

June 08, 2017

NSW Department of Planning and
Environment
Att: Robert Byrne
By Email

Dear Robert,

**RE: WATER CYCLE MANAGEMENT REPORT ADDENDUM; MIXED USE SUBDIVISION, WEST
CULBURRA (SSD 3846)**

1.0 Introduction

We understand that following review of the most recent version of the Water Cycle Management Report (November, 2016) and associated water quality (MUSIC) modelling, the Department's Peer Reviewer maintains their concern with the water quality modelling approach and the specified stormwater treatment solution. Specifically, the Peer Reviewer does not support modelling which includes approach which includes nutrient assimilation with the vegetation in the 7(a) protection zone between the development and the Crookhaven River.

To address the Peer Reviewer's concern, water quality modelling has been revised to achieve NorBe without the treatment of infiltrated water. The specific performance standard adopted is that NorBe be achieved at the 7(a) protection zone boundary. In order to achieve this objective, the proponent has made substantial modifications to the development proposal and footprint.

This addendum outlines:

1. Modifications to the development proposal and subsequently to the water quality model in order to achieve revised water quality objectives.
2. Results of water quality modelling.
3. Final proposed treatment train.

2.0 Development Proposal Modifications

In order to achieve water quality objectives without reliance on the assimilation of nutrients in the 100+ m buffer vegetated zone in the 7(a) land, the proponent has made substantial modifications to the development footprint and proposal:

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1. Most significantly, the proponent has removed 50% of the proposed industrial area. The area previously proposed as industrial is now to be retained with existing forest vegetation. Within the water quality model, the industrial zone was contributing a significant proportion of nutrients generated by the development to seagrass areas and the Crookhaven River. By removal of 50% of this area, water quality objectives are more easily achieved.
2. Project planners (Allen Price & Scarratts - AP&S) completed a detailed assessment of subdivision design based on similar residential land releases in the Shoalhaven region. Through this assessment, the following project modelling assumptions were refined:
 - a. Road areas: Impervious road area assumptions were modified from the previously assumed 50% to an impervious percentage calculated for each road, based on its intended use. AP&S confirmed paved width required was generally 6m with wider widths of 9m along future bus roads and 10m in the industrial zone.
 - b. Roof areas: Previously a roof area of 40% of lot area was applied to the entire site, regardless of location or lot size. Based AP&S's specification, roof areas have been adjusted to range from 200m² (smaller lots) – 275m² (larger lots). It is anticipated that final roof area shall be confirmed at detailed design stage once a final lot layout and extent is prepared.

3.0 Water Quality Model Modifications

The MUSIC water quality model was amended as follows to reflect development proposal modifications and achieve NorBe objectives:

1. Vegetation uptake node (treating infiltrated water) was removed from the pre and post development models and infiltration from treatment devices (e.g. bioswales) was discharged directly to the model outlet, untreated, as required by Peer Reviewer.
2. All base flow 'secondary routing' was deleted from pre and post development model as is normal modelling practice. MUSIC manages and routes the baseflow by its inbuilt routines.
3. Terminal wetland/infiltration systems were removed from the model (excluding catchment O6 which discharges to Lake Wollumboola). These areas are to be left undeveloped.
4. 50% of the industrial area was removed from the model and replaced with forest.
5. Roof areas were refined to 200 - 275 m² as discussed in Section 2.0. Pervious residential areas were increased by an equivalent area.
6. Road reserve percentage impervious is specified on a **sub-catchment basis** based on required pavement width rather than a model-wide assumption.
7. The wetland in catchment O6 (Lake Wollumboola catchment) was increased in size and permanent pool volume in order to increase water storage available to better meet reuse demands. This improved the treatment efficiency of the wetland.

4.0 Results

Results of iterative modelling conclude that NorBe objectives, as prescribed in Section 1.0 are achieved as a result of the development proposal modifications. Results are tabled below (Table 1 and Table 2) for each required receiving environment as previously reported in Table 10 – Table 14 of Marten and Associates, November 2016.

Table 1: MUSIC results – Pre Development catchment pollutant load.

Parameter	Pre Development Loads					
	SEPP 14 /O2	Curleys/O5	Lake	Seagrass	River	Total
TSS (kg/year)	1580.0	9140.0	293.0	12000.0	13600.0	13900.0
TP (kg/year)	4.7	18.0	0.9	28.9	33.6	34.5
TN (kg/year)	50.5	115.0	9.3	203.0	253.0	263.0
Gross Pollutants	0.0	899.0	0.0	899.0	899.0	899.0

Table 2: MUSIC results – Post Development catchment pollutant load and NORBE assessment

Parameter	Post Development Loads					
	SEPP 14 /O2	Curleys/O5	Lake	Seagrass	River	Total
TSS (kg/year)	587	6960	136	8110	8670	8810
Change (%)	-62.8	-23.9	-53.6	-32.6	-36.3	-36.6
TP (kg/year)	4.3	14.2	0.8	22.7	27.0	27.8
Change (%)	-8.3	-21.1	-4.8	-21.5	-19.6	-19.4
TN (kg/year)	49.6	102.0	8.5	190.0	240.0	248.0
Change (%)	-1.8	-11.3	-9.1	-6.4	-5.1	-5.7
Gross Pollutants	0.0	782.0	0.0	782.0	782.0	782.0
Change (%)	0.0	-13.0	0.0	-13.0	-13.0	-13.0

Note: Change is difference/predevelopment. Zero or negative values indicate NorBE test is met.

5.0 Implications on Estuarine Process Modelling

Estuarine Process Modelling (EPM) completed to date assessed the impact of the development on water quality within the Crookhaven Estuary. Two scenarios, each using different landside pollutant generation profiles, were considered:

1. Land-side stormwater quality using MUSIC modelling with treatment of infiltrated water by downslope vegetation (i.e. inclusion of vegetation uptake node).
2. Land-side stormwater quality using MUSIC modelling without treatment of infiltrated water by downslope vegetation.

Modelling scenario 1 achieved NorBe at the receiving environment, while scenario 2 did not. EPM results indicated that under both modelling scenarios, the impact on change in water quality within the Crookhaven Estuary was negligible.

Given the results of water quality modelling for the modified development as documented in Section 4.0 are between Scenario 1 and Scenario 2 above, and much nearer to the lower load of scenario 1, no impact on water quality within the Crookhaven Estuary would be expected. It is therefore unnecessary to re-run EPM in light of these latest modifications.

6.0 Revised Treatment Train

The treatment train developed to achieve NorBE water quality objectives is:

- Roofs discharge to 5KL rainwater tanks on each dwelling.
- Roofs of medium density residential discharge to rainwater tanks of 3KL – 5KL per unit.
- Tank overflows, remaining lot areas and road runoff is treated by roadside bioswales.
- Bioswales discharge into Enviropods and Stormfilters.
- Stormfilters discharge to the outlet.

In the Lake Wollumboola catchment, the treatment train for runoff from the small area of road and oval includes:

- Road areas treated by roadside swales.
- Roadside swale and oval discharge into a wetland of 3,200 m² with a permanent pond volume of 3.2 ML.
- Stored water is available for reuse to irrigate the oval.
- Overflow discharges to the Lake.

7.0 Conclusion

To address the Department's Peer Reviewer's concerns regarding the modelling of stormwater, the MUSIC water quality model has been amended to incorporate changes requested by the Peer Reviewer related to the treatment of infiltrated water. The water quality objective has been revised to require that NorBe be achieved at the 7(a) protection zone boundary. This mean no modelling allowance for the treatment of infiltrated water by the vegetation buffer between the development and the estuary is made. By implementing this change, the revised model addresses the Peer Reviewer's concerns.

To achieve the modified performance objective the application has modified, most notably by removing half the proposed industrial area. This, along with additional model refinements, achieves revised water quality objectives.

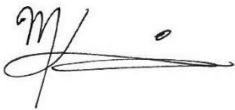
The revised water quality model confirms that the proposed development will have a neutral or beneficial effect on stormwater quality at the boundary of the development at the 7(a) zone, and therefore on the downslope receiving environments. This performance objective is achieved using the treatment train as outlined in Section 4.0. Further refinement of the model at the detailed design stage may alter the sizes of the proposed treatment structures and may allow substitution of elements of the treatment train

provided the final treatment train achieves water quality performance objectives as specified in this document.

If you have any queries please contact the undersigned.

For and on behalf of

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A handwritten signature in black ink, appearing to be 'M. Kovelis', written over a horizontal line.

MEGAN KOVELIS

Environmental Scientist/Planner