SELF-HELP FOR STEVEN THE SEAWALL

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Abstract

Meet Steven the seawall. Some would describe Steven as hippy and new-age. When the other seawalls were getting their imperfections fixed with seawall botox (concrete), Steven embraced his aging status. He hung on to all his wrinkles and cracks and found these brought him a host of marine friends. But even with new friends, Steven isn't happy all the time.

Life as a seawall is tough. Everyone wants something different from you. The ecologists shake their heads at him and sigh. The recreational planners say he is too skinny and needs to be wider to be useful for the mums walking with prams. The "sea-level rise adaptation planners" say he isn't tall enough and that he needs to stand up for himself instead of letting the lake walk all over him. On the plus side, the property owners seem to think he is quite good looking. As they say - "he might be old, but at least he doesn't look ugly like those rock revetments". Sometimes Steven questions whether he is even needed at all. After all, there is no Steven on the property two doors down and they seem to be managing just fine.

Steven is part of the Lake Macquarie City Council community consultation group, tasked with reviewing the council's Foreshore Development Guidelines. Can Council help Steven to understand his place in the world? Will he forever feel pulled in all directions? Will there be other Stevens in future and will they be as handsome as him? The secret to all this and more is in the new and improved "Lake Macquarie Foreshore Development Guidelines".

Introduction

Lake Macquarie is one of Australia's largest coastal saltwater lakes. At almost twice the size of Sydney Harbour, Lake Macquarie is some 110 square kilometres in area, creating 195kms of indented shoreline. The landscape of the area is characterised by bays and beaches, headlands and promontories. The remarkable scenic qualities of the Lake, its foreshores, mountain backdrop and coastal fringe form the centre-piece in the lifestyle of the City's 200,000 residents. The scenery and setting of the Lake are also a major tourist draw card for the Lower Hunter Region. The desire to conserve the environmental, recreational, scenic and heritage values of the Lake and its foreshores is a priority for residents, visitors and Council alike.

Historic aerials indicate that shorelines of Lake Macquarie begun to be modified and seawalls constructed in the 1940's. For many decades this practice continued in an unregulated manner, as development approval was rarely sought or required. Today, development consent is required for all forms of foreshore stabilisation works. Due to the known environmental impacts of seawalls, Council currently does not support the construction of vertical seawalls, instead favouring a range of soft engineering techniques. Unfortunately, seawalls continue to be constructed illegally on both private and public land resulting in environmental harm and increased compliance and monitoring load on Council. Seawalls are typically constructed using concrete, stone, timber and pre-fabricated blocks and then backfilled with rubble and soil. Seawalls can sometimes be

referred to in technical literature as revetments. In common usage, a revetment is usually considered to be sloping and flexible, while a seawall may be either vertical or sloping, and either rigid or flexible. The rationale for seawall and revetment construction includes the following

1. to form a flat surface for garden, recreational use or water access
2. as a form of reclamation
3. to prevent foreshore erosion
4. to provide property protection during storms (wave overtopping)
5. to prevent inundation of low-lying properties
6. to provide a level access way along the foreshore for pedestrians and cyclists.

It is generally accepted that rationale 1 & 2 have unacceptable environmental consequences in relation to the public benefit they provide. However, rationales 3 to 6 may align with Council's strategic objectives in terms of community access, climate change adaptation planning and flood risk management.

The challenge for Council lies in achieving these objectives, whilst also applying foreshore management best practice principles that aim to

- maintain water quality;
- maximise native foreshore and estuarine vegetation;
- maximise habitat diversity and complexity; and
- maintain natural foreshore landform.

Environmental impacts of seawalls and revetments

The environmental impacts of seawalls and foreshore armouring are well documented and include the following.

- Loss of foreshore and intertidal vegetation
- Loss of habitat diversity and complexity resulting in change to species type and abundance
- Decreased intertidal surface area resulting in fewer species, lower abundance and crowding.
- Changing the natural foreshore slope from near-horizontal to near vertical resulting in changes to species type, abundance and behaviour
- Increased recruitment and spread of introduced species
- Changes to sediment movement processes resulting in seagrass loss due to burial, increased scour and increased turbidity
- Prevent natural movement of seagrass wrack onto the shore resulting in anoxic conditions that contribute to benthic fauna mortality
- Increased erosion on adjoining properties due to deflected wave energy and changes to sediment supply patterns
- Harbour for feral animals such as rats
- Trap litter

Seawalls and revetments as tools for reducing foreshore erosion

Shoreline erosion is the term used to describe the natural process of shoreline retreat where the beach changes its location but retains its shape. Seawalls and revetments decrease foreshore erosion by reflecting incident wave energy back into the lake, thereby

reducing the energy available to cause erosion. Traditionally in Lake Macquarie, foreshore erosion has been addressed in a three step process. The foreshore is re-profiled to remove any scarps that have formed as a result of erosion. A cobble beach treatment is then applied to stabilise existing sediments and prevent further erosion. Finally, the foreshore is revegetated with deep rooted native plants such as Lomandra species. These plantings act to stabilise the foreshore further, particularly in higher energy wave conditions that typically occur during storm events. Whilst this method has been successful, it's success relies upon having sufficient land area to effectively produce a natural slope capable of dissipating wave energy.

Where there is insufficient foreshore width (due to property boundaries, assets or infrastructure), slope re-profiling cannot be achieved. In these instances, Lake Macquarie City Council has favoured rock revetments, rather than seawalls for erosion management. In comparison to seawalls, rock revetments provide improved habitat values, greater intertidal surface area and an ability to reflect wave energy in multiple directions. However, vertical seawalls, and to a lesser extent revetments, create turbulence due to wave reflection that may result in scour and subsequent lowering of the substrate level lakeward of the structure. This lowering will continue until the lake bed reaches a new equilibrium profile. In some cases this may be below prevailing tide levels, further reducing the available intertidal and recreation area below the high water mark. The foreshores wave buffering and deceleration effect is also lost, creating the need for a higher seawall and for continual seawall maintenance.

Seawalls and revetments may also accelerate erosion of adjacent, unprotected foreshore areas because they affect the sediment processes and produce end wall effects. Where an unprotected foreshore adjoins a seawall, the seawall may be outflanked at times of high water resulting in structural instability. Additionally, the unprotected foreshore may continue to erode causing a stepped foreshore profile. Inevitably, a seawall or revetment in one location can cause protection structures to be placed on adjacent beaches.

Seawalls and foreshore armouring as a tool for SLR Adaptation

Lake Macquarie City Council has adopted the NSW Department of Environment and Climate Change's projected upper sea level rise figure for the year 2100 of up to 0.91m as the basis for Council staff and the community to proceed with risk assessment, policy development, community empowerment, and planning and development decisions
With a predicted sea level rise of approximately 1m over the next 100 years, storm water levels and wave heights impacting our foreshores will rise leading to increased wave overtopping beyond safe limits and eventually permanent inundation of low-lying land.

In 2014, Council contracted WBM to undertake a study on wave overtopping in the Swan Bay and Marks Point areas. Wave overtopping occurs when the structure or foreshore crest height is below the wave runup level. Overtopping discharge is a particularly important design parameter as it determines the geometric design of the crest level, the structural design of foreshore protection structures and the safety of infrastructure, vehicles and people located on/behind the crest.Wave overtopping was determined utilising the following factors:

- Optimal Crest Height of foreshore works to limit damage to a predetermined risk factor (wave run-up & overtopping).
- Calculations of crest height used in eShorance method.

- Contributing factors
  - Foreshore erodibility
  - Nearshore Slope
  - Existing foreshore crest height
  - Wind fetch
  - Foreshore design slope, roughness

All factors combined to produce a desired crest height to protect foreshore from wave run up and overtopping.

Table 1 – Permissible Overtopping Classes

Table 5-4 Permissible Overtopping Classes

Overtopping Class	Average Overtopping Rates	
	Lower limit (l/m/s)	Upper limit (l/m/s)
0	0	0.01
1	0.01	0.1
2	0.1	1
3	1	10
4	10	50
5	50	200
6	200	Overflow Conditions

Table 5-5 Permissible Overtopping Limits and Corresponding Classes

At Risk	Average permissible overtopping (l/s/m)	Overtopping Class
Pedestrian	0.10 to 10	1 -3
Motor vehicles	0.01 to 50	0 - 4
Damage to paving (landward of the crest)	200	6
Damage to grasses/turf (landward of the crest)	50	5, 6
Seawall structure (crest)	200	6
Buildings and assets	1	3 - 6

Table 2 – Summary of design overtopping calculations and crest height recommendations

Table C-2 Summary of design overtopping calculations and crest height recommendations.

Site: Swan Bay

Profile #	Crest Heights (m) Required to Limit 50 yr ARI Overtopping Rate to 1 l/m/s								
	Armoured Rocky Slope Design			Artificial Cobble Beach Design			Vertical Seawall Design		
	0.2 m SLR	0.4 m SLR	0.9 m SLR	0.2 m SLR	0.4 m SLR	0.9 m SLR	0.2 m SLR	0.4 m SLR	0.9 m SLR
6	0.75	1.00	1.50	0.75	1.00	1.50	0.75	1.00	1.75
16	0.75	1.00	1.75	1.00	1.25	1.75	1.00	1.25	1.75
25	0.75	1.00	1.50	1.00	1.00	1.75	1.00	1.25	1.75
30	0.75	1.00	1.75	1.00	1.25	2.00	1.00	1.25	2.00
Recommended Design Height	**0.75**	**1.00**	**N/A**	**1.00**	**1.25**	**N/A**	**1.00**	**1.25**	**N/A**
Current Crest Height - Minimum	*0.40*			*0.40*			*0.40*		
Current Crest Height - Average	*0.90*			*0.90*			*0.90*		

The study recommended that Council consider the following:

- use the overtopping rates provided to guide design crest levels, such as by requiring the proponent to demonstrate suitable crest elevations to reduce overtopping impacts over a designated timeframe (providing the crest elevation is not substantially misaligned with adjacent foreshores, in which case it will be ineffective and / or a safety hazard);
- design the structure to minimise overtopping, with generally sloped, rough, permeable structures tending to reduce overtopping compared with vertical structures;
- consider the longevity of the structure with respect to other hazards, most importantly, inundation through groundwater or catchment flooding. A protective structure may become obsolete where there is inundation in the backshore area, and in some cases;
- capability of the structure to be upgraded or modified in future in response to sea level rise.

Seawalls as a tool for recreational access

The lake foreshore provides an environment well suited to outdoor recreation. For many years Lake Macquarie City Council sought to acquire waterfront land where able, This land is used primarily for public access and where feasible creates a space for the construction of public footpaths and cycleways. However, the design requirements for pathways often necessitate the construction of a seawall or revetment in order to provide the required footpath grade and width. See table 3 below.

Figure 1 – Rock revetment to support cycleway construction

Table 3 – Design criteria table for cycleways and paths

Design criteria table

Feature	Cycleway	Pathway	Shared use pathway	Separated paths	
				One-way	Two-way
Path width Desirable minimum (To AGRD06A clause 7.5)	Local access path: 2.5 m Major path: 3.0 m	Minimum width:1.2 m ~~Absolute minimum: 1 m~~ High pedestrian volume: 2.4 m Footway dining: 5 m	Local access: 2.5 m Commuter path: 3.0 m Recreational path: 3.5 m	Cycleway:1.5 m Pathway: 1.5 m	Cycleway: 2.5 m Pathway: 2.0 m
Path width Minimum – Maximum (To AGRD06A clause 7.5)	Local access path: 2.5 – 3 m Major path: 2.5 – 4 m	For disability access: 1.5 – 1.8 m	Local access: 2.5 - 3 m Commuter path: 2.5 - 4 m Recreational path: 3.0 - 4 m	Cycleway: 1.2 – 2 m Pathway: ≥ 1.2 m	Cycleway: 2.0 – 3 m Pathway: ≥ 1.5 m

Crossfall	1:40	General: Flat – 2.5% (0 – 1:40) Sealed surfaces: 2%-4% (1:50 – 1:25) Unsealed surfaces: 5% (1:20)	Maximum: 2.5% (1:40)		

Conversely, seawalls and revetments on waterfront private land may inhibit easy public access across the foreshore particularly as the substrate in front of the wall lowers. Typically access stairways or ramps need to be provided on seawalls to ensure the safety of foreshore access by pedestrians.

The Perfect Steven

The perfect seawall or revetment is one that provides protection from erosion, wave overtopping and future sea level rise impacts such as permanent inundation. It is also able to be adapted to cater for change. However, in order for this seawall to meet Council's other goals in terms of ecology, water quality and public access the perfect seawall would be set back a substantial distance from the foreshore itself. The NSW Office of Water Guidelines recommend a 40 metre vegetated riparian zone adjoining estuaries, although allow for public infrastructure such as cycleways to be located in the outer 50% of this zone. In lakeside suburbs with very little elevation, this is theoretically a reasonable solution. Where the ground level is greater than 1 metre AHD within 40 metres of the foreshore, it is unlikely that a seawall would even be required as the effects of sea level rise are unlikely to extend to this elevation in the foreseeable future.

In practice, the 'Perfect Steven' is not achievable as existing building footprints are forward of the recommended 40 metre vegetated riparian zone. In Lake Macquarie there are 112 residential properties with a building footprint less than 3 metres from the high water mark. 637 residential properties have a building footprint with 10 metres of the high water mark. Further, the maximum required setback from the high water mark (the Foreshore building line) is 36 metres and ranges from 6 to 36 metres around the lake.

Figure 2: Swan Bay./ Marks Point (yellow – properties within 3 m of HWM, blue-properties within 10m HWM)

Lake Macquarie City Council Foreshore Development Guidelines

When Council commenced development of the Foreshore Guidelines in 2016, it was hoped that the guidelines could provide a range of foreshore stabilisation options supported by a decision tree. It quickly became apparent that the site constraints of individual properties is highly variable and therefore the proposed approach would not be achievable. Further, it became apparent that the foreshore guidelines needed to be well linked to other planning instruments so that the recommendations of the guidelines were supported and subsequently implemented through the land use planning and development assessment process. A review of current planning tools was undertaken, to establish potential opportunities and constraints in relation to foreshore management.

Planning tool	Opportunities	Constraints
Foreshore building lines	Well accepted planning tool with significant case law to support use. Contained within the LEP and therefore has statutory strength.	Lake Macquarie's FBL was developed to prevent buildings footprints moving forward of the current position. It therefore reflects the building footprints at the time it was implemented rather than a strategic approach to overall foreshore management. Changes to FBL's are likely to be met with high levels of community opposition due to the impact on developable land area and therefore property prices.
LEP zones	Has statutory strength and therefore enforceable. The	Historical land use can present a difficulty when attempting to match

	zones objectives provide an opportunity to prioritise competing objectives. For example, in an environmental zone a 40 metre vegetated zone could be supported whereas in a business zone, community access via footpaths etc. may be prioritised.	zone objectives to foreshore management techniques. In many cases, the proponent may be required to undertake substantial rehabilitation to achieve the LEP objectives. Mixed zones present increased difficulties particularly where narrow council reserves adjoin residential property.
W zoning	There is potential for the waterways zone to be used on the lake foreshore. Creates an understanding that the foreshore and lake are intimately linked and need to be managed in a dynamic way. The W zoning could be extended to a particular flood hazard level to integrate the two tools. Removes the current focus on the 'Deed high water mark' as a planning boundary. The deed high water mark is only current at the time of survey therefore not the best tool where adaptation is required. W zoning continues to permit all structures currently permitted in the foreshore development area (boat ramps, boat sheds, slipways etc.).	Likely to be met with high levels of community opposition due to the impact on developable land area and therefore property prices.
Flood hazard lines	Likely to provide better planning outcomes in the foreshore environment when compared to other setback tools such as the foreshore building line. Addresses future climate change and in particular impacts of sea level rise on lake hydrology, foreshore processes and drainage.	Fails to consider any ecological and public access limitations in recommended solutions.
Coastal Zone Management Plan	The CZMP is a gazetted document and therefore holds statutory weight.	The CZMP is largely a strategic document with a list of actions for public authorities to undertake. It is difficult to apply at a site level where competing objectives are present (i.e. flood planning versus ecology) as objectives are not prioritised within the plan.
Local Area Adaptation Plans	Specifically tailored to the local area therefore able to address	Outcomes may be skewed towards the needs and wants of the directly

	site specific opportunities and constraints.	affected community, rather than the Lake Macquarie community as a whole. For example, property protection may be favoured over recreation and ecological outcomes. i.e. Marks Point Adaptation Plan has a commitment to protect private property rather than planned retreat.

Conclusion

Poor Steven the seawall has a lot of personal development work to do. In order for him to be content, he will have to accept that he will never make everyone happy. More importantly, Steven needs to be clear on his priorities and these need to be transparent to the residents in his community. Council can assist Steven by gaining greater clarity on it's own priorities and where possible selecting existing planning tools to achieve this. My advice to Steven – buy a sports car, get some botox and drink lots of red wine – seems to work for everyone else!

References

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