5. Coastal Processes

5.1 Hydrodynamic Modelling

Section 5 of the Supplementary Environmental Impact Statement (EIS) noted that previous hydrodynamic studies for much larger, more complex marina/canal developments in Boathaven Bay had shown that these developments would have little impact on water flows/circulation patterns/current velocities in Boathaven Bay.

Based on this previous modelling and extensive experience in hydrodynamic modelling for these types of development, it was concluded in Section 5 of the Supplementary EIS that the proposed Port of Airlie was not expected to have any significant impact on flows or coastal processes in Boathaven Bay.

It is proposed to undertake detailed hydrodynamic modelling for Boathaven Bay as part of the detailed design of the project. Detailed hydrodynamic modelling will include:

- Assessment of storm surge levels
- Assessment of sedimentation rates
- Dredge plume modelling.

An outline of the proposed scope of work for these studies is provided in **Section 21.3.1** of this Addendum.

5.2 Differences in Estimated Siltation Rates

The methodology applied in the original EIS (WBM in Burchill, 1998) utilised 2-dimensional mathematical modelling of hydrodynamics and siltation processes, however very limited site specific data was used to verify/calibrate the siltation predictions. Field measurements were taken during predominantly calm sea conditions, thereby requiring some judgement based on the modeller's experience of other similar coastal environments in order to extrapolate siltation rates for moderate and severe sea conditions.

The technique applied for the Supplementary EIS on the other hand, utilised data collected from the actual project site (including during a severe wave and wind event) to calculated expected siltation rates, however no detailed mathematical modelling was undertaken in that approach.

The width, depth, side slopes and plan orientation of the access channel to the marina will all need to be confirmed during the detailed engineering design phase of project implementation. At that time it is proposed to apply both mathematical modelling techniques and site specific data. The data will be used to verify a 3-dimensional hydrodynamic model.

Unlike the 2-dimensional model used for the original EIS (WBM, 1998), a 3-dimensional hydrodynamic model will determine the near-bottom currents (which initiate sediment movement). These currents will therefore be more accurately and confidently established throughout the project area - including in the vicinity of the access channel and the marina basin. The site specific data used to verify the

3-dimensional model predictions of siltation will include that obtained from previous fieldwork as well as from any new data collection if that proves necessary.

5.3 Design of Beach

The detailed engineering design of the beach will address such issues as the volume of sand required so as to provide the necessary buffer against extreme wave events. In order to complete the design of the beach (and any wall structure placed behind it), it will be necessary to complete investigations and studies to determine the following:

- The physical characteristics (D_{50} size, grading) of the sand proposed to be utilised for nourishment purposes; and
- Detailed definition of the ambient and extreme wave climate on the beach.

The response of any beach to incident waves is very much dependent upon the physical characteristics of the local sand. When creating new beaches (or indeed when nourishing existing foreshores) the most appropriate approach from both an economic and environmental viewpoint is to first determine a suitable source - and to then design the beach for this particular sand. There are a number of existing commercial sources of sand in the Whitsunday region. However as each varies subtly in terms of physical characteristics - all sources will be assessed during detailed engineering design prior to establishing the necessary artificial beach system.

Once an appropriate sand is determined, then the detailed engineering design can then address issues such as:

- The volume of this particular sand required to accommodate the beach response to extreme storm/cyclone events;
- The eroded profile of the beach following the "design" event - and even more severe events;
- The natural slope of the beach face (and hence the "foot-print" of the beach on the seabed);
- The equilibrium plan orientation of the beach;
- Fluctuations around the equilibrium plan orientation due to seasonal and annual variations in wave climate, as well as during discrete storm/cyclone events;
- Potential for any sand losses as a consequence of longshore transport and/or offshore transport of sand - as well as possible winnowing of any fines content from the sand.

In order to undertake this design assessment, it will be necessary to have a detailed description of the local wave climate, both during extreme storms/cyclones and for ambient (ie. the "day-to-day") conditions. Consequently the engineering design phase will include a comprehensive Wave Study specifically focussed on providing structural design criteria for the beach and for the adjacent breakwater structure.

The extreme wave climate will be determined from a mathematical simulation of the tropical cyclone population that threatens the Airlie Beach area, so as to provide wave information including:

- Average Recurrence Interval and encounter probability curves for significant wave height.
- Recommended values for any specified Average Recurrence Interval (25, 50, 100 year return period) significant wave height, peak period and mean direction.

In addition, the ambient wave climate will be determined as a time series at one- or three-hourly intervals over a timeframe of some 5 to 10 years. This detailed approach is deemed warranted so as to properly define the directional wave climate for investigating potential longshore sand transport mechanisms on the new beach.

The beach and sheet pile wall will be designed during the detailed engineering design phase of the project. The intent of the design will be to ensure that the volume of sand in the beach itself acts as an erosion buffer during severe wave events - up to a nominated severity (such as say, the 50 year Average Recurrence Interval). The purpose of the wall behind would be to ensure protection against even more severe events.

The design philosophy is basically the same as that implemented in 1999 for the protection of The Strand foreshore in Townsville by beach nourishment techniques. That 2km long artificial beach was designed by CES so that the sandy beach itself was the primary means of protecting foreshore infrastructure. The difference between The Strand system and that being proposed at Port of Airlie is that the “final line of defence” is a buried sheet pile wall as opposed to a buried rock wall.

The proposed beach at Port of Airlie can be a more contained beach compartment - having the potential to better confine/hold the sand on the beach precinct. The beach design would address any potential loss of sand as a consequence of inadequate natural beach re-building processes following a severe erosion event.

It is noted that apparent failures of The Strand beach are attributable to the fact that the design specifications were not followed in construction of the beach rather than deficiencies in design.

5.4 Increased Siltation Across Seagrass Beds

Turbidity in Boathaven Bay is not expected to be significantly increased as a result of changes to tidal circulations and water movement as a consequence of breakwater construction. The hydrodynamic modelling undertaken for the original EIS (WBM in Burchill, 1998) identified that these currents are quite weak and are not sufficient to initiate significant movement of seabed sediments.

The subsequently changed layout (to a smaller scale development) is not expected to increase the velocity of the currents so as to lift a greater amount of seabed sediments into suspension. Nor is it expected to result in a greater impact on coastal processes than that reported by the original EIS and the Supplementary EIS.

On this basis, effects on seagrasses and corals not directly disturbed by the project are expected to be minimal.

Nevertheless these issues will be verified by the 3-dimensional hydrodynamic and siltation modelling to be undertaken during the detailed engineering design of the access channel and marina basin.

5.5 Storm Tide Levels

The techniques for the mathematical modelling of storm tide used to determine the levels presented in the Supplementary EIS are based on accepted coastal engineering practice. They are not inconsistent with the techniques published and applied by the Queensland Beach Protection Authority when determining storm tide risk at locations along the Queensland coastline.

The sheet pile wall behind the beach will be topped with a reinforced concrete upstand wall that will define the beach boundary. Behind the wall will be a 5m wide public walkway that will also provide access to beach maintenance and cleaning equipment. Freehold allotments abutting the walkway also the back of the beach will have the following development covenants:

- All inhabited structures will be set back at least 6m from the seaward property boundary
- The minimum floor level for residential structures will be RL 4.0AHD or 1.2m above the 1 in 250 storm tide level.

5.6 Property on the Breakwater

The risk to any infrastructure located on the crest of the breakwater relates primarily to wave over-topping during severe cyclone events. During the detailed engineering design phase, this issue will be addressed with particular care.

The Wave Study to be undertaken during the design phase will confidently define the incident wave characteristics for a wide range of severe cyclone events. The effect of the waves on the breakwater will depend upon -and indeed, guide - the structural design.

The structural design of the breakwater face and crest (including the risk from green water over-topping) will be determined using internationally accepted best engineering practice. This will include reference to recent physical modelling of seawalls and breakwaters in the Whitsunday region, and possibly project specific physical modelling if found necessary.