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UNSW SYDNEY

Water Research Laboratory

Dear Alana,

Independent Review of the Water Quality Assessment for the West Culburra Concept Proposal (Major Project Application SSD 3846)

1. Introduction

This letter provides an independent review of the technical reports and reviews prepared in support of the West Culburra Concept Proposal State Significant Development (SSD 3846). Our review is targeted at the surface water, groundwater and water quality aspects of the application only.

The review was completed by Dr Francois Flocard, Principal Engineer at the Water Research Laboratory of UNSW Sydney (WRL) and Dr Will Glamore, Associate Professor at UNSW Sydney WRL. Both staff have undertaken multiple expert reviews on similar projects and their CVs are available on request. Over the past 15 years the reviewers have undertaken numerous on-ground projects to study, model, rehabilitate and create large estuarine wetlands across Australia. These projects are extensively documented and have been recognised via multiple awards representing best practice. Associate Professor Glamore also has extensive experience in the Shoalhaven area, having conducted his PhD in the region from 1999-2003 and subsequently completed numerous surface and groundwater studies including field based projects.

WRL staff have an on-going role of providing high-level expert advice to the Federal Department of the Environment and the Murray Darling Basin Authority concerning developments near Ramsar Wetlands. WRL's advice has largely been concerned with the hydrological impact to surface and groundwater of large developments near Ramsar Wetlands in nearly every state and territory in Australia. More information on our background expertise or previous review projects can be provided upon request.

2. Documents reviewed

This independent review was based on the information provided below:

- BMT WBM (2014a), PROC-1000395 – West Culburra Water Cycle Management Review, 6 March 2014.
- BMT WBM (2014b), West Culburra - Water Cycle Management Review – Peer Review, 23 October 2014.
- BMT WBM (2014c), Re: Estuarine Management Study: Proposed Mixed Use Subdivision – West Culburra, NSW. Peer Review., 7 November 2014.

- Martens (2015a), Re: Vegetation Uptake Rates - West Culburra (MP 09_0088), 30 January 2015.
- BMT WBM (2015a), West Culburra - Further Review, 19 August 2015.
- Martens (2015b), Re: Estuary Hydrodynamic And Solute Transport Model Calibration – West Culburra Estuarine Management Study (MP 09_0088), 18 November 2015.
- BMT WBM (2015b), Re: Estuary Hydrodynamic And Solute Transport Model Calibration – West Culburra Estuarine Management Study (MP 09_0088). Peer Review, 18 November 2015.
- Martens (2016a), Water Cycle Management Report (WCMR) - Mixed Use Subdivision; West Culburra, NSW, P1203365JR01V07, November 2016.
- Martens (2016b), Estuary Management Study (EMS) - Mixed Use Subdivision; West Culburra, NSW, P1203365JR02V04, November 2016.
- Martens (2016c), Water Quality Monitoring Plan (WQMP) - Mixed Use Subdivision; West Culburra, NSW, P1203365JR03V04 November 2016.
- HGEO (2017), West Culburra groundwater assessment – Preliminary report (Stage 1). Prepared for the Shoalhaven City Council.
- Martens (2017a), Explanatory Note - West Culburra Concept Plan (SSD 3846); Water Quality Issue Land Side Stormwater Report, 31 January 2014 [*sic*].
- Alluvium (2017a), Review of Explanatory Note - West Culburra Concept Plan and associated documents, 24 February 2017.
- BMT WBM (2017a), Review of Estuarine Processes Modelling Report: Proposed Mixed Use Subdivision, West Culburra, 5 May 2017.
- BMT WBM (2017b), Review of Estuarine Processes Modelling Report: Proposed Mixed Use Subdivision, West Culburra, 8 May 2017.
- Martens (2017b), Water Cycle Management Report Addendum; Mixed Use Subdivision, West Culburra (SSD 3846), 8 June 2017.
- John Toons (2017a), West Culburra Mixed Use Concept Plan Major Project 09-0088, Now SSD 3846 Supplementary Response to Submissions, July 2017.
- Alluvium (2017b), Assessment of West Culburra Concept Plan, 19 July 2017.
- BMT WBM (2017c), Review of Water Cycle Management Report Addendum, 20 July 2017.
- Martens (2017c), Stormwater Quality Assessment – Stage 1; Culburra West Mixed Use Development, Culburra. November 2017.
- John Toons (2017b), West Culburra Mixed Use Concept Plan; Review of Sept. 2017 submissions. November 2017.
- Department of Planning and Environment (2018), State Significant Development Assessment: West Culburra Concept Proposal SSD 3846 (June, 2018), NSW Department of Planning and Environment.
- Martens (2018), Independent Planning Commission Water Quality Briefing – Culburra West Mixed Use Development (SSD3846) (30 July 2018).
- Cardno (2018), West Culburra Mixed Use Subdivision (SSD 3846) – Stormwater Quality Peer Review, 10 August 2018.

3. General Comments

3.1 Environmental Setting of Proposed Development

The site of the West Culburra Concept Proposal is located to the west of the Culburra Beach township on the south coast of NSW. Culburra Beach is surrounded by the Crookhaven River estuary to the north and Lake Wollumboola to the south.

WRL understands that the latest version of the concept proposal envisions the development of approximately 75 ha of the 100 ha site and will predominantly consist of low/medium density dwellings (around 45 ha). The majority of the development will be on the northern side of the ridge line and will therefore affect the surface hydrology within Crookhaven Estuary catchment. The Crookhaven Estuary can be considered a sensitive ecosystem as it supports a number of priority oyster leases and also provides habitat to migratory bird species. At this stage, the concept proposal is to include nearly 3 km of vegetated foreshore in the immediate proximity of two SEPP 14 Coastal Wetlands.

Wetland environments such as the two wetlands north of the development site are highly sensitive to changes in surface water flows, changes in groundwater table elevations, and are likely adversely impacted by changes to the wetting/drying cycle within their catchment area.

A smaller portion of the proposed development (about 6 ha), consisting of medium density dwellings, an industrial precinct and a sport field, is proposed within the Lake Wollumboola catchment. Lake Wollumboola is classified as a Sensitive Coastal Lake in the 2018 State Environmental Planning Policy (SEPP), is listed as a Wetland of National Importance and forms part of the Jervis Bay National Park. Any potential change to the surface water and groundwater dynamics, in terms of quantity or quality, is likely to have a direct impact to Lake Wollumboola, although the extent of impact is difficult to determine.

Lake Wollumboola can be classified as an Intermittently Closed or Open Lake or Lagoon (ICOLL). ICOLLs typically have long residence times as there can be extended periods when the lake entrance to the ocean is closed resulting in limited exchange of lake and ocean waters. As a result of the intermittent entrance opening, ICOLLs can have high flow retention rates resulting in nutrient and phytoplankton levels within the estuary closely associated with catchment development runoff volume and quality. Importantly, calculating the ICOLL water balance and its subsequent influence on water quality can be complex due to the circulation of fresh and saltwater caused by interactions of fresh water runoff, groundwater and coastal waters. The nature of these fresh and salt water exchanges influence lake water quality gradients and sedimentation, and thereby the health of ecological communities.

3.2 Uncertainty regarding the nature of the proposal

The nature of the concept proposal, as reported by DPE and the proponent, has evolved since it was first lodged in 2010 and needs to better framed. This lack of clarity and consistency can directly be observed in the way the proposal has been referred to in the proponent submission documents, such as "Mixed Use Concept Plan" or "Mixed Use Development", while DPE's recommendation referred to it as "Concept Proposal".

According to the proponent, the major project application SSD 3846 only concerns "the basic concepts such as zone boundaries, location and type of facilities and infrastructure" (John Toons, 2017). The proponent states that the considered staged development of West Culburra over 20 years, if approved, will then be the subject of subsequent DAs submitted to the Shoalhaven City Council, which will provide additional information and plans with a higher level of details.

The consequence of the proponent's approach is that a number of Response to Submissions by different agencies and peer-reviewers are not satisfied with the level of detail of the proposal and associated assessments on potential impact to surface water, water quality and nearby ecological sensitive areas.

At this stage, the concept proposal includes development in the immediate proximity of the coastal wetlands around Billy's Island in the Crookhaven River, previously classified as SEPP 14 coastal wetlands and now as SEPP 2018, as well as within the catchment of Lake Wollumboola. The potential disruption to the hydrology of these two sensitive ecosystems calls for a precautionary approach, which cannot be properly assessed without a clear and detailed understanding of what the proponent is considering within the concept proposal area.

As such, we believe that the proposed approach of a staged authorisation and development process is problematic since it does not provide sufficient information for the assessment as well as certainty regarding the effectiveness of storm water treatment solution of the completed development and is therefore not recommended. This major project application would be considered more suitable for assessment if it was submitted with a higher level of detail, this allowing all parties involved in its assessment a higher level of certainty regarding the potential impacts on the environment and more specifically the water quality (NorBE).

3.3 Groundwater

Groundwater is an integral component of the water balance for coastal wetlands and ICOLLs. The groundwater contribution can only be verified and quantified through field based data. Based on our review of the limited onsite groundwater data presented by the proponent for the West Culburra Concept Proposal (SSD 3846) and the Long Bow Point Golf Course (SSD 8406), we believe that groundwater discharges to Lake Wollumboola cannot be adequately assessed. Due to the potential importance of the groundwater regime to sensitive receivers, we consider that this is a critical data gap that warrants further consideration for any development within the Lake Wollumboola catchment.

We are aware that Shoalhaven Council has commissioned HGEO (2017) to undertake a comprehensive groundwater assessment for the area to the west of Culburra Beach, including the proposed golf course development on Long Bow Point. The HGEO field investigation is planned to have a total of 23 monitoring bores, with ongoing monitoring of groundwater levels and water quality parameters. The proposed field investigation and monitoring program, which we understand will be performed over two years, will provide valuable insight into the groundwater contribution to Lake Wollumboola and regimes within the West Culburra proposed development. We recommend its commission as it will offer critical information regarding predevelopment conditions at the site and allow baseline conditions to be measured as a benchmark for assessing any impact of the proposed developments on neighbouring coastal wetlands and Lake Wollumboola.

The 2010 field investigations at the proposed development site did not consist of long term monitoring of the groundwater and therefore do not enable the derivation of a robust understanding of the groundwater recharge cycle at the site. Perched groundwater aquifers were found in multiple locations across the site and would likely be impacted by the development. Based on the presently available investigations, the proponent is only able to conclude that the proposed development will likely alter groundwater flow to downslope sites, which includes the two SEPP coastal wetlands.

4. Review of the Water Quality Modelling

The proponent's water quality management assessment is based on numerical modelling using a combination of the MUSIC and TUFLOW software modelling packages.

A MUSIC model was developed to assess the suitability of the proposed water quality controls and treatment trains for stormwater discharges into the Crookhaven Estuary catchment and within the Lake Wollumboola catchment. The MUSIC software is widely used by industry and is generally suitable for modelling treatment trains of water quality control measures.

WRL's reviewers are familiar with the MUSIC software and have reviewed numerous Storm Water Management Plan models and installations based on modelling results. It is important to note that MUSIC, like any other numerical model, requires calibration based on local flow data as well as treatment performance. Based on our review, it appears that the presented MUSIC model was extensively peer-reviewed but has not been field calibrated for pre-development conditions which are key to to establish the appropriateness of the proposed treatment solution achieving NorBE.

Based on our review of the water quality related documents, the proponent appointed water quality consultant Martens and DPE's appointed reviewers, i.e. BMT WBM / Alluvium, appear to have been actively collaborating on the development of the modelling suite until August 2017. Our review of the provided correspondence between both parties shows that while the proponent did implement some of the requests raised by the reviewers, a number of significant concerns regarding the overall reliability of the proposed stormwater treatment solution and results of the modelling remain outstanding.

The modelling presented in the reviewed report indicates a decrease in the annual average pollutant loads (TSS, TN and TP) into the two neighbouring coastal wetlands and into Lake Wollumboola. This conclusion has been previously questioned both by OEH and DPE. In our opinion, this conclusion has not been sufficiently justified by the proponent. The proponent has stated on numerous occasions that the proposed stormwater treatment solution was able to achieve the required NorBE criteria by showing that post-development values were less than pre-development values. While we would expect the different modifications to the stormwater treatment solution to change post-development values of pollutants, we are concerned that pre-development values of TSS, TN and TP for the SEPP 14 wetlands area and Lake Wollumboola catchment were respectively increased by 30%, 60% and 70% between the November 2016 main water quality report (Martens, 2016a) and the short addendum provided in June 2017 (Martens, 2017b) without any clear explanation. This important modification to pre-development conditions in two highly sensitive ecosystems is concerning as it casts doubt on the exact performance of the proposed solution and if NorBE is effectively achieved.

Additionally, it should be noted that the peer-reviewer appointed by the proponent also pointed out that the most recent modelling, which we can only suppose used these unjustified increased pre-development conditions, was actually not able to achieve NorBE within the SEPP 14 wetlands area.

Overall, the manner in which the surface water quality modelling has been conducted and reported is concerning as the proponent has repeatedly refused to take into account valid recommendations of the DPE's appointed reviewers only to suddenly implement them with very limited explanations (i.e. vegetation uptakes). We disagree with the most recent statement (John Toons, 2018) by the proponent that "*there are no unresolved water quality assessment issues between MA and the peer reviewers*".

Based on our experience in the Shoalhaven area in relation to oyster leases, the risk of faecal coliform contamination will be increased with the development and this risk should be better addressed by the proponent both in the stormwater design and in the water quality monitoring plan.

5. Comments on the Water Quality Treatment Solution

Presently, we understand that the proposed staged approach of the development could result in works being staged over a 20 year period. Such an extended period of construction works is concerning due the risk of high-intensity rainfall events occurring during the development period with an associated high potential for the release of TSS within the Crookhaven Estuary and Lake Wollumboola.

Based on our review of the water quality modelling outputs (MUSIC modelling), the potential effectiveness of the proposed erosion/construction control solutions on TSS during the development phase is unclear. The November 2016 report (Martens, 2016a) does not provide any detailed modelling results and we could not locate any comments by the peer-reviewers on this subject.

The proposed stormwater treatment solution relies on a combination of bioretention basins connected to filter catch-basin type devices (Enviro Pod Storm Filter). We are familiar with these type of devices, having tested a number of them in our facilities for a range of manufacturers. We commend the proponent for representing these devices in MUSIC using field based test data provided by the manufacturer (Cardno, 2018). We are, however, concerned that the available data used to represent the effectiveness of this type of device may not be appropriate for the conditions experienced in the Shoalhaven area, due to the potential for dissolved iron to rapidly clog the filter media used in the catch-pit. This potential clogging has a high risk of rapidly decreasing the effectiveness of the proposed solution and will likely require additional monitoring and maintenance. As such, it is imperative that an Operation and Maintenance Plan for the site be developed in collaboration with Council for the proposed development.

It appears that the proponent will rely on constructed wetlands to perform as bio-retention basins within the Lake Wollumboola catchment. While we do not support any development within the Lake Wollumboola catchment, if development was to occur, it should be noted that this proposed solution has the inherent risk of overflow and release of untreated, nutrient rich run-off into the neighbouring coastal wetlands and Lake Wollumboola. Additional design detail for these ponds is required to fully assess their functionality and likely performance.

6. Gateway Determination for the Planning Proposal

In November 2015, the Deputy Secretary, Planning Services, as delegate of the Minister for Planning, issued a Gateway Determination recommending that land in the Lake Wollumboola catchment be zoned for environmental protection, dependent on the outcomes of a biodiversity offset strategy and water quality studies prepared to support the Planning Proposal.

The reviewers understand that The Gateway Determination for the Planning Proposal will be supported by detailed studies, including a two-year groundwater monitoring study presently underway that will assist in defining appropriate development boundaries around Lake Wollumboola and an investigation into alternative locations for a golf course in the locality, though outside of the lake catchment. It is our understanding that the Gateway Determination for the Planning Proposal will take 3 to 4 years to finalise and be available in 2019.

We support the recommendation that any development within the Lake Wollumboola be deferred until completion of the HGEO groundwater study and finalization of the Gateway Determination for the Planning Proposal.

7. Cumulative Impacts and Tipping Point for Lake Wollumboola

We understand that the area west of Culburra Beach within the Lake Wollumboola catchment is currently the subject of multiple development applications including:

- a portion of the West Culburra Mixed Use Subdivision (SSD 3846), which could include housing, an industrial zone and a sport field;
- the proposed golf course development on Long Bow Point (SSD 8406);
- two separate Development Applications for individual houses in the Long Bow Point vicinity (DA 09/2675 and DA 10/1330).

These approved and proposed developments along the foreshore of Lake Wollumboola, as well as the existing pollutant loads from the Culburra Beach residential area, are likely to be associated with a cumulative increase in nutrients and pollutants into the neighbouring coastal wetlands and the lake.

The different versions of the concept proposal presented between 2013 and 2017, resulted in a number of changes to the location and size of the proposed developments within the Lake Wollumboola catchment. For instance, while the latest proposal in July 2017, retained the industrial estate, in its latest RtS (John Toons, November 2017), the proponent notes that it could accept "…delete it entirely from the concept plan if required by DPE". As previously mentioned, the inherent vagueness of the Concept Proposal and the numerous modifications to the proposal, which appear to be more reactive responses than planned and designed, is concerning.

At present, it is difficult to establish an acceptable level of nutrient or pollutant increase to a complex ecosystem such as Lake Wollumboola. Given the accepted highly sensitive ecological nature of Lake Wollumboola, any proposed development impact should be assessed in accordance with a precautionary approach. Several researchers have previously highlighted the importance of avoiding an algal dominated state with lake systems, as once lakes have turned towards an algal dominated state they are more likely to remain in that state. As such, it is highly recommended that unless detailed scientific processes are supported with field data, a precautionary approach should be adopted. Therefore at this stage, we recommend that all developments within the Lake Wollumboola catchment be removed from the Concept Proposal.

Review of the water quality and estuarine modelling indicates that the development will result in an overall reduction of surface water flows to this SEPP 2018 wetland post development during low intensity storm events. In the absence of an adequate understanding of the groundwater contribution, there is a risk that the hydrology cycle of this coastal wetland will be impacted. It should also be noted that we are concerned that clearing of the riparian vegetation immediately next to the SEPP wetland for creating view corridors and the establishment of a cycle path and walkway, will increase the risk of long term damage to this sensitive ecosystem.

8. Summary

In summary, based on the review of the technical surface water, estuarine modelling, groundwater and water quality reports prepared in support of West Culburra Concept Proposal State Significant Development (SSD 3846), as well as the warranted precautionary approach due to the sensitive ecological nature of Lake Wollumboola, the reviewers support DPE's recommendations to the Independent Planning Commission.

We recommend that the final decision on the project application awaits the final results of the Gateway Determination for the Planning Proposal associated groundwater investigation. This groundwater investigation will offer critically required information quantifying predevelopment conditions at the site and enable baseline conditions to be quantified and subsequently used to assess any impact of the proposed development on the neighbouring coastal wetlands and Lake Wollumboola. Further studies are also required to gain a better understanding of trigger points for the Lake Wollumboola ecosystem after which irreversible changes might occur.

Thank you for the opportunity to provide this independent review. Should you require further information please contact Dr Francois Flocard or Associate Professor Will Glamore in the first instance.

Yours sincerely,

Grantley Smith
Manager