Little Beach Boat Ramp – Understand the Big Picture, Get the Best Solution

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Little Beach is located in Nelson Bay, a suburb of the Port Stephens Local Government Area (LGA), approximately 200km north of Sydney. The Port Stephens LGA is one of the largest tourist destinations in NSW, with over one million annual visitors (defined as a person who lives more than hundred kilometres away and stays for at least 24 hours) and one million day trippers annually. The principle attraction for tourists is the largely natural outdoor coastal environment, particularly for dolphin and whale watching, surfing, diving, fishing and other recreational aquatic activities. For this reason, the demand for safe and adequate facilities in parks and reserves is high.

Waterway usage for recreational boating activities has increased significantly over the last 15 years, although actual numbers of waterway users are not well documented. Both residents and tourists are better able to afford boats than ever before. This has resulted in the intense use of some boat ramps and sections of the foreshore by boat based users. It has also resulted in more accidents and near misses as less experienced people negotiate unfamiliar and crowded boat ramps and facilities. There is a strong expectation from both residents and tourists that this situation will improve.

Little Beach boat ramp is one of the most widely utilised and contentious of the boat ramps in the Port Stephens Council area. Sand inundation has complicated the situation for all recreational and government agency groups.

Over the past decade, significant sand movement has occurred at Little Beach, Fly Point and Halifax Point. The significance and impact of this sand movement was most evident in 2010/11 when this sand movement caused the smothering of valuable sponge gardens at Halifax Park, a renowned SCUBA dive site on the northern tip of Nelson Head within a sanctuary zone of the Port Stephens-Great Lakes Marine Park. Not only has this sand movement impacted these popular dive sites, but it has also had a significant impact on the wider community and tourism.

This sand movement has resulted in four key issues for Council and the community:

- Access/Safety – Sand build up compromises safe access to the Little Beach boat ramp at various times of the year and watercraft safety can be jeopardised.
- Economic –Council removes approximately 6000 tonnes of sand off the Little Beach boat ramp per year, usually over 6 events. The removal of this sand comes at extensive cost to Port Stephens Council. In the last 12 months, the cost has exceeded $70,000. This ongoing cost is significant to our maintenance budget and the forecast is that this will increase unless options are sourced.
- Tourism – Port Stephens is marketed as a playground for aquatic activity. Many tourists visit Port Stephens for boating activities, swimming and diving.

If this area is not investigated, our tourism industry will be impacted as well as reputation.

- Environmental – the extensive sand movement inundated valuable sponge gardens that are natural habitats for much marine life.

Council had been attempting to manage the sand accumulation problem at the ramp by scraping sand and trucking it back to Shoal Bay. A jersey kerb barrier had also been installed by Council in 2009 in an attempt to stop sand migrating onto the ramp surface.

There was pressure from the boating community to upgrade the facility and address these problems. Before spending funding on a structural boat ramp upgrade however, Council sought to understand the big picture to ensure the best solution was adopted. It was therefore proposed that a localised coastal processes study of the Halifax Point, Little Beach and Fly Point area be undertaken. This coastal processes study would investigate the mechanisms influencing the sand movement in order to inform the development of conceptual design options for an improved and environmentally sensitive boating access solution at Little Beach.

The engagement was a high priority for Council, thus a request for Quotation (RFQ) were sought from experienced coastal management consultants. This RFQ included an in-depth Scope of Works that included the following:

- Review of Existing Information
  - previous studies, Management Plans/Studies, projects.
- Coastal Processes Study
  - Consideration given, but not limited to; wave climate, sand movement influences, run-up levels, currents, net stand transport rates and direction, response to stormwater erosion and runoff events and response to sea level rise.
- Concept designs
  - Design a maximum of three (3) concept options to address the current issues with regards the existing structures using current best practice. The designs were to include; boat ramp options for safe accessibility and retrieval by boating users, long-term stability and sand movement, environmental sensitivity with consideration to the impact on the marine park.
  - A cost benefit analysis of the design options will be required as well as an estimate of implementation costs.

- Engineering designs
  - preparation of all necessary documents should be to a level suitable for calling tenders from building contractors.

The successful tenderer for the project was Royal Haskoning DHV, with Natalie Patterson as project manager.

Extensive community consultation was required for such a project. The community consultation was managed internally by Natural Resources, Community and Recreation and the Communication team of Port Stephens Council. This community consultation formally recorded the communities concerns and desires regarding the foreshore, waterway and boat ramp, as well as document available historical information. The information was assessed in conjunction with the coastal processes study to generate a picture of what is going on at the site as well as concept plan for boating access. The consultation included delivery of three (3) presentations of the

draft study and proposed concept designs as part of the community consultation. The groups earmarked included the Port Stephens/Great Lakes Estuary Management Committee/Council staff, the Port Stephens and Myall Lakes User Group/Port Stephens-Great Lakes Marine Parks Advisory Committee, and PSC Councillors

Coastal Processes

Extensive investigations have previously been undertaken into the coastal processes within the broader Port Stephens area as part of the Port Stephens Estuary Processes Studies and Management Plans. Previous studies have also been undertaken more specifically looking at the sand accumulation issues at Halifax Point and Fly Point.

The coastal processes at Little Beach were investigated by initially reviewing these existing studies (refer References). Additionally, aerial photographs, metocean data, new survey data and recent anecdotal evidence were assessed.

In the coastal processes study it was identified that the dominant process resulting in sand accumulation at the boat ramp is migration of sand in pulses from the western end of Shoal Bay and around Nelson Head towards Little Beach. A sand lobe builds up at the western end of Shoal Bay beach as a result of westerly sediment transport along Shoal Bay beach driven predominantly by ocean swell wave energy. The eastern end of Shoal Bay receives sand via onshore sediment transport from offshore sandbanks. Shoal Bay beach was also historically fed by aeolian transport from Zenith Beach however since the revegetation of the dune system between these beaches this supply source has been cut off. As a result the net westerly sediment transport along Shoal Bay beach is causing significant erosion at the eastern end of the beach in addition to a build-up of sand (the lobe) at the western end of the beach.

The main driving mechanisms behind the transport of sediment from the western end of Shoal Bay to Little Beach are tidal currents and swell wave energy. There is a deep and relatively narrow channel running alongside to Halifax Point. At the peak of the incoming and outgoing tide, the current velocity can be of the order of 0.5m/s in the deep channel (Austin, 2011) transporting sediment along the nearshore zone. Swell wave energy penetrating through the heads approaches Halifax Point from the east also transporting sediment around the headland. Analysis of historical aerial photographs indicated a strong correlation between storm events and the amount of sand transported around Halifax Point.

MHL (1998-2001) undertook investigations into the coastal processes of Shoal Bay utilising survey data and historical photographs dating back to the 1950's. The study concluded the following:

- There was a clear reduction in beach sand volume on Shoal Bay Beach between 1951 to 1978;
- Following 1978, beach volumes were seen to increase (coinciding with the commencement of beach nourishment works);
- Estimates of (2001) annual losses under natural processes (no nourishment/protection structures) is estimated at 5000m^3/year;
- Beach stabilisation measures (since 1978) have resulted in a higher dune system located further seaward with a narrower, steeper beach-face;

- Longshore sand transport has bypassed Nelson Head at times in the past, as indicated by aerial photographs from the 1950s and 1960s, with sand moving westward from Shoal Bay into Little Beach; and
- The amount of bypassing into Little Beach appears to have increased along with sediment supplied to the beach through nourishment

Based on an assessment carried out by BMT WBM (2011), there is an estimated 5,000m^3 (normal conditions) to >10,000m^3 (under storm conditions) of sand bypassing the western end of Shoal Bay on an annual basis. Some of this material will be transported into the deep channel to the west of Shoal Bay, and the rest will be transported across Halifax Park from east to west arriving at Little Beach Boat Ramp.

The process of sand movement from western Shoal Bay around Nelson Head is complex and involves many different and sometimes opposing factors, such as ongoing erosion in Shoal Bay, stabilisation of Zenith Beach dunes, past nourishment of Shoal Bay, and interaction of wave climate changes resulting from broad scale changes in the southern oscillation index (SOI) (BMT WBM, 2011).

Figures 1, 2 and 3 present a conceptual coastal processes model summarising the various processes occurring within the Shoal Bay/Little Beach compartments and the forcing mechanisms.

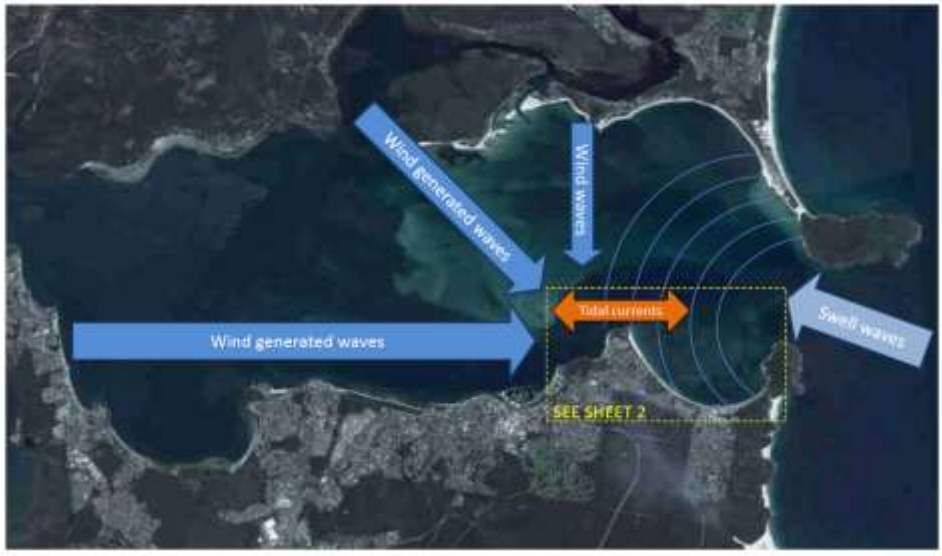

Figure 1: Dominant driving mechanisms for sediment transport at Shoal Bay/Little Beach.

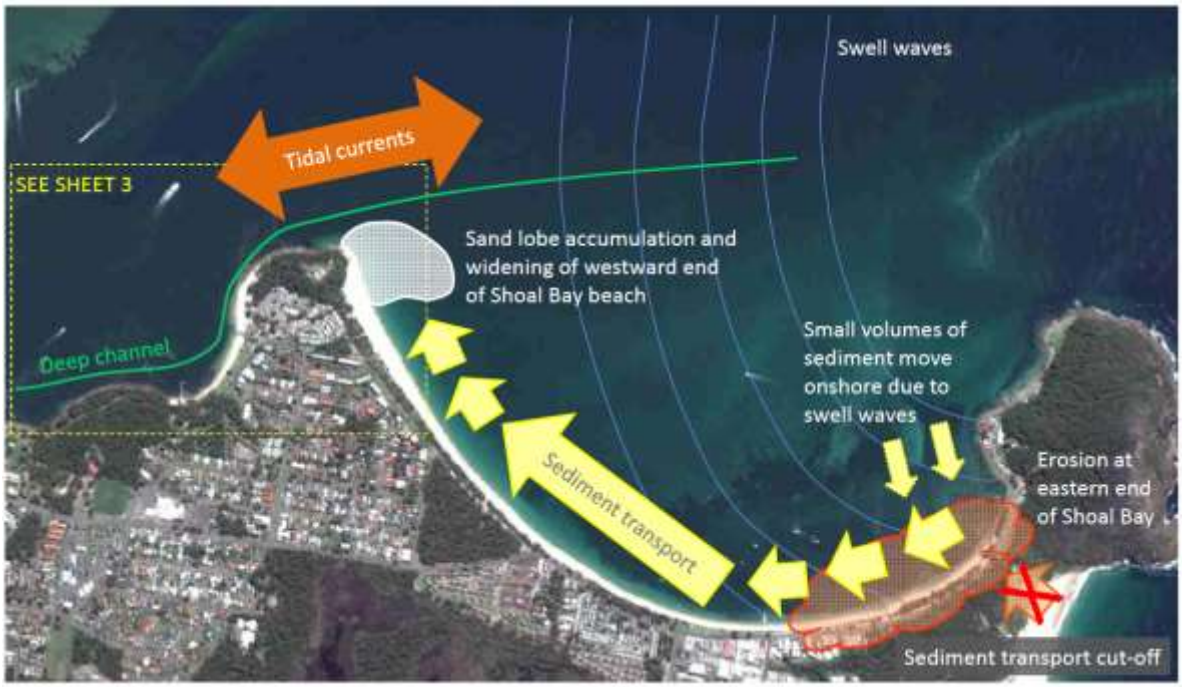

Figure 2: Conceptual coastal processes model, Shoal Bay.

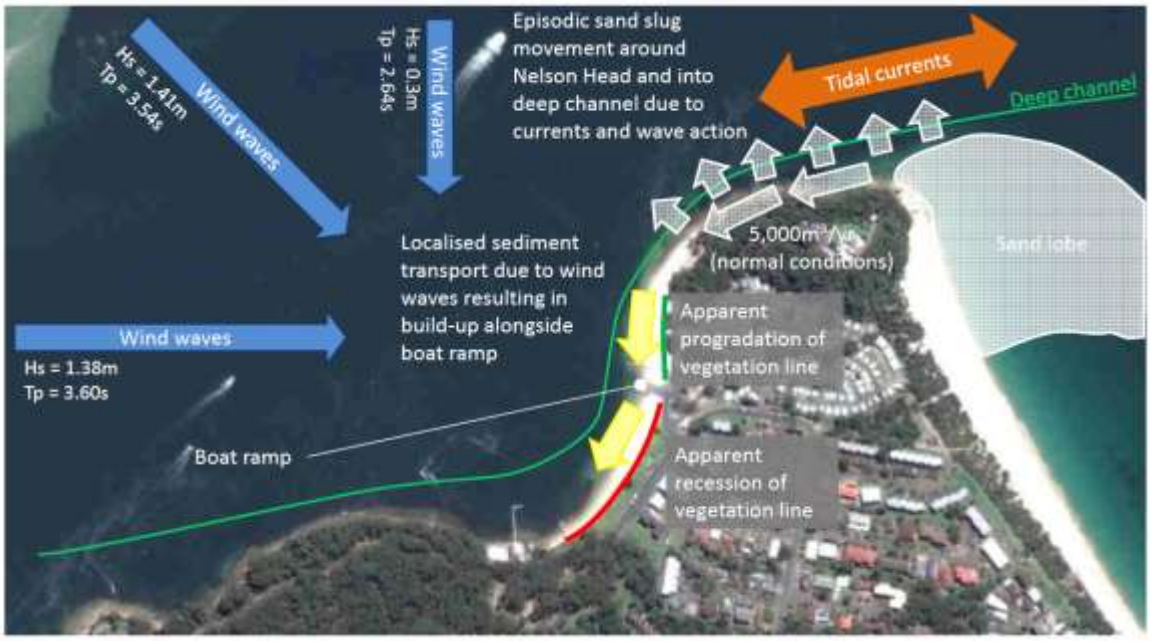

Figure 3: Conceptual coastal processes model, Little Beach.

Boat Ramp Upgrade Strategy

Armed with a better appreciation of the coastal processes at play, it was evident that upgrading the boat ramp may not resolve the main operational problem of sand accumulation. It was therefore deemed appropriate to approach the boat ramp issues from three angles, namely:

1. Sediment management measures – assess options to manage the accumulation of sediment on the ramp and all of the operational/safety problems this causes.
2. Wave Attenuation – assess options to attenuate the large wind waves emanating from the west due to the 8km fetch in this direction

3. Boat Ramp Upgrade – assess options to upgrade the boat ramp to improve operational safety.

Sediment Management Measures
In addition to the problem of sand accumulation on the boat ramp at Little Beach affecting launching/retrieval operations, the sediment transport patterns occurring within Shoal Bay and Halifax Point/Little Beach were also causing ongoing erosion along the eastern end of Shoal Bay and potential smothering of Marine Park Sanctuary sponge beds at Halifax Park.

A number of previous studies and workshops had been undertaken to assess various alternatives for managing sediment transport. These included the construction of revetments, groynes, offshore breakwaters, sand back-passing systems, etc. The findings of these studies and workshops were used to develop the Shoal Bay Management Plan in 2001.

The Shoal Bay Management Plan (DPWS, 2001) recommended that beach renourishment or back-passing at be carried out on a regular basis. The proposed beach renourishment campaign involved trucking approximately 2,500m^3 of sand from the western side to the eastern side of Shoal Bay twice a year. The recommended beach back-passing has not been implemented on a regular basis.

As part of the RHDHV study the following three options for managing sediment transport were considered:

Option1: Do nothing;
Option 2: Implement beach renourishment/ sand back-passing as per the Shoal Bay Management Plan (SBMP); and
Option3: Construct a groyne to limit sand transport around Halifax Point.

A concept design for a groyne constructed from sand filled geotextile containers (GSCs) was developed for Option 3 (refer Figure 4).

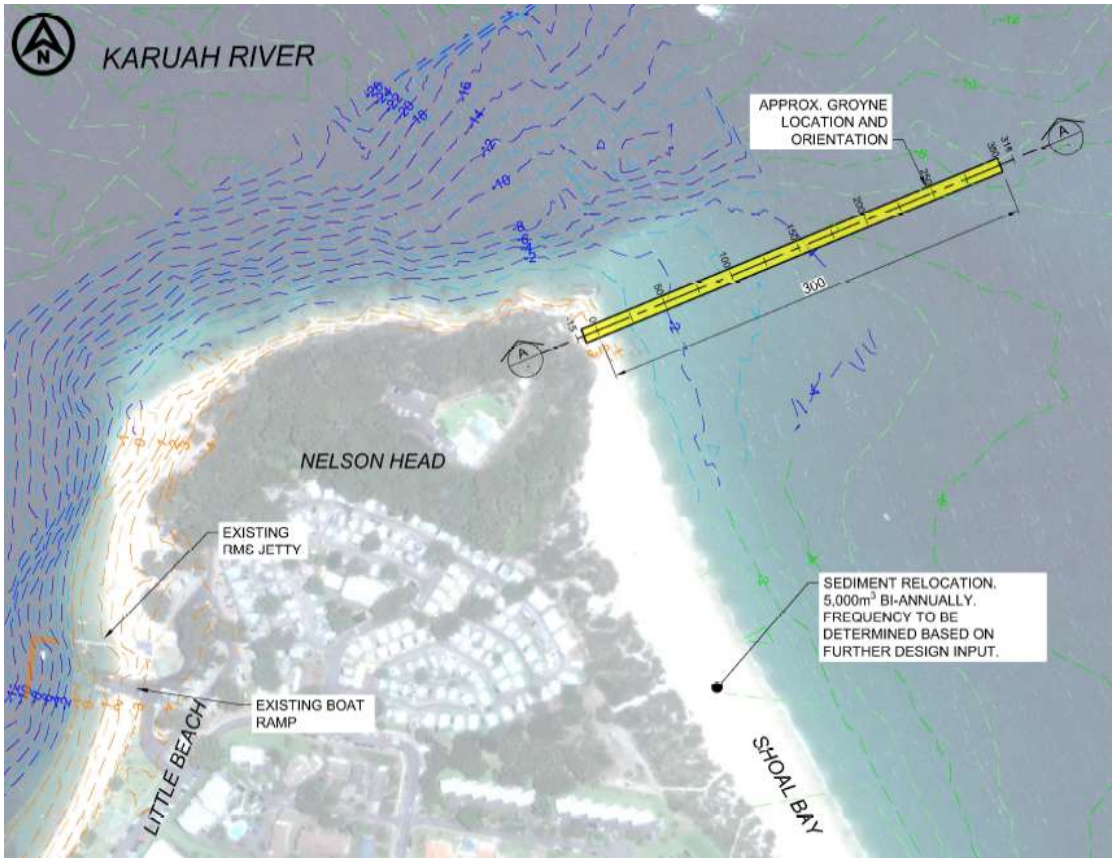

Figure 4: Concept design for GSC groyne.

The three options were costed and assessed in a net present value (NPV) cost benefit analysis. The option to do nothing was not considered a feasible approach as Council will continue facing the challenges of erosion along the eastern side of Shoal Bay, potential smothering of the sponge beds, and sand accumulation on Little Beach boat ramp. The groyne option did not achieve a cost/benefit ratio greater than 1 due to the ongoing threat to the marine park sanctuary and the potential cost associated with this. It was therefore concluded that the only viable option was to implement the sand back-passing as per the SBMP.

Wave Attenuation

The boat ramp at Little Beach is exposed to wind generated waves emanating from the north western sector. Of particular concern are the wind generated waves from the west where the fetch length is approximately 8km. The 1 year average recurrence interval significant wave height (Hs) is 0.6m with a peak period (Tp) of approximately 3 seconds. This creates a difficult and potentially dangerous situation with respect to vessel launching and retrieval.

Options considered for providing a protected boating facility include the following:

Option 1: Relocate the boat ramp to a protected site;
Option 2: Construct a traditional breakwater; or
Option 3: Construct a wave attenuator / floating breakwater.

The southern end of Little Beach is somewhat sheltered from wind generated waves from the west, however, this location is not considered practical for constructing a

new boat ramp due to existing infrastructure, lack of parking space for trailers, and the earthworks that would be required to provide suitable road access.

The construction of a traditional breakwater, such as a rubble mound structure, is not considered feasible due to the significant cost and potential environmental impacts in this environmentally sensitive and valuable location.

Floating breakwaters or wave attenuators are suitable for waves with a short wave period (typically peak period (Tp) < 4 seconds). The wave attenuator / floating breakwater could also be dual purpose by providing a temporary mooring facility for small recreational vessels.

For the degree of exposure at Little Beach, it is not considered practical to design a floating breakwater structure capable of attenuating 100 year ARI wave conditions to a state where boat launching and retrieval could be undertaken. A more practical wave condition to be considered for operational purposes is the 1 year ARI wave. However, even if boat launching and retrieval cannot practically be undertaken during 100 year ARI wave conditions, the structure should still be designed to withstand these larger wave conditions without incurring damage. Therefore the proposed design wave conditions were as follows:

Operational limits: Hs = 0.63m and Tp = 2.8sec
Design limits: Hs = 1.40m and Tp = 3.8sec

The proposed plan shape for the wave attenuator is an 'L' shape, with the long leg of the 'L' protecting the boat ramp from waves approaching from the west (refer Figure 5). The short leg of the 'L' will protect the boat ramp from waves approaching from the north and north-west.

Figure 5: Concept design for floating wave attenuator.

The existing RMS jetty could be used as a shore connection to the floating wave attenuator with access between the jetty and the wave attenuator provided by means of a gangway. The gangway would allow the wave attenuator to be used as a temporary mooring facility for small recreational vessels.

Discussions were entered into with four (4) wave attenuator manufacturers to discuss design and costs, namely Bellingham; Ingemar; SF Marina; and Astra Elements.

The net present value (NPV) benefit/cost analysis showed the floating breakwater wave attenuation project to be marginal. It is noted that this is sensitive to the maintenance costs and also to the ascribed benefits in terms of disabled access and temporary mooring which are difficult to quantify. The wave attenuator costs will also be sensitive to the condition of the RMS jetty at the time of undertaking the works and the associated remediation costs to upgrade this structure to a disabled accessibility standard.

Boat Ramp Upgrade
The existing boat ramp is 15m wide and could therefore accommodate up to 3 lanes. The slope is 1V:9H across the tidal zone and therefore in accordance with the NSW Boat Ramp Facility Guidelines. Although not evident during the site inspection, it is understood that there has been some scouring along the toe of the existing boat ramp.

The concept design options considered for the upgrade of the boat ramp included:

Option 1: Maintain existing boat ramp
Option 2: Sheet pile protected boat ramp
Option 3: Elevated boat ramp on piles

Option 1 Maintain existing boat ramp
From a condition assessment of the above water portion of the existing boat ramp it appears to be in reasonable condition with some cracking, minor edge failure (now repaired) and minor surface deterioration. Accordingly, the ramp could continue functioning as a suitable boat launching and retrieval facility for another 5-10 years with minor upgrades. The main maintenance requirement is to keep the boat ramp clear of sand build-up. This could be achieved through sediment management of the Shoal Bay frontage as discussed previously. There has been reported anecdotal evidence of scour at the toe and the need to extend the length of the ramp. If the existing boat ramp were to be retained, it is recommended that an allowance be made for replacement of some of the submerged precast panels and a double layer of rock material be placed around the toe of the boat ramp to provide scour protection.

Option 2: Sheet pile protected boat ramp
Option 2 includes the construction of a sheet pile wall and the reconstruction of the boat ramp. This option is only relevant if a groyne were to be constructed to manage the sediment issues. The sheetpile design is to cater for the risk of channel migration towards the boat ramp if the sediment supply is cut off from Shoal Bay. As the groyne was deemed non-viable, this Option was also eliminated.

Option 3: Elevated boat ramp on piles
Option 3 comprised an elevated reinforced concrete boat ramp founded above the beach level on piles. A similar boat ramp structure has been constructed and successfully operated at Shoal Bay. The popularity of the Shoal Bay ramp led some to believe this would be a good solution for Little Beach. At Little Beach, an elevated boat ramp would provide a degree of buffering to sand accumulation however, without sediment management measures, it would eventually become smothered. A fully piled option and a partially piled option were considered.

For the boat ramp upgrade component the net present value (NPV) benefit/cost analysis favoured the option to upgrade the existing boat ramp with the highest cost/benefit ratio of 5.5. The partially elevated option had a benefit/cost ratio of 4.4 and would therefore also be worth consideration if the capital funding were available.

Conclusion

The recommendations for Little Beach from the coastal processes study and concept design NPV benefit/cost assessment were therefore as follows:

- Establish sand back-passing regime as per SBMP to resolve the sediment management issues.
- Continue monitoring of Shoal Bay beach, sediment accumulation at Halifax Point and the channel depths/location to refine back-passing operations and optimise benefits for Shoal Bay and Little Beach whilst minimising risk to Marine Park Sanctuary.
- Maintain existing ramp with a view to upgrading in 5-10 years with new piled structure when sufficient funding is available
- Proceed with Design & Construct contract for wave attenuator when funding is available

Once sand back-passing at Shoal Bay has commenced and the sand levels at the Little Beach boat ramp have reduced a detailed condition assessment will be undertaken of the submerged portion of the structure to enable remediation design to be completed.

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