater Dependent Ecosystem Management Plan (GDEMP)  
Attachment : DG DES re GDEMP - 20190409.pdf;image163210.jpg;

FYI

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From: [REDACTED] s.73 @adani.com.au>  
Sent: Tuesday, 9 April 2019 3:55 PM  
To: MERRICK Jamie  
Cc: [REDACTED] s.73  
Subject: Groundwater Dependent Ecosystem Management Plan (GDEMP)

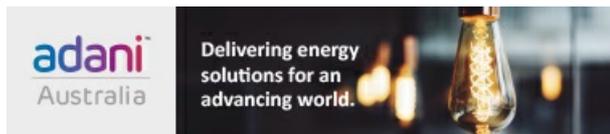
Hi Jamie,  
As per our meeting of yesterday please find attached our response to your correspondence.

Regards,

[REDACTED] s.73

[REDACTED] s.73  
[REDACTED] s.73 - Adani Mining

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9 April 2019

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Mr Jamie Merrick  
Director-General  
Department of Environment and Science  
Queensland Government  
400 George Street  
Brisbane QLD 4000

*By email: [jamie.merrick@des.qld.gov.au](mailto:jamie.merrick@des.qld.gov.au)*

Dear Jamie

### **Adani Mining Pty Ltd – Groundwater Dependent Ecosystem Management Plan**

We refer to your correspondence of 5 April 2019 in relation to the Groundwater Dependent Ecosystems Management Plan (**GDEMP**) and also the opportunity for us to meet on 8 April 2019.

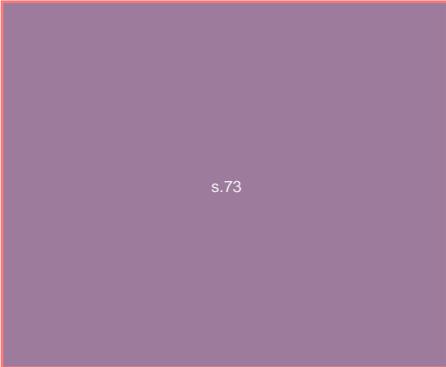
As you are aware, we have been working with both the Federal and State Departments in relation to the finalisation of this plan for more than two years. Unfortunately, despite repeated requests from Adani, the Queensland Government has been unwilling to provide commitments in relation to timing and process to finalise outstanding management plans. This lack of clarity has been evident throughout the Department's approach to finalising the Black -Throated Finch Management Plan (**BTFMP**), which is still dragging on and which has been the subject of last minute interventions, such as the highly questionable review led by Professor Wintle about which we have raised serious concerns.

In relation to the CSIRO and GeoScience Australia report, as we understand it, this was work commissioned for use by both the Federal and State Department; accordingly we find it inexplicable that the Queensland Government is now stating that it does not have access to the report. We would have thought it reasonable that the Queensland Government would have had sufficient foresight and planning to ensure the timely delivery of the report in order to enable the finalisation of the plan. Accordingly, for this to now be offered up as an excuse for continued delay is not reasonable from our perspective.

Absent the Queensland Government detailing a defined process and timing to finalise the GDEMP, the requirements are unclear and it seems the goal posts continue to shift in the same way we have experienced with finalisation of the BTFMP. More specifically, the approach undertaken by the State in assessing the BTFMP has been reflective of the State's apparent desire to create two versions of the same plan. Accordingly, we assumed a similar approach was intended for the GDEMP. Nonetheless, the GDEMP was submitted to the Department on 9 April 2019.

We remain committed to working collaboratively to finalise these plans so that we can get on with the task of delivering thousands of jobs for Queenslanders.

Yours sincerely



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