Fingerboards Mineral Sands Project — Inquiry and Advisory Committee (IAC)

Expert meeting statement — Water balance & water management

Meeting held: *Monday 29th March 2021. Online*

Experts:

Experts	Organisation	Representing
John Sweeney	Coffey Tetra Tech	Kalbar
Jarrah Muller	EMM Consulting	Kalbar
Tony McAlister	Water Technology	Kalbar
Associate Professor Anthony Kiem	University of Newcastle	East Gippsland Shire Council

Observers:

Observer	Organisation	Representing
Mick Hannan	EPA Victoria	

Note taker:

John Sweeney

The key issues and areas of agreement and disagreement were identified by the participating experts at the meeting are described in this document.

The following guidelines are referred to in this document:

Ball, J., Babister, M., Nathan, R., Weeks, W., Weinmann, E., Retallick, M., & Testoni, I. (Eds.). (2019). *Australian Rainfall and Runoff: A Guide to Flood Estimation, Commonwealth of Australia.*

DEWLP. (2016). *Guidelines for Assessing the Impact of Climate Change on Water Supplies in Victoria.* Melbourne: Department of Environment, Land, Water and Planning.

Item No.	Issue	
1	***Appropriate application of the available climate record and the water balance modelling approach.***	
	Matters of agreement	
	No.	**Agreed fact/opinion**
	1.1	*There is inherent uncertainty in water balance model predictions, particularly when accounting for future climate scenarios.*
	1.2	*Each drought or flood event is different. Future droughts or floods may be different to those in the historical record and therefore different from those simulated in the model.*
	1.3	*Stochastic climate modelling (not conducted for the EES) is one method of assessing climate events beyond those that have occurred in the historical record.*
	1.4	*The water balance modelling completed for the project considers a limited range of plausible drought conditions.* *The effect of drought conditions worse than those modelled would be reduced availability of water supply from the Mitchell River.*
	1.5	*The DELWP 2016 'Guidelines for Assessing the Impact of Climate Change on Water Supplies in Victoria' recommends the 'current climate' baseline is from 1975 to date. The shortening of the baseline period, compared to historical baselines, is designed to reflect climate behaviour at the current level of greenhouse gas concentrations.*
	1.6	*The water balance modelling reported in the EES used:* • *a climate baseline of 1938-2018 when reporting Mitchell River winter fill supply reliability; and* • *a climate baseline of 1900-2018 when reporting all other results.* *Modelling restricted to 1975-2018 would be expected to:* *a) predict less runoff on average, with* *- less water reporting to water management dams; and* *- lower flows within the Mitchell River* *b) predict lower frequency of discharge from water management dams to the downstream environment;* *c) require reduced use of the DAF and result in less offset water being returned to the Michell River; and* *d) increase the frequency of restricted winter fill allocation, and increase the reliance on an external water supply from the Latrobe Group aquifer.* *Item d) is apparent in model results presented in Muller's Expert Witness Statement, though items a), b) and c) have not been explicitly reported for the period 1975-present.*
		Assumptions relied upon in reaching agreement
	1.7	*The proponent is suitably informed that the modelling represents one possible scenario in a range of outcomes, and has allowed for this uncertainty and reduced water supply security in their planning.*
	1.8	*The water balance model has applied the 1901 to 2017 climate record which considers historical, protracted droughts such as the 1997-2010 Millennium drought and the 1937-1945 World War II drought.*
	1.9	*The recent 1975-2018 climate record is drier than the full record applied by the water balance model.* *Rainfall percentiles for various periods, using data published by SILO for Lindenow* (mm/yr)*:*

Item No.	Issue		
		Percentile / **1900-2018** / **1938-2018** / **1975-2018** 90% / 880 / 879 / 802 50% / 650 / 652 / 652 10% / 481 / 444 / 456 *SILO: SILO is a database of Australian climate data from 1889 to the present. SILO is hosted by the Queensland Department of Environment and Science (DES). The data system began in 1996 as a collaborative project between the Queensland Government and the Australian Bureau of Meteorology (BoM).*	
	1.10	*The project's water supply strategy (presented in the EES) assumes that a temporary or permanent licenced groundwater allocation can be obtained from the Latrobe Group aquifer for use by the project during periods (such as drought or as a result of climate change) when access to surface water may be restricted. As the Latrobe Group aquifer is fully allocated, Kalbar will be required to successfully seek, purchase, and transfer the required allocation from an existing licence holder(s) within the same Water Supply Protection Area. This also requires Southern Rural Water (SRW) to approve the licence application. We understand that no assurances have been made by SRW that a licence application will be approved for the project.*	
		Individual comments in respect of agreed fact/opinion	
	1.11	*Anthony Kiem*	*The likelihood of protracted droughts or flood events, and uncertainty may be misrepresented in the reporting. Emphasis on a range of potential climate events, not just those experienced in the available climate record should be made. Recent research from the University of Melbourne suggests that applying the full rainfall-runoff record (including periods of protracted drought) significantly overestimates the runoff. The mine operators and the IAC should consider this uncertainty.*
	1.12	*Jarrah Muller*	*The exact likelihood of a drought or flood occurring in the future is unknowable, but planning can incorporate and respond to this uncertainty. The modelling shows that droughts are possible which would prevent utilisation of a winter fill license, and that the site requires a secondary water supply capable of supplying the entire site water needs.*
	1.13	*John Sweeney*	*There is inherent uncertainty in water balance modelling which has been addressed by the mitigation measures and commitments made by the proponent, as documented in the EES. Based on the discussion during the conclave, I do not believe that additional work to further reduce uncertainty is warranted for the purpose of the EES as it would be unlikely to change the assessed risk to the environment or result in altered mitigation measures. These are noted to be important considerations for proponent's mine planning and water supply security.*
	1.14	*Tony McAlister*	*I agree and concur with the comments made by John Sweeney.* *I also note that all project works on the site will be subject to openly available and auditable local and regional environmental (groundwater levels and quality, surface water quality in the Mitchell and Perry Rivers etc) monitoring. Should this monitoring show any unacceptable or unexpected changes, modifications to site operations (best case) or scaling back (or temporarily halting) mining operations (worst case) can take place.* *All modelling and project planning has inherent uncertainty and operation of a project within an **adaptive management framework**, once one is assured that there are no fatal flaws or major impacts associated with a project (as I am), is the best way forward.*

Item No.	Issue		
		Agreed actions:	**Suggested timing:**
		Nil	
	Matters of disagreement		
	No.	**Summary of fact/opinion not agreed**	
	1.15	**Stochastic climate modelling**	
		Anthony Kiem	*Stochastic climate modelling should be included in future revisions of the water balance model to support detailed design of water management dams, the water management system and to inform the project's water supply security.* *The DELWP 2016 'Guidelines for Assessing the Impact of Climate Change on Water Supplies in Victoria' recommend considering droughts worse than the worst on record. The Millennium Drought, used for sensitivity testing in the water balance modelling, is an "on record" drought and even considering two "on record" droughts back-to-back is not the same as considering droughts worse than the worst on record. Two Millennium Droughts back to back just extends the duration of the drought beyond the worst seen on record. Duration is just one aspect of drought that needs to be considered. Other drought aspects that need consideration are the timing, magnitude of rain deficit, and spatial extent (important when relying on surface water or groundwater allocations that might come from outside the catchment of interest). This is why stochastic modelling is used – to assess impacts of droughts that have different duration, timing, magnitude, and spatial extent than those seen in the historical record. Drought duration is assessed by the DELWP guidelines for short term applications but the other aspects of drought are not.* *Impacts of not considering droughts worse than (or different to) the worst on record are seen with each big drought experienced (i.e. the World War II drought had different duration/timing/magnitude/spatial extent to the Federation drought and this caused big problems, then we planned using World War II drought as the worst drought and the Millennium Drought happened and it was different again and caused even bigger problems – and the same could happen again unless stochastic modelling is used more routinely to quantify the impacts of plausible droughts that have different characteristics to those seen in the instrumental record).* *It is understood that serious droughts will require an extended duration of groundwater use. My question (and concern) is how is it known that the groundwater will be available?"*
		Jarrah Muller	*Stochastic climate modelling is not required for a project of this type. The summary results of stochastic modelling are already known, which is that droughts could be worse than we have seen. No new management plans would result from modelling using stochastically generated climate data, so the effort is not warranted.*

Item No.	Issue		
			The DELWP 2016 'Guidelines for Assessing the Impact of Climate Change on Water Supplies in Victoria' recommend considering droughts worse than the worst on record, but do not recommend stochastic modelling for short term applications. The Fingerboards mine life should be considered short term. The DELWP guidelines recommend that for short term applications, historical droughts are considered, plus permutations such as two Millennium Droughts back-to-back for sensitivity testing. *In the case of the Fingerboards project, on site water storages can contain less than 1 year supply of water, which will readily be depleted if winter fill allocation is not available due to drought. Back-to-back droughts would mean an extended duration of groundwater use, but otherwise no change in management response.*
	1.16	**Environmental impacts**	
		Jarrah Muller	*Revising the water balance model to be consistent with DELWP guidance (as per A.Kiem's comments at 1.5, above) would not increase the environmental impacts to the surface water environment beyond those already assessed by the EES, assuming effective application of the proposed mitigation measures.*
		Anthony Kiem	*We cannot know what the effects are without doing the modelling work.*
		John Sweeney	*The condition of the winter fill licence prevents the proponent from extracting surface water under drought conditions (or any low flow periods). The severity of length of the drought cannot increase the potential impacts from the project to the surface water environment.* *Similarly, increased reliance on groundwater due to drought is limited to the capped allocation that may be granted by SRW. Drought won't increase risk to the environment beyond that assessed by the EES.*
		Jarrah Muller	*Groundwater modelling reported in the EES included results representing 100% of water supply from groundwater and 0% from surface water – groundwater usage during extended drought would not exceed the modelled extraction rates, so groundwater extraction impacts cannot be more than those presented. If surface water is used at all, groundwater extraction impacts will be smaller than the results presented in the EES describe.*
	1.17	***SW38 and SW39***	
		Context:	*SW38: Surface water ponding on post-mining landforms will be avoided, where practicable, through appropriate slope profile design and topsoil treatments.* *SW39: The downhill side of containment structures, such as surface water drains and road batters, will undergo soil conditioning and be spread with topsoil and revegetated as soon as practicable to minimise erosion and sediment laden runoff.*

Item No.	Issue		
		Anthony Kiem	*SW38 and SW39 involves changing the catchment characteristics. This will alter rainfall-runoff relationships and could exacerbate the reduction in runoff per unit rainfall already being experienced (especially during droughts). Changes to catchment characteristics such as that proposed in SW38 and SW39 need to be modelled (accounting for the impacts of both climate variability and climate change) so that the impacts of the changes can be quantified and effectively managed.*
		Jarrah Muller	*The water balance considers the change of land use from cleared/mined to revegetated, but does not consider short duration changes in water use of vegetation over time as vegetation establishes.* *These management measures (SW38 and SW39) are common to construction projects and assessment to the level suggested is not warranted. Minor site scale land surface changes will not have meaningful effects on water resources, and revegetation is a required outcome.*
2	***Project water supply requirements***		
	Matters of agreement		
	No.	**Agreed fact/opinion**	
	2.1	*The licence conditions for a winterfill allocation (if granted by Southern Rural Water (SRW)) will restrict the project's ability to extract water when the passing flow in the Mitchell River is below 1,400 ML/day. This is considered to provide adequate protection for year-round irrigators and other surface water users who are permitted to extract surface water at flow rates below the 1,400 ML/day limit during the same period.*	
	2.2	*The EES has adequately documented the contingency if the preferred winterfill allocation from the Mitchell River is not approved or if the approved allocation is limited in a given year due to reduced flow.*	
	2.3	*The currently presented mitigation and management measures (refer to 2.8) are considered adequate to address the potential environmental effects of limited water supply to the project.*	
		Assumptions relied upon in reaching agreement	
	2.4	*The project has not secured water allocations or licences from SRW for the proposed water supply options, and no assurances have been made by SRW that the proposed allocations will be made available to the project.*	
	2.5	*The project has not been given priority access to either groundwater or surface water.*	
	2.6	*The EES has documented that a contingency groundwater supply may be sought from the Latrobe Group aquifer if the preferred winterfill allocation is not approved or if the approved allocation is limited in a given year due to reduced flow in the Mitchell River. Refer to A006, Section 1.4.5 for details of the water supply options considered by the EES.*	
	2.7	*The EES has not assessed any other potential water supply sources (e.g. groundwater from shallower aquifers, or surface water from other systems).*	
	2.8	*The proponent has committed to scaling back (or temporarily halting) the mining operation to meet the available water supply in years where the full supply requirement is not available from either the Mitchell River or the Latrobe Group aquifer. Priority would be given to reserve water for dust suppression and rehabilitation*	
	2.9	*Consideration of the equity or social benefit of granting the 3GL/annum water allocation for the project is outside of the scoping requirements for the groundwater and surface water impact assessment.*	

Item No.	Issue		
		Individual comments in respect of agreed fact/opinion	
	2.10	*Anthony Kiem*	*There is concern that despite the EES considering only the Mitchell River and Latrobe Group groundwater as the two mine water supply options, the proponent may seek alternative supplies during periods of drought or if the predicted supply volume is insufficient.*
	2.11	*Jarrah Muller*	*Nil.*
	2.12	*John Sweeney*	*Nil.*
	2.13	*Tony McAlister*	*Again noting the comments made at 1.13 regarding the operation functioning within an **adaptive management framework** that is based on openly available and auditable local and regional environmental (groundwater levels and quality, surface water quality in the Mitchell and Perry Rivers etc) monitoring*
		Agreed actions:	**Suggested timing:**
	2.14	*Nil*	*Nil.*
	Matters of disagreement		
	No.	**Summary of fact/opinion not agreed**	
	2.15	*Nil*	
3	***Assessment of risks posed by climate change to the project, and implications for the environment***		
	Matters of agreement		
	No.	**Agreed fact/opinion**	
	3.1	*The effect of predicted long-term falling groundwater levels as a result of reduced rainfall recharge under future climates would have negligible effect on the project water balance due to the significant depth of groundwater below the mine site and the time lag between changing climate and aquifer effects.*	
	3.2	*The median predicted climate change scenario has been adopted by the water balance model. A drier climate scenario than the median prediction would reduce water supply security for the project and have similar effects to those summarised in Item 1.6. The environmental risks of a dry climate scenario are likely to be adequately addressed by the existing mitigation measures presented in the EES.*	
	3.3	*The median predicted climate change scenario has been adopted by the water balance model. A wetter climate scenario could result in more frequent discharge of mine contact water from water management dams, beyond that considered by the EES. Such a climate scenario would also see greater background flows in the Mitchell and Perry Rivers - which would increase the dilution of any additional discharges of mine contact water.*	

Item No.	Issue		
		Assumptions relied upon in reaching agreement	
	3.4	*Assumes consistent and effective application of mitigation measures by the proponent.*	
	3.5	*The median climate change scenario has been applied to the Year 15 water balance estimates for mine planning purposes and for presentation in the EES.*	
	3.6	*DELWP 2016 'Guidelines for Assessing the Impact of Climate Change on Water Supplies in Victoria' state that 'confined and deep (>20 m depth) aquifer systems generally respond very slowly or very little to changes in climate'.*	
		Individual comments in respect of agreed fact/opinion	
	3.7	*Anthony Kiem*	*The precautionary principle is not followed if just the median projected change is used to assess climate change impacts. The text should be revised to present the possible range of model outcomes and emphasise the uncertainty.* *What is the contingency plan for the case where the Mitchell River is in drought? And how is it determined when to implement this contingency plan?*
	3.8	*Jarrah Muller*	*The DELWP 2016 guidelines state that the 10th to 90th percentile range of predictions for runoff in 2040 for the Mitchell River catchment is +10.4% to -26.3% with a median result of -11%. In contrast, drought can cause a -90% change to winter fill availability, and so climate variability is of much greater concern through the project life than climate change.* *By assessing the effects of drought reducing winter fill availability by more than 90%, the precautionary principle has been followed.*
	3.9	*John Sweeney*	*The following water supply contingency plan was stated in Appendix A006, Section 1.4.5. "Should river conditions render water supply insufficient to maintain production to the next winter-fill period, water will be sought from the Latrobe Group aquifer. If groundwater is not available operations will taper or cease. Such scaling down of operations will be planned with priority to continue dust control to the following winter-fill period by retaining water or by application of other dust control measures."*
	3.10	*Tony McAlister*	*Nil.*
		Agreed actions:	**Suggested timing:**
	3.11	*Nil*	*Nil*

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<tr><th>Item No.</th><th colspan="3">Issue</th></tr>
<tr><td></td><td colspan="3">Matters of disagreement</td></tr>
<tr><td></td><td>No.</td><td colspan="2">Summary of fact/opinion not agreed</td></tr>
<tr><td></td><td>3.12</td><td>Presentation of the median climate change scenario</td><td></td></tr>
<tr><td></td><td></td><td>Anthony Kiem</td><td>The median predicted climate change scenario has been adopted by the water balance model. The median is not the more likely climate change scenario. All scenarios, including the maximum, are equally plausible. If there are 42 models and all are assumed to be as good as each other (equally weighted) and each produce one scenario then the likelihood of each scenario is 1/42 (2.4%).

Say, for example, there are 5 climate models and each produce a scenario:
Model 1 says 5% increase in rain (+5)
Model 2 says 0% increase in rain (0)
Model 3 says 5% decrease in rain (-5)
Model 4 says 8% decrease in rain (-8)
Model 5 says 10% decrease in rain. (-10)

Median is 5% decrease…….but that situation is no more or less likely than any of the others.

Revised water balance modelling should be conducted to consider a range of plausible climate change scenarios, so that the proponent can adequately manage water supply security, and ensure that adaptive management strategies and water management systems are adequately scaled to address potential future climate scenarios.</td></tr>
<tr><td></td><td></td><td>Jarrah Muller</td><td>If each climate model has a similar level of accuracy and the results taken as equally likely, then a probability distribution of results may be created from the wettest through to the driest. The DELWP 2016 guidelines utilise an ensemble of 42 models and present 10th percentile, 50th percentile and 90th percentile results for rainfall and runoff statistics. For the Mitchell River basin, the DELWP 2016 guidelines present:

Change in rainfall and runoff in 2040 relative to 1975-2014
<table>
<tr><td></td><td>10th percentile</td><td>50th percentile</td><td>90th percentile</td></tr>
<tr><td>Rainfall</td><td>+4.3%</td><td>-2.3%</td><td>-9.7%</td></tr>
<tr><td>Runoff</td><td>+10.4%</td><td>-11.0%</td><td>-26.3%</td></tr>
</table>
(The project is expected to reach completion around 2040)

The extremes of climate change modelling may be summarised as ‘it could get wetter, particularly with more intense storms’ and ‘it could get drier, particularly with longer and more intense droughts’. The Fingerboards project has considered both of these eventualities and incorporated appropriate measures into the EES:
- More intense storms: Water management dams should be designed to ANCOLD standards by competent dam engineers. Best practice contemporary Australian dam design procedures include estimation of flood inflows using ‘Australian Rainfall and Runoff’ (Bureau of Meteorology, 2019), which provides advice for estimating the effect of climate change on flooding. Dam design should be in accordance with these documents.</td></tr>
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Item No.	Issue		
			- *More severe droughts: The EES acknowledges the possibility that the Mitchell River may not be able to supply the site with water in some years, and has planned to develop a groundwater supply sufficient to supply the full site water requirement.* *The EES presented the results of the median climate change result reported by DEWLP 2016. These results did not present any significant change to the results of the model without climate change; all the same water management measures would remain appropriate. The same may be expected if other climate change scenarios were modelled; while volumes of rainfall and runoff may vary to a degree the procedures to manage runoff would be applicable through each scenario.* *The worst conceivable effect that climate change may have at this site is that there may be insufficient flow in the Mitchell River to utilise a winter fill licence. As described above, in this case the site would utilise groundwater as described in the EES; no additional modelling is required to understand this situation.* *In my opinion the analysis presented provides a sufficient level of detail to illustrate that the proposed measures are suitable responses to climate variability. Additional modelling of climate scenarios in the water balance model would not add certainty or alter proposed actions, so is not required.*
4	***Site water management strategy***		
	Matters of agreement		
	No.	**Agreed fact/opinion**	
	4.1	*The water balance model has estimated the potential frequency and volume of discharge events from the water management dams on the receiving environment of the Mitchell River and Perry River. The frequency and volume of discharge is based on the historical record. Future discharge events are expected to be similar to those presented in the EES, but the future will not be a repeat of the past.*	
	4.2	*Offsetting the volume of water retained in onsite dams by returning an equivalent volume of water from the freshwater dam to the downstream catchment was considered an adequate mitigation measure to prevent adverse effects from an altered rainfall runoff relationship.*	
	4.3	*Based on the data and modelling presented in the EES, an unplanned release of mine contact water from a water management dam would not require active remediation unless monitoring identified that the actual impacts were greater than those predicted by the EES, and regulators considered that remediation was required.*	
	4.4	*The term "where practicable" when made in relation to the commitment to re-route natural surface water drainage courses around disturbed mine areas (SW37) was agreed to be open to interpretation and may mean different things to the proponent, community and regulators. It was agreed that undisturbed water should be re-routed unless it would require significant engineering design and associated works that were not commensurate with the environmental benefit, would present a safety concern, or where the mine layout limits the ability to effectively capture and move the water. In these situations, offsetting with an equal volume of returned water from the freshwater dam was considered an acceptable alternative.*	
		Assumptions relied upon in reaching agreement	
	4.5	*The impacts associated with a controlled release (i.e., via spillways) have been assessed in A006, Section 8.4.4. Offsite modelling of water quality impacts has been completed and the EES concluded this was a low risk after application of the stated mitigation measures.*	

Item No.	Issue		
	4.6	*Where necessary, the offset water may be directed to the downstream ephemeral gullies to support the downstream ecosystem between the project boundary and the Mitchell River.*	
	4.7	*The water balance model has included assessment of the likelihood and frequency of the DAF plant usage, and the available capacity in the freshwater storage dam during/following successive storm events.*	
	4.8	*The proponent is committed to fully implementing the mitigation measures irrespective of their recent site experience or short-term climate conditions. For example, flood mitigations or water diversion infrastructure should be maintained equally during periods of drought.*	
		Individual comments in respect of agreed fact/opinion	
	4.9	*Anthony Kiem*	*Nil.*
	4.10	*Jarrah Muller*	*Nil.*
	4.11	*John Sweeney*	*Nil.*
	4.12	*Tony McAlister*	*Again noting the comments made at 1.13 regarding the operation functioning within an **adaptive management framework** that is based on openly available and auditable local and regional environmental (groundwater levels and quality, surface water quality in the Mitchell and Perry Rivers etc) monitoring*
		Agreed actions:	**Suggested timing:**
	4.13	*Nil*	
	Matters of disagreement		
	No.	**Summary of fact/opinion not agreed**	
	4.14	*Nil*	

Prepared jointly by:

John Sweeney

29 April 2021

Anthony Kiem

29 April 2021

Jarrah Muller

29 April 2021

Tony McAlister

29 April 2021