APPENDIX L
Surface water technical memorandum

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MEMORANDUM

TO	Pierre Miquel	**COMPANY**	Evolution Mining
FROM	Dayjil Buhle	**OFFICE**	Brisbane
PROJECT TITLE	Cowal Gold Operations Open Pit Continuation (OPC) Project		
SUBJECT	Surface Water technical input to Submissions Report		
DATE	24 January 2024	**OUR REF**	121155-18-M01 Rev1

1 INTRODUCTION

As outlined in our recent proposal (121155-14-P007 Rev0.pdf), ATC Williams (ATCW) has prepared responses to the submissions related to the Surface Water Assessment (SWA) of the Cowal Gold Operations (CGO) Open Pit Continuation (OPC) Project. These submissions were provided in a supplied file (Copy of J190417a_Submissions Register_surface water.xlsx) and responses are provided in the sections to follow. Responses have been provided on issues rather than to individual submissions, due to overlap of issues, and address matters raised by the following:

- Lake Cowal Foundation.
- Inland Rivers Network.
- Community Submission (local landholder objecting to the Project).
- Community Submission (local landholder commenting on the Project).

2 CLIMATE CHANGE RISK

2.1 Submission Request

Inland Rivers Network: The predicted increase in extreme weather events as climate change intensifies, increase the risk of catastrophic harm locally and downstream should there be a major or environmentally damaging spill because of mine management or weather factors.

Lake Cowal Foundation (LCF): LCF raises concern about the potential for unforeseen impacts emanating from the mine site in the longer term (> 50 years) outside the ML areas and within Lake Cowal due to increasingly intense weather events because of predicted and modelled changing climate processes.

2.2 ATCW Response

The Up-Catchment Diversion System (UCDS) has been designed to accommodate peak flow rates up to the 0.1% Annual Exceedance Probability (AEP) event[1]. Furthermore, the modelled water storages on site are not simulated to spill during the modelled period for all simulated climatic realizations (i.e. equivalent to a less than 1% spill risk). Any impacts to these risks due to climate change will apply to both the existing approved operations and the proposed OPC Project. Rainfall intensity data used in our analyses conform with current industry standards. We are not aware of any current Australian guideline information or data relating to increases in rainfall intensity.

Section 6.4 of the SWA provides information regarding the potential implications of climate change on the water balance model, noting that annual rainfall is predicted to decrease while annual evapotranspiration is predicted to increase which would reduce the risk of spill from the OPC Project water management system. Final void modelling has included these predicted changes to climate

[1] A 0.1% AEP event means there is a 0.1% chance of an event of this magnitude occurring within a period of one year (i.e. there is a 1 in 1,000 chance of this event occurring in any one year).

variables and results show the final void water levels should stabilise well below spill levels and below the local water table level.

3 MINING FOOTPRINT EXPANSION

3.1 Submission Request

Lake Cowal Foundation: notes the impact potential of expansion of LPB [Lake Protection Bund] footprint by more than 275% [into Lake Cowal (compared to the existing LPB)] on surface water regimes during the filling/flooding and drying cycles of the Lake and subsequent influences on function of Lake all ecological systems. More extensive and detailed hydrological modelling is required to account for the inherent system complexities and identify appropriate mitigation/s.

3.2 ATCW Response

The flood modelling and lake balance modelling carried out for the OPC Project and detailed in the Surface Water Assessment, has been prepared by specialist hydraulic engineers and is in accordance with industry practice. The studies carried out are considered fit for purpose and appropriate in identifying the potential change to the hydrology of Lake Cowal from the Project, which is a discrete activity within the broader system. Modelling the broader system would result in a smaller percentage change to flood levels due to the OPC Project, due to the small scale of the Project relative to the broader system.

The aim of the overall modelling was to demonstrate the likely incremental change to lake flood levels as a result of the Project, irrespective of the source of the inflow in the broader system. Hydraulic modelling therefore assumed that the lake system was full at the start of each flooding event.

The lake hydrology is not affected by the Project footprint area but is affected by the volume of water displaced by the expanded LPB and the changed level-volume relationship of the lake. The SWA lake water balance takes this into account. Both lake hydrology and hydraulics have been modelled and assessed as part of the SWA (refer Section 6.5.2) with and without the OPC Project.

No government agencies (including BCD, EPA or DPE Water) raised in their submissions on the EIS, any matters or concerns relating to the hydrological studies carried out to inform the Surface Water Assessment.

4 LAKE VOLUME CALCULATIONS

4.1 Submission Request

Community Submission (local landholder objecting to the Project): We feel like the calculation of a 1.7% volume increase is inaccurate as the EIS [Environmental Impact Statement] only states the water in Lake Cowal itself and does not include the total area of Lake Cowal, Nerang Cowal and their feeder creeks.

4.2 ATCW Response

The flood modelling incorporated Lake Cowal and surrounds, including Nerang Cowal and feeder creeks. The reported change to the Lake Cowal volume (at each elevation) is relevant to all contiguous areas which would be affected by water at that elevation. This is demonstrated in **Map 1**, which presents the connected areas at three key elevations. The quoted 1.7% reduction (not an increase as stated in the submission) in lake storage volume, due to the proposed OPC Project, is the maximum reduction calculated across all elevations (with the 1.7% corresponding to 206.2 mRL). At higher elevations the level of impact reduces, for example, at 207.5 mRL there is a volume reduction of 0.6%.

Table 1 lists the area and volume reductions at some key water levels in Lake Cowal, Nerang Cowal and surrounds. **Graph 1** provides the level-volume relationship for Lake Cowal and surrounds, while **Map 1** shows the plan area extent of three of the tabulated key levels which were used to calculate the areas in **Table 1**.

The lake level-volume relationship was derived from a combination of available data, comprising a lake bathymetric survey (underwater survey of lake floor) undertaken in October 2021, Light Detecting and Ranging (LiDAR) aerial survey flown in January 2022 for the above water lake area/surrounds and the national ELVIS[2] database for other areas.

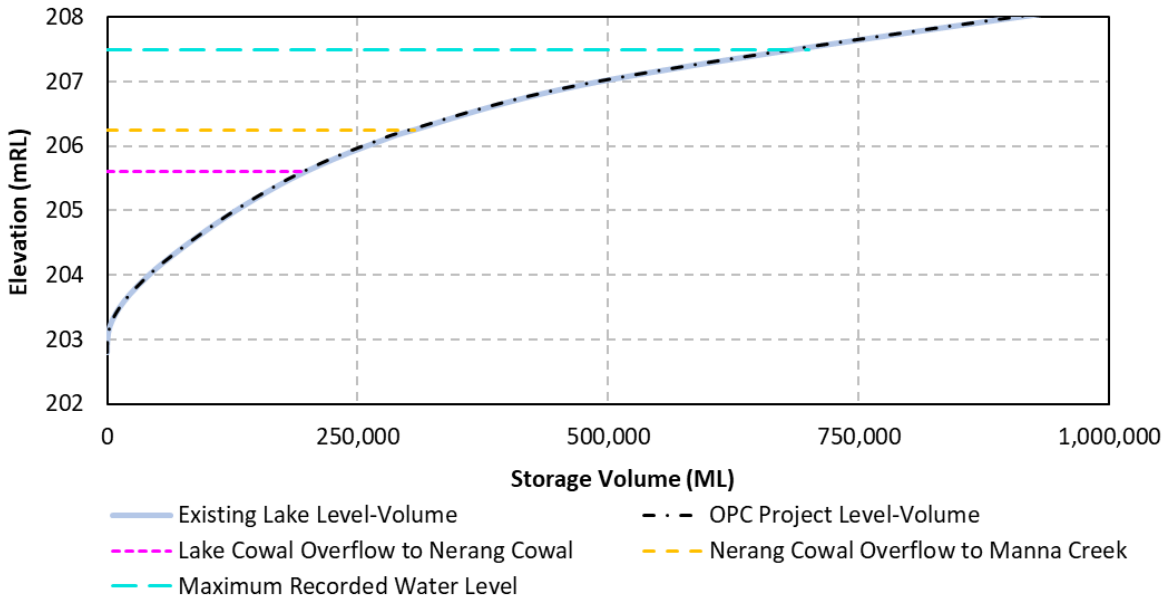
In **Table 1**, the maximum decrease in lake area and volume occurs at 206.2 mRL and results in a 1.7% decrease in both of these parameters due to the OPC Project.

Table 1: Calculated Lake Area and Volume at Key Levels

Key Level (mRL)	Description	Area (ha)			Lake Volume (ML)		
		Existing	OPC	Change	Existing	OPC	Change
205.6	Lake Cowal Overflow to Nerang Cowal	13,589	13,282	-2.3%	197,360	194,558	-1.4%
206.2	Maximum Calculated Change	18,567	18,243	-1.7%	294,538	289,846	-1.7%
206.3	Nerang Cowal Overflow to Manna Creek	19,382	19,057	-1.7%	306,814	302,224	-1.5%
207.5	Maximum Recorded Water Level	41,807	41,631	-0.4%	699,987	696,045	-0.6%

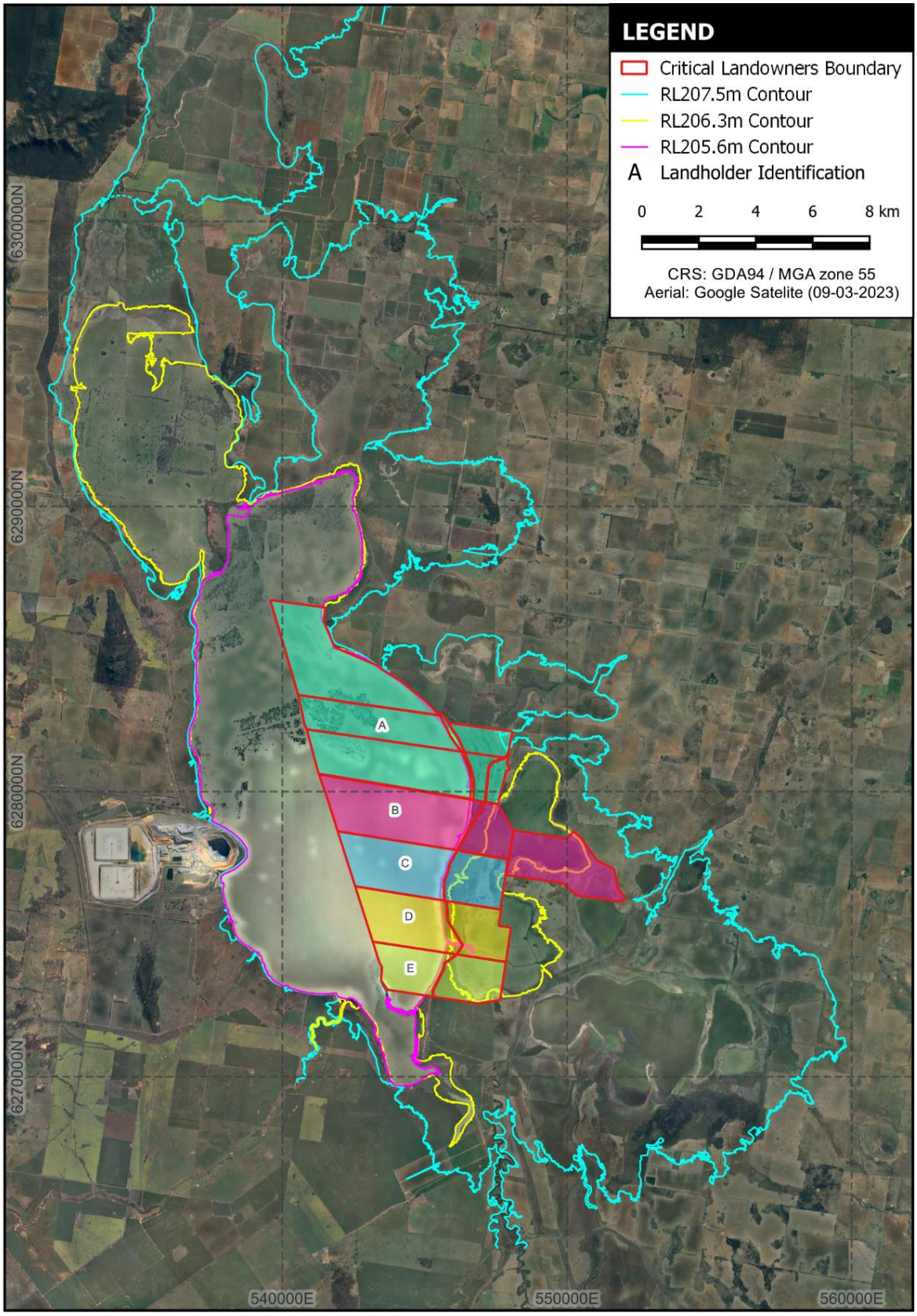
Note: ha = hectares; ML = megalitres (million litres)

Graph 1: Lake Cowal and Surrounds Level-Volume Graph



[2] Elvis Elevation and Depth is a cloud-based system allowing users to obtain Australian elevation and bathymetry data available within an area of interest. Refer https://elevation.fsdf.org.au/.

Map 1: Key Levels in the Lake Cowal Level-Volume Graph and Landholders



5 LANDOWNERS AND INUNDATION TIMES

5.1 Submission Request

Lachlan Valley Water: Some landowners have also expressed concern that the Lake Protection Bund will displace about 4,000 ML of water in Lake Cowal, and effectively increase the lake level by around 15mm. While this may not be considered a significant increase, when combined with heavy rainfall and severe flooding as experienced in the Lachlan in 2022, there can be an impact on neighbouring properties and additional flooding that may not previously have occurred. Farmers in the Lake Cowal region are concerned about the potential impacts on their properties and seek further discussion with Evolution Mining about how this could be managed.

Community Submission (local landholder objecting to the Project): This means an increase of any size will be rather substantial for us. As the presenter mentioned, this increase of 15mm is going to push water further onto higher ground. Once the lakebed goes under, we need the security of that higher ground for as long as possible to lessen the impact to livestock safety and the loss that can occur.

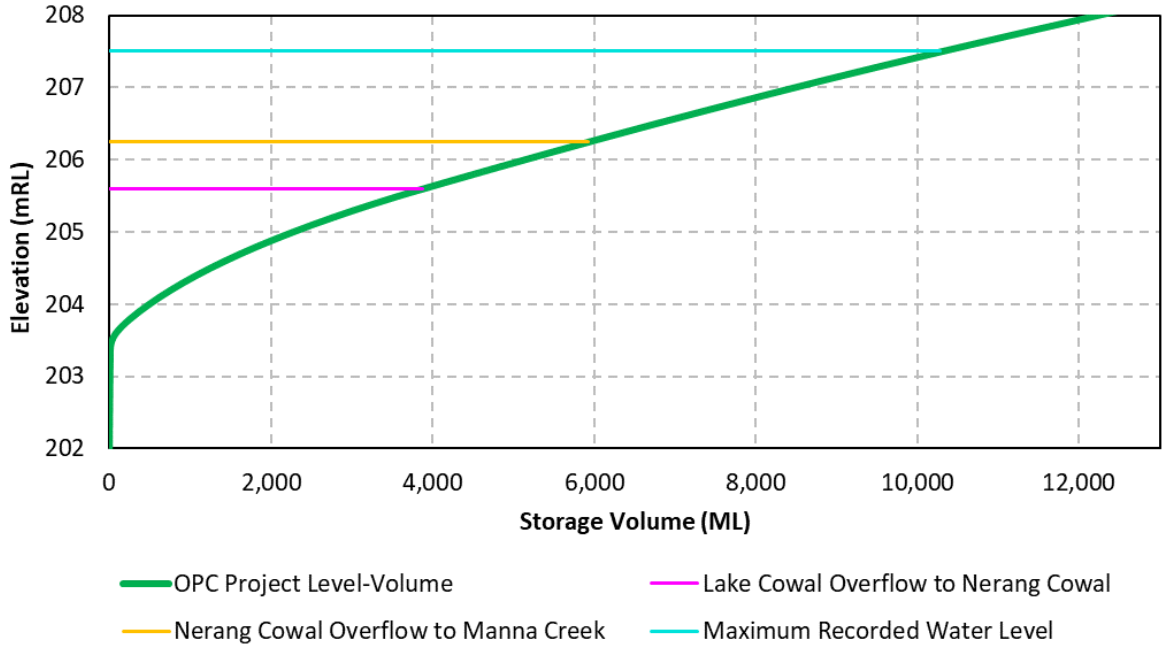
Community Submission (local landholder objecting to the Project) (continued): If the mine is to go ahead with raising this bund, then compensation or an acquisition of land needs to be put into place by Evolution for the Eastern Land holders of Lake Cowal. We need security put in place to cover what will be lost due to this bund increase and water spread.

Community Submission (local landholder commenting on the Project): We are concerned with the impacts on our farming land within the lakebed from the increase in the mine bund. The increased land area that will be encompassed and the amount of water that will be displaced as a result.

5.2 ATCW Response

The level-volume graph for the area behind (upslope of) the proposed expanded LPB is provided below in **Graph 2**. The LPB is estimated to displace approximately 3,900 ML at 205.6 mRL, the estimated level at which Lake Cowal overflows to Nerang Cowal.

Graph 2: Proposed Lake Protection Bund Level-Volume Graph



5.2.1 Impact Assessed by Flood Modelling

Section 6.5.2.3 of the SWA states "The increase in predicted peak flood level was small with an average change of 0.013 m for the cross-section for the 1% AEP, 0.014 m for the 0.1% AEP and 0.010 m for the PMF". **Table 2** provides key information to assess how these flood level changes compare as a percentage increase in peak water level due to the Project.

Table 2: Percentage Increase in Simulated Peak Water Level Due to the Project

AEP Rainfall Event		1%	0.1%	PMF
Initial water level (mRL)		206.300		
Peak water level (mRL)	Existing	208.524	209.262	210.534
	OPC Project	208.537	209.276	210.544
Change in water level (m)	Existing	2.224	2.962	4.234
	OPC Project	2.237	2.976	4.244
Increase in peak water level due to the Project (m)		0.013	0.014	0.010
Percentage increase in peak water level due to the Project		0.59%	0.48%	0.24%

Table 2 shows that for the existing case and the 1% AEP rainfall event, the peak water level is 2.224 m higher than the initial water level whereas the peak water level for the OPC Project is 2.237 m higher than the initial water level. This means that the OPC Project peak water level increases the simulated 1% AEP flood level by 13 mm or 0.59% of the predicted flood level. This percentage increase in peak water level due to the OPC Project decreases to 0.48% for the 0.1% AEP rainfall event and to 0.24% for the PMF. These percentage increases are considered minor and are supported by the maps in Appendix 2 of the SWA which show the predicted flood depth change due to the OPC Project (i.e. Map 011, Map 015 and Map 019).

5.2.2 Impact Assessed by Lake Water Balance Modelling

To assess the likely impact to inundation days due to the simulated increase in lake water levels as a result of the OPC Project, the minimum level of landholders properties were identified (refer **Map** 1 and **Table 3**). The Lake Cowal water balance model (refer Section 6.5.1 of the SWA) was used to estimate the change in the number of days that the modelled water levels would be above the minimum level for each landholder's properties for both the existing situation and with the proposed OPC Project.

Table 3: Simulated Increase in Days above Landholding Minimum Levels

Landholder	Minimum Level on Landholdings (mRL)	Number of days water level in lake exceeds minimum landholding level**		Percentage increase in number of days water level in lake exceeds minimum landholding level
		Existing	OPC Project	
A	203.1	42,535	42,641	0.25%
B	203.0	43,551	43,607	0.13%
C	202.8	45,113	45,148	0.08%
D	202.7*	48,765	48,765	0.00%
E	202.9	44,493	44,544	0.11%

* Note that this is equal to the minimum simulated level in the lake.

** Note that the simulation duration is 48,765 days.

Table 3 shows that the predicted increase in the number of days above minimum levels on landholdings are minor. At 202.8 mRL, there is a simulated 0.08% increase in the number of days

the level is exceeded from the existing situation to the OPC Project. The maximum percentage increase simulated is 0.25% for Landholder A where a minimum level of 203.1 mRL was identified.

The total simulation period is 48,765 days. It is noted that the minimum level on the landholdings of Landholder D is equal to the minimum simulated level in the lake and the lake is not simulated to completely empty. Hence, for both the existing and with OPC Project simulations, the number of days the water level in the lake exceeds the minimum level in landholding of Landholder D is equal to the simulation duration. As such, there is no increase to the number of inundated days.

6 WIND INDUCED WAVES

6.1 Submission Request

Community Submission (local landholder objecting to the Project): This extension means that our houses on the eastern side of Lake Cowal are going to be impacted even more than during the last flood. Potentially sending water through these houses with which the loss could possibly be fatal, especially for the older residents who have lived through many floods with water surrounding their home and the only mode of transport being a tin boat.

Community Submission (local landholder objecting to the Project): We predominantly receive South Westerly Winds on the Eastern side of the lake and if this water is raised another 15mm, taking into consideration the wave action on a windy day, the damage will be outrageous. These waves are immeasurable, but you wouldn't believe the size of some of these waves, and this is without the extra 15mm on top. We lost very well-structured fences and sheds during the 22' flood, some that have been standing for the best part of 50 years.

Community Submission (local landholder commenting on the Project): As a property owner that has land that will be impacted by the water displacement especially in the drying and filling cycle and movement of water by wind. (There has been no modelling of the effects of wind action on the water body within the lakebed in this EIS).

6.2 ATCW Response

To compare the potential increase in lake water level due to wind and waves, ATCW has calculated the increased water level due to wind and waves (i.e. wind induced lake superelevation[3] and the height of waves caused by wind using methods both from Fell[4] and USBR[5]) for different AEP events with the results listed in **Table 4**.

The two AEP events of 10% and 0.1% were chosen to represent a range of possible events, with 10% representing a reasonably likely event (with relatively low wind speed) and 0.1% representing an less likely event (with high wind speed). Two relatively high lake levels have been chosen: the spill level from Lake Cowal to Nerang Cowal (205.6 mRL) and the maximum recorded water level in Lake Cowal (207.5 mRL).

[3] This refers to the effect of wind shear increasing the lake level at the down-wind end of the lake.
[4] Fell, R. et al (2015). "Geotechnical Engineering of Dams 2nd edition".
[5] U.S. Department of the Interior Bureau of Reclamation (2012). "Design Standards No. 13: Chapter 6: Freeboard". DS-13(6)-2: Phase 4 (Final), September.

Table 4: Wind and Wave Calculations

Lake Level (m RL)	Description	Scenario	AEP	Wave Height (m)	Wind Induced Superelevation (m)	Calculated lake level increase due to waves and wind induced superelevation (m)
205.6	Spill to Nerang Cowal	Existing	10%	0.10	0.78	0.88
		OPC	10%	0.09	0.77	0.86
		Existing	0.1%	0.12	1.42	1.55*
		OPC	0.1%	0.12	1.42	1.54
207.5	Maximum recorded lake water level	Existing	10%	0.12	0.68	0.80
		OPC	10%	0.12	0.68	0.80
		Existing	0.1%	0.16	1.25	1.41
		OPC	0.1%	0.16	1.24	1.40

* The total calculated increase is affected by rounding (0.124 m+1.424 m = 1.548 m).

Table 4 shows that the calculated increase in lake water level due to wind and waves is marginally lower for the OPC Project than for the existing scenario. This is because the relationship between wave height and depth of water are inversely proportional. In other words, the deeper the water, the lower the height of the wave. The OPC Project is predicted to increase the average water depth in Lake Cowal (refer Section 6.5.2.3 in the SWA) hence the wave height (and wind induced superelevation) will not be as high for the OPC scenario. This relationship holds at both lower wind speeds (i.e. for the 10% AEP event) and higher wind speeds (i.e. for the 0.1% AEP event).

Runup is the length of the waterbody over which waves can occur. The longer the length of runup, the higher the wave height. The runup length increases for the OPC Project however this has relatively minor impact to the sensitivity of the wave height and wind induced superelevation, even at the maximum recorded lake water level (207.5 mRL).

The above calculations suggest that the OPC Project will not increase the wave height and hence will not contribute to additional increases in predicted flood levels.