I have read over IESC review and Rau *et al* (2018) paper. Below are my thoughts so far:

I concur with most of the points and issues IESC have raised. My additional comments are listed below based on the IESC numbered points:

1 (a) i
The IESC considers 'a scenario-based approach to uncertainty analysis is suitable as it is commensurate with the relatively low risk from the project'.
I don't understand how IESC can say this given their further comments in their review. Vickery's EIS established a low risk from the project based on the limited drawdown effects which were based on Noel Merrick's groundwater modelling...which IESC has rightly called into question.

If the specific storage parameter has been overestimated by Noel, leading to an underestimation of groundwater level drawdown in Layer 2 (which includes the Namoi Alluvium (Gunnedah Fm), regolith and Permian overburden rock) then the project is not 'relatively low risk' and the 'scenario-based approach to the uncertainty analysis' is NOT suitable.

1 (a) ii
I concur with IESC.

1 (a) iii
I agree with the IESC in requesting that a 'full range of plausible parameterisation for specific storage' should be included in the modelling which informs the drawdown effects.

First of all...Specific Storage is directly related to the compressibility of confined aquifer and its ability to release groundwater. If the specific storage is high then it can release a volume of groundwater with minimal drawdown in the aquifer, while the confined aquifer is still saturated. If the specific storage is low then the aquifer is not so capable of compressing and releasing groundwater and the aquifer drawdown becomes larger.

Noel has arrived at the specific storage value of 5E-3 which the model itself has determined as a result of 'parameter optimisation' during transient calibration. Noel states in his report that 'The overall performance of then transient calibration is quantified by a number of statistics in Table A-16. The key statistic is 2.6% Root Mean Square (RMS), which is well below the groundwater modelling guideline value of 5-10% (MDBC, 2001; Barnett *et al*., 2012) for acceptable model calibration'. Therefore Noel can be assured that optimal parameters have been determined for the groundwater model calibrated for transient state conditions. However, in my view that doesn't always mean the aquifer parameters are meaningful in the real world. Noel hasn't presented any published literature, or aquifer tests at Vickery, in support of this value for specific storage. In addition, no groundwater model is unique. There is no one real specific storage that represents the whole alluvial aquifer. Noel should have at least looked at a range of specific storage values. The same can be said for the other hydraulic parameters.

Rau *et al* (2018) found that the maximum value for specific storage for sand and clay hydrostratigraphic units is 3 E-5 (these types of aquifers are the most compressible). However, again I believe there will be a maximum range of specific storages. They state that if a higher specific storage is used in a groundwater model then we can assume the model is not realistic. So Noel's modelled specific storage for the confined lower Alluvium in Layer 2 (Gunnedah Fm) is high compared to Rau *et al* 2018 research.

Noel did not have the benefit of knowing the outcome of Rau *et al* 2018 paper when choosing a specific storage value of 5 E-3. I believe Noel should at least go back and test the model for a lower specific storage of 5E-5. This is why I highlighted in my review that a Monte Carlo type uncertainty analysis should be undertaken to determine the full range of plausible parameterisation for ALL aquifer hydraulic properties. Noel knows this too but says the model is too big. As I stated in my earlier review this is not good enough in this day and age of technology.

The IESC's comment that "the IESC notes that the specific storage values used in the alluvial areas of the model layer two could be unrealistically high. This may cause the predicted extent and magnitude of drawdown to be underestimated and could result in non-compliance with the NW Aquifer Interference Policy" is valid and important.

I also completely agree we your colleagues that 'if we can claim the wrong GW parameters were used, then possibly the original approval can also we called into question'.

1 (a) iv
Well picked up by IESC.

IESC asserted that the peer reviewer stated in his review that the 'applied evapotranspiration rates and volumes appear to be low, which may be compensated for by the application of low recharge in the calibration' (EIS attachment 4, p5). I have not seen this attachment but believe it must be Dr Kalf's peer review as he was the only peer reviewer for the groundwater model. In Dr Kalf's peer review I have read (EIS Appendix A attachment 7) he stated that 'gross recharge was applied in the model as a variable percentage of rainfall over different geological zones as well as evapotranspiration'. I do understand from Andrew Druzynski, Groundwater Modeller and Hydrogeologist, DOI Water, that this proxy method is commonly used but is not the best solution. So what Dr Kalf is saying is that in areas where the evapotranspiration is low Noel has compensated by lowering the effective recharge in the model cells in the area of recharge.

What IESC are saying is that 'compensation in this manner is only suitable under a narrow subset of conditions'. I am not sure what these conditions are?

However I believe that by lowering recharge where it actually occurs to compensate for low evapotranspiration elsewhere in the groundwater model may lead to less recharge via throughflow to deeper hydrostratigraphic layers (deeper alluvium and the Permian overburden layers). I can find out more from Andrew if you would like me to?

1 (a) v
The IESC questioned that 'no flow boundary' with a 'general head boundary' right next to it in the western and southwestern part of the groundwater model.
I thought arranging the boundaries like this was okay. The 'no flow boundary' is there as it is the limit of the catchment boundary where outcropping Permian low permeability rock is outcropping. The 'general head boundary' is only for Layers 1 and 2 for the water level in the colluvium. That is how I read the model.

1 (b) through to (g)
I agree.

2 (a)
I Agree with IESC but I assumed all the bores will be monitored. I believe there is sufficient coverage of all major hydrostratigraphic units. However, I am happy for IESC to pin down Whitehaven to produce more details in their groundwater monitoring plan which is supposed to be done in consultation with DOI Water anyway.

2 (b) through to (k)
I completely agree with IESC