

Draft Narrabeen Lagoon Entrance Management Strategy Snapshot

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Prepared for Northern Beaches Council



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Introduction

This snapshot document is a summary of the Draft Narrabeen Lagoon Entrance Management Strategy. Council has developed the draft Strategy to review current practices and processes and to establish the most effective way to manage the Narrabeen Lagoon entrance in the short, medium and long term.

The Strategy is a comprehensive investigation of all aspects of entrance management, including sand transport, entrance efficiency and dynamics and the long-term benefits, costs and sustainability of entrance-specific options.

A range of potential entrance management options were assessed for technical feasibility and economic, social and environmental impacts and risks. The assessment was informed by reviewing literature, modelling of selected options and a detailed cost benefit analysis by a quantity surveyor.

The main objective of the Strategy is to reduce the risk of flooding on the Narrabeen Lagoon floodplain. Flooding occurs as a result of either heavy rain in the catchment, or from elevated ocean water levels due to storm surges. The worst floods are generally a result of both these factors occurring at the same time, as the high ocean levels prevent the water leaving the lagoon entrance.

Topline recommendations

Following the extensive assessment and analysis the Strategy recommends that Council:

- continue periodic large scale sand clearance operations
- trial more frequent sand clearances but with smaller volumes, in targeted areas
- continue intermittent mechanical breakouts if the lagoon entrance closes between major clearances and in response to forecast high rain and swells
- revegetate and maintain Birdwood Park dune to assist sand stabilisation
- review mobile sand pumping (as an alternative to trucking) if lower cost pricing becomes available

Other long term options were investigated and considered but were ruled out on the basis of cost, feasibility and/or environmental impacts.



Short term closed entrance management

Mechanical opening

Council mechanically opens the entrance of Narrabeen Lagoon when the water level reaches 1.0-1.3m AHD. Although at this level Narrabeen Lagoon is not inundating homes, it is high enough for water to cover some of the foreshore public areas.

A pilot channel is dug through the sand barrier on the beach, which widens as the Lagoon drains out to the ocean. Breakouts are more likely to be successful when the water level in the Lagoon is at least 1m higher than mean sea level with significant rainfall occurring or forecast.

Council uses a comprehensive flood information system to inform decision making for emergency response.

Water level and rainfall gauges throughout the catchment also send notifications to Council staff via automated SMS alerts.

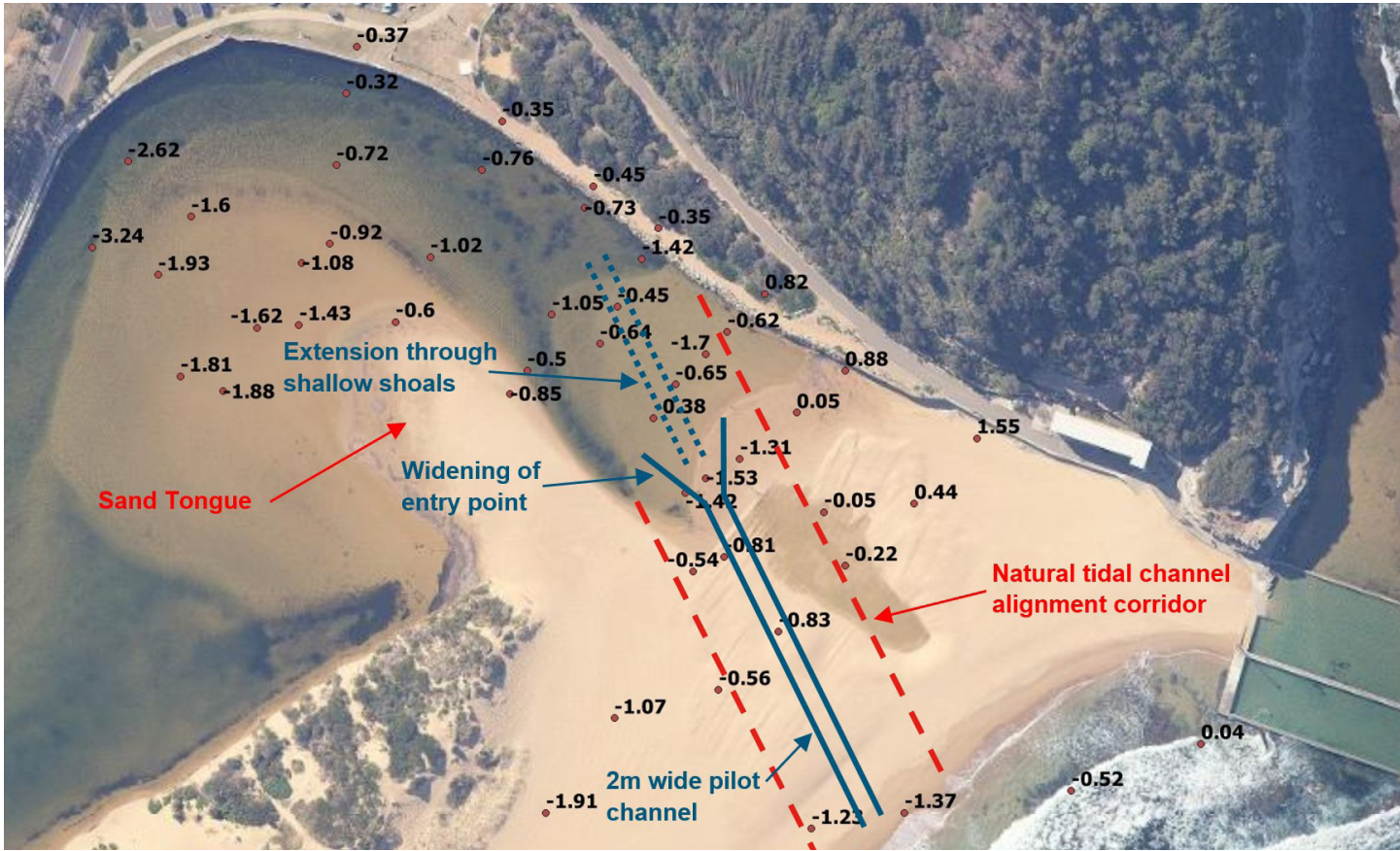
Flood prediction in coastal lagoons is complicated by the highly variable conditions at the entrance related to tide, ocean waves, berm height and quantity of sand in the area, not to mention the uncertainty of the rainfall forecast. Council uses a bespoke forecasting tool which integrates these considerations to provide predictions of lagoon level for up to three days into the future.

This is invaluable to aid in flood prediction and emergency response, and to inform decisions relating to mechanical openings of the entrance.



The strategy **recommends** continuing with mechanical breakouts, as needed, with refinements including:

- develop a flexible set of trigger conditions to allow for a wider range of conditions
- improve the pilot channel to maximise the available scour depth and provide flexibility for current conditions such as the state of beach rotation
- investigate improved technology for data collection



Pilot channel recommended arrangement

Medium term entrance management

Entrance clearance

Council conducts large scale removal of accumulated sand from the Narrabeen Lagoon entrance, which is transported to Collaroy-Narrabeen Beach for beach replenishment.

Entrance clearance operations have in the past been undertaken every three to five years, removing approximately 30,000 to 50,000m³ each time.

Entrance clearance works require significant planning and funding with each operation costing in excess of \$1 million. Pre-clearance planning can take up to six months with design, environmental approvals and construction procurement being required before works can commence on site.



Entrance clearance 2021

The strategy **recommends** continuing with entrance clearances with the following improvements:

- trial undertaking the entrance clearance more frequently but with a reduced volume. A clearance of 15,000m³ every 2 years has a similar economic cost as a clearance of 40,000m³ every 4 years
- with the reduced volume, trial focusing the clearance area on a regime tidal channel or on the western shoal.



Focus on regime tidal channel



Focus on western shoal

Dune maintenance

The Birdwood Park Dune plays an important role in limiting the movement of sand into the entrance area, stabilising the position of the lagoon entrance channel and providing protection to the Ocean Street Bridge.

It's been raised and lowered over the years in response to storm events and community concern.



The Strategy **recommends** maintenance of the dune, including:

- reshape the dune by relocating sand which has blown over on to the western side back to the eastern side, and re-creating the shallow beach on the western side of the dune
- revegetate the dune, first with groundcover species and then with larger species
- maintain the dune, including maintaining the vegetation, monitoring the profile, and considering sand-catching fences along the eastern toe.

Long term entrance management

The Strategy investigated four options put forward by community and technical stakeholders and industry experts:

1. ebb tide channel
2. mobile sand pumping
3. rock training wall
4. low flow pipes

Ebb tide channel

The ebb tide occurs when the tidal current is flowing out of the lagoon, and the flood tide occurs when the tidal current is flowing into the lagoon. An ebb tide channel is the naturally formed underwater channel caused by the ebb tide.

A submerged wall structure can in some cases deflect and focus the energy of the ebb tide to enhance natural channel scour and potentially keep a lagoon entrance open longer if the ebb tide currents are able to transport sand out of the lagoon and into the ocean. Success depends on various factors such as water velocity, direction and sand grain size.

The Strategy does **not recommend** the ebb tide channel option as it was not considered to be a technically feasible entrance management option. Modelling results indicated that the walls would not be effective in generating the desired increase in ebb tide currents to maintain an ebb tide dominated entrance channel thereby keeping the lagoon open.



Concept of Ebb Tide Channel option

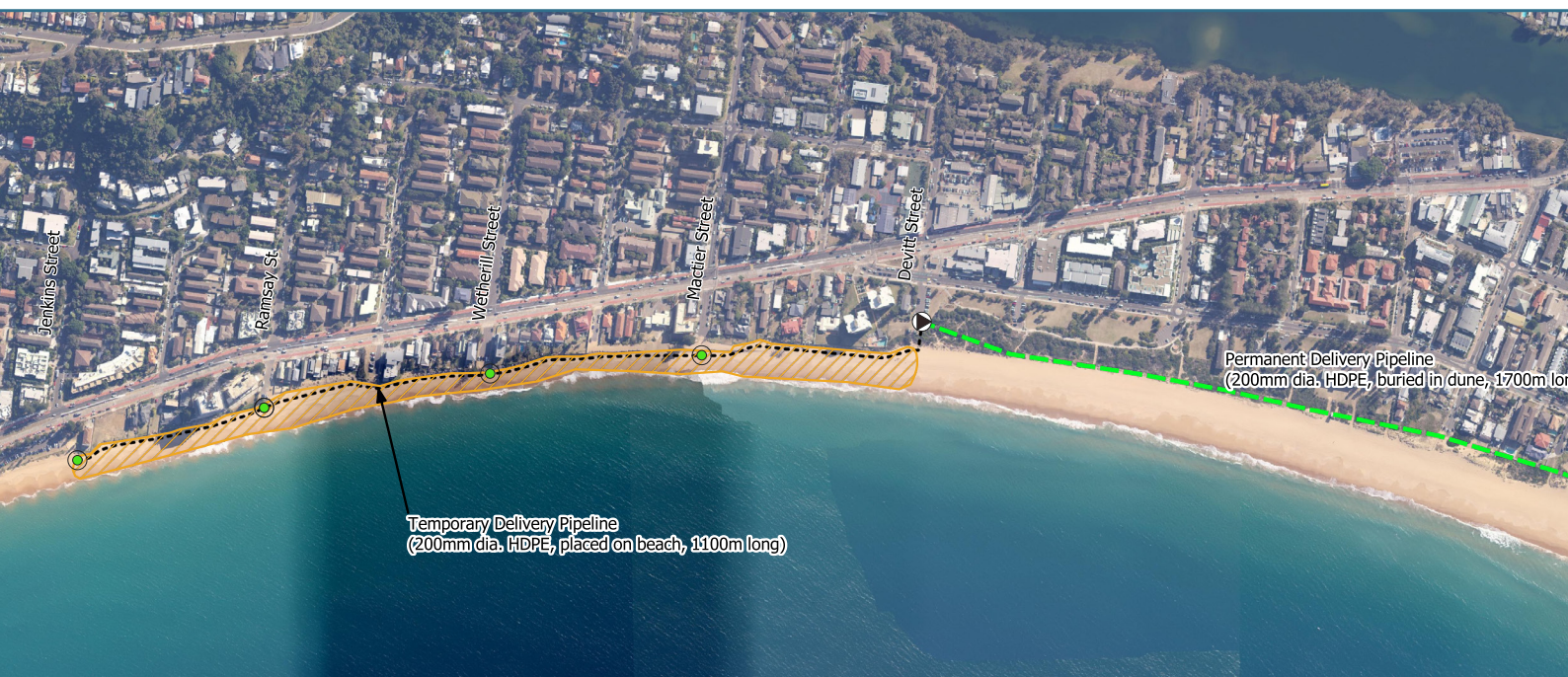
Mobile sand pumping

This option is a different way of dealing with the transport of sand to Collaroy-Narrabeen as part of a normal sand clearance program. Currently sand is taken down to the beach sites by truck, whereas this concept involves setting up a pumping scheme to avoid the trucking process.

A mobile sand pumping system would be fed with sand mechanically excavated from the entrance and, together with Lagoon water, would pump the resulting slurry through a pipeline to the beach replenishment location.

Pumping of a sand slurry over a distance of greater than 2km requires the use of booster stations, which would be necessary for pumping sand further south of Devitt Street.

A section of pipeline would need to be permanently installed along the top of the existing foredune or through a cut and cover operation along Ocean Street. A mobile hopper would need to be periodically deployed and connected to the end of the permanent pipeline to pump the excavated sand. A temporary pipeline would be used to pump sand south of Devitt Street directly to the replenishment location.



Concept of Mobile Sand Pumping option



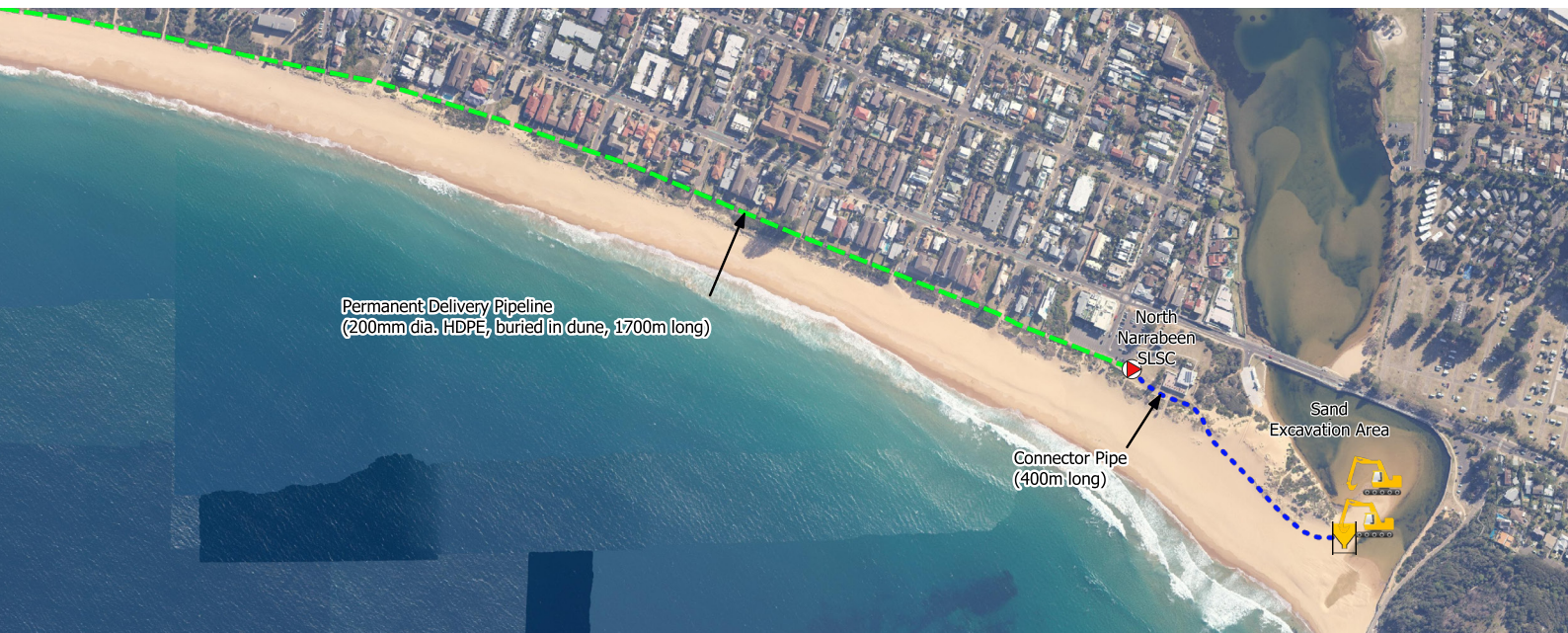
Slurrytrak system operating at Dawesville and Mandurah Inlets, Western Australia



Damage to Jimmys Beach sand transfer system by large swell in 2019 (Source: Newcastle Herald, 5 June 2019)

The strategy does **not recommend** mobile sand pumping as it's not economically viable. However, it does recommend reviewing mobile sand pumping if lower pricing becomes available from a contractor-delivered scheme.

An inherent risk with placement of a pipeline along the active beach is the possible occurrence of coastal storms and associated wave action and beach erosion, which could result in dislodgement or damage to the pipeline. A recent example of this occurring is the damage to the Jimmys Beach (Port Stephens) sand transfer system.



Permanent Delivery Pipeline
(200mm dia. HDPE, buried in dune, 1700m long)

Connector Pipe
(400m long)

North
Narrabeen
SLSC

Sand
Excavation Area

Rock training wall

Council commonly receives requests to consider a permanent opening at Narrabeen Lagoon entrance. The only method to achieve this is to build a training wall (or breakwater) with consideration given to removal of the bedrock platform and/or rock sill that act to control natural scour levels and form a hydraulic control for lagoon water levels.

The Strategy does **not recommend** a rock training wall as preliminary investigations identified a range of significant environmental, recreational, public safety and aesthetic impacts. It also identified that even a moderate training wall (reduced length, no entrance bedrock removal) would be twice as expensive as current management practices over a 30 year period.



Example rock training wall at Tallebudgera Creek entrance

Installation of low flow pipes

This option involves the installation of low flow pipes at the Lagoon entrance to allow the escape of some water from the Lagoon, and to allow tidal exchange when the entrance is otherwise closed. A similar scheme has been implemented at the entrance to Manly Lagoon. This option would not address the ongoing deposition of sand within the entrance. It would be a supplementary option to consider in conjunction with another long term option.

The installation of low flow pipes could be achieved by drilling through the bedrock platform, with the inlet positioned at the bend in the adjacent northern seawall. At this location the bed levels within the entrance channel are relatively stable at around -0.6m AHD, being a sufficient distance away from the more dynamic downstream areas opposite Birdwood Dune.



Existing low flow pipes at Manly Lagoon beneath the beach berm at Queenscliff Beach



Concept of Low Flow Pipes Option

The strategy does **not recommend** this option given the potential environmental impacts associated with lagoon water level lowering and the likely operational challenges associated with pipe access and maintenance.



Recommendations for implementation in the strategy

The Strategy has developed a prioritised set of actions for implementation that are expected to improve the management of the entrance both in terms of efficiency and outcomes.

| Option Type | Option Description | Action | Priority | |
|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| Short term | Maintain mechanical opening of the lagoon entrance for the primary purpose of flood mitigation | Develop a flexible set of trigger conditions to allow for openings to be undertaken in a wider range of conditions, including extenuating scenarios. | High | |
| | | Refine guidelines for where the pilot channel is to be excavated, locating it in a position that works more effectively with the natural configuration of the entrance. Review and update Council's OMS procedures and REF for lagoon openings. | High | |
| | | Enhance collection of data, including through the use of remote data sensing equipment, and use this data to refine flood forecasting, improve the location of the entrance channel etc. and evaluation of the success of entrance openings. | High | |
| | | Enhance publicly available information on Council's website and the MHL flood warning webpage to support understanding of how and why Council manages the Narrabeen Lagoon entrance. Information could include a decision matrix/tree, trigger levels for mechanical openings, and real-time updates on conditions. | Medium | |
| Medium / Long Term | Continue periodic entrance clearance operations | Review design and frequency of entrance clearance operations on an ongoing basis, with consideration for factors including beach rotation and climate change. Investigate more frequent, smaller scale, strategic removal of sand from the flood tide shoals. Consider trialling a focus on the western shoal or a regime tidal channel. | Medium | |
| | | Review mobile sand pumping option | Review mobile sand pumping if lower cost pricing becomes available from a contractor delivered scheme rather than requiring Council to purchase pipes and pumps. | Low |
| | | Review processes for entrance clearance | Review payment methods and procurement strategy for contractor. Review tracking method for excavation depths and extent during works. | Medium |
| | | Reshape, revegetate and maintain Birdwood Park dune | Reshape the dune, with relocation of sand away from western side and re-creation of the beach on the western side of the dune. | High |
| | | | Revegetate the denuded areas of the dune, to stabilise it and to limit wind-blown sand entering the lagoon. Extend the vegetation as far north as practicable, to reduce alongshore width of the lagoon entrance berm to reduce sand entering lagoon. | High |
| | Maintain the dune. Maintain the vegetation, monitor the profile of the dune and adjacent beaches and manage sand movement. Consider sand-catching fences. | Ongoing | | |



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