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The Secretary
Department of Planning & Environment
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Attention: Necola Chisholm

Our reference: 8A0379_ph_04082014.docx
Date: 4 August 2014

Subject **Baseline Monitoring and Verification Report - Condition C11**
3D Numerical Modelling – Condition C12
As they relate to Petite Lake
Trinity Point Marina & Mixed Use Development Concept Approval (MP 06_0309).

Dear Necola

Royal HaskoningDHV (RHDHV) recently presented to Lake Macquarie City Council (LMCC) their baseline monitoring and verification report in response to the requirements of Condition C11 of MP 06_0309.

One aspect discussed at the meeting with LMCC specifically related to the characterisation of current water flow and flushing characteristics in Petite Lake, one of three locations nominated in item (i) of Condition C11. Condition C12 also nominates that a 3D numerical model is to include Petite Lake.

RHDHV is of the technical opinion that the hydro-dynamics of Petite Lake, given its very narrow inlet and given the very low current velocities within Bardens Bay itself, in their own right will have little relevance to the baseline or the modelling and impact assessment of a marina at its approved location. RHDHV have questioned the need and relevance of providing quantitative data of current water flow and flushing within Petite Lake and have also strongly questioned the value of further model calibration or inclusion of Petite Lake itself in the 3D hydro-dynamic model.

From a hydro-dynamic and particle tracking modelling perspective (required to be undertaken under the terms of Condition C12), the 3D hydro-dynamic model extends over the whole of Bardens Bay, including past the narrow inlet to Petite Lake. RHDHV are confident that appropriate qualitative and impact assessment can be presented regarding the marina proposal and any impacts past the narrow inlet to Petite Lake, without the need for quantitative data and inclusion of Petite Lake within the model.

Below is a brief qualitative assessment of the likely flushing mechanisms for Petite Lake:

Qualitative Assessment of Petite Lake Hydrodynamics

Petite Lake has not been included in the 3D model mesh. Inclusion in the model would require inclusion of a cell mesh resolution below 5m to appropriately represent the narrow connection. The mesh resolution in Bardens Bay is 25m. Inclusion of Petite Lake in the existing model would increase model run time by approximately 5 times and have negligible impact on the study outcomes as indicated in the below qualitative assessment of the hydrodynamics of Petite Lake.

Petite Lake is a small water body (typical depth =1 m, surface area = 59,100 m^2) that is connected to Lake Macquarie to the north west of Barden Bay. Petite Lake is connected to Bardens Bay via a small 8-10 m wide opening that is approximately 0.8 - 1m deep. Petite Lake is fed by a small unnamed creek that drains a catchment that is approximately 1.46 km^2.

The connection of Petite Lake to Lake Macquarie is likely to be large enough such that water levels in both water bodies would be the same. WorleyParsons (2010) reports water levels within Lake Macquarie are driven by offshore water levels (tides) and the hydraulic effects of Swansea Channel. WorleyParsons (2010) states that the astronomical tide range in Lake Macquarie is 0.12 m and that the mean water level is 0.12 m AHD, though fortnightly spring tide pumping varies mean lake levels by about 0.08 m. A time-series of observed water levels in Bardens Bay is presented in Figure D2 of the RHDHV baseline Report.

Flushing of Petite Lake will be mainly driven by the tidal fluctuations within Lake Macquarie and freshwater runoff from the catchment. Given that the average depth is 1m and the tide range is 0.12 m, approximately 10% of the lake volume would move though the entrance to Petite Lake with each tidal cycle. However, the actual volume of water exchanged would depend on plume edge mixing as the water is exchanged between the two water bodies.

Local rainfall events will produce catchment inflows into Petite Lake which will also cause water to move from Petite Lake into Bardens Bay. Assuming a catchment runoff co-efficient of 0.3, it would take 135 mm of rainfall to completely flush Petite Lake with fresh water. As average annual rainfall for the area is in the order of 1100 mm, rainfall events would flush the lake approximately 8 times a year. While this catchment flushing of the Lake is significant, the tidal flushing of the Lake Petite is likely to be the dominant exchange mechanism as it occurs approximately every 12 hours.

The use of floating pontoons in the construction of the proposed Trinity Point Marina will not change water levels within Bardens Bay and hence will not alter the flushing of Petite Lake. While the pontoons will locally reduce the wind stress in the immediate vicinity of the Marina, the momentum of wind driven currents will pass around and below the floating structures. The submerged depth of the proposed floating breakwater is approximately 1.2 m and as typical depths in Bardens Bay are 6 m, the proposed marina will only block approximately 20% of the water column. Modelled and observed data indicates that significant (i.e. > 0.05m/s) wind driven currents are generated only by larger southerly winds which blow over the main body of Lake Macquarie. The small reduction in local wind stress will therefore have negligible impact on exchange within Bardens Bay.

In conclusion, it is the position of RHDHV that quantitative data and 3D modelling of Petite Lake is of little relevance as a baseline or for subsequent impact assessment and therefore Council should be satisfied that no specific baseline monitoring or verification of Petite Lake, nor inclusion of it within 3D numerical model is necessary.

Should you wish to discuss the contents of this correspondence please do not hesitate to contact me on 02 4926 9503, 0408 005 660 or email ben.patterson@rhdhv.com

Yours faithfully

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