Office of the Lake Macquarie and Catchment Co-ordinator

Review of the current impacts of Dredge Spoil Islands and water circulation on adjacent seagrass beds – Swansea Flats

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1.0 INTRODUCTION

Lake Macquarie is the largest coastal lake in eastern Australia, covering an area of approximately 120 kilometres squared. It is located approximately 135 kilometres north of Sydney and 20 kilometres south of Newcastle. Lake Macquarie is a barrier estuary characterised by a narrow, elongated entrance channel with twin training breakwaters. As a result tidal exchange is limited, estimated at approximately 1 per cent per tidal cycle (DLWC, 2000). The lake is reasonably shallow with an average depth of 7 metres and maximum depth of around 11 metres.

Swansea Flats is located on the eastern shoreline of Lake Macquarie (151º37'E, 33º06'S), immediately south of the entrance channel (**Figure 1.1**). The Flats are a shallow estuarine area, characterised by water depths typically less than 1 metre, reasonably clean quartzose marine sand and widespread seagrass meadows. The shallow water and seagrass habitat make Swansea Flats an important first refuge and settlement area for fish larvae entering the lake from the ocean. For this reason, the maintenance of water quality and seagrass health at Swansea Flats is very important for the overall ecological productivity of Lake Macquarie.

In the late 1950s, two channels were dredged across Swansea Flats to improve navigational access to the shoreline. The dredge spoil material was retained within the estuary and used to construct a series of linear islands. Over time the detailed morphology of the islands has been modified both by subaerial and estuarine processes, so that they now form a more continuous barrier than in the past. This has raised community concerns that the islands may be impeding water circulation across the shallow sand flats, thus trapping urban stormwater runoff, reducing water quality, degrading seagrass habitat and reducing the area's value for the recruitment of juvenile fish. At the same time, there has been no lessening of demand for navigation access across the sand flats to the foreshore.

This report has been prepared by Umwelt (Australia) Pty Limited on behalf of the Office of the Lake Macquarie and Catchment Co-ordinator, to review and update the report, Investigation of the Impacts of Dredge Spoil Islands – Swansea Flats (Umwelt, 2001).

1.1 STUDY AREA

The study area for this project is the shallow sand shoal area known as Swansea Flats. The sand deposit extends south from Coon Island Point to the Nesca Recreation Area (south of Galgabba Point), and in the vicinity of the dredge spoil islands extends some 1.5 kilometres into the lake towards Wangi Point.

Between 1959 and 1965, two shore normal channels were cut on the Lake foreshore at Swansea to improve navigational access to the foreshore. The northern channel, off Rawson Street (Fishing Co-operative), is bounded by side castings of dredge spoil along both sides. The southern channel, off Lake Road, has dredging spoil side cast along its northern side, to form four small elongate islands that extend from the shore, 750 metres into the Lake.

The southern dredge spoil islands were deposited as a series of low mounds and together form a narrow spit that extends 750 metres from the shoreline, ending at a water depth of little more than 1 metre. The first island commences 40 metres from the shoreline. There is a gap of 20 metres between Island 1 and Island 2 (see **Figure 1.2**), 15 metres between Island 2 and Island 3, and 4 metres between Island 3 and Island 4. The fourth and fifth island is now continuous, although there was formerly a channel about half way along this island, which is now vegetated with saltmarsh. The surface of the islands is generally less than 1 metre above sea level, and all islands are reasonably well vegetated.

The shoreline on both sides of the spit is used for mooring small recreational vessels. Vessels are generally tethered to a post just off the shoreline, and held at right angles to the shoreline. A boat ramp also serves this area (see **Figure 1.3**).

The area of Swansea Flats that is bounded by these dredge spoil deposits is the focus of the present study. **Figure 1.2** shows the local character of the study area.

1.2 THE IMPORTANCE OF SEAGRASS IN LAKE MACQUARIE

Seagrasses are angiosperms (flowering plants) that live submerged in brackish, estuarine and marine waters. Seagrasses require high light levels to grow, and are therefore most commonly found in low nutrient, shallow waters. Seagrass is often seen as an indication that a waterway is healthy. Four species of seagrass occur in Lake Macquarie, *Ruppia sp, Halophila ovalis*, *Zostera capricorni* and *Posidonia australis*.

Seagrass meadows have a number of important functions in the coastal marine ecosystem. Their matted roots bind sediments and reduce local water velocities thereby protecting the shoreline from erosion. Within the meadows, seagrass provides habitat for a wide range of crabs, shrimps, molluscs, algae and microscopic fauna flourish. The combination of physical protection and rich food supply make seagrass meadows important breeding grounds and nurseries for prawns and many commercial fish species (Keogh and Jenkins, 1995). Many species also benefit from the organic matter released by bacterial and fungal breakdown of seagrass detritus.

Macroalgae (benthic algae) are multicellular, large visible algae found in seagrass meadows, on intertidal and subtidal reefs. They occur naturally in all estuaries and contribute substantially to overall primary production. They also provide a major food source for fish grazers and detritovores.

A healthy lake system is characterised by a balance between seagrass and macroalgae. If nutrient levels are too high, macroalgae can bloom, smothering seagrass beds. The decomposition of large quantities of dead seagrass and macroalgae washed up along the foreshore can produce offensive odours and create a thick layer of organic ooze, covering the sandy bottom.

In addition to these direct ecological values, the maintenance of healthy seagrass meadows in Lake Macquarie has important economic implications. Major losses of seagrass (area or density) would have a dramatic impact on available fish stocks for recreational purposes, which would in turn impact on the local economy.

AWACS 1995 identify six main threats to seagrass in Lake Macquarie:

- Boat moorings (swing chains);
- Boat navigation (propeller damage);
- Sedimentation (catchment derived);
- Nutrient enrichment, particularly in the inshore zone;
- Beach formation (resident cropping of seagrass to improve swimming amenity);
- Net hauling (no longer undertaken).

At Swansea Flats, the perceived threats to seagrass relate primarily to sedimentation and nutrient enrichment. Both of these are catchment development impacts that can be exacerbated by changes to estuarine hydrodynamic processes. Although the Lake Macquarie Processes Study does not

specifically identify dredging as a threat to seagrass, it does record that large volumes of sediment have been dredged from the entrance channel of the lake and from several tributaries and bays. Loss of seagrass is likely to have been both a direct and an indirect impact of past dredging activity.

1.3 OBJECTIVES

In response to continued community concerns about the health of seagrass meadows in Swansea Flats, the Lake Macquarie and Catchment Co-ordinator's office requested an update and review of seagrass health to:

- assess the current health of adjacent seagrass beds and evaluate whether the islands are having a detrimental impact on seagrass;
- determine the need or otherwise for dredging the channels between the four dredge spoil islands; and
- determine the point at which maintenance dredging of the channels is to be undertaken.

2.0 SURVEY METHODOLOGY

A seagrass survey was undertaken in the project area by Umwelt (Australia) Pty Limited on 10 February 2004. At the time of the survey, the estuary was particularly calm and clear, aiding the visual assessment.

To make a quantitative assessment of the seagrass immediately surrounding the dredge spoil islands, four sites were sampled from two locations (inshore and offshore), on both the northern and southern shores of the islands (refer to **Figure 2.1**). Percent cover (density) of seagrass and macroalgae was estimated at five replicate samples within each sampling point using a 0.25 metre square quadrat. Also at each sampling point, ten randomly selected leaves of Zostera capricorni were collected and measured to the nearest centimetre and an estimate of epiphyte cover made.

A cross-sectional profile of each channel between the dredge spoil islands was mapped by taking depth measurements every 50 centimetres across the narrowest point of the channel. Notes were also taken regarding seagrass and macroalgae wrack accumulation along the foreshore and the vegetation communities which have established on the dredge spoil islands.

3.0 ASSESSMENT OF SEAGRASS HEALTH

Water flow and circulation between the dredge spoil islands is maintained via three narrow channels. A profile of each channel is provided in **Figure 3.1**. The channels range from approximately 22 metres wide and 80 centimetres deep between Islands 1 and 2, to 4 metres wide and 20 centimetres deep between Islands 3 and 4.

The seagrass *Zostera capricorni* was established in the vicinity of each island channel. At the time of the survey, seagrass wrack had accumulated in the channel between Islands 3 and 4. Seagrass wrack was also evident on the lake foreshore, adjacent to the boat ramp and around the boat moorings.

Each dredge spoil island is vegetated with casuarina, saltmarsh and mangrove species. Saltmarsh has recently been listed under preliminary determination as an endangered ecological community under the *Threatened Species Conservation Act* 1995. In addition, mangroves are a protected

species under the *Fisheries Management Act* 1994. This habitat, although spatially restricted, contributes to the biological diversity of the Lake and aids to replace similar habitat that has been lost around the lakeshore.

Zostera capricorni dominated the seagrass meadows of the Swansea Flats. *Halophila ovalis* was also recorded in low densities. Interspersed throughout the seagrass meadows were clumps of drifting, attached and epiphytic forms of macroalgae. The most common species of macroalgae identified included *Chondria sp*, *Sargassum sp*, *Laurencia sp* and *Gracilaria sp*. No *Posidonia australis* was observed within the study area.

The mean (±SE, n=5) density of seagrass was highest at sites 1 and 2, furthest away from the lake foreshore (refer to **Figure 3.2**). This pattern was also evident in relation to the island foreshores, with the offshore locations consistently showing a higher density of seagrass than the inshore locations. Considerable variability was evident between all sites and locations, a pattern that has been consistently found in estuaries within New South Wales.

Small scale variations were evident in the mean (±SE, n=5) density of drifting and attached macroalgae between all sampling points. Density was greatest at sites 1 and 4, inshore on the northern foreshore (refer to **Figure 3.2**). Generally, the mean macroalgae density was less than 20 per cent.

The mean (±SE, n=10) shoot length of *Zostera capricorni* varied significantly between all sampling points (refer to **Figure 3.3**). In general, shoot length was greatest at sites 1 and 2, with the exception of the northern, offshore, site 2 sample. At site 1, shoot length varied significantly between the northern and southern foreshores, whereas at site 4, the inshore samples were significantly different to the offshore samples.

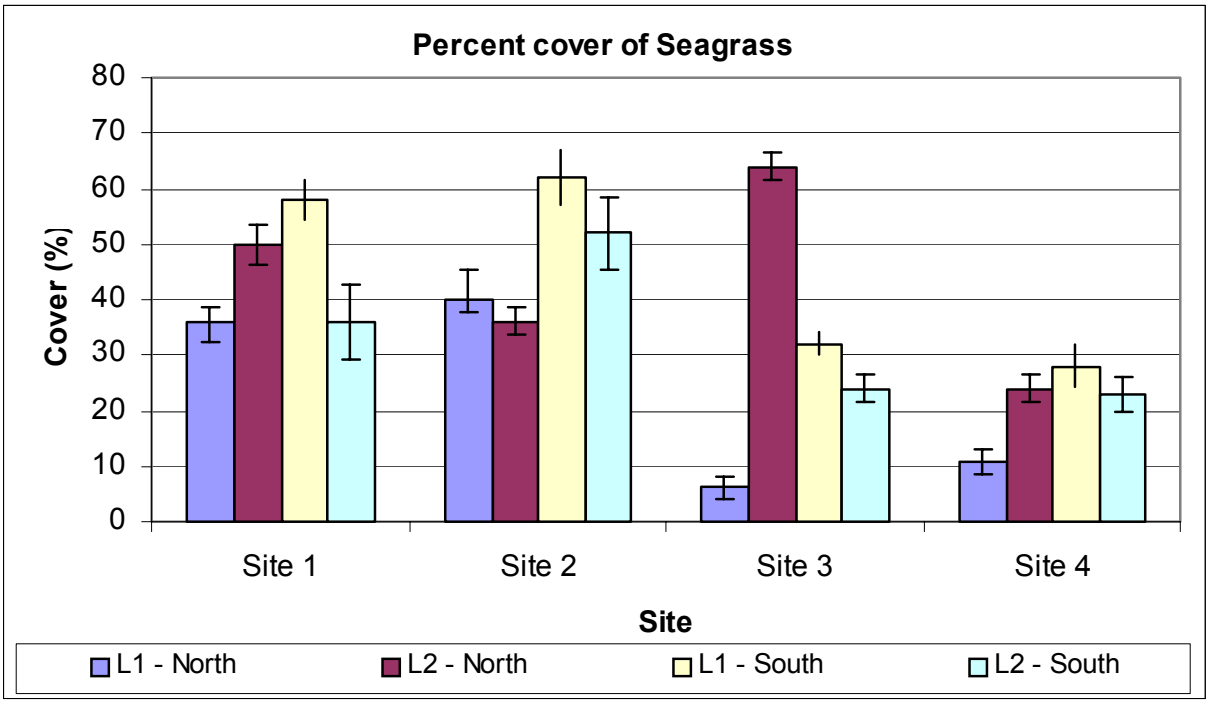
There was no significant difference in the mean (±SE, n=10) epiphyte cover between any of the sampling points (refer to **Figure 3.3**). Epiphyte cover ranged from a mean 3 to 13.5 per cent. Epiphyte cover was highest at the inshore locations of site 4, for both the northern and southern foreshores.

4.0 CONCLUSIONS AND RECOMMENDATIONS

The dredge spoil islands at Swansea Flats have been in place for some 34 years. In that time the islands have become vegetated with casuarina, saltmarsh and mangrove communities. The morphology of the islands has also changed and will continue to change over time. This is particularly apparent between Islands 3 and 4, where the channel has gradually infilled (refer to **Figure 3.1**).

Seagrass, both living and dead is an important part of the foreshore. However, the accumulation of large quantities of seagrass wrack can be detrimental to the scenic amenity and recreational values of an area. The alignment of boat moorings along the Lake Macquarie foreshore, particularly those located directly south and north of the dredge spoil islands (refer to **Figure 2.1**), is likely to be having some impact of foreshore currents by reducing water flow and trapping seagrass wrack. Relocation or re-orientation of the boat moorings, into slightly deeper water and further away from the foreshore, whilst not eliminating seagrass wrack accumulation, may aid in reducing the volume of wrack by allowing the material to drift and disperse under the influence of currents.

The study found that the seagrass meadows at Swansea Flats, on both sides of the dredge spoil islands, were healthy, in terms of density, shoot length and epyphite cover. Seagrass and macroalgae assemblages varied at small spatial scales for all variables. The seagrass meadows do not differ significantly from one side of the dredge spoil islands to the other. The variations in seagrass and macroalgae found between sites were consistent with the patterns found in estuaries throughout NSW, where considerable temporal and spatial variations in abundance are common.



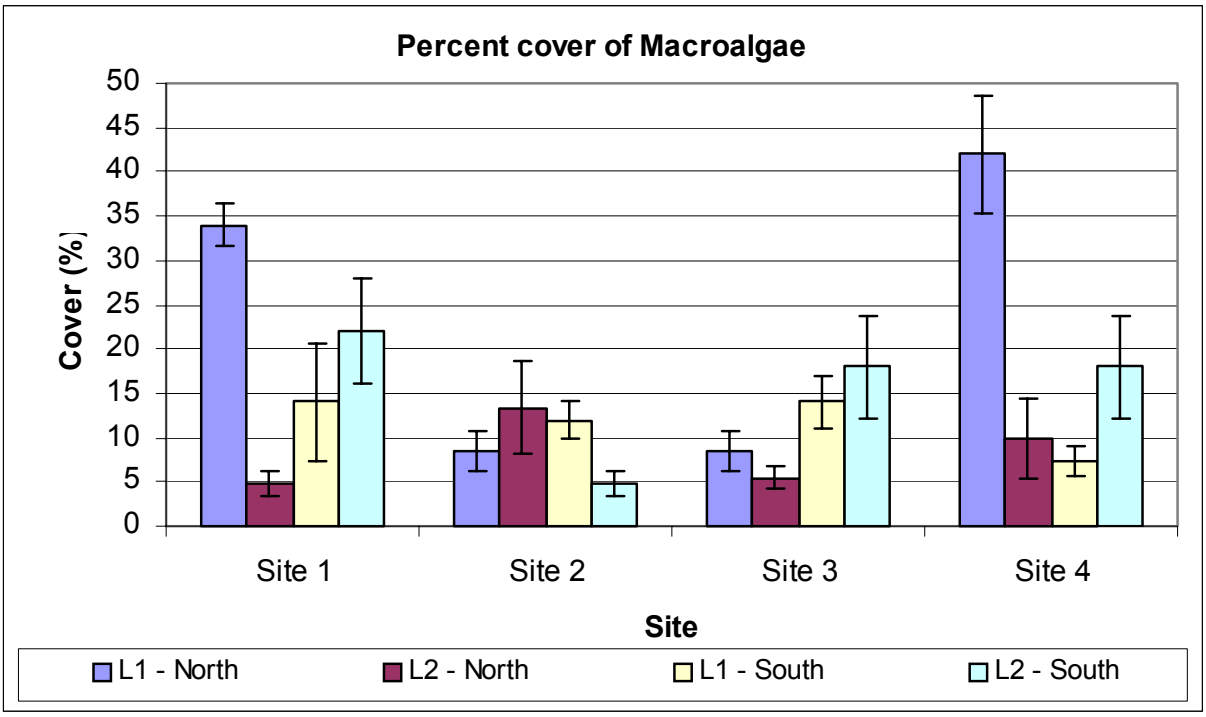
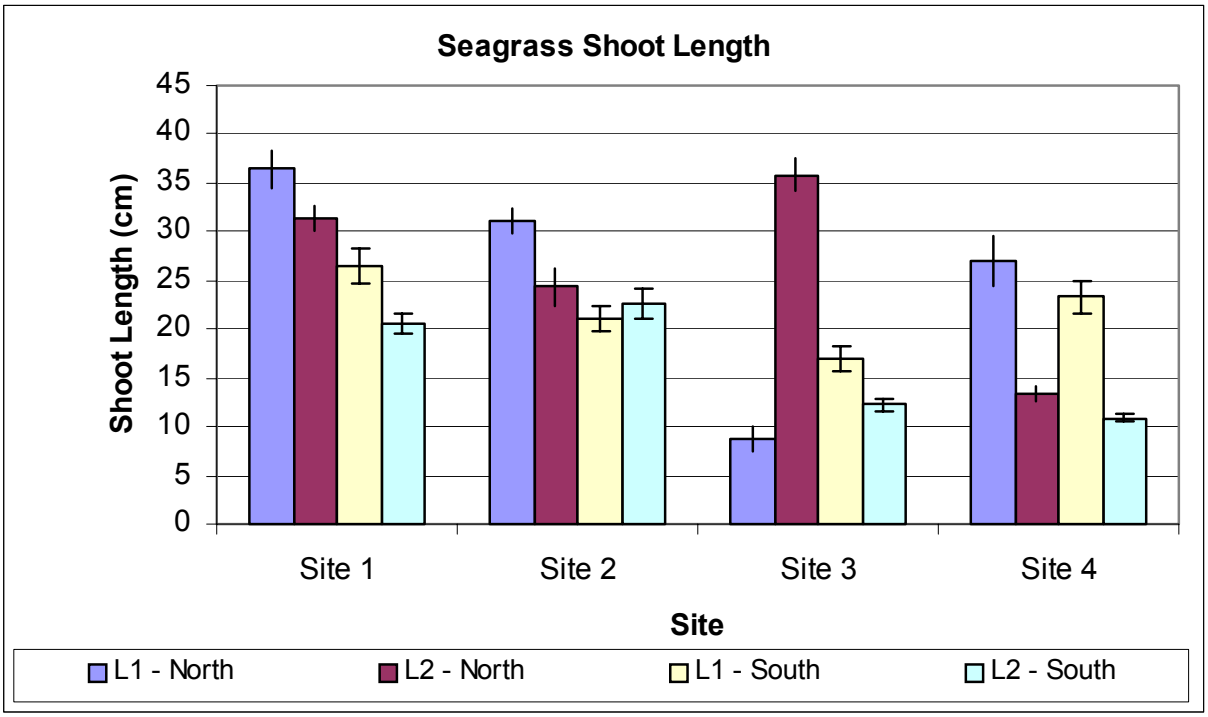


FIGURE 3.2

Mean (±SE) Percent Cover of Seagrass and Macroalgae at each Site



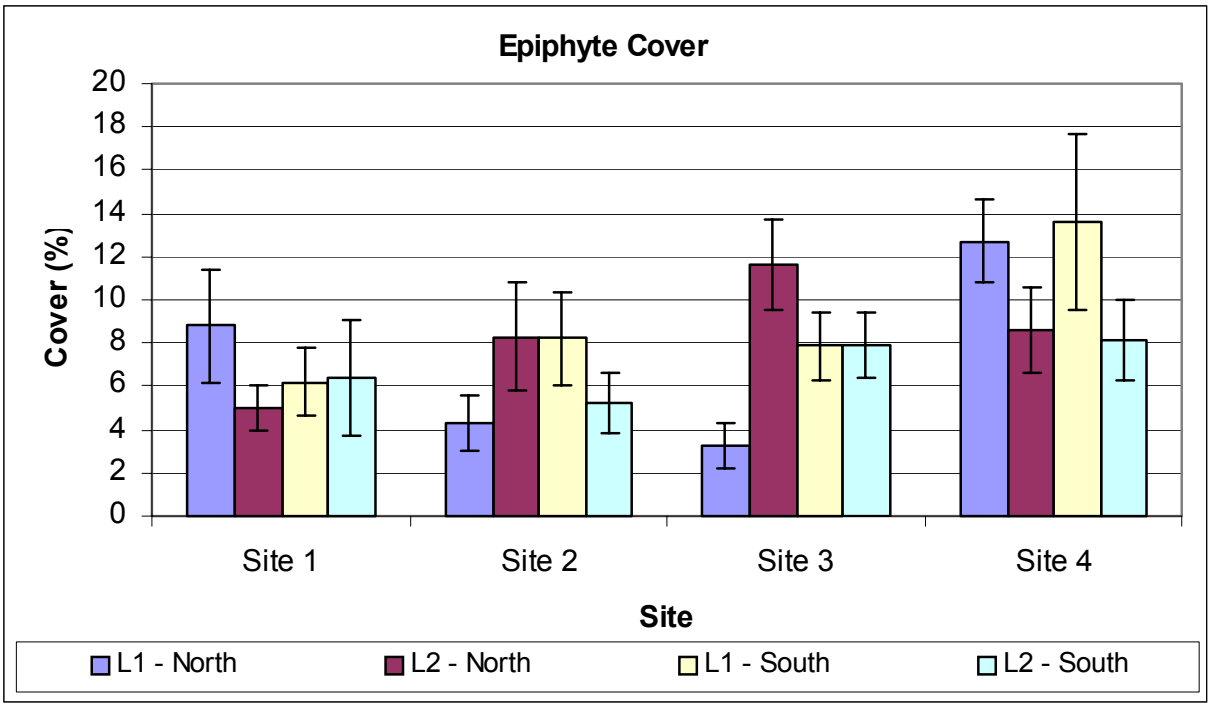


FIGURE 3.3

Mean (±SE) Seagrass Shoot Length and Epiphyte Cover at each Site

The results of the seagrass assessment support the conclusion that the dredge spoil islands at Swansea Flats have not significantly impacted on seagrass health to date.

The seagrass assessment suggests that there would be no significant change to seagrass health if all or part of the dredge spoil islands were to be removed. Indeed the removal of dredge spoil islands would result in the loss of valuable (and protected) saltmarsh and mangrove communities, which play a pivotal role in replacing habitat that has been lost elsewhere in Lake Macquarie.

Previous studies (Umwelt, 2001) suggest that wind and tidally driven currents pass through the channels between the islands (ie between the shoreline and the first island, Islands 1 and 2, Islands 2 and 3, and Islands 3 and 4). At this stage the islands do not appear to be impeding water circulation across Swansea Flats. In addition, the seagrass assessment suggests that there has been no adverse affect on the adjacent seagrass meadows.

Although it is considered important that the existing channels between the islands are maintained to ensure sufficient flushing across Swansea Flats, it is not considered that maintenance dredging needs to be undertaken at this time. It is recommended that annual monitoring of the channels be undertaken and limited maintenance dredging (to the existing depth and width) be instigated when the channels have lost approximately 50 per cent of their current flow capacity. The former channel between Islands 4 and 5 however, which has been overgrown with saltmarsh vegetation should not be dredged at any stage.

5.0 REFERENCES

AWACS, 1995, *Lake Macquarie Process Study Report 94/25*. Australian Water and Coastal Studies, Manly Vale, Australia.

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