LAND COURT OF QUEENSLAND

REGISTRY: Brisbane
NUMBER: EPA495-15
MRA496-15
MRA497-15

Applicant: **New Acland Coal Pty Ltd ACN 081 022 380**

AND

Respondents: **Frank Ashman & Ors**

AND

Statutory Party: **Chief Executive, Department of Environment and Heritage Protection**

STATEMENT OF EVIDENCE IN REPLY TO THE LAND COURT BY BRIAN GEORGE BARNETT

20 MARCH 2017

1. Expert details and qualifications

1.1 I refer to paragraph 1 of the First IESC Statement.

2. Instructions

2.1 I have been requested by Clayton Utz to prepare a reply to the material filed by the Respondents on 10 March 2017 in respect of the additional groundwater evidence addressed in my First IESC Statement. My original letter of instructions from Clayton Utz is contained at Annexure A of the First IESC Statement.

2.2 A glossary of the terms used in this statement is contained at Schedule 1 to this statement.

3. Reply

3.1 My reply to the various matters raised in the Respondents' material is contained in the table in Schedule 2 to this statement.

3.2 In summary:

(a) in my opinion, all of the potential issues of substance that Dr Currell and Professor Werner have identified in these proceedings and repeated in their most recent statements have either been addressed by recent work undertaken by the Applicant or are addressed by the conditions of approval;

(b) there is no doubt that, by virtue of the 2016 IESC Final Advice and the IESC Chair Conditions Letter, the IESC (which, in its various advices, had raised similar issues to those highlighted by Dr Currell and Professor Werner) considers that all of the issues it has raised have either been dealt with by the Applicant or have been appropriately addressed by the EPBC Approval conditions;

(c) where Dr Currell and Professor Werner see "uncertainty" and "significant short-comings", the IESC with identical information, see the modelling as precisely where it should be for this stage of the project and in accordance with industry standards with the conditions of approval addressing potential additional matters that have been identified during the impact assessment stage; and

(d) I agree entirely with the view of the IESC. The groundwater impact assessment that has been conducted is appropriate. In fact, the modelling approach is more rigorous than that used on most other projects of a similar nature. Matters have been identified during the impact assessment that require further consideration and these matters are to be dealt with by the conditions of approval. In my view, this is standard practice and, like the IESC, I see nothing to suggest that the groundwater impacts arising from the proposed expansion cannot be managed through the conditions of approval.

4. Expert's statement

4.1 I confirm that:

(a) the factual matters included in this statement are, as far as I know, true;

(b) I have made all enquiries that I consider appropriate;

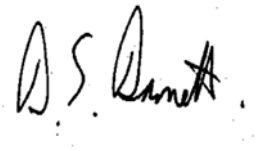
(c) the opinions stated in this statement are genuinely held by me;

(d) this statement contains reference to all matters I consider significant;

(e) I understand I have a duty to assist the court and that duty overrides any obligation I may have to any party to these proceedings or any person who is liable for my fees or expenses and I have complied with that duty;

(f) I have read and understand the rules contained in Part 5 of the Land Court Rules 2000, as far as they apply to me; and

(g) I have not received or accepted instructions to adopt or reject a particular opinion in relation to an issue in dispute in these proceedings.



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Brian Barnett

20 March 2017

Schedule 1 - Glossary

2014 IESC Advice	the IESC Advice to the DoEE dated 10 April 2014 regarding the New Acland Coal Mine Stage 3 Expansion (Annexure C to the Currell SoE, (Document ID: OCA.0021) (Exhibit 435), pages 51-60)
2015 IESC Advice	the IESC Advice to the DoEE dated 10 December 2015 regarding the New Acland Coal Mine Stage 3 Expansion (Document ID: TMP.0009) (Exhibit 495)
2016 IESC Final Advice	IESC final advice with respect to the New Acland Coal Stage 3 Expansion dated 14 December 2016 attached to the First IESC Statement at Annexure B
AEIS	additional information to the EIS (Document ID: EHP.0087 - EHP.0113) (Exhibits 87 - 113)
Applicant's Groundwater Conditions	the conditions contained in Annexure A of the Applicant's Reply Submissions
Applicant's Reply Submissions	the reply submissions of the Applicant dated and filed 30 September 2016
CG	Coordinator-General
CG's Report	the report on the EIS and AEIS of the CG dated 19 December 2014 (Document ID: EHP.0016) (Exhibit 16)
DNRM	the Queensland Department of Natural Resources and Mines
DoEE	Commonwealth Department of the Environment and Energy
Draft EA	the draft amended EA, issued by EHP on 28 August 2015 in relation to the application to amend EA number EPML00335713 lodged 13 April 2015 (Document ID: EHP.0009) (Exhibit 9)
EHP	the Queensland Department of Environment and Heritage Protection
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999 (Cth)
EPBC Approval	the approval for the Expansion issued by the DoEE under the EPBC Act, attached to the First IESC Statement at Annexure H
Expansion	New Acland Coal Mine expansion that is the subject of these proceedings
Fault Hydrogeological Investigation Program - Drilling and Testing Report	the report titled "New Acland Stage 3 Project Fault Hydrogeological Investigation Program Drilling and Testing Report" dated 9 January 2017, attached to the

	First IESC Statement at Annexure G
Fault Hydrogeological Investigation Program Report	the report titled "NAC03 Fault Hydrogeological Investigation Program, October 2016 Status Report" (referred to in the 2016 IESC Final Advice as "SLR, 2016a") dated 24 October 2016, attached to the First IESC Statement at Annexure C
Fault Investigation Site	the site of a fault investigation as depicted in Figure 5 of the First IESC Statement
Federal Minister	the Minister for the Environment and Energy
First IESC Statement	the statement of evidence of Brian Barnett dated 20 February 2017
GMIMP Status Report	the report titled "NAC03 Groundwater Monitoring and Impact Management Plan (GMIMP) October 2016 Status Report" (referred to in the 2016 IESC Final Advice as "SLR, 2016b") dated 24 October 2016, attached to the First IESC Statement at Annexure E
GMMP	Groundwater Management and Monitoring Plan
Groundwater Model Update - Phase 1 Completion Report	the report titled "New Acland Stage 3 Project Groundwater Model Update Phase 1 Completion Report (Numerical Model Scoping report)" (referred to in the 2016 IESC Final Advice as "SLR, 2016d") dated 24 October 2016, attached to the First IESC Statement at Annexure F
IESC	Independent Expert Scientific Committee
IESC Chair Conditions Letter	the letter from the Chair of the IESC to the DoEE dated 21 December 2016 attached to the First IESC Statement at Annexure J
Imposed Conditions	the conditions listed in Appendix 1 of the CG's Report, imposed by the Queensland Coordinator-General under section 54B of the State Development Public Works Organisation Act 1971 (Cth)
OCAA	Oakey Coal Action Alliance
SLR	SLR (Consulting)

Schedule 2 - Reply to Respondents' statements

Row	Statement reference (paragraph)	Reply
Statement of evidence - Dr Matthew Currell dated 9 March 2017		
1.	8 and 11	In paragraph 8, Dr Currell states that he *"disagree[s] that the existence of a plan to conduct further data collection and modelling constitutes the necessary scientific work to provide confidence in the hydrogeological modelling, impact assessment and management strategies".* In paragraph 11, Dr Currell argues that developing a plan to collect and analyse data *"…does not constitute complete science…".* While it is true that a plan does not constitute the completion of the "science" or the "scientific work", I disagree with the inference that *"complete science"* is required before an approval can be gained. I believe that the scientific work used to support the Application will never reach Dr Currell's unreasonable expectation of *"complete science".* In my view, the science should be capable of identifying and quantifying the potential impacts with a level of confidence that is consistent with the available data. I believe that the level of confidence in the model predictions should be illustrated through an appropriate Uncertainty Analysis (refer to row 44 of this table containing my response to paragraph [8] e) of Professor Werner's statement) and that the application should be granted provided the likely range of impacts are manageable through the implementation of appropriate conditions. Neither I, nor the IESC, has suggested that the existence of a plan to conduct further work constitutes the "necessary scientific work". However, both the IESC and I consider that the implementation of the relevant plan as required by the relevant conditions that will be imposed on the Expansion will result in additional scientific work being conducted in order to appropriately manage and mitigate groundwater impacts. This is clear from the 2016 IESC Final Advice. "Scientific work" will need to be undertaken throughout the life of the Expansion in accordance with the CG's Imposed Conditions, the Draft EA conditions, the conditions proposed by the Applicant in these proceedings including the additional mining lease conditions and the EPBC Approval conditions. There may also be additional conditions in the associated water licence requiring "scientific work" to be undertaken. This "scientific work" will not be concluded until after the expiration of the term of the make good agreements and these agreements survive termination of the mining leases to ensure that any ongoing groundwater impacts post mining are appropriately managed.
2.	9	Dr Currell suggests that there are unresolved issues from the 2014 IESC Advice. I refer to paragraphs 3.11 - 3.12 and 5.12 of my First IESC Statement. I note that on pages 2 and 4 of the 2015 IESC Advice, the IESC indicates that it has been specifically asked whether issues from its 2014 IESC Advice have been resolved or addressed. It then responds to those questions. There is no reasonable basis to suggest that the IESC has provided the 2016 IESC Final Advice and the IESC Chair Conditions Letter while failing to mention to the Minister that there are outstanding matters from the 2014 IESC Advice. In my view, the IESC either considers that the relevant issues have been addressed (by completed work or through the conditions of approval) or that it no longer has concerns in relation to those issues.
3.	10 and 11	Dr Currell appears to make a subjective non-specific assessment about what he considers should be done by the Applicant prior to approval being granted. He suggests that there is a specific threshold *"scientific question"* to be answered about the likely nature and

Row	Statement reference (paragraph)	Reply
		magnitude of groundwater impacts from the Expansion. Such suggestions have no basis. Dr Currell never articulates the specific level of data collection and understanding that should be gained prior to approval to answer this question. The IESC, the Federal Minister, the CG and the Chief Executive of EHP all consider that there is a sufficient understanding of the likely nature and magnitude of groundwater impacts from the Expansion and that this understanding will be further enhanced through the implementation of the various conditions post approval. I agree with this approach and consider it to be standard practice.
4.	12	Dr Currell suggests that there will be a *"full re-build"* of the model which *"may render much of the AEIS obsolete…"* The CG's conditions require a review of the conceptualisation and update of the model every 3 years (CG's Imposed Condition 12) as more data are collected to inform the model. By its very nature, this program will provide continuous updates of the predicted groundwater responses to mining. In that regard, the model predictions presented in the AEIS will be updated. However it is not correct to infer that much of the AEIS is obsolete. The current predictions of groundwater impacts as described in the AEIS documentation are the best estimates at this time. The CG's condition is typical of a project of this nature and, while it may result in changes to the original model, it does not mean that the original model is *"obsolete"*. Rather, as additional data is gathered before and during the course of mining, this new data supplements existing data and modelling and the modelling and associated outcomes can be improved. This is merely reflective of the iterative process for the development of the groundwater modelling that the IESC and other regulators have considered appropriate not only for this project but other similar projects. Such a process is consistent with my experience in groundwater modelling. It is also consistent with the Groundwater Modelling Guidelines which provide:[1] *The guidelines encourage regular reassessment of the conceptual model at all stages of the project, with refinements made as other stages of the process suggest that these may be appropriate or necessary. In many cases the conceptual model may not be unique (i.e. different conceptual models can explain all observations) and it is encouraged to propose and maintain alternative conceptualisations for as long as possible through the modelling project. In some cases this may lead to the development and use of alternative numerical models.* In this case, the Applicant has proposed that the initial model update occur earlier than that required by the CG's Imposed Conditions and this is why the work is currently being undertaken. Dr Currell also suggests that the updates to the conceptualisation and the model need to be thoroughly interrogated and reviewed. In this regard, the conditions noted at row 5 below will ensure this occurs.
5.	13	Dr Currell seems to suggest that, even if the Applicant collects the relevant data, its "track record" is such that this collection of data will not be done to the standard he deems is required.

[1] Document ID: OCA.0036 (Exhibit 720), page 10.

Row	Statement reference (paragraph)	Reply
		The various conditions imposed on the Expansion require the further collection of data and updating of the model. For example: • The CG's Imposed Condition 12 requires a review of the model and the conceptualisation every 3 years. Each time this is undertaken, CG's Imposed Condition 12(d) requires the Applicant to prepare a report outlining the findings and any recommendations from the model review (to be prepared by a suitably qualified expert) and submit that report to DNRM for approval. Condition 16 of the EPBC Approval also makes this a condition of the EPBC Approval. • The CG's Imposed Condition 10 requires the Applicant to prepare a GMMP (to be prepared by a suitably qualified person) and submit that report to DNRM for approval. That program must also be reviewed every 3 years. • The EPBC Approval conditions 12 -15 require the Applicant to have a GMMP prepared and peer reviewed by a suitably qualified expert. The plan and the peer review must then be submitted to the Federal Minister for approval and the Federal Minister may refer the plan to the IESC before giving its approval. I believe that the level of independent review that will be undertaken through the implementation of the above conditions is appropriate. Further, Dr Currell refers to the Applicant's *"track record"*. I am unaware of, and Dr Currell provides no evidence that the Applicant has breached any existing conditions by not collecting certain data. I do not consider that a conclusion can be drawn (as Dr Currell seems to suggest) that if the Applicant has not yet collected some data that was not required by any conditions to be collected that the Applicant will not collect that data when required to by conditions. As I understand it, the conditions are legally binding and there is no reason to suggest that the Applicant will not comply with the conditions. If it does not comply with the conditions, there will be serious consequences for the Applicant including the potential loss of its approvals. In addition to statutory consequences, the Federal Minister has an express broad power under the EPBC Approval condition 13A to suspend operations and suspend or revoke approvals.
6.	17	As to Dr Currell's comments about a *"full re-build"* of the model, I refer to row 4 of this table. As to Dr Currell's comments about the re-conceptualisation requiring *"careful scientific review and interrogation"*, I refer to row 5 of this table. In my view, there is no question that such *"careful review and interrogation"* will continue to occur. The conditions demand it.
7.	18	Dr Currell argues that the pumping test recently conducted and reported by SLR does not address concerns that were raised by the IESC in the 2014 IESC Advice and by Dr Currell in his earlier evidence. He argues that there is little useful information on which to conceptualise the hydraulic connections between different hydrogeological units present at the site. Dr Currell appears to ignore the fact that the work he is commenting on was designed to investigate the hydrogeological significance of faulting. It was never intended to answer aquifer connectivity issues that Dr Currell raises in this paragraph. Indeed, the issue of aquifer connectivity is one that the IESC initially raised in 2014, but did not identify it as being a key unresolved matter in 2015. I also refer to row 9 of this table below.
8.	19	Dr Currell points out the inherent limitations of slug tests and fails to disclose the principal benefits of the method.

Row	Statement reference (paragraph)	Reply
		Dr Currell's discussion of the limitations of the slug test method is quite correct. However it should not be inferred that the work of the Applicant in undertaking these tests was in any way faulty or inappropriate. Had the Applicant failed to undertake these tests on the newly constructed bores, they would have been criticised for not collecting useful hydrogeological data. In fact, Dr Currell appeared to criticise the Applicant for just that, in his first statement.[2]
9.	22	Dr Currell appears to confuse the investigations in the Fault Hydrogeological Investigation Program Report with questions regarding the connectivity of aquifers. In this paragraph, he refers to the pumping test that was undertaken as part of the fault investigation program. He then laments that the results tell us nothing about the interconnection between aquifers. I reiterate that the role of faults and the connection between aquifers are two separate issues, both of which are being actively investigated by the Applicant. I also confirm that the pumping test undertaken as part of the fault hydraulic investigation program was aimed at characterising the hydrogeological function of the fault. It has confirmed that the relevant fault that was investigated acts as a strong barrier to the movement of groundwater through the coal seams. The test was undertaken within the Walloon Coal Measures and hence it does not provide any information that will assist with understanding the interconnection between different hydrogeological units (though it did yield estimates of hydraulic conductivity of the Walloon Coal Measures). It was never the aim of this test to provide such information. The proposed approach to answer this particular question about aquifer connectivity is outlined in section 5 of the GMIMP Status Report. As to Dr Currell's comments about the connectivity of aquifers, I also refer to paragraph 5.13(a) of my First IESC Statement. Also, the EPBC Approval conditions (13(ix)) requires the GMMP to include an outline of the proposed methodology to assess groundwater connectivity between hydrogeological units using nested bore arrays and this is discussed in section 5 of the GMIMP Status Report. The IESC and the Federal Minister are comfortable that these matters can be undertaken pursuant to the conditions post approval and I agree with this position. In my opinion, the proposed plan to assess vertical flow processes and connectivity between hydrogeological units as detailed in the GMIMP Status Report and as required under approval conditions is appropriate and will provide useful information that will help further refine the groundwater model. The proposed approach in which purpose designed nested observation sites are to be installed is, in my opinion, more rigorous than most other groundwater modelling projects in which I have been involved. Dr Currell's focus in his statement is on work that has yet to be completed (such as the assessment of vertical gradients and aquifer connection) rather than work already conducted by the Applicant that has produced useful results and upon which the IESC has relied and referred to in the 2016 IESC Final Advice.
10.	23	Dr Currell notes that the initial results of the pumping test that was undertaken as part of the investigations described in the Fault

[2] Document ID: OCA.0021 (Exhibit 435), paragraph 3.7, pages 6-7.

Row	Statement reference (paragraph)	Reply
		Hydrogeological Investigation Program Report indicate a hydraulic conductivity value of the Walloon Coal Measures that is greater than the mean value adopted for the stochastic modelling of the AEIS. This observation is not surprising and simply reinforces the benefit of using a stochastic approach that does not assume that there is a single known value of the hydraulic conductivity in any of the hydrogeological units being modelled. This is consistent with Dr Currell's own words on the matter in paragraph [22] of his statement where he says *"…the information and data gained should be viewed in the context of being useful only for a sub-area of the overall site, namely, the region of the Walloon Coal Measures adjoining the major northwest-southeast trending fault targeted in the program*". Given my expectation of spatial heterogeneity in hydrogeological units, the results are consistent with the conceptualisation and with the modelling approach.
11.	24	Dr Currell highlights the fact that the proposed revision to the conceptualisation of the coal seams will require a significant amount of new data to correctly map the individual coal seams. It must be noted in this regard that mapping of coal seams is a primary objective of the Newhope coal exploration and mining campaign that has resulted in the drilling of some 3000 drillholes within the existing and proposed mining leases and surrounding area as outlined in Figure 1 of the Fault Hydrogeological Investigation Program Report. Information on the location and character of the coal seams has been collected, reviewed and analysed as part of the coal mining operation. Therefore it is clear that *"a significant amount of new data"* will not be required.
12.	25	Dr Currell raises a number of issues regarding the pumping test analysis undertaken by SLR. In my opinion, the issues raised by Dr Currell have no substance and ignore the principal findings of this test that the IESC has relied on in the 2016 IESC Final Advice. For example, his inference that the hydrogeological role of the fault may differ depending on which side of the fault is stressed, has no scientific basis. Similarly his suggestion that potential problems arising from "*well hydraulics*" issues is also without any basis. Contrary to Dr Currell's inferences, the type of and the condition of casing installed in the pumping bore are not a source of error in pumping tests that utilise head measurements in a set of dedicated observation wells, as was the case in this test. Dr Currell states that *"It is also questionable as to why the pumping test was conducted on the downthrown side of the fault (i.e., the side opposite to proposed mining) rather than the up-thrown side, which is where drawdown would propagate due to mining.*" In fact there is a very sound reason for pumping on the downthrown side of the fault that Dr Currell seems to have overlooked. The aquifer elevation on the downthrown side to the fault is approximately 50 m below that on the up-thrown side. A pumping bore extracting water on the downthrown side of the fault is therefore able to operate with significantly more drawdown and hence can sustain higher yields (all else being equal) than a similar bore pumping from the up-thrown side. By locating the pumping bore on the downthrown side of the fault, the test can be conducted at a higher rate of groundwater extraction and with greater levels of drawdown thus improving the chances of creating measurable drawdown at the observation bores and increasing the chances of a successful testing outcome.
13.	26	Dr Currell counsels on the merits of adequate scrutiny and review of any future work undertaken by the Applicant. He refers to the investigations described in the Fault Hydrogeological Investigation Program Report as being a point in question and by inference that the work is flawed. The statement and inferences are not supported by any evidence that the fault testing program and subsequent

Row	Statement reference (paragraph)	Reply
		analysis are flawed. Rather than illustrating a problem with the quality of the data and the applicability of the results, as Dr Currell suggests, the fault testing program has **not** suffered from these shortfalls. To the contrary, Dr Currell himself has described the work as being *"… well designed*" [see paragraph 20] and that *"these data are valuable and help to fill data gaps"* [see paragraph 21].
14.	27-30	Dr Currell suggests that *"a proper conceptual hydrogeological model of a site is not complete without [contour] maps"*. Dr Currell seeks to imply that the absence of such maps is a significant flaw in the modelling. In my view, such maps are an illustrative tool and are not fundamental to the successful development of a numerical groundwater model. Indeed, the IESC no longer has concerns on this matter given that it did not raise the absence of such maps as being a key issue requiring rectification as a condition of its approval in the 2016 IESC Final Advice. The absence of an illustrative tool does not reflect a significant flaw in the modelling as suggested by Dr Currell.
15.	31-32	Dr Currell refers to the absence of existing groundwater users in the model. I refer to paragraphs 4.32, 4.33 and 5.11 of my First IESC Statement. I also refer to the following conditions imposed on the Expansion: • CG's Imposed Condition 12(c)(iii), which requires all groundwater model reviews to include a revised water balance model. • Condition 2(b)(ii) on the mining lease as proposed in the Applicant's Groundwater Conditions[3], which requires the first review of the model to include an estimate of the volumes of water taken by other water users. • Draft EA condition D13(b), which requires, as a component of the 2nd and subsequent model reviews, an assessment of natural and potential pumping based water level variation caused by non-mining authorised users, in the Oakey Creek Alluvial aquifer. • Condition 16(ii) of the EPBC Approval conditions, which requires all groundwater model reviews to include updated groundwater resource user abstraction data. Through these conditions, it is clear that existing groundwater users will be addressed in each of the model updates.
16.	33	Dr Currell suggests that estimates of groundwater recharge must be improved. I refer to paragraph 6a. on page 6 of the 2016 IESC Final Advice, in which the IESC noted that the issue could be dealt with in the model review stage as follows:

[3] Applicant's Reply Submissions, page 293.

Row	Statement reference (paragraph)	Reply
		…These residual risks can be addressed during the regular groundwater model update process required by the regulator and through ongoing monitoring and refining hydrogeological characterisation, including: *a. Consideration of a broader range of **recharge** and specific storage values including **field based estimates of recharge** that are independent of the modelling.* Also, I refer to conditions 13(xiii) and 16 of the EPBC Approval conditions which require the matters in the 2015 and 2016 IESC advices to be addressed in the groundwater monitoring and model review process required under those conditions.
17.	34	Dr Currell provides a discussion on the importance of developing a conceptual water balance to support the development and calibration of a numerical model. He identifies rainfall recharge, evapotranspiration, groundwater extraction and discharge to streams as important water balance components that must be quantified prior to modelling. Unfortunately, Dr Currell has failed to mention the most important aspect of the water balance; that being the extraction of water from the mining pits. It is this component of the water balance that gives rise to the very impacts that are being discussed in this hearing. His failure to appreciate this point perhaps explains his pre-occupation with other water balance components that have a much smaller influence on the matters at hand. In this regard, I can confirm that the Applicant is actively seeking to improve estimates of groundwater inflow to the Stage 2 mining pits for use in model calibration.
18.	35-37	Dr Currell suggests that limited work has been conducted on faults other than the one that was the subject of the recent pumping test. Dr Currell is incorrect in his assertions that *"this new package of work (the Fault Hydrogeological Assessment Programme) focusses on one particular fault…"* being the fault that has been the focus of the pumping test. He fails to acknowledge that the geological mapping and cross sections have also been undertaken on other faults at the site. I note that the IESC has considered the fault mapping and cross sections at a number of sites and have indicated that this work has provided useful information on the significance of faulting across the site. It has not only considered the information obtained from the pumping test site. I further note that the IESC did not have the Fault Hydrogeological Investigation Program - Drilling and Testing Report at the time of the 2016 IESC Final Advice and that this work further reinforces the conclusions drawn by the IESC on the role and significance of faulting at the site. I refer to paragraph 4.12(c) and 4.44 of my First IESC Statement in which I note that the IESC accepted that findings from the Fault Investigation Site could be extrapolated to other faults in the area with significant throw. As noted in my statement, I agree with this assessment. It is unclear whether Dr Currell is suggesting that every single fault in the area be subject to pumping tests, but clearly the IESC did not consider this necessary as a condition of approval and nor do I consider this is practical or necessary. I am unaware of any suggestions that conclusions drawn from the pumping test site can be extrapolated to all faults at the site, irrespective of the displacement across the fault. I understand that a similar level of investigation will be required to characterise faults that only partially disrupt aquifer continuity, should such faults be included in the numerical model. I refer to condition 13(i)(c) of the EPBC Approval conditions, which requires the GMMP to include sufficient bores to determine the

Row	Statement reference (paragraph)	Reply
		effect of faulting on groundwater drawdown. I also refer to the Applicant's proposed amendment to condition D15(d) of the Draft EA in the Applicant's Groundwater Conditions[4] to require the groundwater monitoring network to include bores to assess the nature of faulting. I believe that these conditions will require the Applicant to consider smaller faults around the site as necessary.
19.	39	Dr Currell suggests that *"there are still major problems and uncertainties with the conceptualisation of faults".* As an initial point, I refer to rows 5 and 18 of this table as to the various conditions imposed on the Expansion with respect to groundwater model and conceptualisation reviews and assessment of the nature of faulting. While Dr Currell describes a number of areas which he believes are problematic with the model representation of faults, it is of importance to understand that the IESC has considered all of these issues and has concluded that the current model and proposed revisions to the model are appropriate for on-going impact assessment. Dr Currell challenges the assumption that *"…hydrogeological behaviour at this one fault is analogous to the behaviour to be expected at all faults is highly questionable".* I am unaware that such an assumption has been promoted by the Applicant, the IESC, or any other party to this hearing. In fact, Dr Currell's and Professor Werner's evidence are the only reference that I can find to such an assumption. I am aware that the IESC has suggested that the results obtained from the investigations described in the Fault Hydrogeological Investigation Program Report may be applied to other faults with a significant displacement. The IESC does not suggest that the results can be applied to **all** other faults. Dr Currell's assertion that the hydrogeological function of a fault is dependent on the side on which the hydrogeological stress is applied is lacking in any scientific basis. I refer to row 12 in this regard. I also refer to paragraphs 4.14 - 4.25 of the First IESC Statement in which I conclude that the results of the sensitivity testing in the no faults modelling conducted has illustrated that even when faults are removed from the model, the extent and magnitude of predicted drawdown is not substantially greater than that previously predicted. This further diminishes Dr Currell's suggestions about the importance of the issues he raises about faulting.
20.	40-41	The issue Dr Currell raises in this paragraph was dealt with in paragraph 4.12 of my First IESC Statement. It was also an issue that the IESC was aware of in its 2016 IESC Advice. Regardless of the issues raised by Dr Currell here, I again note paragraphs 4.14 - 4.25 of the First IESC Statement in which I conclude that the results of the sensitivity testing in the no faults modelling conducted has illustrated that even when faults are removed from the

[4] Applicant's Reply Submissions, page 287.

Row	Statement reference (paragraph)	Reply
		model, the extent and magnitude of predicted drawdown is not substantially greater than that previously predicted.
21.	43	Dr Currell criticises the sensitivity analysis done in respect of faulting. He infers that the work does not represent *"a rigorous sensitivity analysis of the effects of faulting"*. He points out that the faults included in the AEIS model are not the same as the fault mapping undertaken by the Applicant. This fact is irrelevant to the sensitivity analysis. This analysis was designed to show the influence of the faulting pattern included in the AEIS model on the predicted groundwater drawdown. In my opinion, the sensitivity analysis has achieved its aim and I disagree with each of Dr Currell's criticisms of it. The IESC formed its opinion on the basis of the information presented to it; the very same information provided to Dr Currell. The IESC does not take the same position as Dr Currell and nor do I. I refer to paragraphs 4.12 - 4.25 of my First IESC Statement.
22.	44	Dr Currell returns to his preoccupation with potentiometric surface maps. His criticism of the presentation of water level and geological displacement at the tested fault is quite unwarranted. The manner in which the data are presented is appropriate and clearly illustrates the information contained in the available data.
23.	45-46	Dr Currell presents tables that summarise various techniques that can be used to characterise the hydrogeological character and impact of faults. His conclusion appears to be that because not all of the available methods have been applied at this site then the work is somehow incomplete. The inference that all of the listed methods are suitable, practicable or indeed necessary does not stand up to scrutiny. For example, the tables list *"The use of heat to characterise flow"* as a method that can be used to characterise faults. Firstly the title of this method is somewhat misleading. It refers to the use of temperature differences measured in boreholes to identify specific locations where water may be entering or exiting a borehole. It assumes (amongst other things) that locations where water enters or exits a bore coincide with a fault intersection. The method can only be applied if there is a measurable temperature difference between the water elsewhere in the bore and the water exchanged with the fault. It works very well in deep geothermal and petroleum wells where, during testing, cold water is injected into the well and the natural subsurface temperatures are typically in excess of 100 degrees Celsius. Furthermore, it will only detect those faults that transmit water (i.e. that act as a flow conduit) and will not provide any information on a fault that acts as a partial or complete barrier to horizontal groundwater flow. The method is most likely to be inapplicable at the New Acland Coal Mine because the prerequisite temperature differences are most unlikely to exist at the depths of interest around the mine. It is quite inappropriate for Dr Currell to imply that the Applicant has been in some way remiss in not applying this method at the New Acland Coal Mine. Further, in Table 2, Dr Currell fails to acknowledge that the Applicant has undertaken groundwater flow modelling at this site. I find this oversight to be quite astonishing given the on-going discussions around this very topic. Contrary to Dr Currell's assertion, the Applicant has assessed the use of Continuum Models at the start of the investigation in 2009 and as a result has implemented a Discrete Fracture Network Modelling approach and this is described at length in the AEIS documentation.
24.	47-49	Dr Currell refers to groundwater quality issues in these paragraphs. I refer to condition D3 of the Draft EA, which requires monitoring of groundwater quality issues. Conditions D5 and D6 of the Draft EA prohibits exceedances to the groundwater quality trigger thresholds and requires an investigation to be undertaken by the Applicant if

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		monitoring shows that trigger levels are exceeded. I also refer to condition 13(ii) of the EPBC Approval conditions which requires the GMMP to include baseline monitoring to determine existing groundwater quality within the project area, particularly adjacent to the proposed pits. In my view, there are clear requirements to monitor and address groundwater quality impacts from the Expansion.
25.	51	Dr Currell suggests that a review of the monitoring network should be undertaken prior to approval. I refer to row 5 of this table as to the regular reviews of the GMMP (which addresses the monitoring network) that are required by the conditions. Such reviews are required to be done by appropriately qualified persons and to be approved by the relevant regulators. These conditions are appropriate and standard for such projects.
26.	52	Dr Currell suggests that an appropriate baseline period is required for monitoring bores. I refer to Condition D4 of the Draft EA which requires that groundwater levels not exceed trigger change thresholds in table D3. I also refer to the footnote to Table D3 and condition D4 of the Draft EA, which notes that water level trigger thresholds will be proposed following 12 months of monitoring of the new bores. I also refer to the Applicant's proposed condition 2 on the mining lease in the Applicant's Groundwater Conditions[5] which provides for the first review of the groundwater model to occur prior to mining and after 12 months of monitoring data has been collected. These conditions collectively ensure that sufficient baseline data will be collected prior to mining.
27.	53	As to Dr Currell's comments about an assessment of the vertical connectivity between aquifers, I refer to row 9 of this table.
28.	55	Dr Currell comments about the need for additional early warning bores. Conditions 13iv. and v. of the EPBC Approval conditions require the GMMP to include details of the location of monitoring bores to use as early warning indicators of groundwater drawdown propagation and threshold triggers for those bores. The IESC in the 2016 IESC Final Advice notes as follows at paragraph 10 on page 7: *10. The progress report for the proponent's GMIMP (SLR, 2016b) provides the preliminary groundwater monitoring network for the proposed project. The IESC notes the GMIMP is an early draft. However, the proponent should include the following within the final document:* *a. Install or adopt existing groundwater monitoring bores to use as indicators of early warning of drawdown propagation. Early-warning bores should be suitably located between the proposed project and an environmental/economic objective or asset.*

[5] Applicant's Reply Submissions, page 293.

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		Early-warning bores could also be used to validate the groundwater model's drawdown predictions. The GMIMP Status Report included bores that would be used as early warning bores.[6] Given that the GMMP is required to be prepared by a suitably qualified person and approved by the Federal Minister, with reference to the IESC if required by the Federal Minister (see row 5 of this table), the final locations of any additional early warning bores will be determined as part of this process. Dr Currell suggests that the early warning monitoring system should include at least two bores aligned on a *"compass line"* at different distances from the mine including one located near existing users' bores. His description of the required layout is not at all precise. By *"compass line"*, I assume he is referring to a line radiating from the mining pit. This in itself is somewhat imprecise given that the mining pit locations will change with time and hence his *"compass line"* origin will also move with time. His suggestion that one of a pair of monitoring bores be located near an existing user's bore seems to be ill-advised given that it is hard to describe such a system as providing early warning when one of the bores is located near the point at which such warning is required. In other words, an observed response at the outer monitoring bore, will not provide an early warming – it will provide a real time illustration of an impact.
29.	57	Dr Currell suggests that the IESC were not asked the appropriate questions by the Minister. He again appears to make a subjective assessment of what he considers is the necessary threshold for a decision maker to grant the approval of the Expansion. In this regard, I refer to row 3 of this table.
30.	59-61	Dr Currell suggests that many deficiencies pointed out by the IESC are yet to be resolved. As is demonstrated by the 2016 IESC Final Advice and the IESC Chair Conditions Letter, the IESC reviewed and approved the relevant plans of the Applicant in respect of the additional work proposed and considered that the work in those plans was appropriate to be conducted after approval in accordance with the conditions. Dr Currell outlines what he considers to be the *"major risks"* of this approach and again refers to the Applicant's *"track record"*. These are all addressed by my comments in row 5 of this table and the continual updating and review of the model and conceptualisation over the life of the project. The IESC was comfortable with this approach and I consider that it is appropriate and represents standard practice.
31.	63-64	This issue is addressed in paragraphs 5.7 - 5.10 of my First IESC Statement.
32.	65	As is acknowledged by Dr Currell in the last sentence of this paragraph, the issues he raises in this paragraph relating to calibration have been determined by the IESC to be dealt with by future processes in the conditions rather than prior to approval. In my view,

[6] First IESC Report, pages 102 and 103.

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		these issues are appropriately addressed by the various conditions requiring review and updating of the model as referred to in row 5 of this table.
33.	66-69	The issues raised by Dr Currell in these paragraphs about faulting are addressed in row 18 of this table.
34.	70-75	Dr Currell suggests that a number of matters from the 2014 IESC Advice have not been addressed. I refer to row 2 of this table.
35.	76-77	Dr Currell refers to water quality issues in the mine voids as being unresolved. I refer to condition 18 of the EPBC Approval conditions which addresses final landforms and voids and requires the Applicant to prepare (and have approved by the Federal Minister) a final land use and rehabilitation plan that must include long term contaminant modelling within pit lakes of each final void as well as addressing the final landform and void management measures outlined in the 2106 IESC Final Advice. The Draft EA already imposes conditions to accommodate such a rehabilitation plan, with a specific overarching obligation to avoid *"serious environmental harm to land, surface waters or any recognised ground water aquifer"*[7]. Conditions H19, H25 and H26 include final void specifications, and impose obligations to investigate final voids and report to the administering authority regarding acceptance criteria for residual void design. In my view, these conditions will require the Applicant to address the IESC's remaining concerns about mine void water quality issues.
36.	81	I refer to row 28 of this table as to Dr Currell's comments about early warning bores.
37.	82	I refer to row 26 of this table as to Dr Currell's comments about water-level baselines needing to be established.
38.	83	I refer to row 9 of this table about connectivity between hydrogeological units.
39.	84 and 85	Dr Currell makes trivial criticisms of the conditions and suggests that he does not consider that the Federal Minister is the appropriate decision maker.
40.	86	Neither the IESC nor I agree with Dr Currell's conclusion in this paragraph about the timing of collection of further data and updating of the model. I believe that there are adequate conditions to ensure that these matters are addressed periodically over the life of the project. I refer to row 5 of this table.

[7] Draft EA, pages 38-40.

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Statement of evidence - Professor Adrian Werner dated 10 March 2017		
41.	5	Like Dr Currell, Professor Werner's conclusions about the modelling focus on issues that he claims are still outstanding from the AEIS modelling. He dismisses the IESC's conclusion that issues raised by them have been satisfied and deems it *"surprising"*, apparently because it doesn't accord with his expectations regarding *"adequate levels of reliability"* at this stage of the process. He fails to acknowledge rigorous conditions that require the monitoring network, the model and the conceptualisation to be reviewed and updated periodically over the life of the project. He also fails to acknowledge the extensive involvement in this review process by qualified persons, various State regulators, the Federal Minster and, if the Federal Minister considers appropriate, the IESC. Like Dr Currell, Professor Werner imposes his own subjective assessment as to what the model is required to demonstrate at this stage of the approval process as if there was some mythical threshold level of reliability that can be defined, or indeed, attained before approval. His view is not shared by the various regulators, all of whom consider that there is a sufficient understanding of the likely nature and magnitude of groundwater impacts from the Expansion and that this understanding will be further enhanced through the implementation of the various conditions post approval. I agree with this approach and consider that it to be standard practice. Where Professor Werner sees *"uncertainty", "critical"* and *"significant short-comings"* and *"misconceptions"*, the IESC, considering the same information conclude that *"The methods and data used by the proponent in their updated groundwater modelling … are appropriate for this stage of the proposed project and consistent with industry standards."*
42.	6	Professor Werner embarks on a discourse on the relative merits of the SLR sensitivity approach and the Durick approach. He points out that the two modelling approaches i.e., that of SLR and that of Durick are both relevant. On the one hand, SLR remove faults and recalibrate before running the predictive scenario. This approach is generally undertaken as an **Uncertainty Analysis** that explores the predictive uncertainty associated with the implementation of faults. Professor Werner's use of the term "conceptual error" in this context is incorrect. The correct term is "conceptual uncertainty". On the other hand, the Durick approach in which faults are removed and predictions run without calibration is a classic **Sensitivity Analysis** that illustrates the sensitivity of the prediction to a variation in a key model parameter or boundary condition (in this case the inclusion of faults). I agree with Professor Werner that both approaches have merit and are informative. However, when discussing the 2016 IESC Final Advice and in trying to understand why the IESC appear to have changed their position on the value of the groundwater modelling, it is the sensitivity analysis of Mr Durick that is most often referred to. For example in item 3b on page 3, the IESC state: *"By modelling groundwater drawdown without horizontal flow barriers to represent the fault, assuming all other model parameters and structures remain the same…"* This description is consistent with the sensitivity analysis as applied by Mr Durick. The important conclusion can be gleaned from both modelling methods and that is that the inclusion of the faults in the AEIS model has a very small impact on the overall drawdown predictions that help design the Bore Assessment program and the Make Good Agreements. The conclusion can be drawn from both the sensitivity analysis of Mr Durick and from the Uncertainty Analysis of SLR. The IESC appear to place a great deal of significance on this finding. In paragraph [6] e) on pages 5 and 6, Professor Werner offers some interesting observations. He states that *"Calibration does not*

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		*necessarily produce the **right answer** (emphasis added) if the conceptual model has significant errors in it."* The statement indicates that in Professor Werner's mind, calibration will produce the **right answer** if the conceptualisation does not have significant error. Professor Werner's statement is quite misleading. In groundwater modelling there is never a right answer. A model can never be produced that includes all of the hydrogeological detail that influences groundwater behaviour. We are always dealing with the wrong model. While groundwater modellers strive to reduce the degree to which a model produces unreliable outcomes, our expectations are often limited to producing a model that is consistent with our conceptual understanding of the site and is consistent with observations of historic groundwater behaviour as illustrated in calibration. Accordingly, our predictions are always uncertain. The robust use of groundwater modelling requires an understanding of the limitations and uncertainties of the model and implementation of processes and management measures that adequately deal with these limitations. In paragraph [6] e) iv), Professor Werner refers to apparent inconsistencies in the alluvium drawdown maps presented by Mr Durick and SLR. When reviewing these figures, the only discrepancies apparent to me are within the Lagoon Creek Alluvium which has recently been determined, by drilling, as being dry. Accordingly, any drawdown representation in this part of model is not appropriate.
43.	7	In these paragraphs, Professor Werner appears to be confused (and adds to the confusion) as to the proposed program of data collection, conceptualisation review and model update. He notes that, with respect to paragraph [7] c), *"For example, the pump test of a section of a large-offset fault (SLR 2017) shows significant leakage, and yet modelled faults use parameters that represent impermeable structures (aside from the ones that have 'gaps')."* Professor Werner appears to be criticising the fact that the AEIS model has not yet been updated to reflect the increased information on the faults obtained from the investigations described in the Fault Hydrogeological Investigation Program Report. The status of the groundwater modelling work is described in the Groundwater Model Update - Phase 1 Completion Report which is referred to as SLR, 2016d in Professor Werner's statement. It is clear that the model is in its early stages of revision and that it has yet to be calibrated. The report includes a description of how the faulting in the model will be re-conceptualised to include information gained from the investigations in the Fault Hydrogeological Investigation Program Report. In respect of Professor Werner's comments in paragraph [7] d) regarding previous model predictions being superseded as a result of the review and updating of the model and conceptualisation, I refer to row 4 of this table. In respect of Professor Werner's comments in paragraph [7] e) regarding inclusion of take from the Oakey Creek alluvium, I refer to row 15 of this table and the various conditions addressing this issue.
44.	8	As to Professor Werner's suggestion that there are issues outstanding from previous IESC advices that were not addressed in the 2016 IESC Final Advice, I refer to row 2 of this table. In paragraph [8] a) ii) 2, Professor Werner indicates that *"The issues of bias and uncertainty raised by IESC (2015) do not appear to have been addressed in the available reports produced by NAC."* His opinion on this matter is shared by neither the IESC nor me. The issue of bias relates to a perceived systematic under-prediction or over-prediction of heads or drawdown. The problem will be manifest in the calibration and, in the Groundwater Model Update - Phase 1 Completion Report, SLR has proposed a number of steps to improve the calibration that will help to address any issues of bias. In particular the IESC has highlighted the addition of groundwater

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		extraction from nearby users and on page 3 of the IESC 2016 Advice, it states *"Improvement of the groundwater model's calibration in alluvial bores is proposed to be undertaken through incorporation of surrounding groundwater user abstraction rates in updated groundwater model predictions. Further, the proponent proposes to consider adjusting the weighting values applied to groundwater user bores to improve groundwater model calibration in the alluvium (SLR, 2016d). This will enable the model predictions to better match modelled and observed water levels in the alluvium."* I also refer to row 15 of this table. In paragraph [8] b) i) on page 13, Professor Werner questions whether the IESC has adequately responded to the question *"Does the proponent's revised groundwater modelling provide a reasonable prediction of the expected maximum range of groundwater drawdown for the proposed mine?"* Professor Werner appears to place some importance on whether or not the IESC assessment of the *"likely range"* of drawdown is consistent with the *"expected maximum range"* of drawdown as queried. In fact, he goes further by removing the word *"expected"* in the *"expected maximum range"*, and questions the difference between the *"likely range"* and the *"maximum range"*. The issue is not relevant since the question posed is in regard to the *"expected maximum range"*. In my view, the IESC consideration of the *"likely range"* of drawdown will include the *"expected maximum range"* of drawdown. I see no inconsistency in the IESC response. In paragraph [8] b) ii) on Page 14, Professor Werner states *"I have relatively low confidence in modelling predictions, which I do not expect have captured* ***"the maximum likely extent of drawdown"****(emphasis added)."* He is apparently quoting something in this sentence but fails to identify the source and I can find no such expression in any of the documents referred to in my evidence. In paragraphs 8] b) ii) and iii), he then proceeds to discuss the Confidence Level Classification for the model as defined by the Australian Groundwater Modelling Guidelines and tries to argue that the model is in some way inconsistent with the Guidelines because the duration of and stresses included in the calibration do not match those in prediction. His argument is inconsistent in that he appears to accept that the model meets a Class 2 level but then criticises the fact the duration of calibration and stresses included in calibration are not similar to those in prediction. While the points raised in this discussion are important, they should not be construed as an inconsistency or flaw in the modelling approach. The reality is that Table 2-1 of the Guidelines indicate that for a Class 2 model, it can be expected that the predictions may be between 3 and 10 times longer than the calibration period and that the level of stresses included in prediction may be between 2 and 5 times greater than those in calibration. In other words, the current AEIS model is perfectly consistent with a Class 2 Confidence Level and that Professor Werner's lack of confidence in model predictions cannot be justified by quoting the Confidence Level Classification criteria as he appears to suggest. In paragraph [8] b) iv), Professor Werner suggests that "*it is not clear whether [the IESC] considers the project greenfield, brownfield or mine site exploration and this has significant bearing on the expectations of the modelling"*. Professor Werner appears to suggest that both I, and the IESC, have erroneously considered the Expansion to be a greenfield site. Professor Werner has misinterpreted my First IESC Statement. I did not suggest that the Expansion is a greenfield site. Rather, at paragraph 4.5(a) of my First IESC Statement, I suggested that the level of data available for the Expansion is far greater than a greenfield mine site. Likewise, I believe that the IESC would not have considered the Expansion to be a greenfield site given their knowledge that it is an expansion of an existing mine. To suggest otherwise effectively implies that the IESC are imprudent. Further, Professor Werner seems to consider that an expansion should be subject to a great level of scientific assessment than a

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		greenfield site. I do not agree. In the case of an expansion, there may be more data available which allows for a more sophisticated modelling approach including stochastic methods to calibrate and run predictive scenarios. Such a sophisticated approach has been adopted for the Expansion. These methods are likely to provide a more rigorous assessment of future impacts, and the uncertainties of those predictions, than a deterministic model, either uncalibrated or calibrated in steady state, that may be the only approach available for a greenfield site with less data. However, in my view, the assessment process should be the same. In paragraph [8] c), Professor Werner seems to suggest that I criticised the experience of Professor Craig Simmons in my First IESC Statement. That is not the case. In paragraphs 4.51 to 4.52 of my First IESC Statement, I merely noted that the addition of two groundwater scientists has brought a great deal of practical, rather than academic, experience to the committee. Indeed Professor Werner's defence of Professor Simmons by referring to his publication track record simply ignores the main thrust of my comment – and that is that Dr Timms and Dr Walker bring with them a good deal of practical groundwater experience to the Committee. In paragraph [8] d) and [8] g) iii), Professor Werner suggests that a sensitivity analysis on the DRN package (representing groundwater discharging to the ground surface) should be undertaken. While I agree that this issue should be considered, I see no reason for it to be done before approval. In my opinion and based on my experience in modelling of mines and excavations, the reduction in groundwater discharge to the ground surface as Professor Werner refers to in the paragraph, will provide insignificant mitigation to pit inflow estimates and the associated drawdown impacts. In paragraph [8] e), Professor Werner suggests that more rigorous sensitivity and uncertainty analyses are required. While I agree with Professor Werner that the presentation of modelling uncertainty is an important issue for any groundwater modelling project, I would like to provide some clarification on this point. The stochastic modelling approach adopted by SKM and SLR in the AEIS modelling provides an excellent representation of uncertainty that far exceeds the level of uncertainty analysis commonly undertaken for Environmental Impact Assessment across most industry and government sectors in Australia. In this regard, I draw on my experience in groundwater modelling and reviewing of groundwater models that have been prepared for mining, water resource allocation, underground construction, infrastructure, irrigation, salinity control and municipal water supply purposes. Professor Werner's inference that the current work is lacking in this area is, in my opinion, unwarranted. In paragraph [8] g) i), he repeats issues about faulting that I have dealt with in rows 18 - 21 of this table. In paragraph [8] g) iv), he refers to recharge and says there are no plans to improve the estimation of recharge. This is not correct and is required by the conditions. I refer to row 16 of this table. In paragraph [8] g) (v), Professor Werner criticises the lack of plans to use multiple calibration statistics. I refer to paragraphs 5.8 - 5.10 of my First IESC Statement as to the plans for calibration of the next model update. Professor Werner suggests that his position on the use of multiple calibration statistics is supported by Guidelines. He states *"No plans to use multiple calibration statistics are in place, despite the Guidelines' recommendation to do this."* I am unaware of any such recommendation in the Australian Groundwater Modelling Guidelines that would support his view. In paragraphs [8] g) (vi) to (viii), Professor Werner raises a number of concerns regarding the model design. These include whether the model will be capable of simulating seasonal fluctuations, whether recharge from streams will be simulated and how the pit lakes will be

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		simulated. Professor Werner is correct in that the model will at this stage not simulate seasonal fluctuations. I do not share Professor Werner's concern that this is an important issue. In future, should it be determined by the relevant regulators that seasonal variability in heads and fluxes are of importance, then such an approach can be implemented. At this stage, I believe that it is not warranted and I believe that my view is shared by the IESC and by the environmental regulators, none of which have to date noted any concerns on this matter. With regard to recharge from streams, I can confirm that this will be simulated through the appropriate implementation of the MODFLOW RIV package. Modelling of the final land form including the pit lake formation in the mining voids is an important aspect of the modelling that must be addressed and I refer to condition 18(ix) of the EPBC Approval conditions which requires the Final Land Use and Rehabilitation Plan to address the final landform and void management measures outlined in the 2016 IESC Final Advice. In paragraph [8] h), Professor Werner expounds the importance of modelling the cumulative impacts of the mining operation. He raises a relevant point in that it is important to consider the combined impacts of all actions that may impact on the future availability and quality of water in the region, including any residual impacts that may arise from Stage 2 mining activities. While I agree that such an assessment is warranted, I do not believe that impacts associated with Stage 2 mining will be significant. This belief is based on the fact that Stage 2 mining is generally being undertaken at higher elevations and that Stages 2 and 3 mining are unlikely to be contemporaneous (depending on the timing of the Stage 3 approval). When mining for Stage 3 commences, groundwater levels will be recovering from the cessation of Stage 2 mining. In fact, the maximum groundwater impacts arising from the Stage 2 operation will be manifest at the completion of Stage 2 which is scheduled for the middle of 2018 and will mostly be captured in the current round of model calibration.
45.	9	Professor Werner states: *"I disagree with statements in SLR (2016d; P7) that imply that the pump test (sic) will allow for parameterisation of all faults in the study area."*. I can find no such statement or implication on page 7 of SLR 2016d (Groundwater Model Update - Phase 1 Completion Report). SLR is not proposing to use the pumping test results to parameterise all faults at the site. On page 7 of the Groundwater Model Update - Phase 1 Completion Report, SLR clearly describes a method in which a small, *"subset"* model will be constructed and calibrated to observations obtained during the pumping test and that this model will help to determine appropriate parameters for faults that create a similar level of aquifer dislocation as that of the tested fault. Faults that include a smaller degree of aquifer dislocation will be parameterised in a manner that respects the level of dislocation relative to that of the tested fault. There is no plan to simply apply pumping test results to parameterise all faults in the area.
Response to Supplementary Statement of Evidence to the Land Court by B.G. Barnett - by Noel Wieck dated 10 March 2017		
46.	General	I am informed by Clayton Utz as follows: • Pursuant to orders 4 and 5 of the Court's Orders dated 2 February 2017, the Respondents were required to provide lay witness or expert statements. • Mr Wieck's statement purports to give evidence on technical matters for which he has not been put forward as an expert.

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		• His statement is not an expert statement of evidence in accordance with the Land Court Rules nor has it been sworn as an affidavit (being the usual manner in which lay witness evidence is given). • His statement is in the nature of submissions, which are not due to be filed by the parties until after the hearing. Accordingly, I respond below to only certain issues which are within my area of expertise and require response.
47.	Paragraph 2 on page 1	Mr Wieck questions my involvement as a peer reviewer of current and model upgrades given my evidence to the Land Court regarding the modelling of a fault that Mr Wieck has described as MD01. He states that I have been inconsistent in my opinions as to whether or not this fault should be included in the model. I would like to reconfirm my earlier evidence *"The faults included in 2009 are one particular representation of faults that may explain the observed pre-mining groundwater levels at the site. I am sure that there are alternative representations of faults that could achieve a similar level of calibration. In this regard I can conclude that there was limited confidence in the faults included in the model in 2009."*[8] At the time I was involved in model development, I had no pre-conceived expectations as to which faults should or should not be included in the model. I still retain that view – except that now there is additional evidence emerging as to the degree to which some of the faults present at the site inhibit groundwater movement. My current position is that, as evidence on faults is further enhanced through more data collection as required by the conditions, as peer reviewer, I am happy to consider other faulting arrangements that are consistent with the current understanding of the groundwater flow processes and the hydrogeology of the site. Mr Wieck appears to criticise the location of the pumping test and argues that a location closer to one of the mining pits would have provided more useful information on the final pit voids. The investigations in the Fault Hydrogeological Investigation Program Report were aimed at characterising some of the more important faults that are present at the site. I have consulted SLR on this point and I can confirm that the location was chosen because the MD01 was known to be present, existing drillhole data provided useful information on which to define the aquifer, due to the fault geometry (including the level of aquifer dislocation) and due to the fact that there were already a number of existing bores at this site that could be used as part of the test. When considering the aims of the test, there is no reason to assume that a site closer to the proposed mining pit is better than other sites further form the pit. Mr Wieck criticises the choice of pumping bore and wonders what result would have been obtained if a nearby, lower yielding bore were used for the test. I do not share Mr Wieck's concerns on this matter. One of the important features of a pumping bore used in a pumping test is that its yield must be sufficiently high to create a measurable drawdown at nearby observation bores. In this regard, the SLR choice of using the higher yielding bore is quite appropriate.
48.	Paragraphs 2 and 3 on	Mr Wieck makes certain statements about underground streams being located in the vicinity of certain bores. There is no scientific evidence to support Mr Wieck's claims and indeed the notion that there are a number of interconnected underground streams at this

[8] Annexure C, B Barnett statement of evidence of 10 May 2016 (Document ID: NAC.0083 (Exhibit 826)), page 31.

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	page 2	site is contrary to all geological knowledge and groundwater observations compiled over the duration of the mining and the investigations. I agree with Mr Wieck's contention that *"The fact that groundwater models were run with and without faults, having no noticeable difference, proves that faulting is of no consequence to groundwater movement."* This conclusion is in line with the IESC conclusions on this matter and, in my opinion, has been instrumental in the change in its position on groundwater modelling issues as seen in the 2016 IESC Final Advice.
49.	Paragraph 2 on page 3	Mr Wieck suggests that final voids should be backfilled as referred to by the IESC. I refer to condition 18(ix) of the EPBC Approval conditions which requires the Final Land Use and Rehabilitation Plan to address the final landform and void management measures outlined in the 2016 IESC Final Advice. The Draft EA contains conditions for the final void design and specifies the post-mining land use for final voids. The Draft EA further contains conditions dealing with final void design (such as slope range and maximum surface area).[9] The Applicant will be required to prepare a Final Land Use and Rehabilitation Plan that will detail the design of final voids and post-mining land capability, and will further be required to investigate and report on rehabilitation of final voids.[10]
Response to the IESC 2016-081 Advice by John Standley dated 10 March 2017		
50.	General	I refer to row 46 above. The same comments apply to Dr Standley's response. Dr Standley's "response" document generally comprises a series of rhetorical questions and statements. I am informed by Clayton Utz that any response is a matter for closing submissions. Accordingly, for the purposes of my expert statement of evidence to the Court, I have not responded to this document apart from the issue below. Dr Standley refers to fault maps as being *"suspect"* (paragraph 3a, page 2) and *"…the deliberations in the Land Court indicated that they were invalid…"* (top of page 5). I am unaware of any finding of the Land Court that would support Dr Standley's assertions on this matter. I am aware that modelled faults included in the AEIS and earlier versions of the model have been criticised by expert witnesses representing the OCAA and previously by the IESC. However, my position was that the faulting represented in these earlier models was one possible representation of the faulting that may explain the observed pre-mining groundwater levels at the site (refer row 47 above). In any event, as a result of the sensitivity analyses conducted by Mr Durick and SLR, additional work in relation to the faults undertaken by SLR and the future plans provided to the IESC with respect to dealing with faults, the IESC has effectively dropped its previous concerns regarding how faults will be dealt with going forward. Its concerns in this regard have now condensed to *"Verification*

[9] Draft EA, conditions H22-H26, pages 39-40.

[10] Draft EA, conditions H16, H24, pages 37, 39.

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		of fault with strike to the southeast needed if it is to be included in the model. Analysis of groundwater behaviour associated with this fault to determine if a barrier/conduit. However, running model without faults addresses this uncertainty."[11] Dr Standley states *"It has been my impression that the aim of the modelling has been principally to study problems of flow into the pits as mining progresses, with the effects on the surrounding landholders and their water supplies being a secondary consideration. This is also the impression conveyed by Mr Holt QC when cross examining Mr Durick…"* My understanding is contrary to Dr Standley's impression. The work was in my opinion primarily aimed at assessing the drawdown impacts of future mining operations.

[11] Refer paragraph 4.43 of my First IESC Statement.