ACCESSING LAKE MACQUARIE

A Strategy for Swansea Channel

For Public Comment

September 2003

Prepared by WBM OCEANICS AUSTRALIA

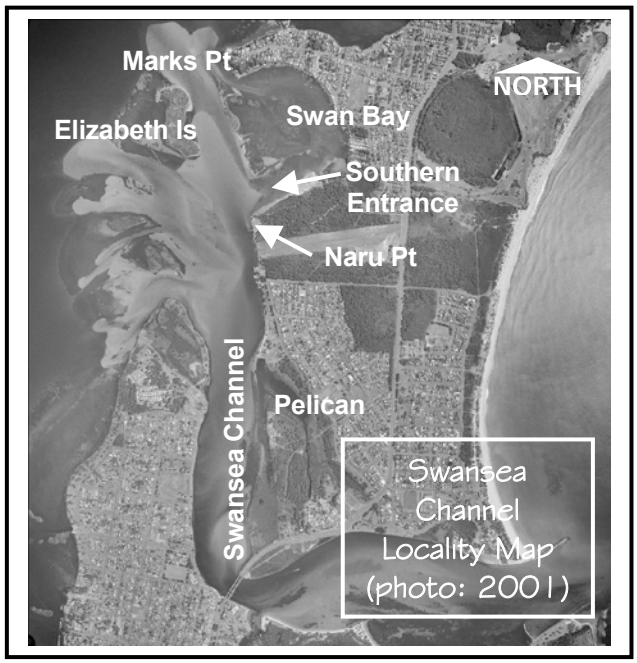
On behalf of The Office of the Lake Macquarie & Catchment Coordinator

CONTENTS

1 WHAT IS THIS REPORT ABOUT?

The purpose of this document is to provide important information to the community regarding navigation and access through Swansea Channel. This document presents the **recommended plan of action for maintaining access to Lake Macquarie**. The Plan has been developed giving due consideration to the historical uses of the Channel, relevant technical and economic factors, and the social perspectives of the channel users and the general community. The outcome is a cost-effective balanced plan, which is now presented to the general community for comment.

2 REPORT SUMMARY



Access to Lake Macquarie through Swansea Channel has been a recurring problem for over 100 years. The highly dynamic nature of the entrance means that sand shoals are constantly moving, causing navigation difficulties.

Dredging was undertaken in the first half of 2003 to provide temporary relief from navigation problems around the notorious 'dog-leg' at the southern entrance to Swan Bay. The dog leg was a natural response by the channel to the recent establishment of a southern opening to Swan Bay.

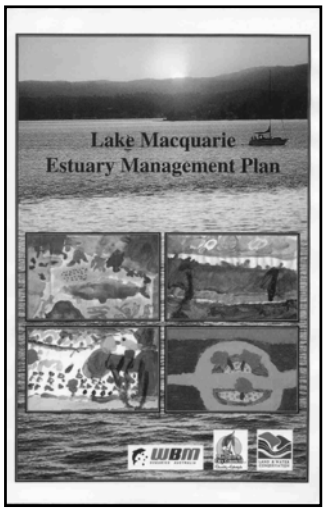
A long-term management strategy for navigation in Swansea Channel is currently being investigated. Potential long-term options have considered the technical, environmental, economic and social perspectives. Unfortunately a 'permanent' solution cannot be achieved by a 'one-off' dredging program due to the ever-changing shoals throughout Swansea Channel. Therefore, any long term management strategy must always consider future *maintenance* dredging.

The recommended strategy for Swansea Channel involves dredging of the channel between Pelican and Marks Point leading to a width of about 100 - 120m and a depth of about 4m, along with the partial closure of the southern entrance to Swan Bay to control flows and prevent future shoaling in this area. Technical studies indicate that the channel would be more stable as the width of dredging increases. The southern entrance to Swan Bay would retain a small gap to ensure satisfactory tidal flushing and good water quality. Although further investigations are still required to optimise the design, it is expected that the gap would be restricted to about 20 – 30 metres wide.

If this strategy is supported by the community and various government agencies, some of the initial works could be carried out under the existing funding for the Lake Macquarie Project. This could include works to partially close the Swan Bay southern entrance and some additional associated dredging of the channel.

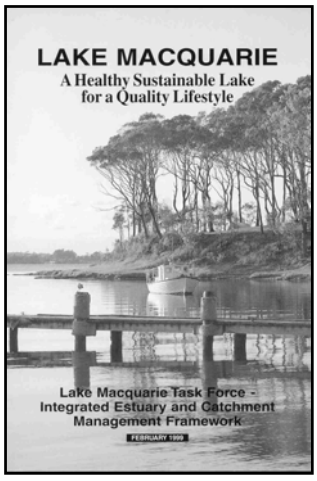
3 BACKGROUND

In 1997, Lake Macquarie City Council released the Lake Macquarie Estuary Management Plan (EMP).



As well as outlining a series of catchment-based works to address water quality and sedimentation issues in the lake, the Plan provided recommendations on navigation through Swansea Channel. One of the specific aims of the Plan was "to maintain or improve the navigable access to Lake Macquarie to a level consistent with warranted boating usage". The plan recommended that initial maintenance dredging of the channel be carried out, along with monitoring for about 3 years. This was to be followed by a detailed scientific investigation and determination of longer-term strategies, including benefit cost analysis of different options.

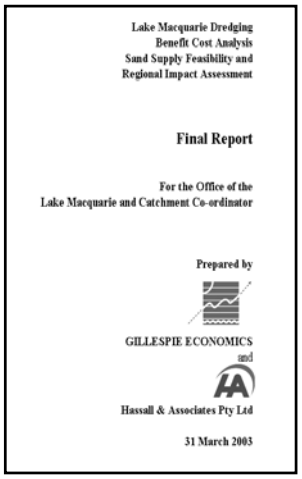
In 1998, the Premier of NSW established a Task Force to develop a range of action plans and priorities for Lake Macquarie aimed at addressing issues affecting the health of the lake. The Task Force produced an Integrated Estuary and Catchment Management Framework document in 1999. With regard to the issue of entrance channel navigation, the Framework built on the recommendations of the EMP, and called for maintenance dredging of the channel and dropover areas as high priority tasks. The Framework also recommended an assessment of the processes of sediment movement in the channel, and a feasibility study to evaluate preliminary concept designs for long term channel stability, as medium priority tasks. The feasibility study and assessment was to select a preferred management strategy for the channel.



Undertaking of the preferred long term channel stabilisation works was also identified in the Framework as a medium priority task, with a preliminary cost estimated in the order of $5million.

Since the release of the EMP in 1997 and the Integrated Framework in 1999, maintenance dredging of the channel has been carried out on a number of occasions. This has included the removal of approximately 40,000m^3 of sand from between Belmont Airport and the dropover in 1998/99, and the removal of approximately 4,500m^3 from the edge of the Swan Bay dog-leg in 2000, and again in 2001. Maintenance dredging works were also carried out in the first half of 2003, with approximately 120,000m^3 of material being dredged from the channel between Pelican Marina and the dropover.

A detailed investigation into the hydraulics, sediment transport and navigation issues in Swansea Channel was initiated in 2002. A draft report on these investigations has been prepared on behalf of the Office of the Lake Macquarie and Catchment Co-ordinator. This report focused on the physical processes that are controlling the movement of sediment within Swansea Channel. The investigation used sophisticated computer modelling to assess the existing patterns of erosion and shoaling within the channel, and to help develop a range of options aimed at improving the long-term navigability of the channel.


Lake Macquarie Dredging
Benefit Cost Analysis
Sand Supply Feasibility and
Regional Impact Assessment

Final Report

For the Office of the
Lake Macquarie and Catchment Co-ordinator

Prepared by

GILLESPIE ECONOMICS
and
Hassall & Associates Pty Ltd

31 March 2003

As a follow-on to the scientific investigation, an economic assessment has been carried out on a number of different long term management options. The economic assessment analysed the benefits and costs of the options, and estimated the likely impact on the local economy based on guaranteed improved access through the channel.

Copies of these recent documents have been placed in Lake Macquarie City libraries.

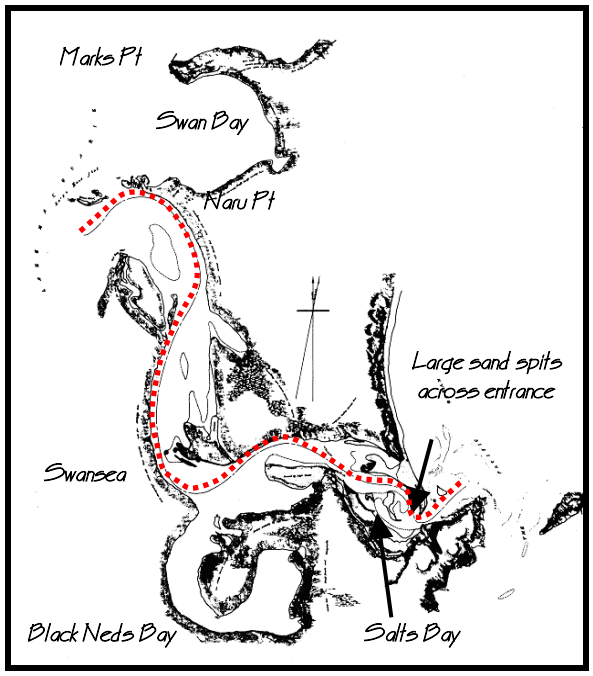
4 WHAT ARE THE DRIVING ISSUES ?

The primary issues associated with Swansea Channel are the susceptibility to shoaling and the impact that this has on navigation through the channel. In addition to this, there are a number of other issues that need to be considered when addressing navigation in the channel, including potential impacts on Swan Bay, and the perceived potential to improve lake flushing.

4.1 Channel Navigation

In the 1800's, Swansea Channel was navigable to only the smallest of boats. In fact, the channel in the 1800's did not go past Marks Point, but instead flowed westward from Naru Point (see plan adjacent).

The channel was first dredged for navigation following construction of the entrance breakwaters in the late 1800's. Throughout the following century, channel navigation was maintained for economic purposes (including transportation of coal and power station equipment), as well as for recreation. Sand dredged from the channel was usually dumped nearby to create the various sand islands that now exist (eg Elizabeth Island, Pelican Island and the Spoil Island in front of Swan Bay).



Swansea Channel, circa 1861

Ever since construction of the breakwaters and opening of the channel to the ocean, Swansea Channel has been in a state of change. Ocean waves can now penetrate the entrance, and have caused more than 400 metres of foreshore recession at Salts Bay over the past 60 years. The eroded sand has been transported upstream due to the increased tidal currents, and has created a network of shoals and sand spits throughout the channel. Also, with the increased tidal currents through the entrance channel, some of the banks of the channel have eroded, requiring rock walls to protect assets such as roads, reserves and Belmont Airport.

Sand is transported through the channel as discrete 'slugs' before being deposited on the dropover. The slugs move upstream at a rate of about 50 metres per year (on average), while the dropover at the end of the channel has been extending into the lake at an average rate of about 10 metres per year.

Over the last 6 years or so, navigation through the channel has been particularly hampered by a large sand shoal between Elizabeth Island and Swan Bay. With the opening of the southern entrance of Swan Bay in 1996, the tail of this shoal has been pushed into the southern entrance causing a

pronounced 'dog-leg' in the main navigation channel. This dog-leg resulted in difficulties in navigating the channel for both recreational and commercial vessels, and prompted the most recent channel dredging works, completed in July 2003.

It can be said that the opening of the southern entrance to Swan Bay has had a negative effect on navigation in the main channel, by reducing velocities and diverting flows out of the channel and into Swan Bay.

Current Shoaling of Swansea Channel and the notorious Swan Bay dog-leg (August 2001): The dog-leg has now been bypassed by dredging works completed in July 2003.

4.2 Swan Bay

Prior to 1958, Swan Bay was completely open to the lake, although the average depth of the bay was still very shallow. During the straightening of the main navigation channel past Marks Point, spoil from the associated dredging activities was placed as a continuous low lying island extending northward from Naru Point. Water exchange between Swan Bay and Swansea Channel was subsequently reduced to a relatively small channel at the north of the bay, next to Marks Point.

Increasing urban development around the bay, combined with the reduced tidal flushing, slowly degraded water quality within Swan Bay. In 1988, approval was granted for the extraction of sand from Swan Bay as part of a private commercial enterprise. The objective of the dredging was to utilise a commercial sand extraction operation to simultaneously achieve improved tidal flushing of the bay, while also providing water access for private jetties around the bay foreshores.

Between 1994 and 2002 over half a million cubic metres of material was dredged from Swan Bay, and a new southern entrance to the bay was created. This southern entrance has eroded rapidly in recent years and is now over 250 metres wide (compared to its original design width of 120 metres). Approximately 10% of the total flow into and out of Lake Macquarie now passes through Swan Bay. Action is required to stabilise the foreshores and prevent further widening of the entrance.

Navigation into and out of Swan Bay will be maintained, and if required, future dredging of the northern entrance can be undertaken as part of the on-going maintenance dredging program.

4.3 Lake Flushing

Lake Macquarie has a small tidal range compared to the ocean. The difference between high and low tide across most of the lake is usually less than 150 mm. The long and heavily shoaled entrance channel restricts the tide as it penetrates the lake. In fact, barometric pressure can have a greater impact on lake levels than astronomical tides.

The amount of water exchanged between the lake and the ocean during every tide is less than 1% of the total volume of Lake Macquarie. Computer modelling of different channel conditions (i.e. current, dredged and heavily shoaled) has shown that tidal flushing plays a relatively minor role in determining the water quality condition of the lake as a whole. Any benefits of tidal flushing reduce rapidly with distance away from the entrance channel.

It is sometimes wrongly perceived that Swansea Channel is simply the 'plug' of Lake Macquarie, and that opening the 'plug' would result in

dramatic improvements in the health of the lake. While the channel does control the tidal influence of the lake, the enormous volume of Lake Macquarie means that daily tides have only a small impact on the quality of the lake's water, and that any benefits would be localised around the immediate entrance area only.

Modifying the tidal range of the lake (through extensive dredging of the entire entrance channel) would result in more problems than benefits. With a more 'open' entrance, large seas would be able to penetrate the lake more easily, resulting in more frequent flooding of low lying areas around Pelican, Swansea Flat and Belmont. If tidal range increases and low tides become lower, then extensive areas of mud flats would become exposed, and large areas of seagrass could die. Seagrasses are critical to sustaining fish populations in the lake.

Large changes to tidal flows through the entrance channel are also likely to result in altered erosion and accretion patterns, possibly with significant bank erosion at areas such as the Swansea foreshore beside Channel Street, along Pelican Flat, and adjacent to Pelican Marina.

It is also sometimes perceived that the formation of Elizabeth Island and the other spoil islands in the channel have choked the tidal flows, resulting in reduced flushing of the lake. Computer modelling has shown that whilst the islands do redirect the tidal flows, the net exchange of water between the lake and the ocean remains unaltered. In fact, the presence of the islands tend to concentrate the tidal flows into specific channels, rather than letting the flow spread evenly across the broad sand flats. This means that the channels become deeper and more stable, and thus are better from a navigational perspective.

The Lake Macquarie Estuary Management Plan recognised the fact that tidal flushing has a limited impact on water quality within the lake. Hence, strategies for improving water quality have focussed on catchment management, community education and addressing point source discharges of pollutants (including sewage overflows and industrial inputs).

5 WHAT ARE THE POTENTIAL LONG TERM OPTIONS ?

Firstly it must be recognised that there is no easy 'one-off' solution to the navigation issues of Swansea Channel. The channel is a highly dynamic system. Erosion of sand from shoals and beaches in the downstream entrance areas means that sand is continually being injected into the channel. Therefore, there will always be a need for on-going channel maintenance particularly at the drop-over. However, through good design and adaptive planning, channels can be created that *optimise* any future maintenance strategy.

The technical long term feasibility assessment (WBM, 2003) considered a number of options, including:

1 Broadscale dredging of the main navigation channel between Pelican and the northern dropover;

2 Redirection of the main navigation channel through the old Air Force Channel (between Elizabeth Island and Pelican Island);

3 Partial or complete closure of the Swan Bay southern entrance (in combination with broadscale dredging as proposed for Option 1);

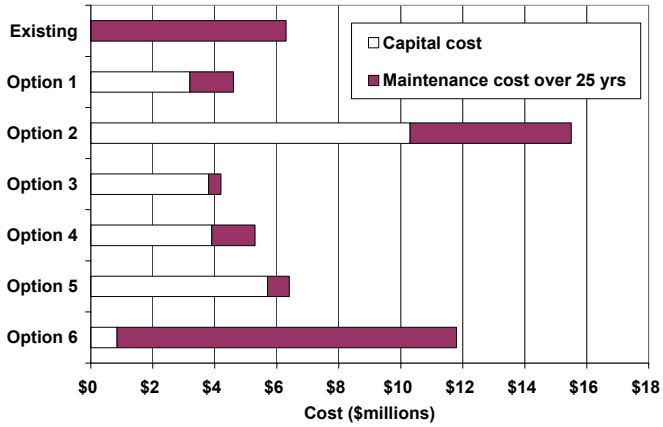
4 Rock training wall in front of the Swan Bay southern entrance (in combination with broadscale dredging as proposed for Option 1);

5 Construction of training walls to prevent any flow over the western dropover (in combination with broadscale dredging as proposed for Option 1); and

6 Complete removal of Elizabeth Island and the other islands within the entrance delta.

A number of variations of each option were considered, with different dredge channel widths and depths, gap widths, and training wall lengths.

Shown below is a cost comparison of the six options, adopting the most appropriate effective configuration for each option, as determined by the technical assessment. Also shown are the costs associated with general channel maintenance, which represents the existing approach to navigation management. Note that the existing approach does not involve large up-front capital expenditure.

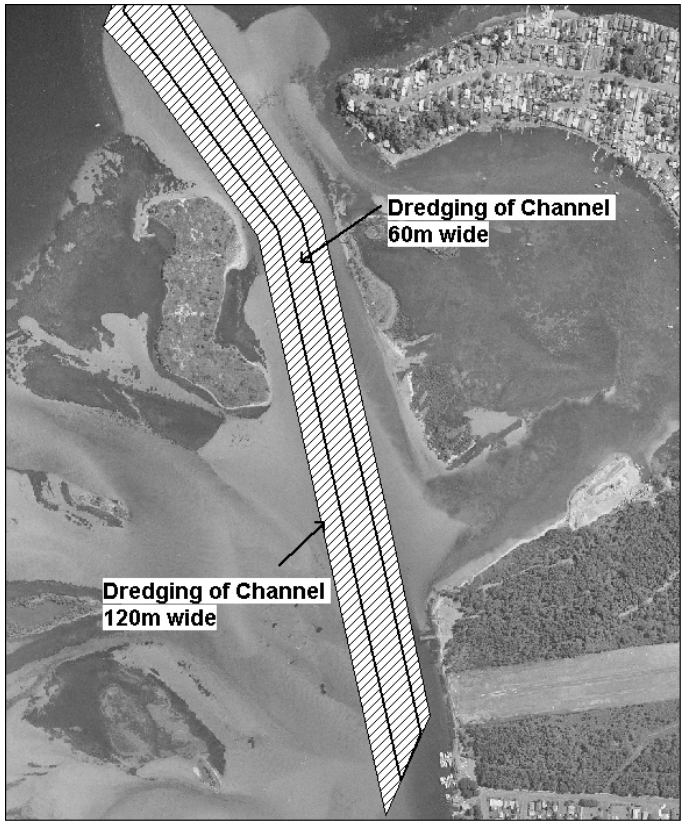


From this comparison, Option 2 and Option 6 can be discounted immediately due to excessive costs. The remaining options were considered against the potential environmental benefits and their relative costs. Two options stood out as being the most cost effective: Option 1 and Option 3. These two options are discussed in more detail below.

5.1 Broadscale Channel Dredging (Option 1)

Option 1 involves extensive dredging of the main navigation channel between Pelican Marina and Marks Point. A number of different channel depths and widths were assessed to try and determine a dredge profile that would be the most stable. If the channel is made too large, flows through the channel would be too slow and sand would tend to fill in the channel. If too small, flows would be redirected away from the channel, which would mobilise sands elsewhere.

Channel widths of 60m and 120m were considered, while channel depths of between 3m and 4.5m were assessed. These depths equate to provision of safe navigation through the channel for vessels with drafts of between 2m and 3.5m, respectively. The largest boats in Lake Macquarie generally have drafts of less than 2.5m.

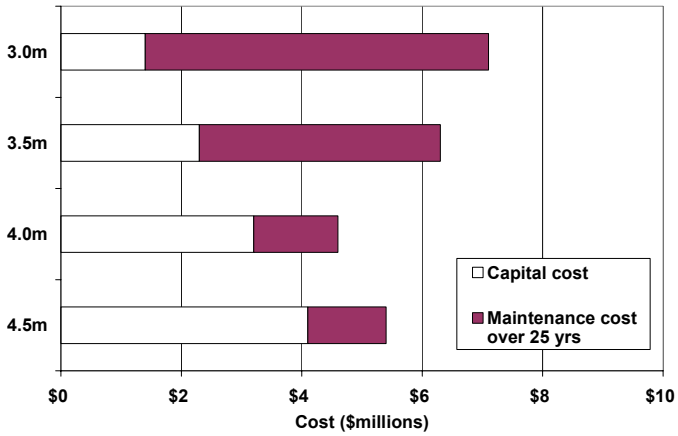


Option 1: Channel Dredging between Pelican Marina and Marks Point

For this option it was assumed that the southern entrance of Swan Bay would remain unchanged from existing conditions.

The technical assessment found that a shallower channel, although being cheaper initially, would require more frequent maintenance dredging. When considered over a period of 25 years, the shallower channel would actually be more expensive, due to the on-going maintenance costs. It was estimated that for a 3m deep channel, maintenance dredging would be required on average every 2 to 3 years. In contrast, it was estimated that a 4m deep channel would require maintenance dredging on average every 10 to 12 years.

Capital costs associated with this option are high. However, it was found that higher capital costs associated with deeper dredging would be more than offset by reduced maintenance requirements in the future, as shown in the graph below.



The most cost effective option is a channel 4 metre deep and approximately 120 metres wide. This option has an initial cost of approximately $3.2 million and a present value cost after 25 years of $4.6 million. These costs assume that the channel is in a shoaled condition before dredging commences.

Economic analysis was undertaken by Gillespie (2003) for a range of possible future scenarios, from maintaining current usage levels to an increase in usage of up to 250%, if the channel was permanently navigable to deep draft vessels. Adopting a conservative estimate of 175% increase in boating usage, the costs associated with establishing and maintaining a 4m deep channel equate to approximately $170 per vessel per trip. These costs are hypothetical and do not mean that a charge per boat is proposed.

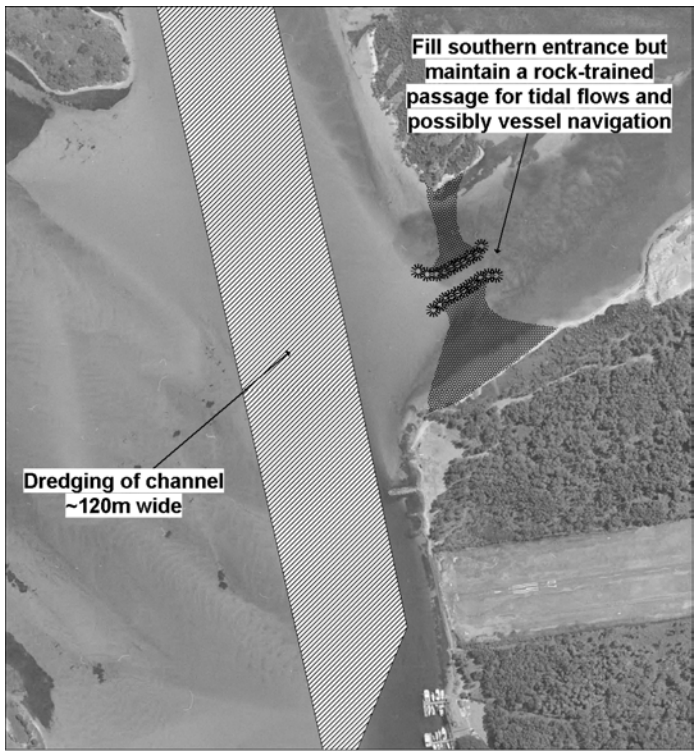
5.2 Partial Closure of Southern Swan Bay Entrance (Option 3)

The technical assessment (WBM, 2003) indicated that broadscale dredging options, as described in Section 5.1, would still be susceptible to shoaling in the area adjacent to the southern entrance of Swan Bay.

To address this issue, options were considered to reduce the total flow through Swan Bay, and direct additional flows through the main navigational channel, thus minimising shoaling within the channel. Options considered included:

- Complete closure of the southern Swan Bay entrance;
- Partial closure with a 50m gap; and
- Partial closure with a 100m gap.

The option that provided the most stable channel configuration was full closure of the southern Swan Bay entrance. Unfortunately, full closure of the entrance would significantly reduce tidal flushing within Swan Bay, and water quality would deteriorate as a consequence.



Option 3: Partial Closure of Swan Bay southern entrance

The results for partial closure of the entrance with a 50m wide gap indicated that water quality within Swan Bay would not be affected. However, relatively high flows would still pass through the gap, resulting in shoaling in the channel adjacent to the southern entrance. It is likely that the optimum scenario would involve a narrower gap, which would minimise shoaling in the channel and

through the entrance, whilst maintaining similar water quality in Swan Bay. The width of this gap would need to be confirmed through further model testing, but is expected to be in the order of 20 – 30 metres.

Costs associated with partial closure of the entrance would be in the order of $0.75 million. When combined with broadscale dredging of the main channel (up to a width of about 120m and a depth of 4m), the total present value costs after 25 years would be about $4.1 million, of which maintenance dredging requirements account for just $0.4 million.

5.3 Where will the sand go?

The optimum broadscale dredging configuration involves the removal of some 370,000m^3 of sand from the bed of Swansea Channel. Disposal of this quantity of sand requires careful consideration, and will be a key aspect of any environmental impact assessment associated with the works. In the past, sand dredged from the channel has been pumped to Blacksmiths Beach, and for the most recent dredging, was used to remediate deep holes within Swan Bay.

Another option is the commercial sale of the dredged sand. The sand would mostly be suitable for fill material, and as such, would have a relatively low market value.

Establishing a commercial sand mining enterprise as part of the dredging works would involve setting-up a land-based processing facility (including dewatering, screening and stockpiling). These costs impact on the feasibility of such a commercial venture.

Commercial opportunities for use of the sand can be explored through the tendering process when future dredging works are being planned to ensure costs are optimised.

5.4 Regional Economic Impacts of Dredging

A regional economic assessment was carried out to explore the wider economic impacts of possible future channel works (Gillespie, 2003). The Lake Macquarie economy was estimated to be worth around $10.6 billion / year, with around $260 million / year related to tourism.

Results of the economic assessment indicate that implementation of the dredging works, including the on-going maintenance requirements, would have a relatively small impact on the Lake Macquarie regional economy. The actual dredging works and the projected visitation from vessels moored outside Lake Macquarie was predicted to add about $5million - $6million/yr to the Lake Macquarie economy. The on-going dredging works and increased visitation to the lake is predicted to create about 20 direct and indirect regional jobs. The main sectors that would benefit include accommodation, cafes and restaurants, wholesale and retail trade, and road transport.

6 WHERE TO FROM HERE ?

Based on the scientific and economic information presented to date, a strategy for future management has been developed that is aimed at maximising access through Swansea Channel, while giving due consideration to the costs involved and the dynamic nature of the Lake Macquarie entrance.

For Swansea Channel, it is recommended that the most cost-effective approach will involve:

1. Carry out immediate maintenance dredging of the channel to bypass the 'dog leg' and restore access to the lake for deeper hulled vessels. This involves the removal of approximately 120,000m^3 of sand from between Pelican Marina and Marks Point in the form of a channel 70 metres wide and 3.5 metres deep.

   These works were **completed in July 2003** at a total cost of $0.75 million.

2a. Carry out works associated with partial closure of the Swan Bay southern entrance. This would first require detailed design of the structure (and associated model testing to optimise the size of the opening), and an environmental impact assessment in accordance with State and Local Government requirements.

The partial closure of the Swan Bay southern entrance, which would include some associated channel dredging, would improve the longevity of the dredging completed in July 2003, and would reduce the need for on-going maintenance dredging in the future.

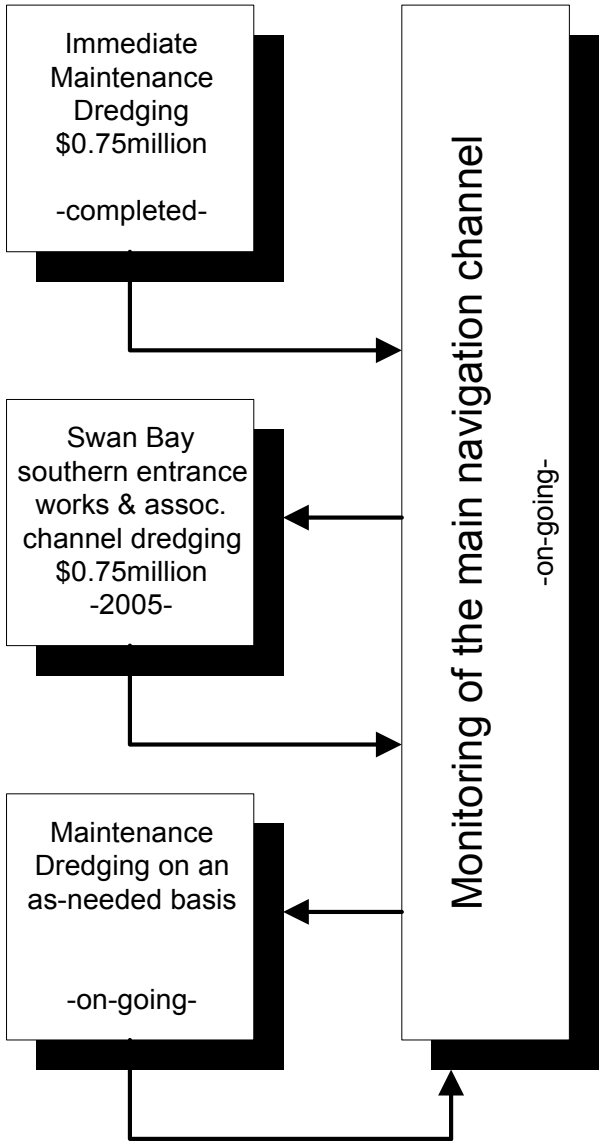
The Swan Bay entrance works and associated channel dredging would cost approximately $0.75 million, and could be completed by 2005.

2b. Depending on the availability of funding, further dredging of the channel could be carried out in order to maximise its size, and hence improve its longevity. The ideal size for the channel (which minimises future maintenance dredging requirements) is about 100 – 120 metres wide and 4 metres deep. However, any additional dredging works that aim to widen the channel beyond about 60 metres would still be beneficial in terms of reducing the need for future maintenance dredging.

3. Adopt an adaptive management approach to channel navigation. Initially, the channel would be monitored regularly by NSW Waterways Authority. When shoaling reaches a threshold ('trigger') level (eg < 2.5m depth), a process will be instigated to initiate further dredging of the channel, as required. Sufficient lead time will be built into the trigger level to account for the time taken in obtaining the necessary funding and approvals for the works.

4. Following dredging, monitoring of the channel would continue until the trigger level is reached once again, when the process for carrying out maintenance dredging would be reinitiated.

The steps involved in this adaptive management approach are shown below.



On-going maintenance dredging will still be required at the drop-over regardless of any broadscale dredging works carried out within the main navigation channel. This is because the flows spread out and slow down as they enter the lake, allowing the sediment to deposit in the shape of a fan.

7 HAVE YOUR SAY

Comments from the community are invited on this proposed strategy. Comments should be forwarded to:

"Channel Strategy Comments"
The Office of the Lake Macquarie & Catchment Coordinator
Box 1906
HUNTER REGION MAIL CENTRE NSW 2310

or via email to: lakeoffice@lakemac.nsw.gov.au

Comments should be receive do later than
DD MONTH 2003

The submissions will be summarised and referred to the Lake Macquarie Project Management Committee for consideration. Following completion, the strategy for implementation in the longer term, will be referred to the NSW Minister for Infrastructure, Planning and Natural Resources and Lake Macquarie City Council.

8 FURTHER READING

Further information on the issues of navigation through Swansea Channel can be found in the following documents. These documents are available through the Lake Macquarie City Council library.

Investigation into Hydraulics, Sediment Transport and Navigation in Swansea Channel and Swan Bay: Final Draft Report by WBM Oceanics Australia, March 2003

Lake Macquarie Dredging Benefit Cost Analysis Sand Supply Feasibility and Regional Impact Assessment: Final Report by Gillespie Economics and Hassall and Associates, 31 March 2003

Swansea Channel Proposed Maintenance Dredging: Review of Environmental Factors, by WBM Oceanics Australia, October 2002

Lake Macquarie: A Healthy Sustainable Lake for a Quality Lifestyle: Integrated Estuary and Catchment Management Framework by the Lake Macquarie Task Force, February 1999

Lake Macquarie Estuary Management Plan by WBM Oceanics Australia, October 1997

Lake Macquarie Estuary Management Study: Volume 1 – Entrance Channel Issues by WBM Oceanics Australia, July 1997

Lake Macquarie Estuary Processes Study by Australian Water and Coastal Studies, 1995, Report 94/25