Department for Planning and Infrastructure

BREMER BAY
Investigation into the Stabilisation of Fishery Beach

Technical Report
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Executive Summary

This report summarises a coastal engineering investigation into Fishery Beach at Bremer Bay on Western Australia's south coast. The history of the beach and the current problems, namely erosion of the western end of the beach and accretion of sand on the boat ramps, are discussed. A preferred solution from five conceptual options is recommended.

The construction of the harbour breakwater in 1996 at Bremer Bay caused the permanent realignment of Fishery Beach. This realignment resulted in erosion of the western end of the beach creating a safety risk and a loss of usable beach. Eroded sand was deposited on the boat ramps at the eastern end of the beach. This accretion of sand hinders the ramps' use, and presents a possible safety risk in an emergency. These ramps are cleared of sand at least annually so that they can be used properly.

A review of the available data was conducted so that conceptual solutions could be formed. Data included hydrographic surveys, difference plots of the area, tidal records, aerial photos, hind-cast offshore wave data and some observed wave data.

Five conceptual options were presented to the relevant stakeholders during a community forum at Bremer Bay in March 2007 (Figure 12). The result of this consultation process was to confirm that the Department for Planning and Infrastructure's preferred two-groyne option (Figure 15) was the best way forward. Although concerns were raised by individuals that this would not solve the problem, most attendees agreed that something needed to be done, and this option represented the best way forward with the available budget.

A design consultant has been engaged to carry out a detailed design of the preferred option. The option involves creating two beach compartments separated by a geotextile 'mid-beach' groyne (Figure 15). Between the eastern compartment and the boat ramps, a rock 'cut-off' groyne will be constructed. Both compartments will be nourished with sand to create a buffer to protect the beach from erosion.

Contents

1 Introduction

Fishery Beach is situated inside the Bremer Bay boat harbour on the south coast of Western Australia between Albany and Esperance (Figure 1). Following construction of the harbour breakwater, the coastal processes were affected and Fishery Beach became unstable. There are safety and amenity concerns with the current beach, and the aim of this report is to investigate, understand and suggest a solution for the problems.

Figure 1: Location of Bremer Bay on Western Australia's south coast.

2 Background / History

The construction of the harbour breakwater in 1996 at Bremer Bay caused the permanent realignment of Fishery Beach. The realignment resulted in the movement of sediment from the western end of the beach to the eastern end, as can be seen in Figure 2 and Figure 3. The realignment subsequently caused ongoing erosion of a dune into a scarp at the western end of the beach, and siltation of the boat ramps at the eastern end of the beach. Sand removal from the boat ramps has been undertaken, typically annually, to maintain adequate depths for boat launching. This work has been completed in partnership between DPI and the Shire of Jerramungup.

In the first six months following construction of the breakwater significant realignment of the beach occurred. Although the alignment of the beach is now more stable, ongoing erosion at the toe of the dune at the western end of the beach has caused the formation of a steep scarp. Comparison of surveys (Figure 4) indicates that this eroded sand is transported to the eastern end of the beach causing the siltation problem at the boat ramp.

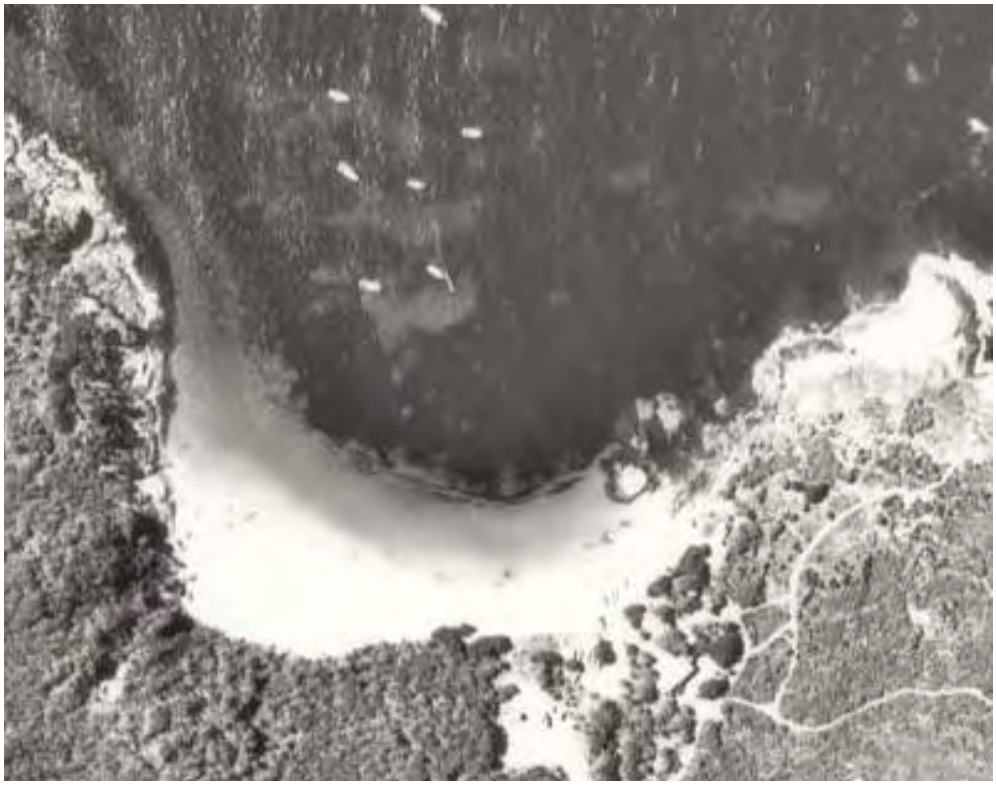

Figure 2: Aerial photograph of Fishery Beach in February 1991, before construction of the boat harbour breakwater.

Figure 3: Aerial photograph of Fishery Beach in April 1997, following construction of the boat harbour breakwater in 1996.

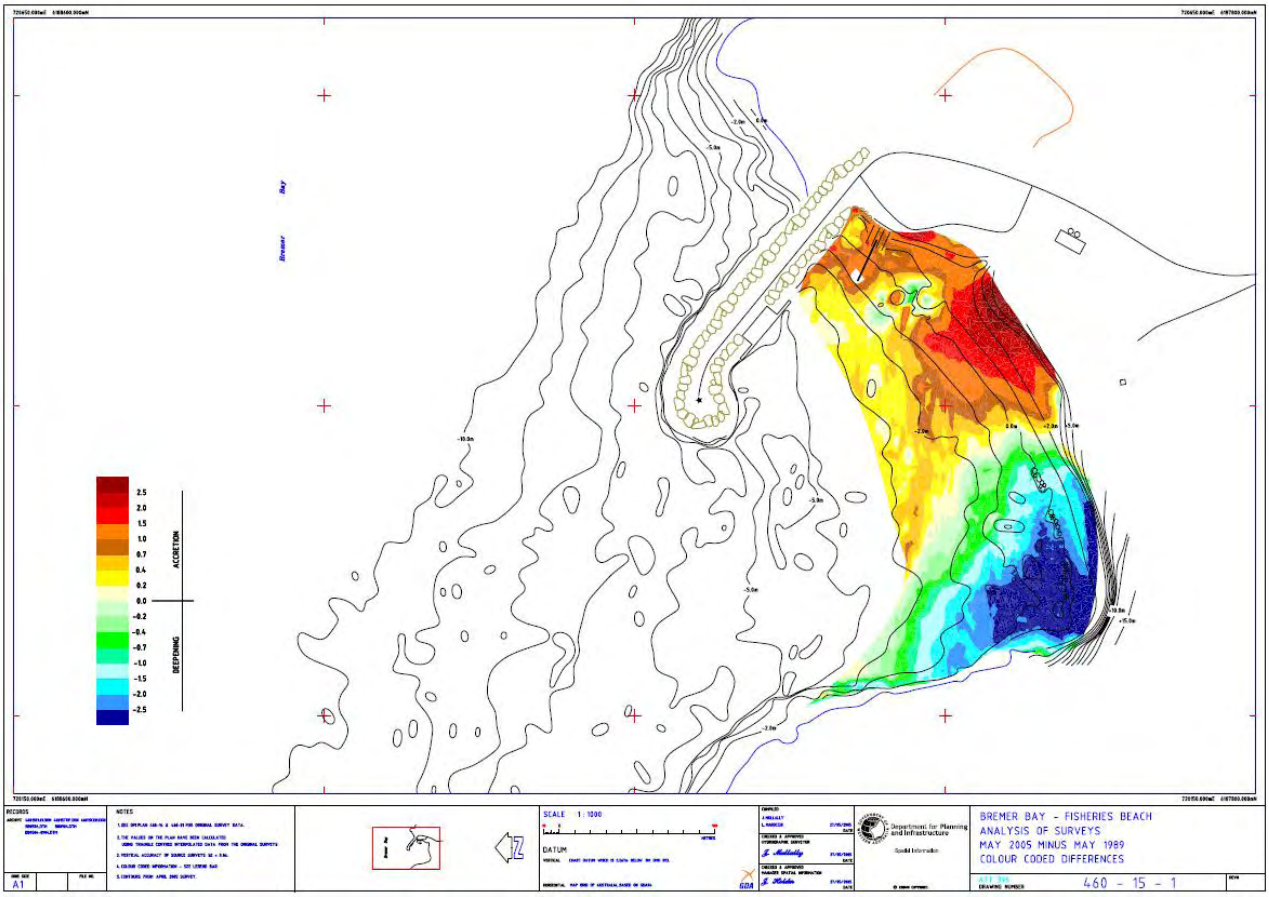

Figure 4: Survey difference plot which compares bathymetry from 1989 with data from 2005. This figure indicates that there has been a large amount of erosion of the western end of the beach (dark blue), accompanied with a large amount of accretion at the eastern end of the beach (red).

In 1999 a cheap trial solution consisting of four offshore rock breakwaters was constructed in an attempt to decrease the erosion of the western end of the beach. These structures were unsuccessful but are still visible today (Figure 5).

Figure 5: Aerial photograph of Fishery Beach in January 2004. Note the four trial breakwater structures visible at the western end of the beach.

The Shire of Jerramungup has expressed increasing concerns in recent years about the safety and loss of amenity of Fishery Beach. The scarp at the western end of the beach poses a safety hazard to beach users and concerns have been raised about children being injured around the dune scarp. Also, the western end of the beach has reduced amenity due to the unattractive nature of the scarp.

The siltation of the boat ramps at the eastern end of the beach reduces their amenity making it difficult for boats to be launched by recreational boat users. The local sea rescue group uses the boat ramps to put to sea in an emergency and they too have raised concerns over the ramps' usefulness.

3 Coastal Processes / Available Information

After the rapid realignment of Fishery Beach from 1996 to 1997 the beach has approached a dynamically stable alignment, but has not reached a stable equilibrium. Figure 6 shows there has been only a small amount of erosion at the western end of the beach after the initial realignment. There has been minimal net accretion at the eastern end, and this is most likely because sand has been regularly removed from the system during excavation at the boat ramps.

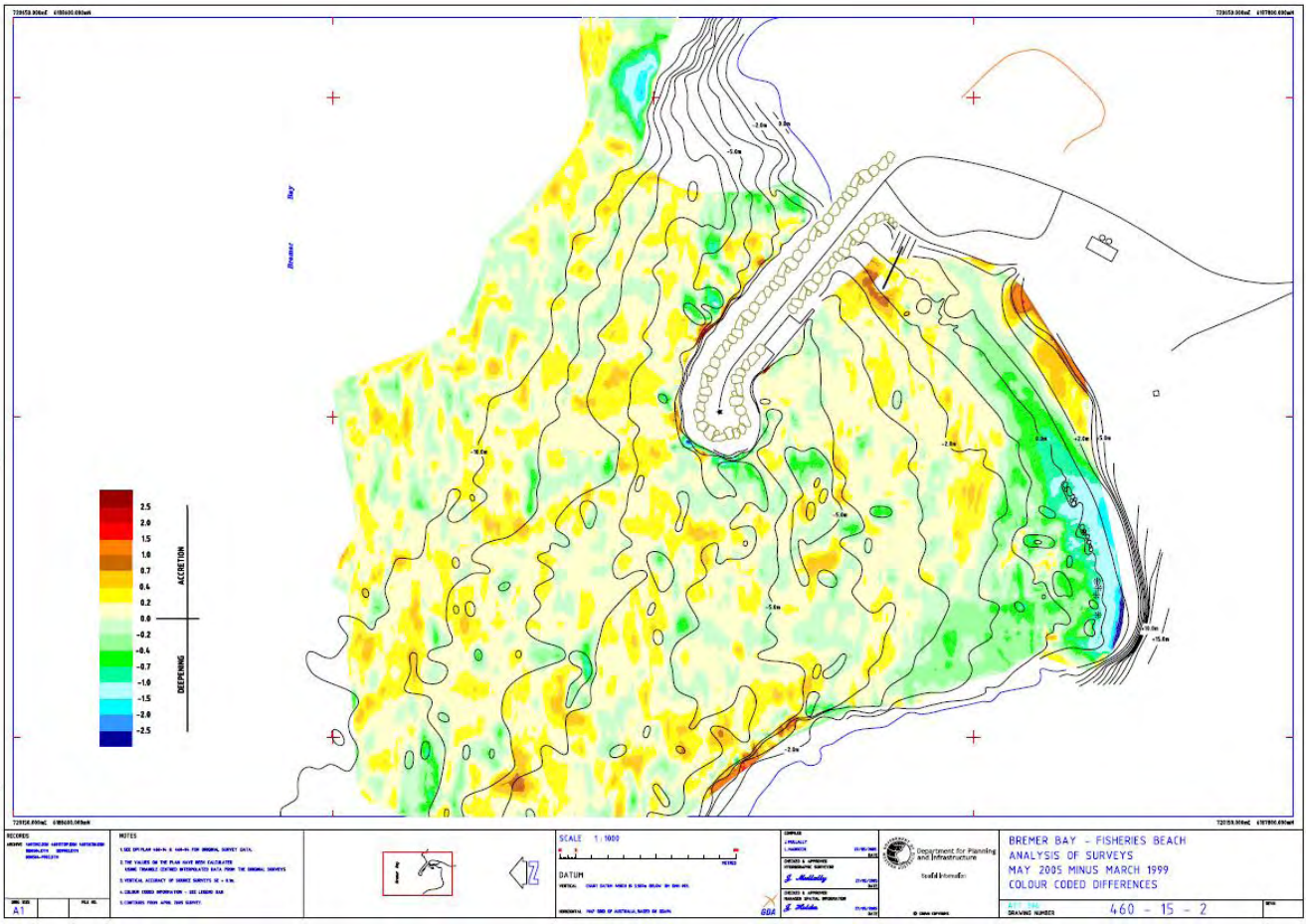

Figure 6: Survey difference plot which compares bathymetry from 1999 with data from 2005. This figure indicates that there has only been a small amount of erosion of the western end of the beach (blue), accompanied with a small amount of accretion at the eastern end of the beach (brown) since the rapid beach realignment after construction of the breakwater in 1996.

Removal of sand from this system is significant because the sediment budget within Fishery Beach and the Bremer Bay Boat Harbour is believed to be largely independent and closed-off from the neighbouring beaches (pers. comm.. Dr. Bill Andrew February 2007). There is likely to be minimal

littoral sand linkage between the beaches either side of Fisheries Beach. The large granite headlands either side of the harbour extend into deep water of the order of 10m (Figure 7). These depths decrease the ability of incident waves to regularly transport sediments around the headlands. It is likely that sand available to local coastal processes inside the harbour comes from the dunes, beach, and near-shore environment within the harbour. Sand is available for redistribution, but once it is removed from the system there appears to be a net loss.

As sand has been removed from the boat ramps at the eastern end of the beach, the western scarp has been increasingly vulnerable to erosion during storms events and periods of high water levels, because there is no beach face to buffer and sacrificially protect the western dune. Any coastal engineering solution(s) need to address this deficiency and rebuild a buffer zone.

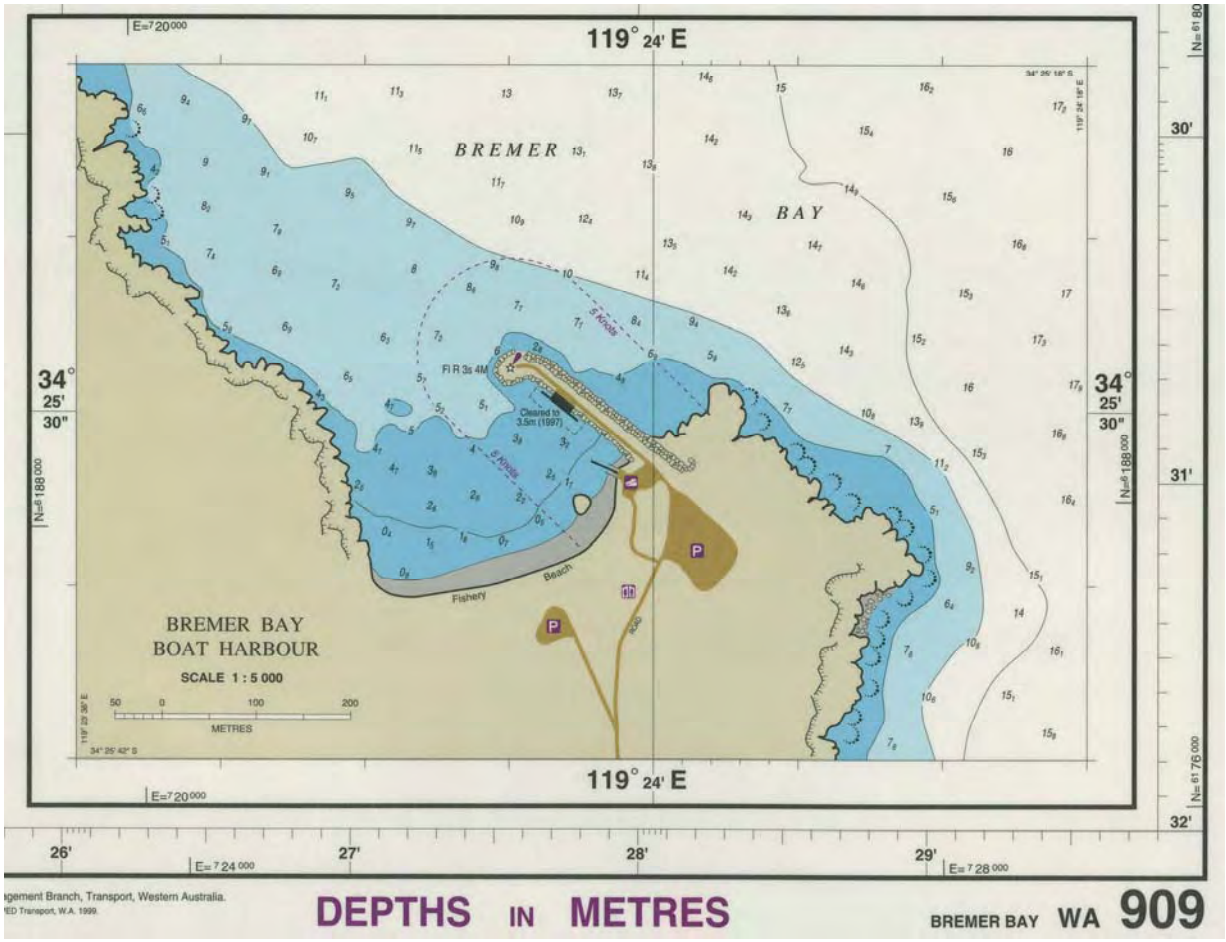

Figure 7: Bremer Bay Hydrographic Chart Inset showing Fishery Beach and the Bremer Bay Boat Harbour. Note the headlands either side of the harbour which extend into water approaching 10m depth. These deep rocky headlands largely inhibit the movement of sediment in and out of Fishery Beach. As such, the sediment budget for the beach is believed to be contained within the confines of the harbour.

DPI has information available which has been used to help understand the problem at Fisheries Beach, and is likely to be used for the design and construction of an engineering solution. These include:

- Hydrographic surveys of area;
- Difference plots of the area, which indicate where erosion and accretion has occurred;
- Tidal records for the last 9 years;
- Aerial photos;
- Hindcast offshore wave data from 1988; and
- Observed wave data (height and period) from two Waverider Buoys for periods of 10 months and 19 months during the years 1992 and 1993 (Figure 8).

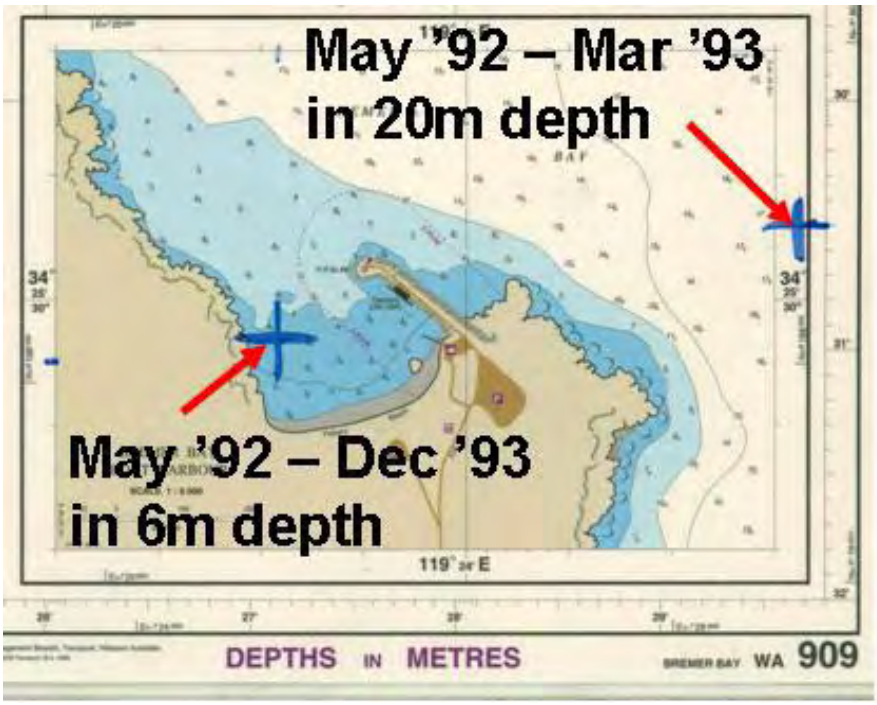

Figure 8: Location and duration of wave data collected prior to construction of the boat harbour by two Waverider Buoys.

4 Cause / Understanding / Impact of Erosion

The current problem at Fishery involves two aspects; Safety and Reduced Amenity.

Safety concerns include:

1) The risk of injury or death to beach users associated with use of the western end of the Fishery Beach and the steep unstable sand scarp which is present there.

2) The risk of injury or death associated with a delay in the launching of the local sea rescue vessel.

Amenity issues include:

1) The western end of the beach is effectively unusable for most beach users due to its narrow beach face, and at times has been closed to the public by the Shire.

2) The boat ramps can become difficult to use for large parts of the year due to the siltation which occurs on them.

The realignment of the beach following construction of the boat harbour has driven movement of sediment from the western end of the beach to the eastern end. This sand movement has been so great as to erode the western dune into an unstable scarp (Figure 10 and Figure 10). A large part of the transported sand has been deposited on the boat ramps and been subsequently removed (Figure 11).

Figure 9: Fishery Beach 13th August 2007, note the eroded dune at the western end of the beach.

Figure 10: Photograph of the eroded scarp at the western end of Fishery Beach, 15th March 2007.

Figure 11: September 2006, boat ramps and finger jetty located at the eastern end of Fishery Beach. These ramps are prone to siltation which makes them difficult to use.

The rate of sediment transport has greatly reduced since the initial realignment, but there is still an ongoing tendency for west to east transport.

The removal of sand off the boat ramps has prohibited the eastern end of the beach reaching a natural equilibrium. The removal of some of the sand from the localised system (i.e. to the car park and down the road from the harbour in recent years) has decreased the net availability of sand in the system. Subsequently the western dune is continually susceptible to erosion because there is no buffer available to protect the dune.

5 Developing a Solution: Stakeholders and Selection Criteria

The key stakeholders involved at Fishery Beach are:

1) DPI – manage and maintain the facility;
2) Shire of Jerramungup – manage and maintain the boat ramps;
3) Local sea rescue group;
4) Commercial fishermen;
5) Recreational fisherman and boat users;
6) Charter boat operator; and
7) Recreational beach users.

To begin to develop potential solutions to the current problem at Fishery Beach, selection criteria were established. Options were judged independently and then relatively (against each other) as to how well they would:

1) Minimise erosion of western scarp;
2) Minimise siltation of the boat ramp;
3) Meet the needs of the various users of the beach and harbour;
4) Minimise environmental impact;
5) Have a total cost within budget; and
6) Could be completed / implemented in a reasonable timeframe.

Five options which satisfy most of these criteria where investigated. They where then judged relative to each other to decide on a preferred option.

6 Options and Consultation

To determine the thoughts and concerns of stakeholders DPI, in conjunction with the Shire of Jerramungup, conducted a Community Consultation Meeting with interested members of the community on the 15th March 2007 at the Bremer Bay community hall (Figure 12). DPI presented their understanding of the current problem and five possible solutions, with one of these a designated preferred option. These options are discussed in this report. Several concerns were raised at this meeting by the various attendees. A copy of the minutes of the meeting is included in Appendix One.

Figure 12: Community forum March 15th 2007 at the Bremer Bay community hall. DPI presented their understanding of the current problem and five possible solutions.

6.1 Options

The five options presented at the community meeting are outlined below. The benefits and disadvantages of each option are discussed in reference to their ability to satisfy the selection criteria

discussed earlier in Section 5. Where appropriate, a conceptual plan for each option has been included.

6.1.1 Option 1 – Continue Maintenance

This option is essentially a 'do nothing' approach. Maintenance of the boat ramps would continue approximately once a year to ensure the ramps can be used over the peak summer holiday period. The cost would continue to be shared 50 / 50 between DPI and the Shire of Jerramungup. It is likely however, that erosion of the western end of the beach and siltation of the boat ramps will continue.

Figure 13: Two photographs from the 26th October 2004 showing the excavation of sand from the boat ramps at the eastern end of the beach. Maintenance similar to this has been conducted at least once a year for several years to ensure the boat ramp can be used at peak holiday periods over summer.

The benefit of this option is that it is well understood, and not allowing for the incidence of influential weather events (such as the January 2007 storm,) the cost is reasonably predictable at approximately $10,000 per year.

The clear disadvantage of this option, however, is that the safety issues of the problem are not addressed, because the western dune would continue to be eroded and there will still be periods throughout the year in which the boat ramp is difficult to use.

6.1.2 Option 2 – Remove / Relocate Boat Ramp

The current boat ramp could be removed or relocated. Removal of the ramp entirely is not considered an option as it is the only dedicated concrete boat launching facility between Albany and Hopetoun. The boat ramp could be moved offshore of its current position beyond a predicted dynamic equilibrium shoreline (Figure 14).

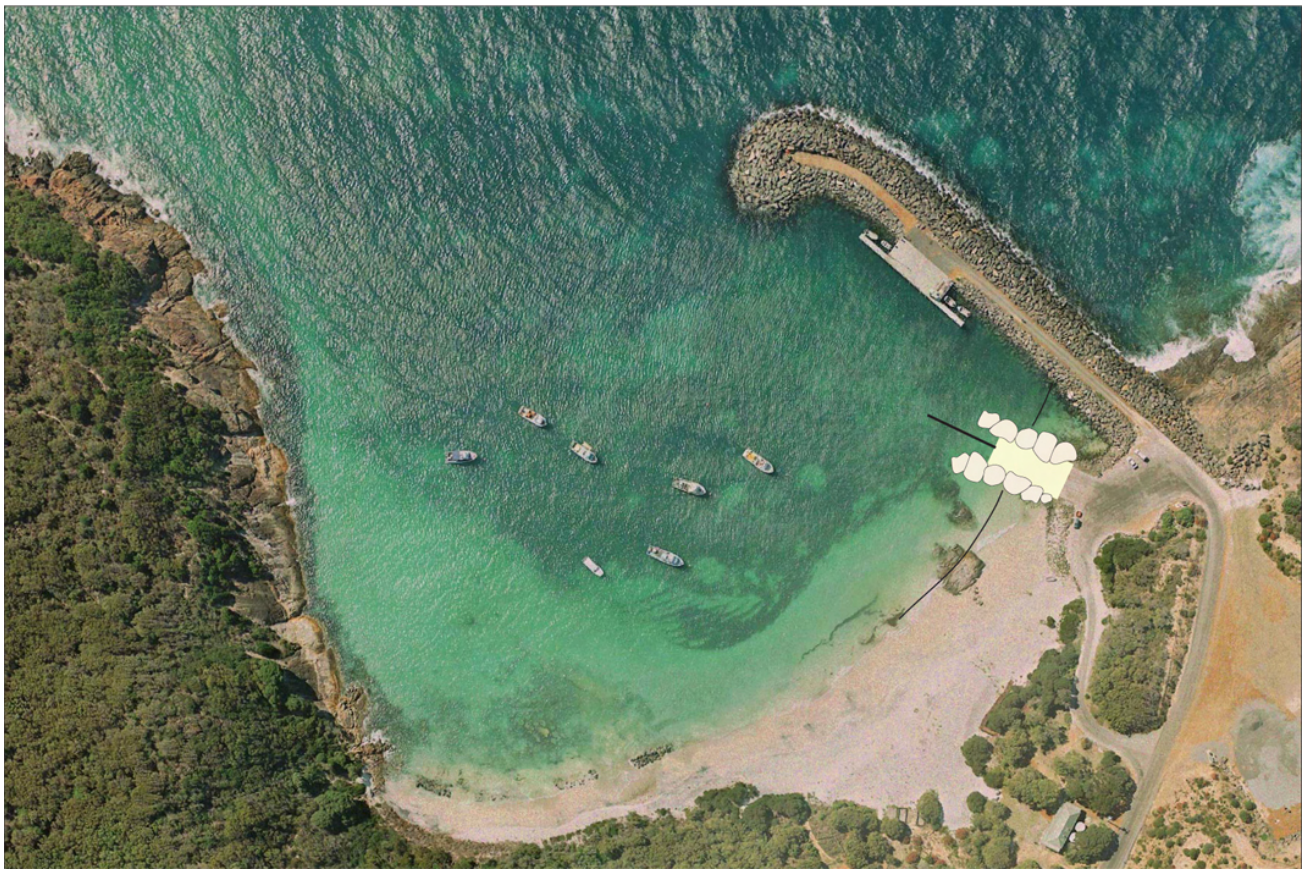

Figure 14: The current boat ramps could be deconstructed or demolished, and then rebuilt or replaced further offshore or possibly at a different location. Moving the ramps offshore, however, would bring them closer to the commercial facility attached to the breakwater.

Benefits of this option include:

- The need to maintain the ramps in the future should be greatly reduced; and
- There would be no introduction of large structure on the beach, or in the harbour.

Disadvantages of this option include:

- The realignment of the beach, and an equilibrium line is difficult to predict accurately, and hence it is difficult to determine where exactly the ramps should be relocated to;
- Fishery Beach is still the preferred location of the ramps;
- Relocation of the ramps is unlikely to restore the steep unsafe face of the western dune;
- There is potential for sand to move further offshore and smother seagrass;
- There is a risk that in the new location, sand may move towards the wharf; and
- Should the ramps be moved further offshore they will be significantly closer to the wharf, and conflicts may arise with commercial users of the wharf facility.

6.1.3 Option 3 – Mid-Beach and Cut-Off Groynes

DPI's preferred option to stabilise Fishery Beach is to construct two groynes on the beach as depicted in Figure 15. A small impermeable 'cut-off' groyne at the eastern end of the beach should minimise sediment being transported both behind and in front of the large rock in the near-shore environment. Hence the amount sand available to deposit on the boat ramps is likely to be minimised. The second part of this option involves the construction of a groyne approximately midway along the beach. The function of this groyne will be to effectively split the current beach into two sediment compartments. Sand nourishment of these compartments will be required to build effective buffer zones in front of the dunes. Both compartments can realign into equilibrium shorelines, which are expected to stabilise the beach.

Figure 15: Rubble mound cut-off groyne to be constructed near boat ramp in combination with a geotextile bag mid-beach groyne to compartmentalise Fishery Beach to ensure stability.

Benefits of this option include:

- The groynes are expected to fully satisfy the six selection criteria (Section 5);
- Groynes are well understood, proven structures;
- General community support;
- The need to maintain the boat ramps is likely to be greatly reduced; and
- There are a number of material options available for their construction, including different types of rock, and geo-textile bags. Rock has been recommended for the 'cut-off' groyne, whilst geotextile bags have been suggested for the mid-beach groyne.

The disadvantage of this option is that some community members raised concerns that this option will not work as it is believed that strong surging currents scour out the western end of the beach. Concerns were raised that the beach groynes would not address this. It is considered by DPI, however, that the erosion is part of the realignment of the beach and can be solved by compartmentalising the beach. The western compartment will have a significant sand buffer which will protect the fore-dune and lessen the ability of incoming waves to erode the dune into a scarp.

6.1.4 Option 4 – Offshore Breakwater and Cut-Off Groyne

This option is similar to Option 3, but includes an offshore breakwater (or 'headland') at the western end of the beach, instead of a beach groyne (Figure 16). A small impermeable 'cut-off' groyne at the eastern end of the beach will prohibit sediment being transported both behind and in front of the large rock in the near-shore environment. Hence the amount sand available to deposit on the boat ramps is likely to be minimised. The construction of the offshore breakwater acts to inhibit incident waves reaching the beach, and allows sand to build out into a spit behind it. This option would require initial nourishment to help build an effective buffer of sand behind the structure.

Figure 16: Rubble mound cut-off groyne to be constructed near boat ramp in combination with an offshore breakwater at the western end of the beach to create a buffer in front of the erosion-susceptible western dune.

Benefits of this option include:

- The two structures are expected to largely satisfy the six selection criteria (Section 5);
- The need to maintain the boat ramps is likely to be greatly reduced;
- There are a number of material options available for their construction, including different types of rock, and geo-textile bags; and
- A large increase in the area of sandy beach available at the western end of the beach.

Disadvantages of this option include:

- Offshore breakwaters are not as well understood as beach groynes. There is a lack of sufficient data to confidently design offshore breakwaters of the correct size and in the correct location;
- Offshore breakwaters have higher construction and maintenance costs associated with them than groynes;
- The offshore breakwater is likely to increase wave reflection the harbour which may be detrimental;
- This option requires a significantly larger volume of sand nourishment than Option 3;
- There will be a noticeable loss of sheltered boat harbour area with the construction of this type of breakwater; and
- There was no vocal community support for this option relative to the other options.

6.1.5 Option 5 – New Breakwater and Extension

This option is on a different scale to the previous options (Figure 17). It involves the extension and construction of large protective breakwaters to greatly increase the shelter of the harbour. These types of structures, whilst being very effective, are very expensive.

Figure 17: Major harbour construction works, including the extension of the original breakwater into deeper water, and the construction of a new spur-type breakwater from the western granite headland. This would effectively shelter the entire beach inside the harbour.

Benefits of this option include:

- This option would create a sheltered harbour environment under all conditions; and
- The need to maintain the boat ramps is likely to be greatly reduced.

Disadvantages of this option include:

- Very expensive structures to construct, and maintain, as they would require quarry blasting and road(s), they are well beyond the budget of this project;
- Any new structure of this size would permanently cover seagrass, and hence may require extensive environmental planning approvals; and
- Use of the harbour is not extensive at present, and this sort of expansion is beyond stabilising Fishery Beach and providing shelter for safety purposes.

A similar large wrap around breakwater from the west, outside the current breakwater, was proposed during the original 1996 construction, but is not viable for the same reasons as the option above.

6.2 Consultation of Preferred Option

Although not all community members were convinced the preferred option would be successful, Options 1, 2, and 4 received no support. There was a lot of initial support for Option 5, but the majority of the attendees appreciated that the significantly higher cost of the large breakwater structures could not be justified at present. The current budget would not go very far towards beginning construction of such large structures, hence the preferred option (number 3) was considered to be the best way forward by a majority of community members. There was concern that the problem has been ongoing for almost 10 years and due to the minimal commercial use of the harbour, significant new funds in the near future were not likely. As such, attendees agreed from a safety perspective that Option 3 should proceed.

An eventual condition of agreement to proceed with Option 3 was that various community members who were sceptical of the success of the mid-beach groyne would prefer it be constructed from geo-textile sand bags. The opinion was that, should they prove unsuccessful, they could be cut open and more easily removed than a rubble-mound structure. There was an agreement that the eastern 'cut-off' groyne was both necessary and likely to be successful, and as such, several attendees expressed the opinion that it should be constructed from rock.

7 Recommendations

DPI has engaged a consultant to design the two groynes and sand nourishment details required for implementation of Option 3. This option has been agreed upon in consultation with local community members and is considered to be the most appropriate solution to stabilise Fishery Beach.

The option will compartmentalise Fishery Beach into two sections which are free to align naturally, whilst providing a beach face to act as a buffer against storm erosion. Nourishment of the two compartments will be necessary, and sand will need to be sourced. Possible sources include the fore-dune at Fishery Beach, the river mouth directly east of the townsite (subject to environmental approvals), and inland sources.

The mid-beach groyne is to be designed for construction from geo-textile sand bags, whilst the cut-off groyne will be designed for construction from locally available rock. There is rock available from various locations around the Bremer Bay townsite. The design consultant will need to locate enough suitable rock from the following sources, and / or identify others;

- The four offshore breakwater trial solutions still present in the near-shore zone at the western end of the beach. These are constructed of granite rocks of the order of 100kgs;
- Excess granite rock from construction of the main breakwater is located around the quarry at the base of the breakwater; and
- Other rock leftover from the 1996 breakwater construction which is now located around town.

The design phase of this project is expected to be completed by September 2007, with tendering, approvals and construction to follow.