# SWANSEA CHANNEL DREDGING TO IMPROVE NAVIGATION

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## Overview

Swansea Channel is the marine gateway to Lake Macquarie on the NSW Central Coast. Lake Macquarie is an outstanding recreational waterway used by local and regional boating enthusiasts and contributes to the social, environmental and economic values of the Lake Macquarie area.

To date the Swansea Channel has been dredged in small campaigns on an "as needed" basis to relieve constraints to navigation in specific areas of shoaling. Dredging on this basis leads to uncertainty about locations of shoaling and reliability of boating access. Maintaining reliable boating access to the lake is considered desirable for social and economic reasons (Umwelt, 2013).

The Swansea Channel dredging works have been extended to establish a more functional channel form sought after by the boating community. NSW Crown Lands intend to undertake a larger scale "once off" maintenance dredging campaign to achieve this, with smaller subsequent campaigns for ongoing maintenance.

In response to public interests, dredged material from the initial maintenance campaign is to be pumped to Blacksmiths Beach, dewatered, and used to aid Council and other land care groups with ongoing dune rehabilitation.

The dredging project is complicated by several constraints that include:

- presence of sensitive environmental ecosystems;
- involvement of numerous stakeholders and interest groups;
- proximity to local residents;
- near and far field effects on estuary processes; and
- limited time frame to complete the dredging prior to the summer boating season.

These constraints are being overcome through thorough stakeholder consultation, careful management, and specialist engineering tools and experience.

## Study Area

Lake Macquarie is located on the NSW Central Coast and is a large waterway of approximately 110 $km^2$, with a catchment area of around 700 $km^2$. The lake is connected to the ocean by Swansea Channel which has been trained by breakwaters since the early 1880s. The entrance is approximately 400 m wide between the breakwaters but narrows to about 170 m at the Swansea Bridge crossing, which was first constructed in the mid-1880s.

Reclamation of the northern approach to the Swansea Bridge introduced a flow constriction promoting increased velocities and turbulence in the vicinity of the bridge

resulting in bank erosion. Adjustment of Swansea Channel to entrance training resulted in erosion of sand primarily from Salts Bay and scour of the outer channel (the channel downstream of Swansea Bridge). Sediment mobilised from these areas by the improved hydraulic efficiency of the entrance is propagated upstream in pulses by the dominant flood tide and is deposited upstream of Swansea Bridge in the inner channel. The inner channel originally entered the lake to the west but now enters the lake in the north and has been stable in this position since 1976 (WBM, 2003). Shoaling of the inner channel has created a navigation hazard for deep-keeled yachts and cruisers.

Dredging works to improve navigation commenced in 1939, with various islands at the lake end of the channel created from dredge spoil (including Elizabeth Island, and Spoil Island across Swan Bay). From 1970 records indicate that inner channel dredging has generally been undertaken in small campaigns, removing between 10,000 and 50,000$m^3$ of sand every one to five years (Umwelt, 2013), apart from some isolated major dredging campaigns including in early 2003 which involved removal of 120,000 $m^3$ of sand from a mid-channel shoal adjacent to Swan Bay (WBM, 2005).

Figure 1 shows the channel and associated bays and shoals, together with sandbanks and islands within the inner channel formed by spoil from past dredging campaigns.


**Figure 1 Study Area**

## Navigation Issues

Issues within the Swansea Channel associated with navigation depths less than 2m were identified as follows by Umwelt (2013).

- Scrapes to yacht and motor cruiser hull anti foulant and keel damage.
- Minor injury to crew and passengers thrown around vessels as the keel hits the bottom and the vessel stops suddenly.

- Motors on both keel and motor cruiser vessels becoming clogged with sand.
- Limited navigable area for vessels, especially if several changes of direction are needed to manoeuvre through the channel.
- Vessels being laid over and dragged across the shoals.
- High level of skill required to negotiate the channel under most conditions.
- Safe transit times (in relation to water depth) limited to high water.
- Time required for RMS officers to shepherd recreational vessels through the channel, or drag them off shoals or through the shallow areas.
- Uncertainty affects event planning and tourism business opportunities, when events involve safe passage of vessels into and out of the lake, e.g. regattas on the lake and offshore yacht charter and day cruising.
- Reputation of Lake Macquarie as a weekend yachting destination. People cannot be certain they can get into the lake safely, and then, once in, cannot be certain when they will be able to leave.
- Underutilisation of marine facilities and flow on effects because yachts and large motor cruisers from other ports do not enter the lake. For instance, marinas in Lake Macquarie have facilities suitable for a larger number of visiting vessels than can currently enter the lake safely. Poor navigability also indirectly affects spending in restaurants and clubs.

## Project Proposal Development

The project proposal was developed based on consideration of scientific and engineering information, environmental data, waterway use statistics, policy and regulatory frameworks; approval processes, cost-benefit analysis and funding opportunities as outlined in *Towards a Sustainable Framework for Navigation in Swansea Channel* (Umwelt,2013).

The project was also informed by early consultation with waterway users and stakeholders. NSW Crown Lands established a Project Steering Committee with key community and agency representatives prior to the project commencing. A project web site provided information and an email submission facility. Face to face meetings were held with multiple boating organisations, tourism and commercial groups, as well as agency and Lake Macquarie City Council staff and local political representatives.

The Project Steering Committee concluded that maintaining a channel depth of 3.5 m and width of 60 m would assist with the following:

- improve safety for crews and passengers;
- reduce/ eliminate damage to vessel hulls, keels, motors;
- reduce attendance at channel incidents for RMS boating officers;
- provide certainty in being able to transit the channel on all tides; and
- provide certainty in planning boating events that rely on attracting vessels from outside Lake Macquarie.

In addition, sand dredged from the channel could be beneficially re-used for dune management, beach nourishment and foreshore improvements etc.

## Project Considerations

Royal HaskoningDHV was engaged by NSW Crown Lands to prepare design and environmental approval documentation for the project. In consultation with the Project Steering Group, and other public authorities and stakeholders, the following areas were considered and accommodated within the dredging design and methodology, where required.

***Hydrodynamics, Hydraulics and Sediment Transport***

- impacts on tidal prism and flooding
- impacts on foreshore stability (including sand islands) and foreshore stabilisation assets
- reduced conveyance of stormwater channel used for delivery pipeline
- impacts on drainage system due to pipeline placement
- impacts on coastal processes from sand placement on beach
- consideration of beneficial re-use of dredge sand to build-up area where dune is low to reduce potential for wave overtopping

***Water Quality***

- turbidity at dredging site
- management of spills
- contamination issues associated with an old night soil disposal site (pipeline route)
- impacts on water quality at disposal sites
- potential impacts on soil and land resources
- management of acid sulphate soils

***Waste Management***

- potential contamination and classification of dredged material
- management of stockpiled material including height limits and minimising double handling
- erosion, sediment and leachate control

***Impacts on Sensitive Ecological Areas and Species***

- Swan Bay, including seagrass and mangroves
- seagrasses around Elizabeth Island and off Pelican foreshore
- fish nursery on eastern side of Elizabeth Island
- disturbance to seagrass and macroalgae
- impacts of sand transport on wetland ecology
- threatened and migratory birds – Osprey, Little Tern, Pied Oystercatcher, Lesser Sand Plover(particularly Little Tern and Pied Oystercatcher which are known to use sand islands)
- impacts on dune ecology from sand placement including on interstitial meiofauna and other benthic organisms

***Heritage***

- Indigenous heritage impacts

***Odour***

- in relation to environmental harm, human health and amenity

***Noise and Vibration***

- noise associated with dredging, sand transport and placement
- construction traffic noise
- vibration from construction activities

***Traffic***

- associated with dredging, sand transport and placement/ disposal

***Access and Recreational Use***

- impacts on navigation during dredging and other community use of Swansea Channel, Swan Bay, and associated community facilities such as the Naru Point boat ramp
- impacts on public safety (including pedestrians, vessels and other users) during sand transport
- impacts on recreational use of Blacksmiths Beach and surrounding areas including disruption to four wheel driving (4WD) use

Information on the project and environmental assessment was presented to the following groups/ committees:

- LMCC Aquatic Services Committee user groups: and
- Lake Macquarie Estuary Management Committee.

NSW Crown Lands also issued media releases to inform the public of the proposal, has carried out an informative letter box drop for residents near the pipeline route, and was prepared to hold information sessions for local user/ interest groups if necessary.

## Project Works

The proposed channel form is shown schematically in Figure 2 (note that the vertical scale has been exaggerated). The channel is designed to provide adequate underkeel clearance for vessels drawing up to 2.5 m and includes an allowance for siltation. To achieve a channel base width of 60 m, depth of 3.5 m below approximate mean water level (0.0 m AHD) and stable batters of 1 in 6 (vertical to horizontal), up to 100,000 $m^3$ of sand may need to be dredged from the inner channel over a distance of 1.8 km.

Two similar channel alignments were explored with the preferred selected due smaller dredge volumes, thereby minimising potential for local bank erosion and impacts on seagrass beds.

The dredging footprint i.e. areas within the preferred alignment where sand is to be removed to meet required channel widths and dredge depths, is shown in Figure 3.

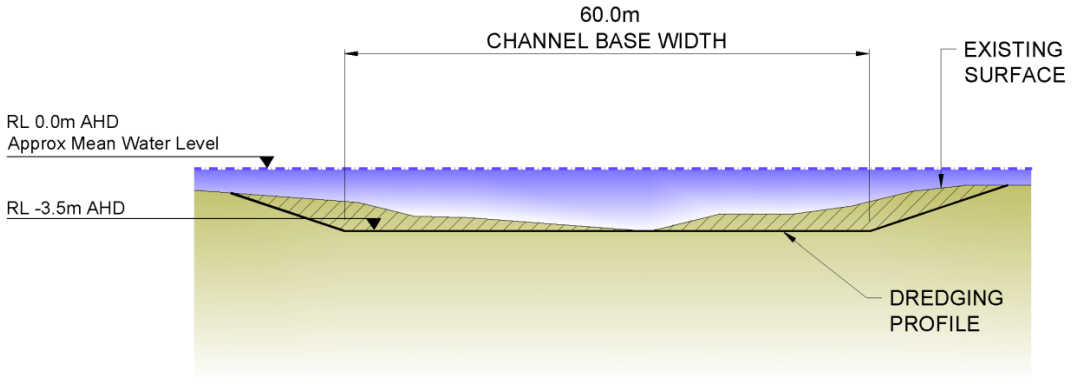


**Figure 2 Typical Dredged Channel Cross-Section**


**Figure 3 Dredging Footprint for Preferred Channel Alignment**

***Large Scale Maintenance Dredging***

The once-off large scale maintenance dredging campaign is to comprise:

- Dredge mobilisation and establishment;
- Dredging up to 100,000 $m^3$ of sand;
- Installation of a temporary pipeline from Old Belmont Sands site to the placement area at Blacksmiths Beach;
- Installation of booster pumps;
- Construction of dewatering areas at Blacksmiths Beach; and
- Dune construction.

Dredging is to be carried out using a small to medium sized Cutter Suction Dredger (CSD) pumping dredged sand to Blacksmiths Beach. While working at the northern end of the channel, the CSD would pump to the Old Belmont Sands site in Swan Bay with

the pipeline being submerged on the bed where possible to reduce navigation impacts and floating where necessary to avoid disturbance to seagrass beds. The water-based section of pipeline would be between 0.5 km to 2 km long, depending on the location of the dredge.

From the Old Belmont Sands site, the dredge slurry would be delivered by pipeline approximately 1.5 km long to dewatering areas at the back of Blacksmiths Beach (refer Figure 4).


**Figure 4 Blacksmiths Beach Material Placement Area**

Dewatering of the dredge slurry and reconstruction of the dunes would mostly take place in front of the Belmont Golf Course (refer Figure 4). At Blacksmiths Beach, existing dune sand would be used to form an initial bund to contain the dredged slurry in an existing low lying area. Dredged sand would be added to the bund and an outlet would be formed at the end of the bunded area to allow return water to flow out across the beach. Extensions to the delivery pipeline and bund would allow sand to be placed across the length of the placement area. Dewatered dredged sand would be shaped by dozers to a stable dune profile. Sand would be placed between existing vegetated hummocks to preserve existing primary dune vegetation.

Figure 5 shows a typical profile (indicative only) for the constructed dune, with dune crest of 7 m AHD and dune face at a slope of 1 in 5 (vertical to horizontal). Building up this low lying section of dune area could accommodate at least 100,000 $m^3$ of sand. The finished profile of the placed sand would be shaped to conform with a natural dune

profile (refer Figure 6) comprising an incipient dune and foredune in accordance with the Coastal Dune Management Manual (DLWC, 2001).

Dredging is scheduled to commence November 2014.

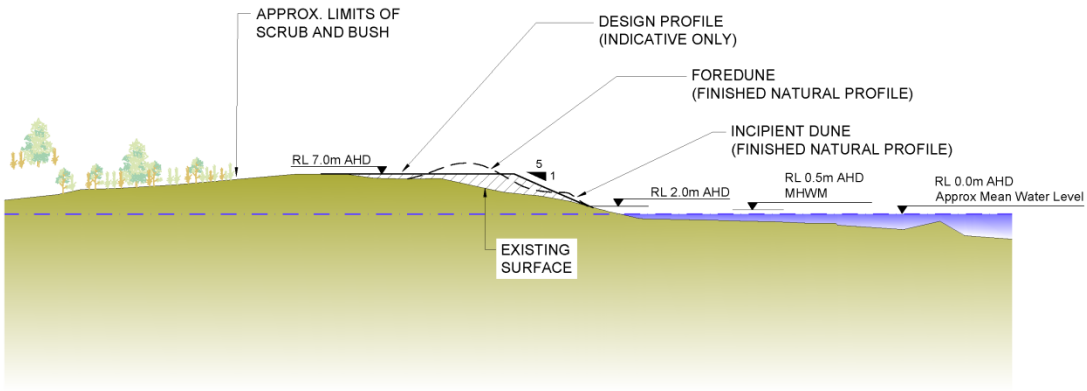


**Figure 5 Typical Constructed Dune Cross-Section (indicative only)**

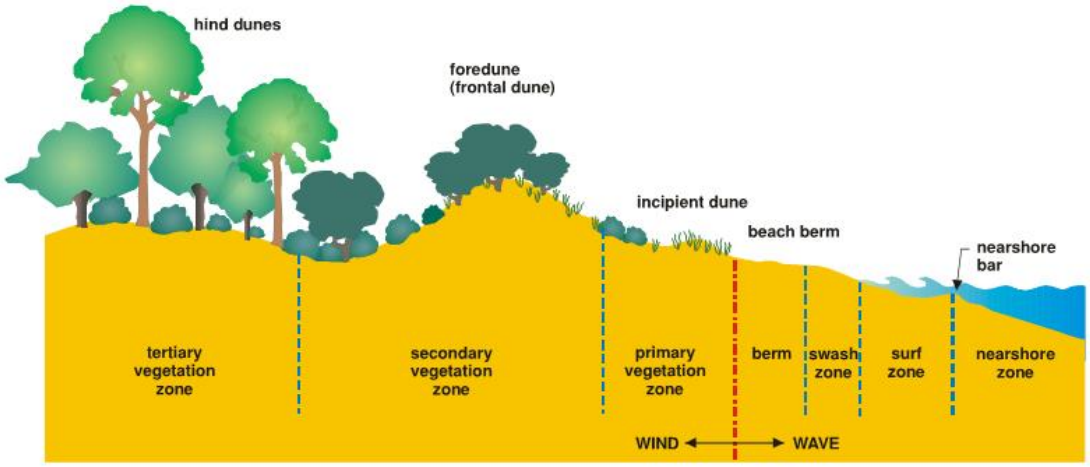


**Figure 6 Natural Dune Profile (DLWC, 2001)**

***Ongoing Maintenance Dredging***

Smaller ongoing maintenance dredging campaigns are estimated to comprise of dredging up to 10,000m$^3$ to 20,000m$^3$ of sand as frequent as every 1 to 2 years. Dredging plant for these smaller campaigns could include CSDs and barge mounted backhoe dredgers. The selection of plant and equipment would depend on costs, production rates, required dredge depths, environmental impacts, and the preferred delivery/placement method and location.

The method of dredging and delivery of sand from periodic, smaller maintenance campaigns would also depend on a number of factors including the placement site(s) selected for particular maintenance dredging works. The use of a particular placement site(s) would depend on the dredge quantities involved. Also, the frequency of ongoing maintenance dredging may vary depending on navigability of the channel, funding availability and requirements for beach/ foreshore nourishment sand etc.

Placement sites within the Swansea Channel have been identified to facilitate foreshore improvements, or to stockpile for future re-use. Pumping dredged sand to Blacksmiths Beach also remains an option for future maintenance dredging campaigns. Table 1 provides an indication of some of the available placement sites.

**Table 1 Potential Placement Sites for Minor Maintenance Dredging**

| Location | Purpose |
|---|---|
| Elizabeth Island - south end | address foreshore erosion |
| Spoil Island Foreshore | address foreshore erosion |
| Pelican Foreshore - north of airfield | create wider beach between groynes |
| Pelican Foreshore - south of airfield | sandy foreshore for boaters |
| Blacksmiths Beach | dune restoration/ beach nourishment |
| Naru Point | stockpile for future re-use |
| Old Belmont Sands site | stockpile for future re-use |

## Concluding Remarks

It is estimated around 700,000$m^3$ of dredging has taken place at Swansea Channel over the past 45 years to maintain navigation between the ocean and Lake Macquarie. Dredged material from these campaigns has been placed to form various islands and beaches. Some of this placed dredged sand has probably been eroded and reintroduced into the navigation channel only to be redredged during subsequent campaigns.

NSW Lands has embarked on a more comprehensive project involving a substantial once-off large scale maintenance dredging campaign followed by smaller ongoing maintenance dredging campaigns. Careful consideration has been given to the dredge design and also to the most sustainable dredge disposal locations. The intention was to develop a medium-term project where environmental impacts were assessed and mitigated, and approval put in place.

Lessons learned from the recent Swansea Channel dredging project have application for most other navigable estuarine waterways in NSW, particularly those which are located close to eroding beaches where beneficial placement of the dredged sand can take place.

## References:


WBM (2003), *Investigation into the Hydraulics, Sediment Transport and Navigation in Swansea Channel and Swan Bay.*

WBM Oceanics Australia [WBM] (2005), *Maintenance Dredging Swansea Channel and Swan Bay Northern Entrance, Lake Macquarie Review of Environmental Factors.*

NSW Department of Land and Water Conservation [DLWC] (2001), *Coastal Dune Management: A Manual of Coastal Dune Management and Rehabilitation Techniques*, Coastal Unit, DLWC, Newcastle, October.

*Royal HaskoningDHV (2014), Swansea Channel Dredging Review of Environmental Factors*

Umwelt (2013), *Towards a Sustainable Framework for Navigation in Swansea Channel*