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6 March 2014

NSW DoPI (via email)

Attention: Necola Chisholm/Kim Johnston

Dear Necola and Kim

RE: PROC-1000395 – WEST CULBURRA WATER CYCLE MANAGEMENT REVIEW

As per your recent request we have conducted a review of the water cycle management components of the West Culburra proposed development. In undertaking this review, Darren Lyons and Tony Weber have examined the flooding, groundwater and water quality management and monitoring reports provided by DoPI through the Major Project Assessments section of the DoPI website

The results of the review are presented in the sections below.

Fundamentally, the development of a site such as that proposed at West Culburra will need to be conducted with considerable sensitivity and care given the proximity of the SEPP 14 wetlands nearby and the use of the Crookhaven estuary for commercial oystering and fishing. Parts of the site also discharge to Lake Wollumboula, which itself is also a sensitive receiving environment and has a documented history of water quality issues through algae growth and odour generation. The areas in the Crookhaven Estuary closest to the site are also likely to be poorly flushed given the extent of wetland vegetation and configuration of the estuary, as such, any impacts are likely to have a significant effect on the estuary and would persist for some time.

1. Assessment of Water Quality Impacts upon Crookhaven River and Lake Wollumboula

The assessment of the water quality issues focussed around whether the proponent could adequately demonstrate whether the impacts of the development could be mitigated to result in a Neutral or Beneficial Effect (NorBE) on the receiving environments of the Crookhaven River and Lake Wollumboula. Within the immediate vicinity of the proposed development is a SEPP 14 wetland adjacent to Billy's Island. Also within close proximity of the development, adjacent to Cans and Rocky Points are oyster leases that are observable from aerial imagery.

The site itself is also relatively undisturbed in recent times with significant stands of vegetation in existence and only small amounts of clearing on the western side of the development. Conversion of this land to urban development of the extent noted has the potential to cause significant water quality and hydrologic impacts if not carefully managed, and based on the reviewers' experience, demonstrating that NorBE could be achieved on such a site is very challenging.

From an assessment of the Martens consulting engineers report "Water Cycle Management Report – Mixed Use Subdivision; West Culburra, NSW – P1203365JR01V04" dated October 2013, we have identified a number of issues that would require further work.

a) In terms of water quality impacts, by far the largest impact on the receiving environment would come from the construction phase of the development, however only cursory information has been provided on the proposed erosion and sediment control aspects. Given the risk and likelihood of sediment discharges into the estuary during construction, a significantly more detailed examination of the construction phase of the development would be necessary for such a sensitive receiving environment.

Recommendation 1 – A more detailed analysis of construction phase management and potential impacts on the receiving environment needs to be conducted. This may require additional modelling of both the frequency and magnitude of construction site runoff and detailed modelling of the estuary itself in order to demonstrate no significant short term and long-term effects from the development taking place

b) Within the Martens report and associated MUSIC model, the proponent is relying upon the operation of proprietary devices to assist in achieving the stormwater quality targets for the site. In this case, numerous SPEL Storm Ceptor Class 1 units have been proposed. An indicative image of the layout of these devices is shown below.

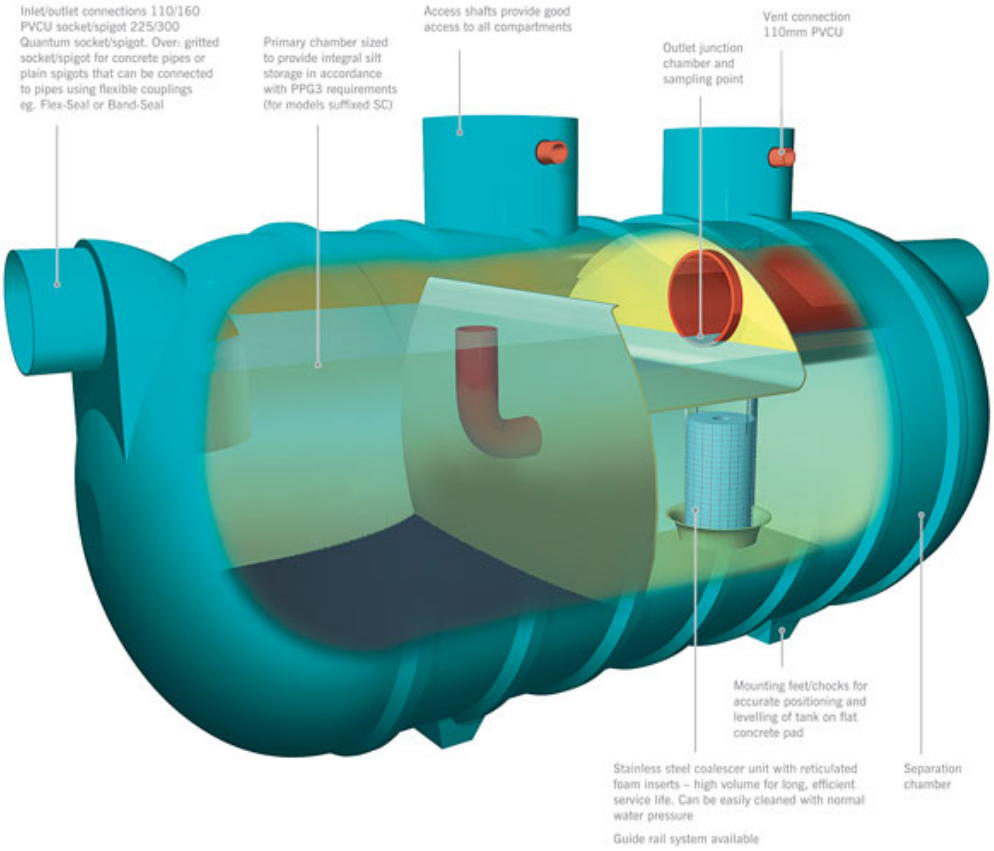

Figure 1 SPEL Storm Ceptor Class 1 (SPELenvironmental.com.au)

Within the MUSIC model, pollutant load reduction rates of 97% for Total Suspended Solids and 30% for Nitrogen and Phosphorus have been used, however no documentary evidence has been provided to show that these devices can achieve such high reductions. The draft NSW MUSIC Modelling Guidelines to which the report author refers to states that "This data should be derived from an independent, published source (i.e. not simply based on proprietor supplied data)." It would appear that they have relied upon the proprietor supplied data in this case. I note also that the unit proposed is designed as an oil and grit/sediment separator, not a gross pollutant trap. Again the draft NSW MUSIC Modelling Guidelines state "If a proprietary device is noted as being and oil and grit/sediment separator, no gross pollutant removal is to be attributed to the device, nor should it be used for this purpose."

As such, the pollutant removal potential of these proposed devices is likely to be significantly less than that modelled within MUSIC and given that they are not appropriate for the locality

proposed, would likely represent a significant and on-going cost burden to the local council if they were a contributed asset. If maintenance of these devices is also not maintained, they have a strong potential to actually release contaminants to downstream waterways rather than continue to reduce them.

Recommendation 2: The proponent considers the use of other treatment measures than the proposed SPEL Storm Ceptor units. In particular, the use of surface treatment systems such as vegetated swales would offer considerable benefit in reducing both sediment and nutrients into the downstream bioretention basins and would also trap any gross pollutants on their surface. While not ideal from a gross pollutant perspective, the loads of gross pollutants post-development is unlikely to be significant and therefore such treatment systems are anticipated to be acceptable.

c) A CDS unit is proposed for the planned sub-station. Such devices are usually installed where there is a high generation rate of litter. This is unlikely on a substation site and it would be more suitable to ensure suitable spill capture infrastructure (e.g. bunding around transformer areas) was put in place rather than installation of a CDS device such that any potential hydrocarbon spills from transformer oils or other electrical equipment can be contained adequately on site.

Recommendation 3: The proponent examines suitable spill capture infrastructure more suitable for the proposed land use in the planned sub-station.

d) The MUSIC modelling undertaken for the West Culburra site has some significant issues which result in it not being suitable for demonstrating compliance with NorBE. In the first instance, the parameters used for the pervious areas (i.e. forested, grazing and urban parks/gardens) do not appear to be consistent with the draft NSW MUSIC Modelling Guidelines, given that the modeller has stipulated that the parameters for Clayey Sand have been selected, however the values in the model itself are not those stipulated for that soil type within the guidelines.

Recommendation 4: The proponent revise the parameters within the MUSIC model such that they are consistent with the draft NSW MUSIC Modelling Guidelines or provide suitable justification for the parameters selected.

e) Given the sensitivity of the receiving environment and the close proximity of the development to the receiving waters, some assessment of the suitability of the model outputs (hydrology, water quality etc.) would be beneficial to ensure that the results provided are a reasonable representation of the existing and future cases. Such assessments may consist of model calibration with hydrologic measurements, evaluating runoff coefficients and comparing these with literature etc. While the draft NSW MUSIC modelling guidelines provide suitable parameters, they are based on broad scale calibration and local scale calibration may provide better results. It is noted however that comparison of existing and future scenarios are made and the relative changes are more important to some extent than an exact representation of hydrology and water quality.

Recommendation 5: The proponent should undertake some assessment of the suitability of the developed MUSIC models to represent the location.

f) The MUSIC model of the developed site assumes that there will be 3.6 mm/hr of seepage out of each of the treatment measures however there are several issues associated with this. Firstly,

such seepage rates were not used in the pre-development model so that a direct comparison with the runoff and pollutant loads cannot be made. Secondly, the infiltration rate assumed is not consistent with assessments of infiltration in the groundwater modelling section which identify a rate of <1mm/hr as representative of the soils on site. Thirdly, and most importantly, the model has been set up to assume that any infiltrated water effectively "disappears" from the site and does not reach the receiving environment. Given the proximity of the site to the Crookhaven estuary, such an assumption is not likely. A revised MUSIC model was developed where all infiltrated water lost through the seepage loss was directed to the catchment outlet using the "split-flow" functionality of MUSIC version 5.1.16 (and later versions). A screenshot is shown below. The red dashed lines represent the infiltration from the treatment measures.

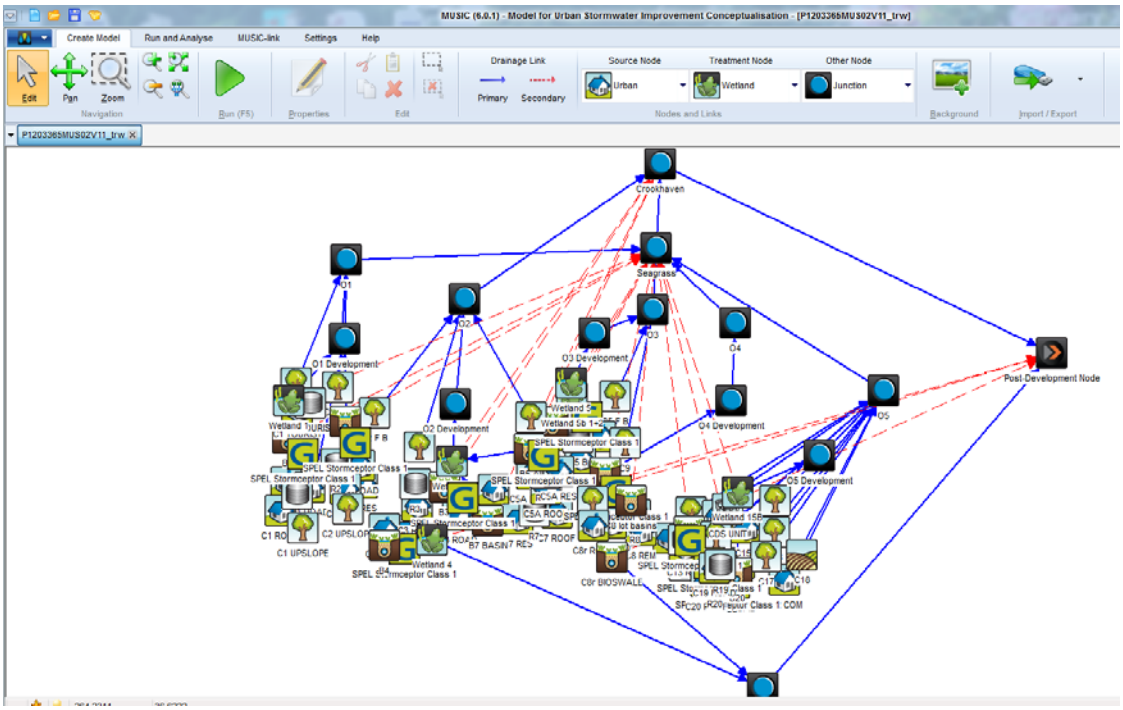

Figure 2 Revised MUSIC Model Spreadsheet

When applied, the revised pollutant export results are shown below

Table 1 Revised MUSIC Modelling Results

Indicator	Predevelopment	Post Development	Difference
Flow (ML/yr)	315	394	25%
Total Suspended Solids (kg/yr)	14000	11600	-17%
Total Phosphorus (kg/yr)	34.3	42.9	25%
Total Nitrogen (kg/yr)	260	358	38%
Gross Pollutants (kg/yr)	899	899	0%

As can be seen, with the seepage losses accounted for, the development is predicted to significantly increase the loads of nitrogen and phosphorus into the Crookhaven estuary and Lake Wollumboula with the proposed management measures, with a significant increase in flows

also. These are likely to cause impacts to the SEPP 14 wetlands, the Crookhaven estuary and Wollumboula if allowed to proceed as currently planned.

Recommendation 6: The proposed treatment train as modelled in MUSIC is not sufficient to protect the Crookhaven estuary, SEPP14 wetlands and Lake Wollumboula. The use of seepage losses in the model and the assumption that the infiltrated water "disappears" is not valid for the locality. The proponent should therefore significantly revise both the treatment train and the way it is modelled in order to demonstrate compliance with a Neutral or Beneficial Effect on the relevant receiving waters.

2. Assessment of Flooding Impacts of the Proposed Development

There would appear to be few issues in relation to flooding. Design flood levels at the site have been established in previous flood studies undertaken for Shoalhaven City Council, with corresponding design peak flood levels provided to the proponent through the Council issued Flood Certificate. The design 1% AEP peak flood level incorporating sea level rise allowance to the year 2100 planning horizon is established at 3.6m AHD. The proposed development layout in relation to the design peak flood level contour is shown on Drawing 25405-37. This drawing indicates that the proposed infrastructure essentially lies outside this flood envelope, with only the open space/reserves subject to inundation at this level. The design Flood Planning Level (FPL) for proposed infrastructure would however incorporate the required 500mm freeboard, providing for a FPL of 4.1m AHD.

Whilst development controls such as the FPL are typically based on the 1% AEP flood condition, larger flood events up to the Probable Maximum Flood (PMF) are considered in relation to flood emergency risk management and response. The ground level contours shown on Drawing 25405-37 indicate a relatively steeply rising ground surface away from the typical flood inundation extents. The majority of the area within the development extent lies above the PMF, thereby providing suitable flood refuge above the PMF level with suitable access. Further, the large size of the contributing catchment for the Crookhaven River is expected to provide a reasonable flood warning time to enact suitable flood response.

The development may be expected to provide an increase in peak runoff volumes/flow rates through the urbanisation of the existing local catchments. Typically in this situation developments may be required to incorporate appropriate stormwater management measures, such as on-site detention, in order to limit the increase in stormwater runoff. As noted in the application documents however, the location of the site and receiving waters (i.e. Crookhaven River) being at the far downstream end of the drainage system suggest that there would be little impacts as a result of minor increases in the total catchment runoff. Accordingly there would be little need for runoff reduction measures from a flooding perspective.

3. Assessment of Groundwater Impacts

The groundwater assessment contends that there will a reduction in evapotranspiration as a result of conversion to urban development and as such an increase in groundwater recharge. This is actually incorrect in the majority of urban developments, as the overall loss of vegetation and increase in imperviousness tends to reduce groundwater recharge rates considerably and alter hydrology to deliver significantly higher and more frequent surface flows and much lower rates of subsurface flow. Given that the CLASS modelling undertaken only considers changes in soil moisture and doesn't examine changes in subsurface flow rates, it is therefore difficult to understand how such a statement regarding increase in groundwater recharge could be made.

The parameters shown in Table 4 of the Martens report (p20) shows input parameters for the CLASS model. In that, the Soil K values are given as 1.061 and 0.048 m/day, however the K values determined in assessment of the groundwater bores show levels 50 times less than the first value, with a mean of only 0.023 m/day. It is therefore difficult to understand how these parameters were derived.

In terms of groundwater quality, the proponent states that groundwater quality is not expected to be adversely impacted by the development, as given that in some cases the groundwater table very close to

the surface (<0.5m), it is difficult to understand how the groundwater would not be impacted to some degree, however no quantitative assessment is made.

In the results of the CLASS modelling, the proponent has assumed that the pervious areas of the development will all be grassed, however with significant buffer areas remaining, it would seem likely that the forested component would maintain its existing recharge rate. The developed condition recharge rate of 67 mm is some 39.5% greater than the that of the modelled predevelopment scheme, however again this does not appear consistent with the documented changes in hydrology of urbanised catchments where significant decreases in baseflows and increases in surface flows have been recorded in numerous waterways downstream of urban areas across Australia.

Based on the above, we believe that the groundwater assessment is inadequate to properly quantify the impacts on the groundwater system and would require significant revision in order to adequately demonstrate that no impacts are likely to occur.

Recommendation 7: The proponent undertake a significant revision of the groundwater analysis and resultant impacts upon subsurface flows and quality as result of development. The current assessment also contains broad assumptions and errors within the modelling that are not consistent with current hydrologic understanding of urbanised catchments. Revision of both the assessment technique and appropriate assessment targets to properly quantify what is meant by "not be significantly altered" as the 39.5% change as modelled would appear to be a significant alteration.

4. Adequacy of the proposed Water Quality Monitoring Plan

The proposed water quality monitoring plan as outlined in Martens Consulting Engineers report "Water Quality Monitoring Plan – Mixed Use Subdivision, West Culburra, NSW, P1203365JR03V02" dated October 2013 has been reviewed in regards to its suitability to assess the impacts of the proposed development on the receiving waters downstream of the proposed development.

In terms of monitoring elements, the groundwater and estuary water quality monitoring programs should also be supplemented by similar monitoring of the discharges of the development. The proposed SQIDs monitoring is simply part of a normal maintenance regime and provides little certainty as to whether the proposed treatment train is operating effectively to mitigate the impacts of the development. As such, undertaking monitoring of at least the wetland systems would demonstrate whether the final "line of defence" is operating satisfactorily. This, combined with a revised SIDS monitoring program that adequately assesses the establishment of the vegetated systems (typically it takes 1-2 years for such systems to establish properly and provide sufficient treatment), would provide adequate certainty that the treatment measures are working as designed.

Recommendation 8: Include some surface water discharge monitoring from the wetlands system prior to discharge into the receiving waters and monitor the establishment of the vegetated treatment systems to ensure that they perform as designed.

Generally, the monitoring program lacks structure in terms of compliance assessment. No targets or water quality objectives are noted so it would therefore be extremely challenging to demonstrate compliance with a Neutral or Beneficial Effect test if no quantitation of existing water quality is given as compliance targets.

Recommendation 9: Adopt suitable compliance targets for each of the monitoring program components.

Given the sensitivity of the downstream receiving environments, a proper risk assessment approach to the design of the monitoring program is warranted, which documents the risks and likelihoods, the measurement techniques and the management responses if exceedences are noted would result in a more definitive monitoring program that would lead to management actions being undertaken if compliance problems were identified. The current monitoring program lacks detail on what actions would

be undertaken if issues arose with monitoring values not being “acceptable” (it is noted that no limits are placed in the program on what may be considered “acceptable”).

Recommendation 10: Revise the monitoring program to a proper risk assessment based structure

The proposed estuarine monitoring program is not likely to be adequate to properly assess impacts from urban development to any great degree and lacks sufficient detail to provide any confidence that impacts would be detected. Specifically, key urban runoff pollutants such as heavy metals and petroleum hydrocarbons (present in road runoff and significant toxicants to shellfish) are not included amongst the monitoring parameters. The faecal coliforms parameter for assessing faecal contamination is also not consistent with current faecal biomarker monitoring and other indicators may provide a far better way of assessing potential faecal contamination of receiving environments.

Recommendation 11: Revise the monitoring indicators to better detect urbanised runoff pollutants and faecal contamination.

5. Conclusions

Given the above points, we are of the opinion that the current Water Cycle Management Report and Water Quality Monitoring Plan are not sufficient to demonstrate and assess compliance of a Neutral or Beneficial Effect on the Crookhaven Estuary, SEPP 14 Wetlands and Lake Wollumboula. The statements of commitments are therefore insufficient, based on the information reviewed, to adequately mitigate the impacts of the proposed development on the receiving enviroments.

Given the issues identified with the modelling as is within the water quality section of the Marten’s report, my opinion is that the diversion of water to the Crookhaven river from the Lake Wollumboola catchment will not be acceptable due to the inadequacy of the proposed treatment train in mitigating the impacts of the development.

Runoff from the proposed oval and road entry to the development will flow to Lake Wollumboola. When revised to account for infiltration losses also potentially flowing into Lake Wollumboola, that area of the development will result in nearly a doubling of the nutrient (nitrogen and phosphorus) load compared to the same area pre-development and therefore the impacts would not be considered consistent with the water quality outcomes of the South Coast Sensitive Urban Lands Review.

I hope that the above is satisfactory for your current requirements. Please feel free to contact me if I can be of further assistance.

Yours Faithfully
BMT WBM Pty Ltd

Tony Weber
National Practice Leader – Water Quality
Associate

References

SPELenvironmental, Stormceptor Class 1 diagram, http://www.spelproducts.co.uk/product_separators_stormceptor.php , accessed February 2014

SMCMA 2010, draft NSW MUSIC Modelling Guidelines, Sydney Metropolitan Catchment Management Authority, Sydney, February 2014.