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26 May 2009

Chris Wilson
Executive Director
NSW Department of Planning
PO Box 39
SYDNEY NSW 2001

Our ref: 22/14532/13511
Your ref:

Dear Chris

Residential Subdivision at 740-742 Pacific Highway Sapphire Beach - 06_0148 Mod 1 and 09_0060 - Climate Change Assessment

In 2006, GHD was commissioned by Sapphire Beach Developments Pty Limited to assess climate change impacts associated with the redevelopment of the Pelican Beach Resort at 740-742 Pacific Highway, Sapphire Beach. GHD submitted its *Coastal Hazards, Water Management and Services Assessment (August 2006)* report based on a development that, at that time, comprised 122 dwellings comprising a mixture of apartments, town houses and houses. Subsequently, GHD prepared a further letter report for the proposed 122 dwelling development, *Addendum to Coastal Hazard, Water Management and Services Assessment Report (December 2006)* that addressed additional information supplied by the relevant authorities.

An amended concept plan for 39 residential dwellings is now proposed, with dwellings and lots interfacing with dunes and beach as proposed in the previous development area. The Department of Planning has issued Coastal Processes Director Generals Requirements (DGRs) for this amended concept plan, which are:

- 5.1 *Assessing the potential impacts of sea level rise and an increase in rainfall intensity on the flood regime of the site and adjacent lands. In doing so consider the conditions of the Draft Sea Level Rise policy statement DECC 2009, and the Practical Considerations for Climate Change – Floodplain Risk Management Guideline, DECC 2007;*
- 5.2 *Provide details of any proposed measures adopted to avoid or mitigate any adverse impacts as a result of the proposed modification. Include as a minimum any changes to mitigate flooding or oceanic inundation concerns over flood prone areas of the site, cut and fill areas, building platforms, minimum freeboard and construction requirements.*

In terms of coastal processes, we address the aspects of coastal recession and oceanic inundation in the following letter.

1 Coastal Recession

The development recognises the NSW DECC Draft Sea Level Rise Policy and supporting scientific basis of the 2009 sea level rise benchmark Draft Technical Note. This nominates (based on 1990 baselines) a sea level rise of 0.4m to 2050 and 0.9m to 2100. On the recommendations of Council, our original proposal relied on the Willings Partner Campbell's Beach Coastal Management Study and the definition of the 100-year hazard line as defined in this report (Map 1, Issue A September 1999).

For Campbell's Beach this study adopted the pre- NSW DECC Draft Sea Level Rise Policy sea level rise estimates and used these to defined the "in general" 100-year recession line. The calculation also adopted a general 1:20 beach slope, which resulted in a 51m offset from the back beach crest for the 100-year recession line. Willings Partner used the calculation in Table 1:

Table 1 – Definition of original 100-year Hazard Line for Campbells Beach (after Willings Partner)

Item	Horizontal Offset Distance (m)	Comment
Storm Bite	10 m	
100-year recession	30m	0.30 m/yr
Sea level rise impact	11 m	Based on 1:20 beach slope and 0.55m sea level rise scenario
TOTAL	51 m	

The Willings Partner report also defined beach slope and shoreline recession for three individual beach blocks along Campbell's Beach. This data was determined through photogrammetry of 9 historic beach profiles and the site is located in beach Block 1. The 100-year recession line adopted by Willings Partners was based on a mean beach slope of 1 in 20.

Table 2 Campbell's Beach, Beach Slopes and Shoreline Recession (after Willings Partner)

Beach Block	Slope	Shoreline Recession
Beach Slope Block 1	1: 10	0.35 m/yr
Beach Slope Block 2	1: 20	0.13 m/yr
Beach Slope Block 3	1: 50	0.00 m/yr
Adopted Mean Beach Slope	1: 20	0.30 m/yr

For the current proposal, in recognition of the recent NSW DECC Draft Sea Level Rise Policy, the steeper slope at the southern end of the beach (Block 1 opposite the site), and slightly increased shoreline recession prediction for Block 1, the calculation in Table 3 is determined as the likely 100-year recession line offset from the dune scarp.

Table 3 – 100-year Hazard Line for Campbell's beach at the site

Item	Horizontal Offset Distance (m)	Comment
Storm Bite	10 m	
Recession to 2100	31.5 m	0.35 m/yr shoreline recession for Block 1 * 90 years
Sea level rise impact	9 m	Based on 1:10 beach slope for Block 1 and a 0.9m sea level rise scenario as per the recent NSW DECC Draft Sea Level Rise Policy
TOTAL	50.5 m	

While this recession is slightly less than predicted by Willings Partners, it is proposed to adopt the Willings Partners defined 100-year recession line for conservatism, and confirm that our development is landward of this predicted future recession.

2 Oceanic Inundation

Willings and Partner recommend an oceanic inundation planning level of 7m AHD. From their report, this value was calculated as described in Table 4. From the table it does not appear that Willings Partners made provision for sea level rises on account of climate change. However it is evident that the predicted oceanic inundation planning level comprised a number of combined probabilities, constituting an extremely rare event.

It is therefore considered extremely rare that a 100-year still water level event would occur at the same time as a 100-year offshore significant wave height. In addition, that at levels of 7m AHD, one would conceivably expect that the majority of wave energy is dissipated and any inundation is minor, being at the upper end of the wave run-up.

On this basis, it is proposed to maintain platform levels at 7m AHD and dwelling floor levels at 7.5m AHD as previously specified however, adopting a precautionary approach, make provision for risk adaptive management throughout the project life (up to 2100). This provides a 0.5m freeboard to dwelling floor levels.

Table 4 Coastal Inundation

Component	NSW Government Coast Management Manual (m)	Inundation adopted by Willings Partners (m)	Comments
Astronomical tides	1.1	1.5	Still water level (ie. excluding wave effects), based on a 100-year event at Fort Denison
Barometric set up	0.2 - 0.4		
Wind set up	0.1 - 0.2		
Wave set up	0.7 - 1.5	1.26	Based on 10 to 15% of the 100-year offshore significant wave height
Wave run up	3.0 – 6.0	4.24	Based on the 100-year offshore significant wave height
TOTAL	5.1 – 9.2	7.0	

3 Adaptive Risk Management Approach

Given that the site is located landward of the 100-year recession line and the extremely rare probability that a 100-year still water level event would occur at the same time as a 100-year offshore significant wave height, an Adaptive Risk Management Approach is proposed for the site. The following precautionary approach is proposed:

- As per our advice of the 14th December 2006, the buffer area between the dunes and proposed dwellings will be protected and heavily vegetated. The stability of the dunes has been raised as a concern and subsequently, a number of options have been considered. These options include, but are not limited to, the planting of appropriate species, rock protection and beach renourishment. The applicant has provided a comprehensive Plan of Management for the Dune Area and the 7A Environmental Zone as part of their original submission, its called 'Sapphire Plan of Management' and located in Volume 1, Appendix 8 of the original submission. It is worth noting the northern dunal area is already heavily vegetated and the Plan of Management, as well as the Landscape Masterplan, indicates the southern dunal area will be revegetated and stabilised. The dune rehabilitation work and ongoing management plan has been adopted for the whole of the dune area in accordance with the 'Coastal Dune Management Manual' prepared by NSW Department of Land and Water Conservation 2001;
- As per our advice of the 14th December 2006, to alleviate concerns regarding potential oceanic inundation during storm events in regards to this matter, the foundations of the first row of residential dwellings will be designed to withstand wave run up; and
- Proclamation of a Sea Rise Protection Zone (SRPZ) within the property boundary parallel to the beach. This zone will be 15 m wide, to allow for the future construction of a range of amelioration measures to combat the effects of possible sea level rise. These measures include but are not limited to the following;
  - Dune anchoring & revegetation (including fencing to restrict access);
  - Dune replenishment / renourishment;
  - Wave inundation protection devices / wall;
  - Oceanic recession protection seawall;

  The SRPZ will be in the location of the 50-year hazard line, and will make land available, should it be required, to manage beach inundation or recession due to sea level rise in the future. The strategy would extend the SRPZ to include protection measure along the north and south boundaries of the property if required.

  The SRPZ will be located in the Community Property whereby it can be managed through the Community Association and governed by special provisions in the Community Management Statement and By-laws. Our client has advised that the cost of the amelioration measures will be provided through a sinking fund and special levy depending on the timing and the amelioration measure adopted.

  The decision on the appropriate measure to be adopted will dependent on the severity and frequency of events in the future. Having a specific SRPZ in which to adopt an Adaptive Risk Management Approach allows the owners through the Community Association in conjunction with the local authorities to instigate the appropriate measures as and when required.

The normal oceanic process could potentially replenish the beach over time, however if required, “soft” beach protection techniques such as dune anchoring through revegetation (Spinifex runners, fabric mesh to fencing, protective brush matting) would be used after large storm events. In the future, if rare probability events require more advanced protection techniques, such as sand renourishment, wave run up protection or boulder seawall construction, they can be instituted if required in the SRPZ.

There is access to the SRPZ through Community Property therefore no individual lot on the site will be affected. In the future, if wave run up or seawall construction are found to be necessary, the designs will need to prevent impact to neighbours’ property. This could be achieved by considering design parameters available in the future, amongst others, predominant wind/wave directions and offshore profiles.

It is our view the SRPZ at the 50-year hazard line offers the opportunity for the authorities to adopt and further develop the strategy for the section of Campbell’s Beach immediately adjacent our client’s property. The properties on either side of the site have freehold land available seaward of the 100-year hazard line, in which to adopt a similar strategy. If this were to occur the protection along our north and south boundaries of the site would not be required.

4 Conclusion

As part of the amended concept plan for 39 residential dwellings of the Pelican Beach Resort and addressing the Director Generals Requirements (DGRs) on coastal processes, we conclude the following in respect of coastal recession and oceanic inundation at the site:

- For the current proposal, in recognition of the recent NSW DECC Draft Sea Level Rise Policy, the steeper slope at the southern end of the beach (Block 1 opposite the site), and slightly increased shoreline recession prediction for Block 1, the likely 100-year recession line offset from the dune scarp has been calculated at 50.5 m. While this recession is slightly less than predicted by Willings Partners, it is proposed to adopt the Willings Partners defined 100-year recession line for conservatism, and confirm that our development is landward of this predicted future 100-year recession line;
- Willings and Partner recommend an oceanic inundation planning level of 7m AHD, which does not make provision for sea level rises on account of climate change. However it is evident that this predicted inundation comprises a number of combined probabilities, constituting an extremely rare event. For example, it is considered extremely rare that a 100-year still water level would occur at the same time as a 100-year offshore significant wave height. In addition, that at levels of 7m AHD, one would conceivably expect that the majority of wave energy is dissipated and any inundation is minor, being at the upper end of the wave run-up. On this basis, it is proposed to maintain platform and dwelling floor levels as previously specified, however make provision for risk adaptive management throughout the project life (up to 2100). In addition, the foundations of the first row of residential dwellings will be designed to withstand wave run up; and
- Given that the site is located landward of the 100-year recession line and the extremely rare probability that a 100-year still water level event would occur at the same time as a 100-year offshore significant wave height, an Adaptive Risk Management Approach is proposed for the site. The approach is twofold comprising protection of the buffer area between the dunes and proposed dwellings and through the proclamation of a Sea Rise Protection Zone (SRPZ), within the property

boundary parallel to the beach. This zone will be 15 m wide, to allow for the future construction of a range of amelioration measures to combat the effects of possible sea level rise. The SRPZ will be in the location of the 50-year hazard line, and will make land available should it be required to manage beach inundation or recession due to sea level rise in the future. The SRPZ will be located in the Community Property whereby it can be managed through the Community Association and governed by special provisions in the Community Management Statement and By-laws. We are advised that the cost of the amelioration measures will be provided through a sinking fund and special levy depending on the timing and the amelioration measure adopted.

Yours faithfully
GHD Pty Ltd

Dr Rainer Berg