

January 31, 2014

NSW Department of Planning and  
Environment  
Att: Robert Byrne  
Senior Planner – Industry Assessments

Dear Robert,

**RE: EXPLANATORY NOTE – WEST CULBURRA CONCEPT PLAN (SSD 3846); WATER QUALITY  
ISSUE LAND SIDE STORMWATER REPORT**

As requested in recent correspondence from NSW Department of Planning and Environment (NSW DoPE) (December 23, 2016), we provide the following tabulated summary of how latest reports submitted addresses the concerns raised and/or recommendations made by BTM WBM in each of their previous letters; being:

1. 'PROC-1000395 – West Culburra Water Cycle Management Review', March 6, 2014.
2. 'West Culburra Water Cycle Management Report – Peer Review', October 23, 2014.
3. 'West Culburra – Further Review', 19 August, 2015.

Reports referred to in Table 1, being the latest versions of supportive documentation prepared by Martens and Associates, are:

- o 'Water Cycle Management Report – Mixed Use Subdivision; West Culburra, NSW'; Report reference: P1203365JR01V07; dated November 2016 (hereafter WCMP).
- o 'Estuarine Management Study – Mixed Use Subdivision; West Culburra, NSW'; Report reference: P1203365JR02V04; dated November 2016 (hereafter EMS).
- o 'Water Quality Monitoring Plan – Mixed Use Subdivision; West Culburra, NSW'; Report reference: P1203365JR03V04; dated November 2016 (hereafter WQMP).
- o 'Estuarine Processes Modelling Report – Proposed Mixed Use Subdivision; West Culburra, NSW'; Report reference: P1203365JR04V02; dated November 2016 (hereafter EPMR).

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**Table 1:** Summary of documented response to WBM BMT concerns/recommendations.

March 6, 2014		
Point	Concern/Issue Raised	Response/Comment
1	Analysis of construction phase management.	A Construction Phase Water Quality Assessment has been completed to address this concern. Outcomes are provided in: WCMR: Section 5. EMS: Section 3. WQMP: Section 2.6; Section 3.
2	Replacement of proposed SPEL stormceptor units.	In consultation with WBM BMT these units have been replaced with Stormwater 360's Stormfilter-EnviroPod (SFEP). The treatment efficiencies of these devices have been published in <i>Water</i> the journal of the Australian Water Association and also endorsed by Blacktown City Council. See: WCMR: Section 4.4.3 WQMP: Section 2.11
3	Treatment of the proposed substation.	Given the proposed substation shall be owned and managed by Endeavour Energy; the substation was removed from the post development model. An equivalent area was also removed from the pre development model. This was agreed as acceptable by WBM BMT.
4	Pervious area input parameter	The typographical error generating confusion with regards to pervious input parameters has been corrected. See: WCMR: Attachment B and Attachment D.
5	Assessment of model output suitability	As requested, an assessment of MUSIC model output suitability has been completed, which evaluates runoff coefficients, examines model calibration and examines the relative change in pollutant loads comparing pre and post development. See: WCMR: Section 4.5.1.
6	Use of seepage losses from model:	
	a) Inclusion in the pre-development model	Pre and post development models are now consistent with regards to seepage rates and infiltration.
	b) Infiltration rate consistency with Groundwater Assessment	Field investigations (Martens and Associates, 2010 & 2014) found site soil hydraulic conductivity is 1.14 mm/hr. This has been adopted for groundwater and water quality modelling. See: WCMR: Section 3.3.2, Section 4.4.10.1 & 4.4.10.2
	c) Use of secondary drainage links for infiltrated stormwater.	Pre and post development models now include secondary drainage links to ensure base flow and exfiltrated stormwater does not 'disappear' from the model. With regards to the treatment of this water, an approach was developed at the time in consultation with WBM BMT. This is summarised in: WCMR: Section 4.4.10.1 & 4.4.10.2 Martens and Associates maintains the position that bypassing infiltration, untreated, to model outlet nodes - thereby ignoring the natural water quality treatment processes that would occur within the 7(a) zone is incorrect and overly conservative.

7	Groundwater analysis:	WBM noted during teleconference (June 5, 2014) that works completed to address Point 6 also satisfy concerns related to groundwater. Specifically:
	a) CLASS model input parameters	Comparison of CLASS default K input parameters for topsoil to the results from field testing results of weathered rock is incorrect as they detail parameters for distinctly different strata. See: WCMR: Section 3.2, 3.3.2 and 3.5
	b) Groundwater quality impacts	MUSIC results have been used to assess the pollutant load being discharged to the groundwater table. Works to address Point 6 also address potential impacts of the development on groundwater flow and quality. See: WCMR: Section 3.3.4, 3.3.5 and 3.5 WQMP: Section 2.7.
	c) Recharge rate	Groundwater is expected to increase by 19 mm/year which will not have a significant impact on wetland hydrology as: <ol style="list-style-type: none"> <li>1. There are no GDEs downslope of the site.</li> <li>2. There are no nearby groundwater users.</li> <li>3. Site investigations found aquifer to be low yield, limited distribution and ephemeral.</li> <li>4. Considerable water quality treatment (see WCMR Section 4.4) measures ensure infiltration does not have adverse impacts on groundwater.</li> <li>5. Total infiltration for both pre and post development are small.</li> </ol>
8	Water Quality Monitoring Plan – wetland system discharge monitoring.	Recommendations and requirements related to end of line discharge monitoring and monitoring of vegetated treatment systems as included in: WQMP: Section 2 and in particular Section 2.11.
9	Water Quality Monitoring Plan – compliance values for monitoring programs.	The revised WQMP includes trigger values where appropriate. In the case of shellfish and estuarine monitoring, it is to be completed as part of a wider strategy and setting individual trigger values is therefore not appropriate. See: WQMP: Section 2.
10	Restructure of Water Quality Monitoring Plan to include risk assessment.	The WQMP was restructured to be in a risk assessment format. See: WQMP: Section 2 (particularly Section 2.2 – 2.5) and Attachment C.
11	Revise Water Quality Monitoring Plan monitoring indicators.	The WQMP for estuarine monitoring was revised accordingly. See: WQMP: Section 2.8.

October 23, 2014

Point	Concern/Issue Raised	Response/Comment
1	Groundwater recharge increases will result in major hydrologic change	<p>As detailed in advice addressed to the NSW DoPE (Martens and Associates, December 5, 2014):</p> <ol style="list-style-type: none"> <li>1. There are no GDEs downslope of the site.</li> <li>2. There are no nearby groundwater users.</li> <li>3. Site investigations found aquifer to be low yield, limited distribution and ephemeral.</li> <li>4. Considerable water quality treatment (see WCMR Section 4.4) measures ensure infiltration does not have adverse impacts on groundwater.</li> <li>5. Total infiltration for both pre and post development are small.</li> </ol> <p>At meeting held at their office (December 18, 2014) (see Attachment A for minutes) the NSW DoPE resolved to:</p> <ul style="list-style-type: none"> <li>o Engage wetland ecologist to advise on significance of increased groundwater recharge.</li> <li>o BMT WBM were to compile a list of 3 specialist consultants for applicant to consider.</li> <li>o Applicant to advise DoPE of specialist prior to engagement.</li> </ul> <p>To our knowledge this has not been undertaken by WBM BMT.</p>
2	Water quality objectives	<p>At meeting at NSW DoPE offices (December 18, 2014) it was agreed that this is no longer an issue (see Attachment A). The WCMR demonstrates that both NorBe and Council's requirements (pollutant reduction criteria) are achieved. See:</p> <p>WCMR: Section 4.5</p>
3	Lake Wollumboola	<p>At meeting at NSW DoPE offices (December 18, 2014), the Department noted that there is not further discussion required on the matter of Lake Wollumboola.</p>
4	Bioretention swale design	<p>At meeting at NSW DoPE offices (December 18, 2014) it was agreed that swale design was a detailed design matter, and what was important was establishing a minimum filter area requirement to maintain treatment efficiency.</p> <p>Since this meeting the applicant and NSW DoPE have agreed that internal road (and hence bioretention swale) layout design shall be removed from the concept approval stage. Bioretention swale requirements are therefore to be confirmed at detailed design stage once an internal lot layout has been prepared. See:</p> <p>WCMR: Section 4.4.2.0</p>
5	Exfiltration rates and vegetation uptake (Use of CSIRO 1999 uptake rates and further justification on approach)	<p>As documented in correspondence to WBM BMT (January 30, 2015) a literature review was undertaken in relation to nitrogen and phosphorus uptake rates. Based on this review, uptake rates adopted for modelling were reduced to 51.8 kg/ha/year for nitrogen and 10 kg/ha/year for phosphorus. See:</p> <p>WCMR: Section 4.4.10</p> <p>Martens and Associates maintains the position that bypassing infiltration, untreated, to model outlet nodes - thereby ignoring the natural water quality treatment processes that would occur within the 100m wide 7(a) zone is incorrect and overly conservative.</p>

6	Faecal coliform breakdown	
	a) Bioretention design	The proposed development shall be sewered and so source of this contamination is limited primarily to animals. As per WCMP (Section 4.6.3) the water quality treatment train has been designed to maximise stormwater exposure to UV light and residence time in order to allow breakdown of faecal coliforms.
	b) Risk to oyster leases as a result of faecal contamination	The WQMP was developed in consultation and with the support of the oyster industry and their representative to ensure the development mitigates potential risk to the oyster industry and public health.
7	Construction phase development	WBM BMT have agreed that this work has been ' <i>well thought out</i> ' (T. Weber, October, 2014) and therefore we consider this matter resolved. See: WCMR: Section 5. EMS: Section 3. WQMP: Section 2.6; Section 3
8	Extended detention depths of proposed bioretention basins	WBM BMT agreed at meeting at NSW DoPE offices (December 18, 2014 that bioretention basin design would be reviewed by the wetland ecologist to be engaged as per Point 1. To our knowledge this has not been undertaken by WBM BMT.

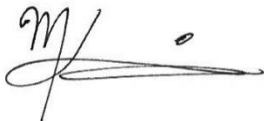
**August 19, 2015**

Point	Concern/Issue Raised	Response/Comment
1	a) Use of uptake rates in MUSIC modelling.	Martens and Associates maintains the position that bypassing infiltration, untreated, to model outlet nodes - thereby ignoring the natural water quality treatment processes that would occur within the 7(a) zone is incorrect and overly conservative.
	b) Increased hydraulic head on the groundwater may lead to an increased flow of groundwater offsite which may contribute to receiving environment nutrient loads.	A sensitivity analysis, assuming no exfiltration occurs, was completed and results used as inputs for estuarine process modelling to quantify the impact on nutrient load delivery to the estuary. See: WCMR: Section 4.5.5 EPMR: Section 13 The EPMR concludes ' <i>changes to sensitivity models</i> ' estuarine concentrations due to the proposed development are considered negligible, even in infrequent storm events' (pg. 113).
2	a) Use of a 'proper' groundwater model to simulate groundwater/surface water interactions to provide confidence of uptake in vegetation zone.	Martens does not agree that additional groundwater modelling is required. Site investigations to determine site soil and groundwater characteristics have been used to inform CLASS groundwater modelling, which in turn have informed MUSIC modelling to ensure there are no adverse groundwater quality impacts. See WCMR: Section 3.2, 3.3.2, 3.3.4, 3.3.5 and 3.5 WQMP: Section 2.7
	b) Little data looking at low concentration uptake rates, most data for agricultural catchments. Until it is demonstrated this is accounted for, use of vegetation uptake rates is not supported.	As discussed above, to further address these comments, a sensitivity analysis, assuming no exfiltration occurs, was completed in MUSIC and results used as inputs for estuarine process modelling to quantify the impact on nutrient load delivery to the estuary. See: WCMR: Section 4.5.5 EPMR: Section 13 The EPMR concludes ' <i>changes to sensitivity models</i> ' estuarine concentrations due to the proposed development are considered negligible, even in infrequent storm events' (pg. 113). Thus, even if we exclude infiltration from water quality modelling, thereby ignoring the natural processes that will occur within the 100m wide 7(a) zone, the implications on estuarine conditions during the rare storm events is negligible. Further modelling and assessment is therefore not required.

If you have any queries, please do not hesitate to contact our offices

**For and on behalf of**

**MARTENS & ASSOCIATES PTY LTD**

A handwritten signature in black ink, appearing to be 'M Kovelis', with a stylized flourish at the end.

**MEGAN KOVELIS**

BEnvS(Hons1)

Environmental Scientist

A handwritten signature in blue ink, appearing to be 'A Norris', with a stylized flourish at the end.

**ANDREW NORRIS**

BSc (Hons), MEngSc, MAWA

Director/Project Manager

**ATTACHMENT A – MINUTES NSW DOPE MEETING, DECEMBER 18, 2014**

## Record of Conference Minutes

<b>Date</b>	18/12/14	<b>Reference</b>	P1203365JC16V01	<b>No. of Pages</b>	6
<b>Start Time</b>	3:00pm	<b>Finish Time</b>	4:10 pm		
<b>Meeting Location</b>	Department of Planning and Environment (DoPE), Bridge Street, Sydney				
<b>Subject</b>	BMT WBM Review of West Culburra Water Quality & Estuarine Process Modelling				
<b>Attendance</b>	<p>Robert Byrne (RB) (DoPE)</p> <p>Christopher Ritchie (CR) (DoPE)</p> <p>Kate MacDonald (KM) (DoPE)</p> <p>Andrew Norris (AN) (Martens)</p> <p>Megan Kovelis (MK) (Martens)</p> <p>Daniel Dhiacou (DD) (Martens)</p> <p>John Toon (JT) (Realty Realizations)</p> <p>By phone:</p> <p>Tony Weber (TW) (BMT WBM)</p> <p>Michael Barry (MB) (BMT WBM)</p>				
<b>Copies to</b>	John Toon				
<b>Apologies</b>	NA				

### WATER QUALITY

#### 1. Groundwater Infiltration and Impacts

- WBM (TW):
  - Groundwater is critical to downstream wetlands adjacent to the site.
  - Modelling completed is low-specification.
  - More certainty is required to say that the change in infiltration will not result in any impact.
  - Although wetland is not a GDE it is a coastal wetland.

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- Need input from a wetland ecologist and their confirmation that the increased infiltration is not an issue.
- Martens (AN):
  - Groundwater is not a critical component to the downslope vegetation; rather surface and subsurface flow is.
  - No apparent impact of existing Culburra township on vegetation fringing Curleys Bay.
  - The context of the results is a 19mm/year increase which will not have significant impacts on wetland hydrology.
- DoPE (RB)
  - Best way forward is to engage a wetland ecologist.
  - BMT WBM are to compile a list of 3 specialist consultants for the applicant to consider.
  - Applicant to advise DoPE of specialist selected prior to engagement.
- Martens (AN):
  - Wetland ecologists should be NSW based.

## 2. Water Quality Objectives

- WBM (TW):
  - Not an issue.
  - NorBe is most suitable test for water quality modelling – however if Council require compliance with DCP objectives this can be left in documentation.
- Martens (AN):
  - DGEARs required the applicant to consult with Council.

## 3. Lake Wollumboola

- DoPE (RB):
  - No further discussion required on this.

## 4. Bioretention swale design

- Martens (AN):
  - Confirmed issue adequately addressed by proposal to form a kerb or similar to create vertical sides for swales thereby increasing the filter area?
  - Design of swales is a detailed design matter – a minimum filter area requirement will be set to maintain treatment efficiency.
- WBM (TB):
  - Agreed.

## 5. Exfiltration and Vegetation Uptake

- Martens (AN):
  - After thorough research CSIRO values were considered appropriate in absence of any better options.
  - Not aware of any other figures in literature or otherwise that are more suitable.
  - Surprised this issue is being raised at this stage given level of consultation with WBM and that the CSIRO values were previously noted as Martens' preferred figures.
- WBM (TW):
  - The model is currently using nutrient removal rates related to effluent reuse onto plantation which doesn't resemble the subject site.
  - Nothing has been documented to say concentrations, soil types, residence times for CSIRO findings are similar to the site.
  - The approach is not justified solidly in documentation. Therefore use of the vegetation uptake node is not acceptable.
- DoPE (RB):
  - How can Martens move forward on this issue?
- WBM (TW):
  - Do not use exfiltration in modelling.

## 6. Faecal Coliform Contamination and Oyster Leases

- DoPE (RB):

- What is the source of this contamination that is raising this as a concern? Given the development will be sewerred.
- WBM (TW):
  - Animals.
  - Much evidence demonstrating that urbanised catchments deliver more faecal coliforms and other organisms.
  - Also residual issue with DPI on this matter.
- Martens (AN):
  - A WQMP has been developed and supported by the oyster industry and their representative.
  - Industries main concern lies with existing STP and pump stations.
  - DPI were involved in the consultation period and were the only body to have ongoing concerns.
- DoPE (RB):
  - Is there the option to have pet restrictions for the development?
  - SEPP may require DPI (Fisheries) sign off for the approval – so their concerns may have to be addressed (CR).

## 8. Detention Depths of Bioremediation Basins

- Martens (AN):
  - We can consult with the wetland ecologist on this matter to confirm wetland vegetation species suited to depths > 0.3m.
- WBM (TB):
  - Agreed.

## **ESTUARINE PROCESSES MODELLING**

### 1. Model Selection

- WBM (TW):
  - TW does not recall advising Martens not to use TufLOW FV.

- WBM (MB):
  - Use of TufLOW classic with AD is acceptable if applied appropriately.
- Martens (AN):
  - We will proceed to use our current TufLOW classic model with AD and make amendments to the model cell size.
- WBM (MB):
  - Agreed.

## 2. Model Cell Size

- WBM (MB):
  - The grid cell size selected should be capable of representing narrow channels / hydraulic constrictions.
  - Bathymetry data should be reviewed to ensure it is being represented appropriately.
- Martens (AN):
  - We can review the appropriateness of say a 25 m grid cell size and compare to bathymetry data, in consultation with WBM, to reach an agreed position.
- WBM (MB):
  - Agreed.

## 3. Hydrodynamic Calibration

- WBM (MB):
  - The distance from the site to the calibration points does not matter.
  - The entire model domain should be appropriately calibrated or else it should not be relied upon.
  - The model needs to properly represent the tidal flushing within the estuary.
  - To achieve adequate calibration the model must utilise upstream water level data and flow data via a boat mounted acoustic Doppler current profiler (ADCP) to determine tidal flows.

- Martens (AN):
  - The level of detail required for this assessment is above what is reasonably expected for a development of this nature.
- WBM (TW):
  - Disagree.
  - The current level of assessment is inadequate to determine whether there are impacts on the estuary and Crookhaven River.
- WBM (MB)
  - Modelling is inconsistent with best practice engineering and should not be relied upon.
- Martens (AN):
  - We shall put together a scope of works to address calibration concerns and consult with WBM to reach agreement.

#### 4. AD Calibration

- WBM (MB)
  - Need to collect continuous depth, temperature and salinity data using CTD loggers for use in AD calibration.
  - The appropriate period of monitoring depends on rainfall, and should include inflow event(s).

#### 5. Scenario Assessment

- Martens (AN)
  - We will model a wet year, a dry year and a local storm event without upstream inflows.
- WBM (MB)
  - Also model a typical year.
- Martens (AN)
  - Agreed.
  - We will agree on scenarios and inflow inputs before rerunning the model.