



Addendum

Introduction

This Addendum was prepared following concerns raised by Avoca Beach Boardriders. It provides additional information to further support the modelling findings, summarised in Section 6.2.3 of the EX-HMAS ADELAIDE Artificial Reef Review of Environmental Factors (REF), and reported in the Coastal and Oceanographic Processes Report which forms Appendix E to the REF.

The Coastal and Oceanographic Processes Report included investigation of wave processes at the site and impacts as a result of the proposed scuttling of the Ex-HMAS Adelaide. Numerical wave transformation modelling was used to investigate the existing and post scuttling nearshore wave climate at Avoca Beach (including the rock shelves at the northern and southern ends of the embayment). As documented in the REF, on comparing the model results for pre and post scuttling conditions, it was concluded that:

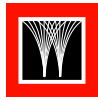
- the change in the long-term nearshore wave climate is negligible (less than 1% Root Mean Square Deviation (RMSD)).
- the quantity of littoral drift or other related beach processes such as surf quality, beach safety or beach state, is not be expected to be significantly altered.
- no significant shoreline response at Avoca Beach is anticipated as a result of the introduction of the artificial reef.
- there is not expected to be a significant change to the wave climate off the rocky headlands.

The results relate to the long-term wave climate and indicate that there would be no discernable difference between existing and post scuttling wave conditions at the beach and adjacent headlands on a day to day basis. However it is recognised that for surf formed by headland point breaks, or rock shelf reef breaks (or a combination of both, as is the case at Avoca Point), it is the most infrequent wave conditions that have the potential to produce quality waves. The surf culture at such locations develops around the potential for these rare conditions to produce the perfect wave, which in essence is the constant pursuit of every surfer.

Avoca is renowned for quality waves at Avoca Point and a strong surf culture within the community has developed as a result. For this reason, numerical modelling was undertaken to investigate the impact of the scuttled Ex-HMAS ADELAIDE on those rare wave conditions that have the potential to create high quality surf at Avoca Point.

Optimum Surf Conditions

It is important to note that surf quality at point and reef breaks is more greatly influenced by wave period and direction, than it is by wave height. Long period swell waves travelling over large distances, which arrive at the surf break with the least amount of refraction (change in direction) contain the most energy for surfers to create power and speed on the breaking wave. The longer the wave period, the better the surf quality.



The directional window considered by surfers to be the most desirable for this to occur at Avoca Point is from the NE. The sources of long period waves emanating from the NE to E sector are:

- tropical cyclones systems in the Coral Sea
- the formation of a strong and broad Easterly ridge across the Tasman Sea (centred to the north of New Zealand) as a result of stalled high pressure systems over the southern Tasman Sea and New Zealand region, coupled with a broad area of low pressure across the South-Western Pacific and Coral Sea.

Waves from these sources with periods in the order of 15 seconds (which are in the upper bound of those recorded along the NSW central coast) are generated large distances from the coastline and as a result corresponding wave heights are not extreme, due to energy dissipation as waves radiate out from the source location. However, these conditions are very infrequent. From analysis of the Sydney (50km south of the site) offshore directional wave data record (1992 - 2008) the following is noted:

- wave periods of 15 seconds or greater (from all directions) occur much less than 0.01% of the time;
- when these wave periods do occur, significant wave height (H_s) is less than 1.5m, 76% of the time;
- only eight hours on record (since 1992) had waves emanating from the NE direction, H_s greater than 1m and wave period of 15s or greater.

For modelling purposes, the scenario selected to represent the rare offshore conditions producing high quality surf conditions at Avoca Point was:

- offshore significant wave height – 2.0m
- offshore wave direction - NE
- peak wave period – 15 seconds

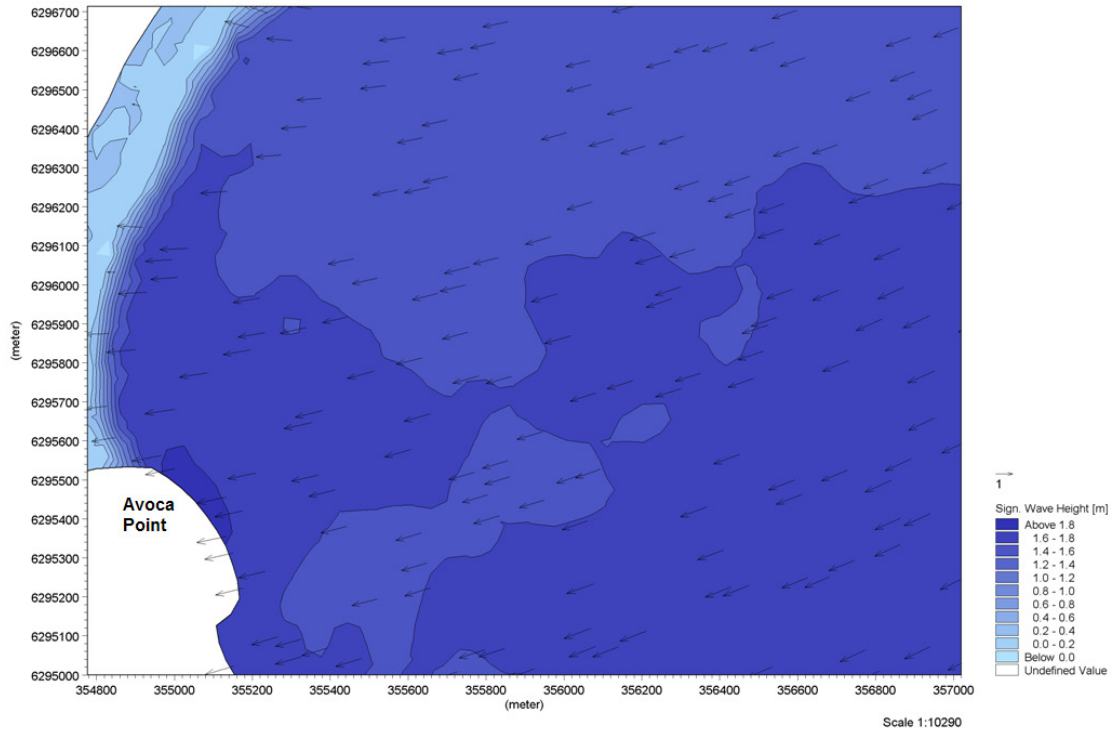
Model Outcomes

The scenario, with wave parameters as described above, was applied to the offshore boundary of the wave transformation model and was run for both the existing bathymetry model setup and the post scuttling setup.

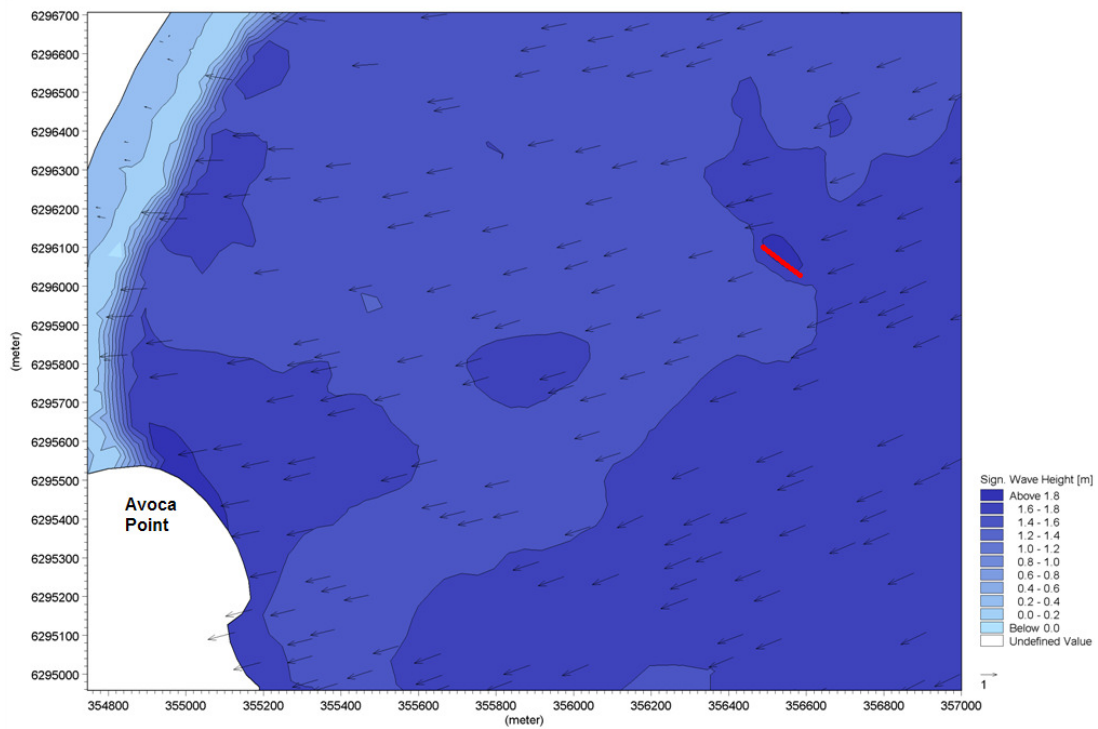
Comparison of the outcomes of these model runs (see figures below) indicates that there is insignificant change to waves incident at Avoca Point post scuttling. To demonstrate the difference in wave height at locations along the edge of the reef at Avoca Point, five output points were compared. The last figure indicates the location of these points adjacent to the reef, seaward of the location at which water depths would induce breaking. The proposed ship location is indicated by the red line.

It is recognised that due to the orientation of the NSW Central Coast coastline (SSW – NNE) surfers may refer to a 'NE swell event' producing the optimum wave conditions, which in fact may be of a more Easterly direction. Sensitivity to offshore wave direction was analysed to investigate the significance of offshore wave direction. Similar wave height and period conditions were run for the two model setups for directions of ENE and East. However, the most significant change to wave climate at Avoca Point and adjacent Avoca Beach was the offshore NE direction (as reported in the Table below).

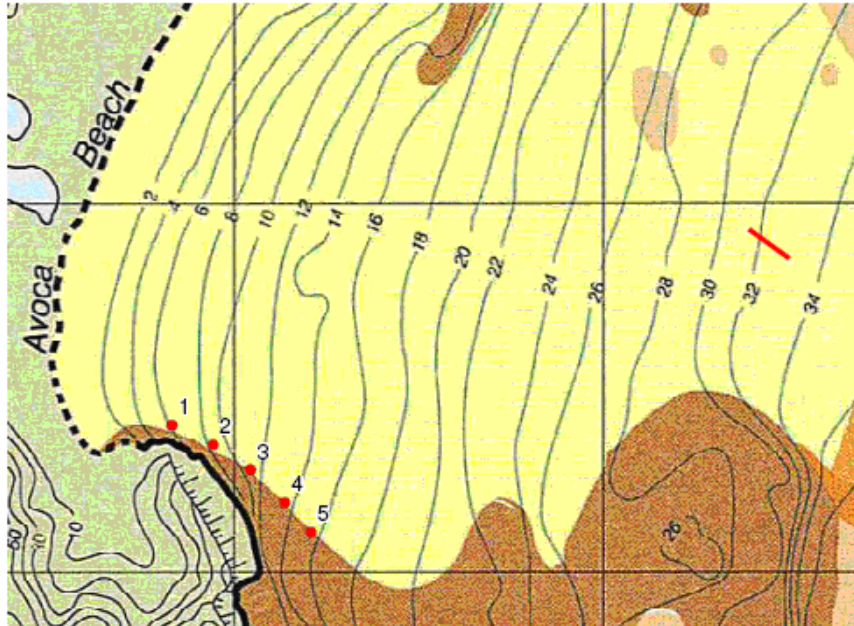
Surf quality at Avoca Point and Beach is unaffected for offshore wave directions from the East to South quadrant due to the proposed location of the scuttled vessel.



Wave Height and Direction - Existing



Wave Height and Direction - Post Scuttling



Wave Height Output Points

Wave Height (Hs)

Point	Existing	Post Scuttling
1	1.82	1.86
2	1.80	1.77
3	1.79	1.76
4	1.68	1.64
5	1.61	1.57

Wave Direction (degrees from north)

1	80.1	80.0
2	78.7	79.2
3	79.2	76.6
4	79.1	79.5
5	77.9	78.0

Wave period was unchanged.

Discussion

Comparison of the existing and post scuttling scenarios presented in the figures above indicates that for swell events with very long wave periods the scuttled vessel does affect the waves in the immediate vicinity of the vessel. Shoaling of waves at the vessel location and a minor wave shadow in the order of 800m behind the vessel's location are evident. However, these changes are not of a significant magnitude and would not be discernible at Avoca Point or the adjacent beach.

The scuttled vessel is modelled as a solid bump with sloping sides in the bathymetry of at least twice the real width of the scuttled vessel. The scuttled vessel would also have sub vertical sides and be of a permeable nature, due to diver access holes in the hull and internal structure, reducing its ability to influence wave transmission.

The conservative nature of the wave model setup (as described above) and the insignificant changes to modelled wave conditions, results in high confidence that there will be no identifiable change in surf conditions at Avoca Point.